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Cotton in Arizona: A historical geography

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COTTON IN ARIZONA: A HISTORICAL GEOGRAPHY

by

Erik-Anders Shapiro

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A Thesis Submitted to the faculty of the
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In Partial Fulfillment of the Requirements
For the Degree of
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WITH A MAJOR IN GEOGRAPHY
In the Graduate College
THE UNIVERSITY OF ARIZONA

1989
STATEMENT BY AUTHOR

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I have to first acknowledge the aid of my thesis director, Leland Pederson, for bringing order out of chaos. Thanks also to the others on my committee, D. Robert Altschul and Gordon Mulligan, and to graduate advisor Richard Reeves. Just after my thesis proposal was approved Melvin Hecht, the now late professor emeritus of geography and regional development at the University of Arizona, made several practical suggestions for research and gave me a wealth of library references for this study. Most valuable, he transmitted a spark of enthusiasm for the study of the historical geography of Arizona agriculture that lasted me the distance. Thanks to the late Florence Larson for early help in editing, to Jorge Lizarraga for cartographic counseling, to Owen Shapiro for the graphs, thanks for comments and suggestions from University of Arizona Professors Hiroshi Muramoto, Theodore Downing, Michael Bonine, and especially Amir Ajami, and thanks to my parents for debts beyond measure. The errors are mine.

This research is dedicated to those who picked cotton in Arizona, especially Chiyo, because she missed out on the watermelon.
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ABSTRACT

This thesis is a historical geography of cotton production in Arizona from the prehistoric Hohokam cotton farms to the large-scale agribusiness operations that dominate modern Arizona agriculture. The purpose is to chart the expansion and distribution of cotton production and identify important cultural, biological, and physical factors that have influenced cotton planting decisions and so contributed to the evolution of Arizona's commercial cotton production region. In a final analysis, the businesses that are backward- and forward-linked to the growers—such as banks, agricultural implement and agricultural chemical dealers, and cotton ginner and cottonseed processors—have more responsibility in the evolution and endurance of Arizona's cotton production region than do the growers.
CHAPTER 1

INTRODUCTION

Arizona is a cotton state. Cotton has been produced in the Arizona area for at least seventeen centuries and commercial cotton production has dominated Arizona's oasis lands for more than 70 years. The state is now the nation's fourth largest producer of cotton, after Texas, California, and Mississippi, and the primary U.S. producer of Gossypium barbadense cotton (ACLRS 1988, 7). Cotton dominates Arizona irrigated agriculture because it tends to offer local growers the highest possible return in a single season. These growers depend on cotton as their primary source of income; other crops are generally of secondary importance (Wade and Selley 1980, 16). The commercial cotton production region of Arizona, roughly the irrigated oases below 4,000 feet in the southern third of the state, is a significant element of the western irrigated cotton production region which is itself the most important sector of the U.S. cotton belt. This study is both a narrative of the evolution of Arizona's cotton production region and an interpretation of this evolution with reference to the factors influencing cotton planting decisions through time. I interpret the historic, contemporary, and projected dominance and distribution of planted cotton acreage in Arizona, indicating the evolution of the Arizona cotton production region, with reference to the myriad primary and contingent factors that influence the economic decision to plant cotton.
The Problem

Commercial cotton production involves a fantastically complex web of causes and consequences and only a holistic perspective can represent the reality of a cotton state. My approach to the problem is guided by Joseph Spencer and Ronald Horvath's article "How Does an Agricultural Region Originate?" (1963). Their thesis is that agricultural regions are the landscape expressions of agricultural systems, or agrosystems, and are best interpreted with reference to the interplay of cultural processes by which they are powered and shaped. They identify six categories of cultural process as "significant to the study of the cultural origin, maturity, and change" of agricultural regions: economic, psychological, political, agronomic, technologic, and historical (Spencer and Horvath 1963, 90). Cotton production in Arizona is preeminently an economic activity as all cotton planting decisions are ultimately motivated by profit. Psychologically, Arizona cotton producers are, whether by choice or circumstance, short-term profit maximizers who respond to anticipated economic and political realities by shifting acreage in and out of cotton in order to maximize returns. Politics, particularly since the institution of the cotton programs in the early 1930s, constrain and motivate the decision to plant cotton. Agronomic developments, particularly in cotton breeding, were essential in the origin of the Arizona commercial cotton production industry and are important in the continuing competitive position of Arizona cotton producers. Technological developments such as the set of innovations that allowed the efficient pumping of groundwater are
reflected in the expansion of cotton production into hitherto uncultivated areas. Historically, native cotton was significant in Arizona for centuries and there were occasional experiments with cotton production by colonists and early settlers, yet southern Arizona's cotton production region did not really take shape until the introduction of new and unrelated cotton seed in 1912. In the development of Arizona's cotton production region the most important category of process, through which the other categories act, is always the economic.

The six categories are useful tools, yet the highly complex reality of an agricultural region requires the formulation of a more narrowly focused methodology to render studies that will be comparable from region to region and demonstrate the action of individual factors in the evolution of agricultural regions. William Norton (1984, 26-27) contends that the holistic approach advocated by Spencer and Horvath "might be complemented by detailed statistical descriptions." Planted cotton acreage is a good statistical measure of the changing geographic distribution of cotton production (Hart 1977, note 4; Prunty 1951, 203), and for this study, I have used the record of planted cotton acreage as the explanandum, that which is to be explained. The categories of cultural process represent the explanans, that which can explain the evolution of Arizona's cotton production region.

My primary source for planted cotton acreage data is Arizona Agricultural Statistics (ACLRS 1966-88), which reports total planted acreage data for both species [G. barbadense and G. hirsutum] and
planted cotton acreage data by county after 1932. I assembled county data for the period from 1912 to 1932 from diverse other sources and tempered these data together into a single document—representing a tabular record of the evolution of Arizona's cotton production region—that is included in the Appendix. References to planted cotton acreage in Arizona in this work are from the Appendix unless otherwise indicated.

Agricultural regions are human creations. Quite basically, a planted acre of cotton is the consequence of someone deciding to plant an acre of cotton. Thus the essential task of interpreting the dominance and distribution of planted cotton in Arizona is to arrive at a comprehension of the cotton planting decision process. Every spring the Arizona cotton growers weigh a myriad of factors—such as knowledge of world markets and politics, farm programs, water and land resources, labor supplies, available technologies, and curious notions—to arrive at planting decisions that are motivated by profit, mitigated by prior commitments, molded by the decision process of political bodies, made possible by available resources, and affected by individual personalities and collectively held ideologies. Arizona cotton growers are maximizers operating, like all farmers, with agricultural knowledge that is incomplete and not necessarily perfect. As Wolpert (1964, 538) comments, "The information available to the farmer most likely does not include all of the relevant facts about costs and technology, and it cannot include knowledge of future events which will affect the consequences of his decisions."
Planting decisions are independently arrived at by individual growers, but since the growers are all constrained and motivated within essentially the same agrosystem and the same general cultural system, their actions are collectively, to use systems philosopher Ervin Laszlo's terminology, "macrodetermined" in general tendency. According to Laszlo (1972, 113): "The components of natural systems form something like democracies in which it is agreed that certain functions will be carried out, but where it is left up to volunteers to fulfill them. . . . The system as a whole is determinate, but the relationship of the parts is not." Cotton is the Arizona growers' crop of choice, but the choice is macrodetermined and the decision to plant cotton is often a forgone conclusion.

Dorothy Scarborough's novel *In the Land of Cotton* (1936), set in the Brazos bottomlands of Texas and covering the period from 1908 to 1922 and coincidentally encompassing the period of the origin of commercial cotton production region of Arizona, depicts the situation of growers operating within a cotton production system. Etulain (1982, 33-34) writes that "each of the major characters in Scarborough's book castigates the cotton-raising system, pointing out its limitations and noting its inequities; yet all of them are unable or unwilling to declare their independence and search for new locations or to take up new occupations." The novel accurately illustrates the tribulations and conundrums of growers who, like those in Arizona, are locked into a system that economically compels them to plant cotton.

In a sense, cotton planting is a habitual or addictive
behavior, conditioned by the possibilities, pressures, restraints, and opportunities of the cotton production agrosystem and its environs. It is this cotton agrosystem that finds landscape expression as the cotton production region. According to Spencer and Horvath (1963, 90):

As the selection of crops continues toward the point at which some general uniformity of human decision results, the operation becomes a group procedure in which many different specific cultural processes are joined in the making of collective decisions. Herein lies the determination of a way of life and the patterns of crop combinations which the geographer can recognize as regional expressions.

Cotton growers consider the collective state of affairs to make decisions that are expressed as planted cotton acreage, while I interpret the record of planted cotton acreage with regard to the collective state of affairs confronting the growers at planting time. I gathered information on Arizona's cotton production agrosystem from published materials that were of immediate interest to Arizona cotton growers, such as the bulletins of the Arizona Agricultural Experiment Station and local newspapers. Since my sources are much the same as the growers themselves used, I hope that I have approached "... the ability to see the land with the eyes of its former occupants, from the standpoint of their needs and capacities" (Sauer 1941, 10).

Related Literature

This study of the evolution of Arizona's cotton production region could both fulfill the demand for in-depth research into Arizona's agricultural past and add to the knowledge of the origin of
agricultural regions, in addition to contributing to the body of research on the geography of cotton and the history of agriculture. There are numerous studies that describe agricultural regions but these are not complemented by an equivalent body of literature dealing with the origin of agricultural regions (Spencer and Horvath 1963, 92). According to Meinig (1955, 221), there is a particular gap in the geographical literature in research into the development of agricultural regions in the western United States. Agricultural region development in California has since been studied, for example Preston's work on the Tulare Basin (1981), but agricultural region development in Arizona remains largely an untilled field of inquiry.

Cotton is the world's most important non-food crop; it is very important in world trade, and it has long evoked the interests of geographers. O.E. Baker (1927) identified and mapped the cotton belt of the southeastern United States; Earl Case (1929) recorded the changes that took place in this region after the First World War, and Merle Prunty (1951) documented the decline of the southeastern cotton belt from the 1920s through the 1940s. Geographers have documented the "demise" (Hart 1977; Prunty and Aiken 1972) or "devolution" (Mattingly and Aspbury 1986) of cotton production in areas of the Southeast. Paul Mandell and Luther Tweeten (1971) offer an analytic perspective of the location of cotton production in the United States and there are also geographical studies of cotton in such places as Peru (Rosenfeld and Jones 1927) and Mexico (Garloch 1944). Aiken (1973) studied the geography of cotton ginning in the Southeast and Deasy (1941) researched the geography of the cottonseed oil
industry. But there are apparently few geographies all or partially concerned with cotton in Arizona.

Geographer P.J. Perry (1972, 261) notes that agricultural history is a complex topic for which geographers conversant in the mechanisms of interacting systems are very well suited. Historians, like historical geographers, might well find material of interest in the West's agricultural past. Yet, according to Caughey (1959, 1974), historians of the western United States [with the major exception of Gerald Nash (1973, 1985)] have been generally obsessed with the "frontier" period and truncate their studies around the year 1890. Western agricultural history, Schmidt (1959, 334-35) asserts, is an especially fallow field of inquiry. Moreover, according to Melvin Hecht [late Professor Emeritus in the Department of Geography and Regional Development at the University of Arizona] "Arizona's agricultural history has yet to be written" (Hecht 1985). Schmidt (1959, 338) identified several research areas for western agricultural historians and particularly a demand for research into the history of Arizona's \textit{G. barbadense} cotton industry. Joseph McGowan (1960) completed his master's thesis on the history of \textit{G. barbadense} the following year. My study, however, is neither redundant nor replicative of McGowan's for several reasons. McGowan's is a survey of \textit{G. barbadense} production in the United States, Peru, Egypt, and Sudan with special attention to the influence of markets, politics and developments in cotton breeding in the industries growth. My study is an interpretive description of the landscape expression of cotton \textit{[G. hirsutum var. punctatum, G.}}
hirsutum, and G. barbadense] production in Arizona from prehistory to the present, with the emphasis on identifying the important cultural, biological, and physical factors that have contributed to the evolution of Arizona's modern commercial cotton production region since 1912.

**Format and Content**

The task of presenting the material necessary for a holistic and interpretive description of the origin and evolution of an agricultural region presents many challenges. There is need for a narrative discussion of the diffusion of the crop assemblage and other elements of the agrosystem as they expand across the landscape to result in an agricultural region. There is also a demand for an analytic discussion of the actions and interactions of the subsystems that form that agrosystem. The discourse must sometimes flow chronologically to capture significant sequences of events, it must sometimes survey sets of factors that work to affect the general map of agricultural production, and it also must frequently dwell on the functional appraisal of separate subsystems.

I have tried to format this work so as to both provide a narrative of the evolution of Arizona's cotton production region and to demonstrate the action of specific factors in the region's evolution. This introductory chapter presents the problem and how I intend to surmount it. The second chapter is a survey of cotton production in Arizona from prehistory to 1912. Chapters three through six concern separate subsystems and factors necessary for a
holistic interpretation of the narrative presented in chapter seven, a discussion of the year-to-year evolution of the modern Arizona cotton production region. Chapters eight and nine relate to the endurance of Arizona's cotton production region and the future of cotton production in Arizona, as well as provide a concluding summary for the major points developed.

The development of the full-fledged commercial cotton production region after 1912 was prompted by numerous related and unrelated factors that simultaneously boosted the demand for cotton, and provided the cottonseed and oasis land necessary to initiate a cotton production region. These factors were partially caused and fully enjoyed by a retinue of influential and powerful business interests - boosters such as Alexander Chandler and Dwight Heard, corporate producers such as Goodyear and the Tucson Farms, and quasi-corporations such as the Mormon church and community - that I discuss in chapter three. In chapter four I examine some factors that generally influence the dominance of cotton in Arizona. Chapter five examines factors that influence the distribution and interspecific mix of cotton in Arizona and so generally give shape to the cotton production region. Chapter six is a documentation of oasis development, which has generally preceded the expansion of the Arizona cotton production region.

In chapter seven I chart in a series of maps the distribution of planted cotton acreage in Arizona through time and interpret this narrative with reference to the major factors influencing cotton planting decisions. The dominant influences in year-to-year
fluctuations are cotton prices and cotton programs. The record of
oasis development aids in interpreting the particular areal
expression of cotton production. Other factors such as labor
shortages and insect infestations are of more occasional importance
in year-to-year variations in the extent and distribution of planted
cotton acreage.

Much as the vested and integrated interests of the business
entities that I discuss in chapter three were influential in the
genesis of Arizona's commercial cotton production region, the
continued endurance of the cotton industry and region is influenced
by, and benefits, the numerous business entities with integrated
interests in the continued production of cotton in Arizona that I
discuss in chapter eight. Chapter nine concerns the future of cotton
in Arizona. On the one hand there exists a continuing injection of
public money, such as through the reclamation projects and farm
programs, which will influence the endurance of cotton in Arizona.
On the other hand, a sharp decline of cotton production in Arizona
could be precipitated because of increased foreign competition and a
possible reduction of farm program benefits; cotton production will
decline ultimately as access to water becomes economically,
physically, and legally limited.

The cotton production agrosystem of Arizona, and its
landscape expression as a cotton production region, represent a vast
complexity of factors. Yet the subject is an inherently systematic
entity and certain generalities can be formulated about the critical
factors in the region's evolution. This study will contribute to the
larger question of how agricultural regions originate as well as intersect with lines of research in the geography of cotton production and the agricultural history of the western United States. In addition, the research might be of some practical value to those concerned about the future of agriculture in Arizona.
CHAPTER 2

EARLY COTTON

Arizona's modern cotton industry dates from 1912, yet cotton has been planted in the area of present-day Arizona for centuries. Some southern Arizona oases have been farmed continuously for more than two millennia and, according to Morrisey (1949, 108), "both native and Spanish agriculture . . . left deep imprints upon the farming institutions which have been carried down to the present."

Although the modern commercial cotton agrosystem did not evolve directly from pre-modern systems, the earlier cotton growers provided stimulus and lessons for cotton production in territorial Arizona. The largest group of non-Indian cotton producers in territorial Arizona, Mormons, were also in the majority of Arizona cotton growers after 1912. In addition, all cotton growers in Arizona have worked within systems with certain points of commonality - such as the prerequisites and problems of irrigation, market constraints and opportunities, and varietal deterioration. Indeed, the agribusiness system that currently dominates Arizona growers has its roots in the early territorial period when the Pima Indian farmers came under the domination of forward-linked non-Indian wheat millers.

Indian Cotton

Cotton was produced by Indians in the area of present-day Arizona from many centuries before the U.S. cotton belt's 'birth' at
Jamestown in the 17th century to about 1875, when Arizona's native cotton production system essentially vanished.

Cotton in Pre-Columbian Arizona

All of the classic pre-Columbian cultures of Arizona - Hakataya, Mogollon, Anasazi, and Hohokam - produced cotton (Haury 1976, 118, 302; Martin and Plog 1973, 280). Some genetic evidence suggests that this cotton, *G. hirsutum* var. *punctatum*, was a result of a cross that occurred somewhere in northern Peru between an indigenous wild species and a domesticated species from Asia that had been conveyed to the western hemisphere via pre-Columbian trans-Pacific migrations. *G. hirsutum* var. *punctatum* was carried along with the basic corn-bean-squash triad into present-day Arizona very early in the first millennium A.D. (Carter 1946, 17; Hutchinson et al. 1947, 43; Kent 1957, 465-67; Lee 1984, 10; Sauer 1963, 42-43).

The dominant cotton producers in pre-Columbian Arizona were Hohokam Indians, who migrated into southern Arizona from northern Mexico around 300 B.C. (Haury 1976, 151; Josephy 1986, 168; Wagoner 1975, 19). The Hohokam villages in the vicinity of the confluence of the Salt and Gila Rivers were important regional centers of cotton culture and trade (Kent 1957, 467-69). The first crops were probably grown under flood irrigation on the middle Gila; by 500 A.D. Hohokam farmers had begun to construct small dams and canals which allowed expansion of agricultural settlement into the Salt and lower Verde River Valleys (Comeaux 1981, 72). The first large canals were dug around 800 A.D. and the system was largely abandoned with the decline
of the Hohokam civilization in the 1400s (Haury 1976, 355). The southwestern pre-Columbian cotton system generally flourished from 1250 to 1400 (Kent 1941, 1). Cotton production at Snaketown, a large Hohokam settlement located about 30 miles southeast of present-day Phoenix, began sometime between 100 and 300 A.D. The fiber was used for fabric and the seeds were parched for food and cotton remained an important element of the Snaketown economy until the settlement's abandonment sometime between 1100 and 1200 (Bohrer 1970).

Cotton in Spanish Arizona

It is likely that the heirs of the ancient Hohokam cotton growers are the Pima and closely related Tohono O'odham Indians (Haury 1976, 355; Martin and Plog 1973, 145–46; Wagoner 1975, 16, 26). The Pimas themselves, despite the doubts of some archeologists, consider this to be so (Webb 1959, 53). Certainly, the historic Pima agrosystem bears a direct relationship to the prehistoric Hohokam agrosystem (Hackenberg, 1955, 13), particularly in regards to the large-scale production of cotton. Whiting (1966, 316), for example, typifies the Piman agrosystem as having "... massive irrigation systems and almost 'industrial' production of cotton." The Tohono O'odham Indians grew cotton [under run-off irrigation] on a scale bested only by the Pimas (Dobyns 1976, 5; McCarty 1976, 1.

1. When I speak of the Pimas I generally follow precedent (Coffer 1982, 30; Dale 1949, 18; Ortiz 1973, 245-46) and include the Maricopa Indians, linguistically distinct from their much more numerous Pima neighbors but agriculturally very similar.
Spanish conquistadors crisscrossed the Southwest during the late 16th century seeking, among other things, the Seven Cities of Cibola, which were characterized as wealthy urban centers with, significantly, people clothed in cotton (Bancroft 1962, 27-48; Comeaux 1981, 82-91; Lockwood 1932, 9-10; Wagoner 1975, 47-68). To the conquistadors, cotton clothing was indicative of civilization (Todorov 1984, 34-35). The conquistadors noted native cultivated cotton in the Gila, Salt, San Pedro and Santa Cruz oases, and on the Hopi mesas in the north. Then as now, cotton production was most intense in the ample oases of the Salt and middle-Gila Rivers (Parish 1915, 1:3; Kent 1957, 469; Lewis and Richmond 1968, 7; Lewton 1912, 3; McGregor 1931, 1). Spanish missionaries consistently commented on the cotton industry of the Pima villages (Bolton 1948, 267; 1963, 459; 1984, 248; Kent 1957, 469; Lewton 1912, 4; Rea 1983, 17; Robinson 1919, 312-13). As one early Jesuit noted, "so much cotton is raised and so wanting in covetousness is the husband-man, that, after the crop is gathered in more remains in the fields than is to be had for a harvest here in Sonora" (cited in Castetter and Bell 1942, 104; Morrisey 1949, 103).

Besides the cotton grown by Indians on their own, there was some cotton, possibly an introduced variety, produced by Indians settled around the Spanish missions of southern Arizona. Cotton production on the mission farms apparently did not meet local demands because the missionaries annually purchased - with money earned from the sale to early silver miners of Pima-grown maize and other produce
- 3 to 4 thousand pesos worth of cotton and linen cloth for the Indians (Morrisey 1949, 105-07). Reports from the Tucson presidio in 1804 indicate that the Apaches de Paz [Apache Indians settled under programs of forced dependence] produced cotton which went into making clothing for local consumption (Brinckerhoff 1967, 15).

The Decline of Indian Cotton

Significant aboriginal cotton production in Arizona continued into the 20th century only among the Hopis in the northeast. Hopi cotton endured because of the fiber's importance in religious ceremony (Clark 1928, 239; McGregor 1931, 5). The production of Hopi cotton for secular purposes, however, ceased by 1900 because of competition from commercial cotton products by 1900 (McClintock 1921, 18). Significant cultivation of Hopi cotton for ceremonial purposes continued until the early 1930s in the vicinity of Moenkopi, which means "cotton fields" in the Hopi language (Kent 1957, 469).

Cotton production in the Pima villages was noted by the Mormon Battalion in 1847 (Farish 1915, 1:146; McClintock 1921, 18; Merrill 1972, 259), the Bartlett Survey Commission in 1852 (Bartlett 1854, 224), a hay contractor in 1854 (Farish 1915, 2:29-30), a journalist in 1858 (Cozzens 1967, 186), and another journalist (Browne 1950, 109) and a peripatetic judge (Nicolson 1974, 109) in 1864. The Eighth U.S. Census - the first to include Arizona [then a county within the New Mexico territory] - reports that 19 bales of cotton were produced in Arizona in 1859 (USBC 1864, 179). This was most likely Pima or Hopi cotton and would represent the production of
only about 35 to 40 acres, although there might well have been additional unreported cotton. As late as 1873 the Pimas were still growing a small amount of cotton (Castetter and Bell 1942, 104) but the Piman cotton system generally perished by 1875 (Lewton 1912, 4; Russell 1908, 150). Hinton (1954, 363) in 1877 mentioned Piman cotton only in the past tense, and by the turn of the century the total production of Piman cotton was hardly enough to weave a small kerchief (Castetter and Bell 1942, 104-05). Three factors contributed to the demise of the once substantial Piman cotton agrosystem: changing markets, seed stock confusion, and the disruption of irrigation water supplies.

Changing Markets. The Pimas began to shift away from cotton production after the U.S. occupation of the territory in the late 1840s. On the one hand they could not market Indian cotton products to the newcomers, and on the other hand they had access to imported cotton products which reduced the local demand for Indian cotton products. According to a special report in the Tenth U.S. Census, the Pimas abandoned cotton production "... upon the advent of the Americans, from whom they could procure better blankets in exchange for wheat" (Hilgard 1884, 130). The competition was in the markets and not for land; wheat and other introduced Spanish annuals are winter crops in Arizona and did not compete directly for irrigated land with cotton and the Pimas' other summer crops (Castetter and Bell 1942, 56-57; Comeaux 1981, 185-86; Ortiz 1973, 247-48).

The Pima villages were located on a main route through Arizona, the Gila trail, and developed a thriving caravansary
economy. The Pimas provided provisions, shelter, and fresh mules to numerous travelers. The first big wave of customers were the 60,000 odd forty-niners that passed through Arizona on their way to the gold fields of California (Bartlett 1854, 214; Farish 1918, 8:236; Hackenberg 1955, 32; Hamilton 1966, 100; Lockwood 1932, 73-81, 116; Merrill 1970, 46; Ortiz 1973; Russell 1908, 30-31; Wagoner 1975, 300-01). The Pimas' patrons wanted food and fodder products but did not need Indian cotton; in fact, they sometimes paid in cotton products.

The Pima farmers on the middle Gila were Territorial Arizona's primary agricultural producers. The irrigated acreage of the Pimas expanded from 3 to 15 thousand acres in the period between the Gadsen Purchase in 1854 and the establishment of the Gila River Indian Reservation in 1859 (Bancroft 1962, 548; Comeaux 1981, 185, 220; Farish 1918, 7:226; 8:3; Forbes 1911, 9; Ortiz 1973, 248). During this period the Pimas began to shift from retailing a

1. Imported cotton shirts were particularly prized by the Pimas. The Mormon Battalion found the Pimas, "... very friendly, bringing food, which they readily exchanged for such things as old shirts" (McClintock 1921, 22). A forty-niner noted, "We bought corn, fodder, wheat, melons, and such things from the 'Pijmos'. They asked high prices in money, but a hickory shirt would go so far as $5 with them" (cited in Wagoner 1975, 300-01). Bartlett, surveying Gadsonia in 1852, was informed by the Pimas that fabric products, particularly shirts, were the preferred item of trade in the Pima villages, as the Indians had at that time no use for money (Bartlett 1854, 219). And Daniel Jones, the first Mormon missionary to the Pimas in the late 1870s, eventually realized that much of the reason for his success in converting the Indians was due to the new shirt that each received at baptism (Jones 1890, 317-18). Consequently, when the shirts wore out the new Mormons wanted to be baptized again (Merrill 1975, 137-39).
diversity of agricultural produce directly to travelers, to wholesaling mainly wheat through trading posts for consumption mostly by the U.S. military. During the 1860s the Pimas supplied many millions of pounds of wheat, in addition to fodder, poultry, and truck crops, to about 3,000 infantry and cavalry troops garrisoned in Arizona and California (Browne 1950, 100-01; Castetter and Bell 1942, 38, 114; Farish 1918, 8:3; Hackenberg 1955, 32-33; Officer 1971, 52; Russell 1908, 90).

With the intensification of hostilities between Indians and settlers after the Civil War the military presence was increased. The Indian Wars generally lasted until the mid-1880s and the Pimas continued to produce a 'surplus' of wheat at least until the early 1880s. This production was largely purchased by unscrupulous traders. Nearly the entire production was marketed to trading posts located on the Gila River Indian Reservation and Maricopa Wells [a formerly important stage-coach stop southwest of Phoenix]. For their wheat the Pimas received 2 cents per pound in "ballettas," scrip redeemable in merchandise only at the trading posts. The traders turned around and sold the wheat to the military for 6 to 7 cents [cash] per pound (Bancroft 1962, 549; Farish 1918, 6:8-9, 67; 8:3-4; Ortiz 1973, 248).

The major businessman in territorial Arizona was Carl

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1. According to Russell (1908, 32), "for a period of thirty years, or from 1850 to 1880, the Pimas were visited by some of the vilest specimens of humanity that the white race has produced."
Hayden. Hayden, late of Connecticut, arrived in Tucson on the first Overland stage and during the 1860s he did a substantial amount of freighting for the military. Hayden bought into a canal company that was developing an area on the south side of the Salt River in 1871 and founded Hayden's Ferry, shortly renamed Tempe. Here he established the Salt Oasis' first store which supplied other canal builders with supplies. He began flour production in 1874 and eventually controlled an extensive business empire including the mill and mercantile operations, a blacksmith shop, and a carpentry shop. Hayden annually purchased between 500 and 750 tons of Pima wheat each year. The Pimas sold their wheat to Hayden in exchange for "Hayden scrip" which was redeemable in trade only at Hayden's stores. Hayden also established trading posts on the Gila and Salt River Indian Reservations (Farish 1915 2:288-90; 1918, 6:103; Horton 1941, 201; Lockwood 1932, 143; Merrill 1970, 155-57; 1972, 47; 1977, 134-36, 225-28; Sargent 1975, 3). Indian cotton production declined as wheat production boomed and the Pimas shifted from producing a diversity of crops for subsistence, trade, and sale to producing a single crop, wheat, for sale.

**Seed Stock Confusion.** By the mid-1960s, because of the changing market conditions that I have outlined, Pima Indian cotton production was at a low ebb. At this nadir the system received a serious jolt resulting from the introduction of exogenous cottonseed. In an 1864 effort to capitalize on the high cotton prices generated during the Civil War by the Union blockade of Confederate ports, Charles Poston, then Superintendent of Indian
Affairs for the Pimas, gave his clients 500 pounds of *G. hirsutum* cotton seed from the cotton belt (Lewton 1912, 5). The seed introduced by Poston was sufficient to plant from 14 to 20 acres (Thompson and Wood 1919, 270). Given the diminished scale of production, this relatively substantial introduction was enough to hasten the demise of the Pima Indian cotton industry through massive seed stock confusion.

Usurpation of the Gila. Pima cotton culture ultimately perished with the death of the Gila River at the dams of investors who promoted and financed the settlement around Florence, upstream from the Pima Villages. These investors were also merchants with lucrative military contracts for wheat and fodder production, and they were also Pima Indian agents. Ammi M. White was a miller who had traded in Pima wheat since before 1860; he was the Indian agent 'for' the Gila River Pimas from 1864 to 1866 and developed the town of Adamsville [since subsumed by Florence]. White was replaced as Indian agent in 1866 by Levi Ruggles, who 'served' until late in 1867. Ruggles, also a trader in Pima wheat, was responsible for developing the settlement of Florence. As early as 1859 Indian agents and others cautioned about what would happen to the Pima agrosystem if upstream diverters diminished the Gila River's flow. White and Ruggles knew of the possible consequences of the upstream diversions and probably anticipated positive economic benefits (Parish 1918 6:50; Hackenberg 1955, 37-39; Russell 1908, 33).

The finite flow of the Gila River was capable of producing a relatively finite amount of wheat. The Florence usurpation might
have actually been a bid by the competition to undercut the power of Carl Hayden. In addition, the diversion pumped Pimas into the wage labor pool, thus lowering farm labor costs. Downing's (1985, 22) analysis of the plight of 20th century Indian farmers applies as well to those of the territorial period:

The goods produced by American Indians and other marginal farmers generate little or no capital which may be reinvested in the larger economy. Until they are alienated from their subsistence pattern and sell their labor, they only marginally consume the products produced by capital invested elsewhere in the economy.

Settlers in the Florence area on the Gila River began irrigating winter crops by simple diversion of the high winter flow of the Gila in 1866. The first small canals were dug in 1870 and by 1887 the entire flow of the Gila River was diverted into the newly completed Florence canal (Comeaux 1981, 213; Farish 1918, 7:46-50; McClintock 1916, 442; Officer 1971, 53). The usurpation prompted the first recorded assault by Pimas on non-Indian settlers during the U.S. period. In November of 1869 "four hundred Pimas moved into fields owned by Mexicans near Adamsville and harvested their crop of corn and beans. They also tried to collect land rentals from the Mexicans settled there, claiming that both the land and the crops belonged to them" (Hackenberg 1955, 40). The middle Gila River went completely dry for the first time in anyone's memory in October of 1871. Such was the outrage of the Pima farmers that they wanted to drive the settlers from the Gila by force of arms and were only thwarted by the Indian agent's empty promise to remedy the situation (Farish 1918, 18:253-55; Ortiz 1973, 248-49). With the final death
of the Gila in 1887 the Piman irrigated agrosystem on the Gila essentially ceased to exist. The period from the Florence usurpation, around 1870, to the development of a sufficient demand for farm labor, around 1910, is characterized by Pima oral historians as the "forty years of famine" (Hackenberg 1955, 42; Ortiz 1973, 252). Ironically, a major factor in the increased demand for Pima farm laborers was the development of the commercial Pima cotton industry. Despite some legends that developed to the contrary, the native Piman cotton \( G. \text{hirsutum var. punctatum} \) grown in Arizona for more than 1,500 years is unrelated to the introduced Pima cotton \( G. \text{barbadense} \) that has been commercially produced in Arizona since 1912 (Hutchinson et al. 1947, 43; Lee 1984, 10).

**Exogenous Cotton**

The Census reports for 1870, 1880, and 1890 indicate no cotton produced in Arizona (USBC 1872, 98; 1885, 666; 1895, 392); however Bancroft (1962, 595) wrote in 1888 that in Arizona "... cotton has always been raised in small quantities." The cottons of territorial Arizona were either the perennial Mexican dooryard cotton, which was confined to the Yuma lowlands, or the more

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1. For example, Merrill (1975, 226-28) relates a story that genetic material from Piman cotton \( G. \text{hirsutum var. punctatum} \) was incorporated in the early breeding program that resulted in Pima cotton \( G. \text{barbadense} \); and on a recent train ride through northern Arizona I overheard the man behind me telling the woman next to him, "the Pima Indians have their own cotton, Pima cotton, it's the best kind."
ubiquitous annual varieties introduced from the Southeast. Production of annual cotton was initiated with the early settlement of the Salt Oasis in the early 1870s and picked up considerably with the entry of the Mormons in the late 1870s.

Perennial Cotton

Mexican perennial ["dooryard"] cotton was formerly grown in the vicinity of Yuma. Mexico's cotton industry grew significantly in the mid-1860s as a response to high cotton prices generated by the U.S. Civil War (Brown and Ware 1958, 13), and the perennial cotton in Arizona was probably the northernmost evidence of this expansion. Until 1892, the type of cotton grown in Mexico was dooryard cotton, a shrubby perennial variety of G. hirsutum grown in gardens instead of as a field crop (Garloch 1944, 70; Lewis and Richmond 1968, 7). A special report attendant to the Tenth Census relates that "... near Yuma cotton-plants grow for several years without any special care." A Yuma merchant had an experimental crop of 200 plants near the mouth of the Gila in 1860. The report suggests that perennial cotton, needing little care besides irrigation and bearing for up to ten years, would be a highly profitable agricultural venture for

1. It is at least remarkable that Mexican perennial cotton probably crossed the border into Arizona at El Paso de los Algodones [Spanish for "the pass of the cottons"] which lent its name to the El Paso de los Algodones land grant, a small Mexican border settlement on the right bank of the Colorado River called Algodones, as well as the Algodones Dunes, west of Yuma.
Arizona (Hilgard 1884, 129-30). There were some experiments with cotton plants - probably also perennial - on the San Ysidro Ranch, between the Colorado and Gila rivers, in the late 1870s (Hinton 1954, 279; Robertson 1942, 107). The production of perennial cotton in Arizona is limited to the relatively frost-free Yuma Oasis and never attained any real significance.

Annual Cotton

During the territorial period there was quite a bit more interest in the production of annual cotton grown as a field crop as in the southeastern U.S. Mormons were territorial Arizona's most visible cotton producers. Yet there was a modicum of cotton production even before the Mormon colonization in 1877.

Pioneer Cotton Planters. Some early settlers in the Salt Oasis planted the "upland" variety of *G. hirsutum* from the U.S. cotton belt to the east. There are two identifiable sources of probable inspiration for their interest in cotton. Jack Swilling [the Salt Oasis' first non-Indian irrigator in the late 1860s] was with a group of prospectors who provisioned at the Pima Villages in 1863 (Parish 1918, 8:236). Thus he would have known of the potential for cotton production in the area. Also, the migration field for the plurality of early pioneers in southern Arizona was the cotton belt South (Comeaux 1981, 264; WPA 1940, 7). John Osborn, a prospector who reached Prescott in 1864 and left there with his family in January, 1870 to settle in the Salt Oasis (Farish 1918, 7:95), was the first non-Indian to plant cotton in the Salt Oasis in 1873. He
used the lint from his five acre patch for mattress stuffing. In 1884, to encourage agricultural development, the Arizona territorial government offered a prize of $500 for the highest yield from a five acre cotton patch; this was awarded to Terapean Felix Hardwick (Peplow 1958, 332; Robinson 1919, 313; Wagoner 1970, 204), a Mormon cotton planter. The largest cotton growing cohort in territorial Arizona were Mormons. The early Mormon cotton production in the Salt and upper Gila Oases is particularly significant because the interest in cotton apparently carried over into the commercial period. Curiously, while cotton is so often indicated as an introduced crop that replaces subsistence crops, the Mormons, in compliance with a mandate of church-wide self-sufficiency to be self-clothed as well as self-fed, produced cotton as a subsistence crop (Peplow 1952, 394). Besides the mandate, there were other sources of inspiration for the early Mormon cotton production in the Salt and upper Gila Oases. The early Mormon cotton production in the Salt and upper Gila Oases was partially significant because the Arizona territorial government offered a prize of $500 for the highest yield from a five acre cotton patch; this was awarded to Terapean Felix Hardwick (Peplow 1970, 204).
production after the Pima example (McClintock 1921, 34-36, 249; Merrill 1970, 46). Also, the majority of Mormons who moved into the upper Gila Oasis from 1890 to 1920 were new converts from Texas and other cotton belt states (Sayers 1979, 74). However, the most powerful force behind Mormon pioneer cotton farming was the official church decree to grow cotton which was institutionalized in the cotton missions.

Such was the Mormon penchant to produce cotton that they defied environmental realities by trying to produce cotton in the Wasatch Oasis of northern Utah. Horace Greeley (1966, 235) toured the area in 1859 and reported that "an attempt to grow cotton is likely to prove a failure, as might have been predicted. The winters are long and cold here for the latitude, and the Saints must make cotton or shiver. I trust they will soon be able to clothe themselves."

Part of the reason the Mormons began to move south in Utah was to locate areas suited to the production of cotton and other semi-tropical crops. The oases of the Virgin River and its tributaries in extreme southwest Utah were settled and agriculturally

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1. The Wasatch Oasis has an average frost-free growing season of about 140 days (Spencer 1940, 182) but standard upland varieties of *G. hirsutum* required about 200 days (Smith 1945, 29; 1956, 95-98). Hopi cotton [*G. hirsutum var. punctatum*], with its short growing season [84-100 days] (Kent 1957, 456-56), would have done splendidly in the Wasatch Oasis. The Mormons first established contact with the Hopis in 1858 (James 1974, 86). If they had adopted Hopi cotton instead of moving south to produce long-season cotton the map of Arizona and southern Utah might have been very different.
developed in the 1850s by Mormon cotton missionaries, mostly poor
Mormon converts from the Texas cotton belt who were called to the
task from the pulpit by Brigham Young. By 1860 there were several
cotton missions distributed throughout the Virgin Oasis and the total
annual cotton production was reported at 155 bales. The U.S. Civil
War gave a substantial boost to cotton production, which led to the
establishment of St. George as a major cotton processing center. The
Virgin Oasis subsequently gained the moniker "Utah's Dixie." In all
there were some 1,100 families - upwards of 4,000 individuals -
called to the cotton missions during the 1860s. The cotton
missionaries were told that their job was as important as that of the
proselytizing missionaries. Most of the cotton produced by the
Mormons was consumed by the local Mormon market and some was shipped
to eastern markets. Ten percent of the crop went to the General
Tithing Office in Salt Lake City where it was distributed to local
Mormon and eastern markets (Arrington 1956).

Arizona's first non-Indian cotton producers were Mormon
cotton missionaries in the Muddy River Oasis, which was a part of
Arizona until May of 1866 when the area was ceded to Nevada (Bancroft
1962, 613; McClintock 1921, 102-04). In October of 1864, a large
group of cotton missionaries, 50 to 60 families, moved about 100
miles southwest of St. George to settle on the Muddy River, a

1. Brigham City in northern Utah hosted a substantial cotton
goods mill which processed the Mormon cotton into clothing for the
Mormon market (McClintock 1921, 130-31).
tributary of the Virgin River, now beneath the waters of Lake Mead (Arrington 1956, 226-28). St. Joseph and seven other cotton missions were established in the Muddy Oasis beginning in January of 1865. St. Joseph was destroyed by fire in August of 1868 and listed among the losses was a cotton ginnery. In 1869 Muddy Oasis Mormons purchased stock in the St. George cotton factory. Their attempt at clothing self-sufficiency, however, apparently came to little. A late 1870 plea for aid revealed of the Muddy Oasis cotton missionaries: "Many are nearly naked for want of clothing. We can sell nothing we have for money, and the cotton, what little there is, appears to be little help in that direction" (cited in McClintock 1921, 118-20).

The abandonment of the Muddy Oasis cotton missions was greatly accelerated by an official survey that placed the area in Nevada, and not in Utah as the Mormons had thought. The Nevada state government, generally anti-Mormon, immediately assessed the Muddy Mormons back taxes to be paid in gold. These taxes, which had in fact already been mistakenly paid to Utah, were a prohibitive expense. Following Brigham Young's advice the Muddy Oasis cotton missions were abandoned in 1871. Some of the Muddy Oasis cotton missionaries eventually settled in the upper Gila and south Salt Oases (Bancroft 1962, 530; McClintock 1921, 249), bringing with them the knowledge and inclination necessary to produce cotton. The cotton produced in the Muddy Oasis represented most of the total production of all of the Mormon cotton missions from 1866 to 1870 and the fall of the Muddy Oasis settlements contributed greatly to the
general decline of Utah's Dixie (Arrington 1956, 235-36).

Droughts, floods, poor soil, pests, and other factors converged so that "it seemed to the colonists as though all earth and heaven had conspired to render the Cotton Mission a failure" (Arrington 1956, 235). The Virgin Oasis, with a growing season of about 185 to 210 days (Spencer 1940, 182), was really only marginally suited to cotton production, although yields were occasionally satisfactory (Arrington 1956, 237). With railroad developments clothing self-sufficiency dropped in importance and cotton generally diminished. The final blow to Utah's Dixie was dealt around 1900 when over-grazing of local rangelands forced a greater production of alfalfa on the limited oasis lands and squeezed cotton out of the picture (Spencer 1940, 186-87).

The Mormon settlements in the Salt and upper Gila Oases, although not actually cotton missions, did carry on the Mormon tradition of cotton production. The first Mormon settlers in the south Salt Oasis planted cotton from their first year in 1877 (Hinton 1954, 281). A 1881 letter written by a young Mormon girl home to her friends in Utah mentions the continuing Mormon experiments with cotton in the south Salt Oasis (Merrill 1972, 65-66).

Mormon settlers south of Safford were territorial Arizona's premier non-Indian cotton producers. Prior to 1898 this area was unsettled except for non-Mormon ranchers. The development of artesian wells made irrigated farming possible (Sayers, 1979, 76). The first well borer in the area was John A. Lee, who struck artesian water in 1897 in the place later called both "Lebanon" and "Algodon"
[Spanish for "cotton"]. The townsite of Lebanon/Algodon was purchased in 1900 by John Lee and his brother, William Franklin Lee; other Mormons settlers soon followed (Barnes 1960, 123; McClintock 1921, 259). These newcomers, many of them impoverished Texans, began filing on homestead acreage and buying up previous claims. The first experiments with cotton in the area took place in the late 1890s and the first cotton growers were two brothers from the south, possibly the Lees. Many followed the example and the first cotton ginnery in the Cactus Flats Oasis was established in 1908 (Sayers 1979, 76, 91-92).

Yet, despite the considerable interest and long history of cotton production in the area, there was not a bonafide cotton production region in Arizona until 1912. Prior to railroad developments in the late 1880s Arizona growers were essentially cut off from outside markets, making cotton production for export unfeasible. Some showed early interest; for example the special report on cotton in the Tenth U.S. Census carries an abstract of a letter from Charles Hayden. Musing over the possibility of an Arizona cotton industry, Hayden suggested that the fiber be processed and marketed locally: "With the abundant water I have here a mill to manufacture heavy cotton cloth, such as goes so largely into

1. Lebanon and Algodon were originally two adjacent settlements that fused and the names are more or less interchangeable (Barnes 1960, 123; McClintock 1921, 281-82).
consumption in this part of the territory, would enable planters and mills to be successful without doubt" (cited in Hilgard 1884, 129). Hayden's enthusiasm for cotton production was not shared by all. For example, at Arizona's exhibit in the 1884 World's Industrial and Cotton Centennial Exposition in New Orleans, the territory's copper mining industry was featured but the potential for cotton production in Arizona was ignored (Wagoner 1970, 204-05). While the rail developments allowed the large-scale production of a crop such as cotton for export, the inception of the commercial cotton industry of Arizona ultimately awaited an extraordinary confluence of circumstances that promoted the cotton industry's development: the release of a special cultivar of *G. barbadense* cotton for Arizona, the completion of the Salt River Project, inflated cotton prices, and the interest of tire companies and other businesses in the production of cotton.
CHAPTER 3

BUSINESS INTERESTS IN THE GENESIS OF THE ARIZONA COTTON PRODUCTION REGION

Cotton production in Arizona expanded with the release of a special cultivar of *G. barbadense* in 1912 and within five years a recognizable cotton region emerged. This expansion would not have been so rapid were it not for the interests and efforts of several business entities that had strong interests in the development of an Arizona cotton industry: boosters such as Alexander Chandler and Dwight Heard, corporations such as the Goodyear Tire Company and the Tucson Farms, and quasi-corporations such as the Mormon community.

**Boosters**

Boosters were wealthy and well-educated businessmen that generally migrated to the western United States between 1895 and 1905. Many of them were real estate developers and they took up the task of promoting western colonization that had been dropped by the railroad companies around 1890. As Nash (1973, 12-14) writes that.

... this new generation of boosters undertook even more aggressive and systematic promotion campaigns to develop their new homeland. Chambers of commerce became major spokesmen for business leaders of western communities, enthusiastic agents who propagandized the nation in their penchant for further western growth.

Alexander Chandler and Dwight Heard, boosters with integrated interests in both oasis and cotton development, played very important roles in the genesis of Arizona's commercial
cotton production region.

Chandler

Dr. Alexander Chandler was an important figure in real estate speculation, oasis development, and the development of Arizona's *G. barbadense* cotton industry. Chandler became a very wealthy man with the completion of the Salt River Reclamation Project in 1912 and the coincidental release of a specially developed cultivar of *G. barbadense* by selling land to settlers who flocked to Arizona to plant the new cotton in the new Project.

Originally from Quebec, Canada, Dr. Chandler came to Arizona in 1887 to serve as first Veterinary Surgeon of the territory. Chandler jumped on the booster band wagon in the early 1890s when he quit his post and formed the Consolidated Canal Company with two associates. In 1891 Chandler and associates constructed the Consolidated canal to take water out of the Salt River at a higher point and distribute it through the old Mesa Canal to the smaller downstream canals. Chandler had two very large steam powered dredges shipped in to dig crosscut canals and to extend and enlarge the Mesa canal. In addition to consolidating the downstream canals, the Consolidated Canal delivered water to previously uncultivated lands that lay south and east of the town of Mesa. In the early 1890s Chandler had one of the first successful wells in the Oasis and

1. Chandler's associates were D.M. Ferry, president of the Ferry Seed Company, and an investor from Detroit (Merrill 1975, 108).
introduced Arizona's first electric pump to deliver water to the surface. Electricity to power the pump came from Chandler's private hydroelectric plant, installed in 1898 and the first in the valley. Besides pumping groundwater for his own croplands, Chandler's plant provided power for Mesa (McClatchie 1902, 82; Means 1902, 310; Merrill 1972, 170-73; 1975, 106-8; Robinson 1919, 299-300; Stevens 1954, 14-24; Zarbin 1986, 122).

From 1893 to 1907, Chandler accumulated almost 20,000 acres of Salt Oasis farmland, mostly south of Mesa. This land had been claimed under the Desert Lands Act of 1877 by settlers who then were forced to sell during a period of extreme drought around the turn of the century. Almost 50 sales were involved, ranging from 29 to 640 acres each, at prices just under $10 an acre (Merrill 1975, 106-08; Stevens 1954, 14-24; Zarbin 1986, 122).

Owners of large plots of Salt River Project land were forced to divest their holdings because of the 160-acre limitation stipulated in the Reclamation Act of 1902. To encourage settlement and facilitate divestment, "speculative towns" were constructed on the subdivided project lands: Gilbert, Tolleson, and most notably Chandler, the town planned by Dr. Alexander Chandler as "the Pasadena of the Salt River Valley" (Comeaux 1981, 211; Meinig 1971, 85). The development of the Salt River Project sent average land values from $30 an acre in 1900 to about $100 an acre in 1912 (Barrows 1913, 284). Chandler offered 18,000 acres in 10 to 160 acre tracts for $100 per acre (Stevens 1954, 24). At $90 profit per acre, in addition to the interest he earned on land that was bought on time,
Chandler netted well over 1.5 million dollars from these sales. In addition, the Bureau of Reclamation purchased Chandler's canal company in 1909 for $187,000, but Chandler retained the right to use the water flow for his hydroelectric plant (Zarbin, 1986, 147).

Chandler, with a five acre cotton patch north of Mesa around 1899 [sources vary as to this date], was the first individual to plant *G. barbadense* in Arizona (Fairchild 1938, 141-42; Hathorn 1951, 8-10; McGowan 1961, 51-53; Peplow 1958, 332, 542; Robinson 1919, 313; Stevens 1954, 33). Plant explorer David Fairchild, who had originally collected the seed in Egypt, visited Chandler and took a personal interest in his experiments with cotton (Fairchild 1938, 207; McGowan 1961, 52). Chandler was impressed by the quality and yield of the Egyptian cotton and induced A.J. McClatchie to conduct variety trials at the Territorial Agricultural Experiment Station on Grand avenue near Phoenix in 1901 (Clothier 1908, 426; Kearney and Peterson 1908, 34; McClatchie 1901, 323; Peplow 1958, 332-3; Robinson 1919, 313). A specially bred cultivar of *G. barbadense* was released by the USDA in 1912 and one of the first three cotton ginneries in the Salt Oasis was erected at Chandler in time for the 1913 crop (Myrick 1975, 766).

The Boys' Cotton Club of Chandler, Arizona's first 4-H program, was organized in 1913. Incidentally, like his fellow Tempean Felix Hardwick, thirty odd years before, Floyd Medlock of Tempe was a champion cotton grower, taking the national 4-H cotton championship for his record yielding 1917 crop (Burt and Watson 1984, 3-4).

Specific 4-H programs, such as competitions, were often sponsored by
boosters and others with agribusiness interests. The return is 
"...a reward of publicity that could not be bought at commercial 
rates" (McCune 1956, 264).

Dwight Heard, in true booster fashion, emigrated from Chicago to Arizona in 1895 for health reasons. Heard had a very important role in the development of the Salt River Project and become an ardent cotton booster after 1912. Like Chandler, Heard became very rich by selling his Project land to settlers who came to Arizona to plant cotton.

Rancher, speculator, newspaper publisher, and real estate developer, Heard made his first fortune by investing his father-in-law's money in Salt Oasis farmland that had been foreclosed on during the great drought at the turn of the century (Smith 1986 26-27; Zarbin 1986, 89). Heard's major acquisition was the San Francisco Canal and the 4,800 acres of farmland under it (McClatchie 1902, 80, 106-07). The Bartlett-Heard Land and Cattle Company's holdings totaled 7,000 acres (Merrill 1977, 37). Heard was appointed in 1901 by the territorial legislature to the Maricopa County Board of Water Storage Commissioners, which was charged with studying the potential of the Tonto [Roosevelt] dam site (Robinson 1919, 301). Heard happened also to be a personal friend of U.S. President Theodore Roosevelt (Peplow 1970, 90). In the summer of 1902 Heard was sent by his fellow Water Storage Commissioners to Washington where he was to use his connections to lobby a bill through Congress
that would permit Maricopa County to sell bonds to fund the construction of a dam and reservoir at the Tonto dam site. The subsequent failure of the bill was a moot point because of the simultaneous passage of the Reclamation Act of 1902. Heard immediately returned to Phoenix to organize efforts that eventually made the Salt River Project the first federal reclamation project (Zarbin 1986, 46, 89).

Heard was also a cotton booster. A booster magazine called *The Earth*, in anticipation of the completion of the Roosevelt dam, devoted its August, 1909 issue to promoting the settlement of the Salt River Project ("The Earth" 1909). I found cotton mentioned only two times in this issue: an article by Dwight Heard contains an incidental mention of cotton in a list of possible crops (Heard, 1909, 11), and a real estate ad placed by Heard and reproduced in Figure 1 lists cotton among several dozen crops that could be grown in the Salt River Project. Heard was singularly responsible for the military's interest in *G. barbadense*, which played an important role in the industry's early development. Biplane wings were formerly covered with linen but a small flax crop in 1917 forced airplane manufacturers to find an alternate fiber. Heard, as chairman of the Arizona State Council of Defense, convinced the military of the advantages of Arizona-grown *G. barbadense* for biplane wings (Hathorn 1951, 11; Peplow 1958, 334; Robinson 1919, 316). Heard was head of the Arizona Pima Cotton Growers' Association in 1920 (McGowan 1961, 103) and traveled in 1925 to Sudan to study that country's system of *G. barbadense* production with the goal of improving the Arizona
We Would Like To Tell

you more about the Salt River Valley. If this magazine has interested you
in some particular industry, write us for complete information. We will also
give you the names of men engaged in that particular line so that you may
correspond with them direct.

For twelve years I have made a specialty of locating people on farm
lands in this Valley, and am glad to say that the men I have located are
among the best friends of this office.

C. T. Hirst, the manager of my Real Estate department, James S. Day,
in charge of the Buckeyes business, and myself are practical farmers
of long experience. If you will let us know how much land you want and
what you want to raise, our experience will be an aid to you in selecting the
land most suitable for your purpose.

I believe that my list of selected Valley farm lands is unequalled, and I
am fortunate in being able to assist all newcomers in financing their purchases
on most favorable terms.

Write us for a copy of our illustrated sectional map of the Valley which
will be sent free with other interesting literature.

Dwight B. Heard
Investment Securities -- Real Estate
Phoenix, Arizona

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<td>ETC., ETC.</td>
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</tr>
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</table>

Source: ("The Earth" 1909, 39)

Fig. 1. Heard's Real Estate Advertisement | Photocopy
cotton production system (McGowan, 1961, 22).

Corporations

When corporations farm, the planting decisions are not locally made, rather "... the strategic, long-range planning and financial decisions are made in distant, corporate headquarters" (Vogeler, 1981 127). Corporations, either oriented mainly towards cotton production like Goodyear Farms, or to land speculation like the Tucson Farms, were extremely important in the genesis of Arizona's cotton region, and corporations continue to be important in Arizona agriculture. Fifteen percent of U.S. farmland was corporate-farmed in 1974, while 35 percent of Arizona's farmland was farmed by corporations (Vogeler 1981, 128).

1 Goodyear Farms

Tire companies, most significantly Goodyear but also Fisk, Dunlop, and Firestone, were largely responsible for the rapid expansion of Arizona's cotton landscape. The long-stapled *G. barbadense* was ideal for belting in the newly developed high pressure pneumatic tires (Brown and Cassmore 1939; 49; McGowan 1961, 37, 80). The primary developer of pumplands outside the Salt River Project during the early cotton boom was the Goodyear Tire Corporation which

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1. The Southwest Cotton Company, Goodyear's agricultural subsidiary, was renamed "Goodyear Farms" in 1943 to signify a diversification away from cotton (Myrick 1975, 768; Reed 1952, 36). For simplicity's sake I use the "Goodyear" name throughout.
was forced to operate outside of the Project because of the 160-acre limitation (McGowan 1961, 97). Goodyear Farms was Arizona's single largest cotton producer during the war years; from 1917 to 1922 it planted annually from 9 to 20 percent of Arizona's total cotton acreage (Goodyear 1953, 3-7). In addition to planting cotton, the tire companies promoted cotton production through low-interest loans and guaranteed purchase contracts (McGowan 1961, 78-81). Goodyear purchased one half of the 1917 Salt Oasis crop and over one fourth of all the cotton produced in the Oasis between 1916 and 1924 (Goodyear 1953, 8; McGowan 1961, 98).

After listening to the USDA's pitch for G. barbadense as a belting material for pneumatic tires, Goodyear sent Paul Litchfield to Arizona in 1916 to promote G. barbadense production. Litchfield offered a grower a contract to grow 10,000 acres of G. barbadense on land leased from Dr. Chandler. The contract fell through and Goodyear started its own cotton production operation. Goodyear leased 8,000 acres of land south of the town of Chandler from Dr. Chandler. As part of the lease agreement, Dr. Chandler installed an irrigation system to deliver groundwater which would be pumped with power from the Salt River Project. In addition, Goodyear purchased 16,000 acres along the Agua Fria River (Goodyear 1953, 7; Hathorn 1986).

1. Contract farming reduces the role of the farmer as a decision maker; "... they can retain the illusion of independence because they are self-employed but they effectively become employees of the companies" (Vogeler 1981, 32). In 1974, 20 percent of U.S. cotton was produced under contractual arrangements (Wessel 1983, 64).
1951, 11; McGowan 1961, 97; Myrick 1975, 766; Peplow 1958, 333; Reed 1952, 31; Robinson 1919, 315; Schetter 1976, 3).

Starting in December of 1916, 6,000 acres of "primeval desert" land had been cleared, leveled, watered and planted to G. barbadense by the spring of 1917. Figure 2 portrays the Arizona landscape before and after Goodyear. As Peplow (1958, 333-34) writes, "the change in the aspect of the country was little less than miraculous." By 1918 Goodyear's Arizona operations included 15,000 acres of pumplands [Chandler Ranch, 7,000 acres; Agua Fria Ranch, 4,000 acres; Anderson Unit near Yuma, 4,000 acres], 1,000 mules, numerous tractors and other earth moving machinery, a headquarters that became the town of Ocotillo, 2,500 employees, and two labor camps that became the towns of Goodyear and Litchfield Park (Comeaux 1981, 264; McGowan 1961, 97-98; Myrick 1975, 767; Parker 1917, 8; Peplow 1958, 333-34; Robinson 1919, 15, 314-15; Schetter 1976, 1-4, 12; Thompson 1986, 23).

The tire companies established the cotton post-harvest infrastructure and otherwise helped to sustain the industry through its formative years. In 1917, Goodyear operated all 8 of the Salt Oasis' cotton ginneries; in 1920, Goodyear operated 18 of Arizona's 50 ginneries (Goodyear 1953, 8; McGowan 1961, 81, 99; Reed 1952, 31; USBC, 1920, 11). Goodyear also opened up the state's first cotton oil mill in Phoenix in early 1919 (Schetter 1976, 15). Goodyear's cotton buying department gained an extension function and supplied information on cotton cultivation by 1920 (Goodyear 1953, 8; McGowan 1961, 81; Reed 1952, 33).
Goodyear Farms was virgin desert land, unpromising and forbidding, when the Farms Project was started during 1916.

Clearing of the desert was completed, land levelled and cotton planted. First crop, 1,500 bales, produced in the Fall of 1917.

Source: (Goodyear 1953, 4)

Fig. 2. Before and After Goodyear | Photocopy
Fueled by the cotton boom, the Goodyear Corporation paid out its largest dividend in history at the beginning of 1920, but with the cotton bust at the year's end the company was close to bankruptcy (McGowan 1961, 93). In 1920 Goodyear acquired the Marinette ranch, northwest of Peoria between the Agua Fria River and the New River (Goodyear 1953, 7; Myrick 1975, 768; Reed 1952, 33). This acquisition was not only poorly timed, but the area's micro-climate was apparently inappropriate for cotton. In Marinette, cotton was damaged and cotton workers tents were blown away by heavy winds and rain in September of 1923; and heavy hail destroyed one quarter of a 1,000 acre Marinette cotton patch in May of 1924 (Sellers et al. 1985, 20-21). Goodyear also had plans in 1920, which it abandoned, to extend its cotton production operations into northwest Mexico (McGowan 1961, 93). Goodyear turned away from cotton production and some cotton lands were turned over to the testing of tires for farm machinery (Smith 1948, 46; Goodyear 1953, 12). In 1923 the post-harvest facilities [ginneries, oil mills, etc.] of the Goodyear and Firestone tire companies were acquired by the Pima Cotton Growers' Association (McGowan 1961, 39).

Tucson Farms

Unlike Goodyear, whose primary objective was cotton production, the developers of the Tucson Farms meant to make their fortunes from land speculation. Between 1912 and 1914 a syndicate of Tucson and Chicago investors purchased tracts of land totaling 12,000 acres including land in the previously settled Jaynes-Flowing Wells
area [now in northwest Tucson], most of the previously settled Santa Cruz bottomlands, and new pumplands in the Sahuarita area. With the aid of off-duty U.S. Reclamation Bureau engineers a system of wells, electric pumps, and canals was constructed to irrigate the acreage (James 1917, 311-17; Schwalen and Shaw 1957, 82-94).

The Pima cultivar of *G. barbadense*, released in 1917, required a shorter growing season than its predecessor and allowed production at growing areas higher than 1,500 feet, such as the upper Santa Cruz Oasis (McCatchie and Coit 1916, 70). Thus in 1918 the Tucson Farms planted 150 acres to *G. barbadense*. The following year they planted 1,100 acres and established a cotton ginnery. In the fall of 1919 the corporation sold its land to cotton producers at prices of $200 to $300 an acre. Many of the purchasers were newcomers from the midwestern United States. Others were late of the Salt Oasis, where they had sold their holdings at a profit in order to purchase larger operations near Tucson (James 1917, 317; Knipe 1919; McGowan 1961, 86-87; Sheridan 1986b, 73).

The Mormon Community

Cotton boomed much more strongly in the vicinity of Mormon Mesa than anywhere else in Arizona (Horton 1941, 199). This was in part a relic of the cotton mission system. In addition, the communal Mormon economic system allowed Mormon farmers to profitably grow cotton on small farms because they could achieve certain economies of scale usually accruing only to cotton growers with very large acreages. Mormon cotton producers had access to the help of their
Mormon neighbors, as well as easy credit from Mormon-owned agricultural suppliers and processors.

An important early ginnery was established at Mesa in 1912 by the Egyptian Cotton Company. This company vigorously promoted cotton among local growers so that by 1917 nearly all oasis lands in the Mesa area were under cotton (Melvin 1933, 43-44; Mesa Public Schools 1978, 124). "Cotton Days" were first celebrated in 1917, the merchants of Mesa offered a $50 prize to the grower getting the first bale to the ginnery. Monocropping was the rule and the diversified traditional Mormon agricultural landscape became memory (Horton 1941, 200; Melvin 1933, 43-48). Here is McClintock's slightly premature assessment of the situation:

At all times since its settlement, Mesa has prospered, but its prosperity has been especially notable since the development, a few years ago, of the Pima long-staple cotton. Nearly every landowner, and Mesa is a settlement of landowners, has prospered through this industry, though it has been affected by the post-war depression. The region is one of comfortable, spacious homes and of well-tilled farms, with less acreage to each holding than known elsewhere in the valley (McClintock 1921, 211).

As it was, in 1920, just as local merchants were poised to sponsor a series of "Mesa King Kotton Karnivals", the cotton market crashed (Mesa Public Schools 1978, 133). The 1921 cotton recession hit Mesa with terrific force, far worse than the national depression of 1930. When cotton prices bottomed out, panic and not cotton reigned in Mesa; there were many subsequent bank foreclosures and land transfers (Horton 1941, 200-01; Melvin 1933, 49-50).

Two prominent Mesa Mormons from pioneer families established agribusinesses - one forward-linked and the other backward-linked to
cotton production — that flourished with the cotton boom. Calvin Phelps, who arrived in Mesa in 1879 with his parents from Idaho, was cofounder of the Attaway-Phelps Cotton Company, which both ginned cotton and produced cottonseed oil. O.S. Stapley, born to Mormons who settled in Mesa in 1882, started his company in 1894. Based in Mesa, the Stapley Company became a major supplier of agricultural implements throughout Arizona (Melvin 1933 38-39, 79, 92).

The Stapley Company had a primary role in the mechanization of the cotton harvest in Arizona, which reached commercial proportions in 1949 when 140 International pickers were employed state-wide to harvest about 10 percent of the cotton crop (Barr 1950, 6; Vanvig and St. Clair 1954, 1). By 1949 the Stapley company had sold a total of 125 cotton picking machines in Arizona, most of them in the heavily Mormon Queen Creek Oasis, and Mormon Queen Creek Oasis cotton growers brought together 14 picking machines, the largest number ever assembled at one place anywhere to that date, for a mass harvest. The profits were then tithed over to church coffers (Farrell, 1949).

The Mormon cotton farming community, integrated through the church with Mormon-owned suppliers and processors, acted for all the world just like an immense vertically integrated [or diversified] corporate farm that, along with the bonafide corporations and the boosters, strongly influenced the genesis and rapid early development of Arizona's cotton production region.
CHAPTER 4

FACTORS GENERALLY INFLUENCING COTTON'S DOMINANCE IN ARIZONA

Arizona growers are generally locked into a system that almost demands the production of cotton. Specifically, cotton is planted to recapture the costs of reclamation, to generate the capital necessary to pay the rent, and to pay off loans. Monocropping with cotton is the consequence of these and other factors that encourage and allow cotton production.

Reclamation and the Imperative to Plant Cotton

Reclamation, the clearing of desert land and the installation of irrigation systems prerequisite to cotton production, entails a significant sunk production cost and irrigation represents a significant fixed production cost. Oasis development, and to a less extent oasis maintenance, create demands for capital that are generally met through cotton production. After the sunk cost is met, the pressure to produce cotton is reduced somewhat. However, the continuing costs of irrigation remain to create the need for quick and high returns, as from cotton production.

Reclamation often proceeds independently and cotton gets planted as a necessary consequence. Federally funded reclamation projects generate a debt that usually is paid off through the production of a crop with high, immediate capital returns, generally cotton in Arizona. The Salt River Project began in 1902 and the...
barbadense cotton breeding program was initiated a few years before. By 1908 the breeding program was looking promising and there were plans to put the new project under the new cultivar (Padfield and Martin 1965, 85; McGowan 1961, 51-57). The opening of the Project in 1912 was coincident with the release of the cultivar and the further expansion of the Salt River Project during the 1920s was directly due to the water demands of cotton producers (Wyllys 1950, 263).

The Yuma Project was also completed in 1912 and around 1930 the Project had 57 percent of its land under cotton and contained 70 percent of Yuma County's total irrigated acreage; no cotton was planted on the 30 percent outside the Yuma Project ("Cotton Grown on the Projects in 1930" 1931; UAAES 1932a, 5-6). A period of decline in Yuma County cotton production coincided with a period during which the reclamation process in the area had stagnated and the acceleration of reclamation in Yuma County in the early 1950s was accompanied by a renewed interest in cotton (Barr 1951, 4-5). Cotton production was also the agrosystem of economic choice in the newly reclaimed lands of the San Carlos Project in Pinal County; 77 percent of the Project lands were under cotton in 1930 (UAAES 1931 19-20).

As with federal reclamation with surface water, the expense

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1. International examples of reclamation projects funded by cotton production are the Sukar barrage on the Indus and the Aswan High Dam and the Gezira Project on the Nile (Case 1929, 340-44; Zimmermann 1951, 325). As the Kaban Dam on the upper Euphrates in Turkey was being finished, Smith and Reynolds (1972, 396) predicted that most of the reclaimed land would be planted to cotton.
of pumpland development demanded that cotton be grown as it is the crop offering Arizona growers the highest and most immediate capital returns. Perennial tree and vine crops have the disadvantage of a long gestation period between planting and economic production (Pifer 1969, 584). Thus pumpland development in Arizona was intimately linked with the development of Arizona's cotton landscape. In general, cotton production follows as a necessary consequence of pumpland development and the production of other crops follows as an adjunct to cotton production. The situation is very similar to that in California's Central Valley, of which Gregor (1962, 3) writes:

Cotton, easily the most profitable crop raised by plantation units, is commonly rotated with winter crops such as barley, flax, wheat, and alfalfa. These latter play a vital part in the plantation economy because they enable the grower to lower his irrigation costs by extending the crop period well beyond the cotton season. Only by pumping water almost constantly can the cotton grower amortize the heavy initial costs of irrigation equipment. Income from cotton is still far greater, however, than that from subsidiary crops, and other crops would not be grown if cotton were not produced.

Nearly 85 percent of the water used on cotton in Arizona in the mid-1940s was groundwater, while only about half of total irrigation water was pumped. Throughout the 1930s and 1940s Pinal county dominated Arizona cotton production, producing more than the rest of the state combined. This was also the area of greatest pumpland development during this period (Barr 1946a, 2, 9). Through the end of the period, cotton planting continued to accompany pumpland development in Pinal county. As Barr (1949, 5) writes, "New acreages developed for pump irrigation in Pinal County in the winter of 1947-48 were put into cotton and a small additional acreage was
developed in 1948 to be put into cotton in 1949"; and of the 10,000 acres of Pinal County pumpland developed in 1951, Barr (1951, 4) reported, "This land will go into cotton."

In long settled areas, cotton production could gradually give way to tree and vine crops as the initial costs of reclamation are paid off. Nevertheless, other factors would remain to encourage the endurance of cotton production.

Tenancy and the Imperative to Plant Cotton

Cash-leased tenant farming, a general consequence of the concentration of farmland ownership in the hands of absentee landlords, also demands a crop with quick and high returns, like cotton. The concentration of farmland is more prevalent in the western U.S. than the East, as Worster (1984a, 38-9) writes, "... today a mere 5 percent of the nation's landowners control almost half the farm acreage, while in the Mountain West a minuscule 1 percent owns 38 percent of all agricultural land and, in the Pacific states, that same percent owns 43 percent of the land."

By 1940 there was a growing concern about the spread of tenant farming in Arizona. As Barr stated, "There has developed a system of absentee ownership in which farms are being operated by tenants or managers, often on a large scale, with the owners frequently living in other states" (cited in McWilliams 1944, 74; WPA 1940, 84-85). There were several reasons behind the trend towards tenant farming, including the availability of large amounts of cheap state land, speculative land ventures by out-of-state investors, farm
mechanization, and the profitableness of large scale farming (Greisinger and Barr 1941, 290). Barr (1946b, 28-29) in fact recommended that new agricultural settlers accept tenancy as the tenure of choice. New settlers

... should give serious consideration to renting rather than buying land. A renter on a good farm may make a better return on his labor and investment than the man who buys a farm. This is especially true if the purchased farm is too small to be operated efficiently or if the owner has gone too heavily in debt to secure it.

Some trends in Arizona agriculture that were aggravated by widespread tenant-farming include the expansion of cotton monocropping with attendant high seasonal labor requirements and pest problems, the over expansion of pumplands and depletion of the aquifer, and the instability of land ownership and insecurity of land occupancy (Greisinger and Barr 1941, 289).

There are two basic sorts of lease arrangements: cash and share. Under the most common share arrangement, the 50-50 share-lease, the landlord provides the land and water, harvest and post-harvest costs are shared, and the tenant supplies the remaining technological and labor inputs. The crop is divided equally, as are AAA payments (Greisinger and Barr 1941, 288; Tetreau 1942a, 401-02). The cash-lease tenant simply pays a fixed sum of cash for the use of the land. Absentee land owners generally favored cash-leases, while resident landlords favored share-leasing (Tetreau 1942a, 391).

Cotton production is influenced by leasing generally and cash-leasing specifically. Table 1 demonstrates the distribution of tenure of Arizona farmland by county in 1940. Pinal County was the
### TABLE 1

**Arizona Farmland Classified by Tenure of Operator: 1940**

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<td>percent of acreage</td>
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Source: (Tetreau 1942a, 399)
fastest growing cotton production district at this time and also led in cash-leased tenant farmed acreage. In 1939 the 419 farms in the Casa Grande area of Pinal County were 24 percent owner-operated, 19 percent were farmed by part-owners, and 57 percent were tenant farmed. Investors that lived outside of Pinal County owned 43 percent of the farmland. These non-resident owners leased more than 80 percent of their farm land to tenant farmers. By comparison, only 60 percent of the resident-owned farmland was tenant-farmed.

Approximately 75 percent of the farmland in the Casa Grande area was leased: 40 percent was cash-leased, 20 percent was leased on a 50-50 share basis, and 40 percent was leased under miscellaneous other arrangements [cash-share, 80-20 share, etc.]. With 60 percent of the total cropland under cotton: 68 percent of tenant-farmed land was in cotton, 53 percent of part-owner farmed land, and only 48 percent of full owner-farmed land (Greisinger and Barr 1941, 281-90).

The rental pressures made it imperative for tenant farmers to plant a crop with high and immediate returns. For tenant farmers, field crops are favored over perennial tree or vine crops because of the insecurity of land occupancy (Barr 1946b, 14). Cash-leased land was generally cropped to cotton, lettuce, and truck crops while share-leased land was often under alfalfa and grains. The decline during the late 1930s of cotton acreage in Yuma County was in fact coincident with a decline in cash-leasing (Tetreau 1942a, 399-405). This would indicate that there might be a two-way relationship between cotton production and cash-lease farming. Brown and Cassmore (1939, 50-51), however, ascribe the expansion of cotton production in
This increase in Arizona cotton acreage was the logical result of the recently accelerated tendency toward industrialized farming under the cash-lease system. Absentee landowners who have made the large investment required to reclaim new land, or who have foreclosed on bankrupt developments with perhaps some loss of original investment, usually find it more immediately profitable to lease their holdings to a few large-scale operators rather than to break up the land into a greater number of family-size farms.

The operators who lease the land under this system have little choice in the crop they must plant. Market uncertainty discourages the large-scale expansion of both lettuce and citrus. Lettuce is expensive to produce, and crop failure hazards are great. Citrus, while not so liable to crop failure, has the disadvantage of yielding no income during the 4 years in which the trees are maturing. Alfalfa and grain crops are less hazardous but do not produce a high cash yield.

Cotton, on the other hand, fits all of the requirements of the large scale, cash-lease system in Arizona. It has a relatively stable market, it yields a cash crop in the first year of cultivation; and it is easily financed at the beginning of the season. Moreover, it is an intensive crop offering the possibility of high returns an acre.

An emotional testimony against landlords and cotton comes from Jeff Wilson, a tenant farmer in Scarborough's novel, who complains, "... they've made me plant cotton, cotton, cotton, till I'm sick o' the word. I hate to look at a boll. Landlords that live in town can handle cotton easier'n anything else, an' so they make us raise it. I'd like to ram a bale down their throats, I would!" (Scarborough 1936, 164).

Credit and the Imperative to Plant Cotton

The demand for capital for reclamation, leasing, and other costs of cotton production creates a demand for credit, which leads to a demand for even more capital, which leads to even more cotton. Credit is a vital element of the cotton agrosystem, although the
relationship between growers and financial lending institutions is not necessarily symbiotic. As King Louis XIV of France once opined, "credit supports agriculture as the cord supports the hanged" (cited in Moore 1965, 152). The special interests of the financial lending institutions and the widespread use of credit fostered the origination of the U.S. cotton belt. According to Street (1957, 234):

Upland cotton was introduced into an economy already accustomed to the colonial system of specialized production under conditions of commercialization. Existing credit institutions relying almost exclusively upon the use of the crop lien were preserved and extended as the cotton culture expanded westward. These institutions contributed to the establishment of a one-crop economy in the south.

Once established, the cotton-credit-cotton treadmill is self-perpetuating: "... credit pressures - themselves partly caused by dependence on cotton growing - mean a constant stimulus to keep the land in cotton" (Rose 1964, 84). For example, Arizona growers monocropped with cotton during the 1919-1920 boom and used cotton profits to purchase food and fodder that they might otherwise have grown for themselves. Cotton, offering economically reasonable returns when prices were good during the boom, turned out to be a "false friend" when "tobogganing" depression-era cotton prices forced many growers to go deeply into debt in 1930. The following season the growers needed a cash crop which was easily financed to service the mounting debt. Cotton, for which planting contracts were readily available, remained the crop of 'choice.' Frequently, however, the contracted price was not adequate to service the mounting debt, leading to even more cotton (Matlock and Clark 1934, 47-48).
For at least three decades cotton companies held oligopsony power over Arizona cotton producers. Around 1940, production loans in the Arizona cotton lands were much easier to secure for cotton than any other crop (Greisinger and Barr 1941, 286-87), and cotton growers usually financed their crops through the ginning companies, Brown and Cassmore (1939, 51ff.) write, "At one time one ginning and cottonseed oil company had the deciding voice as to whether growers could receive loans from the federally controlled Intermediate Credit-Banks. Growers receiving such loans usually agreed to sell their seed to this company only."

In Arizona in 1939 the Western Cotton Products Company [a subsidiary of Anderson-Clayton] financed 485 cotton production accounts involving 57,236 acres of cotton [about 30 percent of the state's total] and ginned 41 percent of Arizona's total 1939 cotton production (McWilliams 1944, 82-83). Of a sample of 152 cotton producers in 1952, 119 used production credit; 107 borrowed directly to finance cotton, and 10 borrowed to finance the acquisition of such things as mechanical cotton pickers. Production credit was by this time an "essential tool on cotton farms." About one half of the cotton growers that used production credit financed through the cotton companies and local ginneries. This type of financing required a tie-in agreement to gin the cotton only with the

1. Anderson-Clayton ginned about 35 percent of the total 1937 cotton crop of Arizona and California (Majka and Majka 1982, 78).
financier. Occasionally cotton companies offered loans for other commodities, but only as attachments to cotton production loans. As with contract farming, the decision-making capacity of the cotton growers was seriously reduced and many expressed concern over their reduction in bargaining power. Some cotton growers felt that they were being taken advantage of and that the loan agencies should operate independently of the ginneries (Vanvig 1955, 18-22, 45).

Vanvig (1955, 3) reported:

Much of the increase in irrigated acreage, particularly that developed to grow cotton, has been made possible by the courageous policies of lending agencies. Further, this expansion could not have been so extensive nor so rapid without this aid. New and rapidly developing areas are usually deficit areas for loanable funds, particularly for agriculture. This steady increase in the size of the agricultural industry in Arizona as measured by agricultural income, coupled with the increase in farm and ranch land prices in recent years, has resulted in a steady upward trend in the need for credit.

By the mid-1960s, the primary source for production loans in Arizona had apparently shifted from the cotton companies, as commercial banks and insurance companies held 90 percent of production and other non-real estate loans (UAAES 1966, 12-13).

Credit pressures, along with other factors, led to a condition of monocropping - the concentration of a single crop in a landscape that results in an agricultural region. Mr. Llewelyyn, the wealthy owner-operator, and Mr. Bob, the lawyer, discuss the complex relationship between credit and cotton monocropping in Scarborough's

*In The Land of Cotton* (1936, 165):

"Between the credit merchant and the landlord, a lot of farmers in Texas are practically in a condition of peonage," said Llewellyn thoughtfully. "This credit system is a graft,
a curse on the state. I suppose it's so everywhere where cotton is the chief crop and the money comes in all in a lump at the end of the year."

"Do you think the one-crop system is the cause or the effect of this credit scheme?" asked Mr. Bob.

He pondered a moment, and spoke deliberately. "I suppose each is part cause and part effect. And the banks make it almost as hard for the tenant farmers as the merchants do."

Monocropping

Monocropping, "... agriculture as an engineer might conceive it to be" (Carson 1962, 10), is simply a general region-wide concentration of the frequency of a crop in an agricultural landscape. Cotton is favored in Arizona for the reasons above, in addition to the lucrative government benefits bestowed on cotton producers through the farm programs and an entrenched system of suppliers and processors that thrive from cotton production. Other factors reduced the desirability of other crops, particularly alfalfa [Medicago sativa], and allowed even more cotton.

A crop rotating regimen for cotton production includes, besides the cotton, a leguminous crop and a grain crop (Brown and Ware 1958, 292-93). In the late 1920s, G. barbadense farmers in the Salt Oasis maintained soil fertility by keeping their land under alfalfa for three years for every 4 to 5 of cotton on gravelly and sandy soils; cotton grown on heavier clay loam or silt soils went 5 to 6 years between alfalfa crops (UAES 1928, 24-25). According to the 1940 WPA guide to Arizona:

The old standby of the Arizona farmer is alfalfa. ... In their search for water, alfalfa roots go to incredible depths, open and aerate the soil, and prepare it for perfect moisture penetration. A common procedure is to grow alfalfa on a piece of land for three or more years, then plow it up
and grow such soil-depleting crops as cotton, sorghum, small grains, melons, and vegetables for an approximately equal period (WPA 1940, 81).

A very important reason to plant alfalfa was as fodder or pasture for draft animals. The replacement of work animals with tractors substantially reduced the amount of land required for fodder production and pasture (Musoke 1981, 350). In Arizona around 1930 about 75 percent of Salt Oasis cotton growers used tractors while the rest relied entirely on animal power. In the Salt Oasis in the early 1930s, each acre of cotton required 62.5 horse-hours or 8 tractor-hours per acre for annual production (Matlock and Clark 1934, 7-10). In 1937, with four-row planters and all purpose tractors, each tractor replaced 16 mules or horses (Tetreau 1940b, 552). From 1920 to 1935 the number of Arizona farms and ranches reporting horses fell from 85 to 66 percent of the total, and those reporting mules decreased from 29 to 24 percent. During the same period, the average number of horses per farm fell off from 16.0 to 6.2, and mules from 4.2 to 2.6 (Tetreau 1940a, 202-03). In 1956 about 32 percent of Arizona farms reported total tractorization [no animal power used at all]; these were concentrated in the cotton counties, especially Yuma (USBC 1956b, 202-3). Tractorization seriously reduced the demand for fodder production. In addition, the residual cake left after pressing cotton seed oil served to partially replace alfalfa as a fodder source (Cunningham 1937, 47; WPA 1940, 83). For each bale of [G. hirsutum] cotton produced, about 140 pounds of cottonseed oil, and the feed equivalent of 375 pounds of grain and 175 pounds of hay
were produced (Barr 1943, 7-8).

Despite the gradual fall in the demand for alfalfa with tractorization, low cotton prices in the early 1930s and other factors combined to sustain alfalfa production for a time (UAAES 1932b, 11). Thus, Matlock and Clark (1934, 50) asserted that, "Alfalfa is an older crop than cotton in the Salt River Valley and without doubt alfalfa is the basic crop upon which depends the permanency of agriculture in the Valley." However, alfalfa and grain acreage in Arizona generally did not keep pace with the expansion of cotton after 1934. In addition, cotton replaced almost 30,000 acres of grain and alfalfa between 1933 and 1937 (Tetreau 1938a, 197-200). Soil conservation provisions of the farm programs strongly promoted alfalfa production, and somewhat forestalled the growth of cotton monocropping (Greisinger and Barr 1941, 291-92), as Barr (1942, 367) predicted, "This requirement may result in an increase in alfalfa acreage planted in pump-irrigated areas of Arizona."

In the late 1940s about one third of the land in the Salt Oasis was generally cropped to alfalfa. Although alfalfa planting decisions were determined primarily by government soil conservation inducements, crop prices, and water costs, growers still generally believed that it was necessary to rotate alfalfa with other crops at

1. Because of the high evapo-transpiration rates of the arid lands, it takes 20 to 40 percent more water to grow a humid-adapted crop such as cotton in the desert than to grow the same crop, albeit with lower yields, in a more humid environment (Nabhan 1984, 173).
least every 4 to 6 seasons in order to maintain soil fertility and keep the land in good tilth (Robertson 1948, 1). In the late 1950s, with almost total adoption of commercial fertilizers throughout Arizona's cottonlands, it was still generally recognized that cotton following alfalfa seldom required additional fertilizer amendments (Goldschmidt 1959, 29).

However, alfalfa uses more water than cotton and as water costs became an issue alfalfa lost favor to cotton. The water duty of a crop, the amount of water required to be applied to an acre of cropland during a growing season expressed in acre-feet [af], can vary with different edaphic and climatic conditions and with different cultural practices (Smith 1925, 7-9). In Arizona, alfalfa generally demands the most water, about 6.2 af. The average water duty of cotton, about 3.75 af, is approximately the same as that of navel oranges, sugar beets, safflower, and grapefruit, and about the average water duty for all Arizona irrigated crops. Cantaloupes, maize, grapes, broccoli, soybeans, wheat, guar, potatoes, barley, and grain sorghum demand about half the average. Lettuce, carrots, and cauliflower demand the least water (Barr 1944, 9-10; 1945, 7, 11; Comeaux 1981, 256; UAAES 1928, 12-3; 1932b, 8-9). Rising water costs around 1940 induced a general shift from alfalfa to cotton (Greisinger and Barr 1941, 286-87), and were a major factor in the shift from alfalfa to cotton in the San Carlos Project after a water price increase in 1942 (Barr 1945, 6). Similarly, in the Tulare Basin of California rising irrigation costs led to a shift from alfalfa to cotton (Preston 1981, 183).
In the late 1940s, despite the objections by extension and research workers who warned of hazards to soil quality, the shift away from alfalfa [because of high water costs and low prices for alfalfa relative to cotton] continued (Barr 1949, 14). The cotton boom of the early 1950s further accelerated the shift from alfalfa (Barr 1951, 11). With the re-imposition of cotton acreage restrictions after the Korean War, Barr (1954, 7) evaluated the potential of alfalfa as an alternate crop. He correctly predicted that since alfalfa sold for less and used more water than cotton; and since its primary benefit, as a soil improver, took time to pay off, alfalfa would not be a popular alternate crop for cotton producers.

The tendency away from alfalfa was accelerated by the pesticide revolution which quickly eliminated the natural controls that kept the alfalfa aphid [Theroioaphis (Pterocallidium) macukata] under control. After 1954 the pest was a serious hindrance to alfalfa production in Arizona (Tuttle et al. 1958, 3-8). In addition, the use of pesticides forced a further narrowing of crop diversity. For example, cotton growers using the pesticide BHC were cautioned against growing root crops on the treated fields for 5 years afterwards (Roney et al. 1963, 10). Taking a broader perspective, pesticides permanently altered the ecosystem of southern Arizona by reducing predator populations and allowing pests to gain resistance. Thus, the use of pesticides created a situation where pesticide use almost has to continue, favoring the production of a non-food crop, such as cotton.

Winter grains and alfalfa are still grown on cotton lands as
an alternative to a winter fallow. As in California, this is necessary to amortize the substantial costs of pumpland development (Gregor 1962, 3). Nevertheless, there was a marked decrease in alfalfa production in Arizona after the Second World War. In Arizona of the 28 years from 1919 through 1946, 11 had total alfalfa acreages that exceeded total cotton. From 1947 to 1987, however, the total alfalfa acreage in Arizona never exceeded the total cotton acreage (ACLRS 1966, 8–9, 56–57; 1969, 21; 1971, 25; 1972, 13, 24; 1977, 14–15; 1979, 11; 1986, 32; 1988, 30). Alfalfa hay does, however, endure as Arizona's second most important crop (ACLRS 1988, 30).

The drop in diversity represented by monocropping had serious ramifications in three important subsystems: labor, marketing, and ecological. Labor demands are skewed, with a large gap between regular and seasonal requirements, helping lead to the deplorable living conditions typical of lands dominated by cotton. Monocropping is a risky strategy for marketing reasons as well. A diverse grower anticipates modest but sure returns but a cotton grower's fate hinges on the market for a single crop, cotton. Finally, monocropping, along with the adoption of pesticides and cutting down of wind breaks as fields are enlarged, continues a dangerous trend of reducing ecological diversity. The consequences are increased pest problems and numerous health risks from the increased use of pesticides.

The need for irrigation creates a demand for cotton, as does the concentration of land ownership by non-resident landlords and the dominating influence of financial lending institutions with interests
in cotton production. Technological changes made it less necessary or desirable to plant crops other than cotton. The consequence is a general condition of monocropping with cotton, resulting in a cotton production region in the oases of southern Arizona.
CHAPTER 5

FACTORS GENERALLY INFLUENCING THE DISTRIBUTION OF COTTON IN ARIZONA

Commercial cotton production in Arizona is generally confined by the length of the growing season to oases of southern Arizona. Numerous factors influence the distribution of *G. hirsutum* and *G. barbadense* within this possible cotton landscape. Due to a confluence of factors related to elevation and climate, *G. barbadense* production is concentrated in western Arizona. Figure 3 is a map that indicates the average planted cotton acreage in Arizona during the period of commercial production from 1912 to 1987. Maricopa County, with most of the state's farmland, leads in the production of both species. Pinal County comes in second for both species. However, third place for *G. barbadense* production goes to Graham County while Yuma County [together with La Paz County which was created from Yuma in 1983] comes in third for *G. hirsutum* production.

**Factors Affecting the Areal Expression of Cotton in Arizona**

Areal variations in the distribution of cotton production are a consequence of the varying returns due to variations in production costs and yields. The returns from cotton production vary principally with: 1) yield per acre, 2) the rental rate or interest on investment and taxes, and 3) the cost of water (Barr 1946a, 9). Some other factors that influence yield and so affect differences in returns include contour irregularities, soil borne pathogens, noxious
Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 3. Average Acres of Cotton Planted in Arizona: 1912-1987 | Map
weeds, and alkaline and compacted soil. However, the costs of land use vary in a given year mainly on the basis of their water relations: the availability of irrigation water, the quality of that water, and the ability of the soil to absorb and retain moisture (Harris 1949, 3-16).

Factors With a Mitigated Influence on the Distribution of Cotton

The depth to groundwater and the distance to market have less of an influence on planting decisions than might be imagined.

The Depth to Groundwater. The direct influence of depth to groundwater and cost of water on cropping decisions is actually very slight because of an inverse relationship between water costs and land costs. Land with cheap water is more valuable than land with expensive water. The more valuable land carries higher taxes, rental rates, and interest than the less valuable land, mitigating the lower water costs (Barr 1946a, 9). Thus, as Barr (1950, 7) states, "Throughout the years the total [land and water] cost is about the same in all cotton producing parts of the state." Of course, as I will discuss in the final chapter, farmland is idled when the water table reaches a depth which makes pumping uneconomical.

Distance-to-Market. Similarly, distance-to-market has surprisingly little influence on the spatial aspect of cotton planting decisions in Arizona. Sent Visser (1980, 311) argues that distance-to-market as a primary influence on planting decisions is diminished in importance in irrigated agrosystems because of the high costs of reclamation. In my research I found only two references
relating distance-to-market with cropping decisions or land values in Arizona. Because of alkaline soils and the long distance to the market town of Tempe or railroad shipping points such as Glendale, Means (1902, 330) suggested that producers in the vicinity of Buckeye run cattle. Barr (1957, 1-2) noted the Yuma area's strategic location in relation to west coast markets - along with a diverse cropping base allowed by the long growing season and a perceived "mastery" of pest problems - as a factor making the area desirable for agricultural development.

Elevation-Related Factors and the Distribution of Cotton

The distribution of cotton in Arizona is strongly influenced by climate, which varies principally with elevation. In general, the high eastern oases have shorter growing seasons, cooler temperatures, and more rain than the lower western oases. Yield per acre is a good indicator of the areal differences in the productivity of different counties, although this does not account for areal differences in the quality of cotton produced or differing levels of inputs required. Table 2 indicates the average yield per acre for the five-year period from 1983 to 1987 for major cotton production counties arranged by elevation. A longer growing season allows the cotton plant more time for lint production and there is an obvious tendency for the lower oases to give higher yields. However, this is by no means a constant rule; although the longer growing season of the lower western oases offers a generally larger production, there are other factors - such as fewer pests - that favor cotton
Table 2

Average Yield Per Acre of the Cottons in the Major Cotton Production Counties of Arizona: 1983-1987

<table>
<thead>
<tr>
<th>County</th>
<th>Elevation at:</th>
<th>G. barbadense</th>
<th>G. hirsutum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cochise</td>
<td>Willcox - 4,167'</td>
<td>711</td>
<td>775</td>
</tr>
<tr>
<td>Graham</td>
<td>Safford - 2,920'</td>
<td>757</td>
<td>904</td>
</tr>
<tr>
<td>Pima</td>
<td>Tucson -- 2,389'</td>
<td>723</td>
<td>1,061</td>
</tr>
<tr>
<td>Pinal</td>
<td>Eloy ----- 1,565'</td>
<td>1,004</td>
<td>1,339</td>
</tr>
<tr>
<td>Maricopa</td>
<td>Phoenix - 1,092'</td>
<td>981</td>
<td>1,347</td>
</tr>
<tr>
<td>La Paz</td>
<td>Parker -- 420'</td>
<td>881</td>
<td>1,251</td>
</tr>
<tr>
<td>Yuma</td>
<td>Yuma ---- 141'</td>
<td>872</td>
<td>1,315</td>
</tr>
</tbody>
</table>


production in the higher eastern oases. In addition, there are other elevation-related factors that influence the distribution of the cotton species within the cotton production region. In summary: the low western oases are at a general advantage because of a longer growing season and less rain, and they are at a specific advantage for G. hirsutum production because of fewer problems with verticillium wilt. The high eastern oases are at a general advantage because of free defoliation from early frosts and a lack of aflatoxin contamination and they are at a specific advantage for G. barbadense production because of the lack of extremely high nighttime temperatures.
The Length of the Growing Season. Cotton traditionally requires a minimum of a 200 day growing season for economic
production (Smith 1945, 29; 1956, 95-98). The oases of southern Arizona trend generally from low elevations in the west to high
elevations in the east. With micro-climatic variations due to differences in exposure and air drainage, the length of the growing season between damaging frosts in Arizona is reduced by 3 to 4 weeks for each 1,000 foot increase in elevation (Smith 1956, 46-47; WPA 1940, 12). Cotton is grown in Arizona at elevations from below 200 feet to above 4,000 feet (Dennis and Briggs 1969, 3) and the average growing season ranges from 215 days and shorter in the east to 265 days and longer in the west (Smith 1945, 29, 71-76).

The length of the growing season has a major and discernible impact on cropping decisions and thus on the distribution of crops. Cotton growers in the high eastern counties have generally fewer

1. This is a general, but not constant, rule. G. barbadense requires a slightly longer growing season than G. hirsutum (McClatchie and Coit 1916, 70; Thompson and Wood, 1919, 274-75). Technological and agronomic developments have allowed a shortening of the cotton growing season in Arizona. The establishment of cotton plow-up deadlines to combat the pink bollworm forced growers to engineer increasingly early harvests (ASES 1959, 5; 1960a, 12; 1961, 3; 1962, 4, 1963, 4; 1967, 5). The Deltapine cultivar, planted extensively in the early 1960s, matured earlier than the previously popular Acala 44 and allowed an earlier harvest. Additional factors that allowed an earlier harvest included the increased use of chemical defoliants, machine picking, and the added ginning capacity of new and improved ginneries (ASES 1962, 4; 1964, 13; 1965, 5; UAAES 1962, 14). An early harvest, however, is not consistently desirable; under favorable economic and climatic conditions [high cotton prices and low fall rains], as in 1980, the harvest is delayed for 2 to 3 weeks to maximize production (Stiles 1980).
alternative crops to choose from than cotton growers in the low western counties. Citrus requires a more frost-free growing situation than cotton. Citrus lands can also be planted to cotton, and fodder or vegetable crops can be grown during the winter months. Cotton lands can also produce a great variety of other crops [except citrus] and will obtain high yields of crops like alfalfa (Harris 1949, 13-14). Conflating a 1955 list of "major crop activities" by county in Arizona (ASES 1955, 16) and a 1986 list of "principal crops" (ACLRS, 1987, 109) reveals a marked tendency in southern Arizona for the lower western counties to be more diversely cropped than the higher eastern counties. Cotton, alfalfa, wheat, and barley are common to all eight southern Arizona counties. Principal crops produced in the lower counties [Maricopa and Yuma], and not in the higher counties, include Bermuda grass seed, cabbages, celery, strawberries, lettuce, citrus, and grapes. Additional crops produced in the low counties and variously distributed in at least one of the higher counties [Pinal, Pima, Santa Cruz, Graham, Greenlee, and Cochise] are maize, sorghum, melons, carrots, potatoes, and onions. Only chili peppers are produced in a high county [Cochise], but not at all in the low counties.

Because of the long growing season the lower oases offer generally higher yields for cotton production. This might be tempered by the fact that the growers in the low oases have relatively more non-cotton options to choose from. There are also numerous elevation-related factors besides the length of the growing season that influence cotton distribution in Arizona.
Precipitation. Precipitation is generally deleterious for cotton production and the dearth of rainfall lends a great advantage to cotton producers in the arid west. Within Arizona, precipitation is greater in the high eastern oases than in the low western oases. Yuma gets an average of 3.43 inches annually, Eloy 8.67 inches, and Willcox 11.89 inches (Sellers et al. 1985, 112-15). Rain after the bolls open can stain the cotton and reduce its quality, and rain generally increases the incidence of boll rot, which seriously reduces yield. As Ledbetter (1962, 39) indicates, "... when them cotton bolls get rotten you couldn't pick very much cotton."

Frost. Frost greatly reduces the potential for pest problems and gives an advantage to growers in the elevated eastern oases. Also, cotton growers in the higher eastern oases were and are favored slightly by natural leaf drop from early frosts. This made cotton easier, and thus cheaper, to pick before the development of chemical defoliants, and continues to reduce the need for the expensive chemical defoliants in the eastern oases (ASES 1954, 30-31).

Aflatoxin. Aflatoxin contamination of cottonseed, now endemic to the low hot oases of Arizona, reduces the value of the seed crop and decreases the competitive advantage of lowland cotton producers. Aflatoxins, first discovered in cottonseed in 1960, are produced by thermophilic fungi of the genus Aspergillus.  

1. Arizona's aflatoxin problem was discovered in 1960 when a shipment of trout that had been fed cottonseed meal pellets displayed high aflatoxin levels (Harper 1972, 6).
especially *A. flavis*. Cotton and certain other crops grown under warm and humid conditions can develop potentially dangerous aflatoxin levels in the seed, rendering it unfit for consumption by humans or their domestic animals. Dairy cattle that are fed aflatoxin contaminated seed pulp can produce milk with dangerously high aflatoxin levels (Agrios 1978, 368-69; Comeaux 1981, 267). Although high temperatures are the major factor in *Aspergillus* infestations, high humidity and insect damage to the bolls are also important factors. Aflatoxin levels in Arizona, as elsewhere, are lower in cotton seed grown in the relatively cooler growing areas above 1,800 feet. The growing areas below this elevation, generally Yuma, La Paz, and Maricopa counties, constitute Arizona’s "aflatoxin belt."

Cotton producers in this area are at a comparative economic disadvantage to those outside the belt because they produce cottonseed with high aflatoxin levels, often above the 20 ppb. limit set by the FDA (Russell 1980, 55-58).

Verticillium Wilt. Caused by either or both of the soil borne fungi *Verticillium albo-atrum* and *V. dahliae*, verticillium wilt is the most destructive disease of cotton in the irrigated southwest and influenced the concentration of *G. barbadense*, which is resistant to the fungi, in the high oases of eastern Arizona where verticillium

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1. The development of Arizona’s serious aflatoxin problem was directly related to the rise of the pink bollworm in the mid-1960s [which I discuss in Chapter 7] since the primary means of entry of *A. flavis* is through pink bollworm exit holes (Harper 1972, 6).
wilt infestations were concentrated. The spread of wilt in Arizona was facilitated by the cotton agrosystem's post-World War Two technological revolution, specifically the increased applications of irrigation water, the increased use of nitrogen fertilizers, the new heavily fruited cultivars, the compacted soils from heavy tractor use, and cotton monocropping in general (Presley and Bird 1968, 355; Wood 1972, 17). Arizona's first and most severe infestations of verticillium wilt occurred in the elevated and relatively cool and moist eastern oases (Thomas 1948, 23; Barr 1956, 5). Cotton losses from verticillium wilt increased significantly between 1950 and 1956 and by the mid-1950s the wilt occasionally infested cotton fields in Maricopa and Pinal counties (Barr 1956, 5; 1957, 8).

*G. barbadense* is resistant to verticillium wilt but *G. hirsutum*, although tolerant cultivars [the Acalas, which I discuss in Chapter 7] have been developed, is generally not (Brown and Ware 1958, 179-80; Presley and Bird 1968, 354-55). Cotton growers in the vicinities of Las Cruces, New Mexico, and El Paso, Texas, began to plant *G. barbadense* in the late 1930s, and production increased during the war. Because of its resistance to verticillium wilt and the local dominance of that disease, *G. barbadense* production in these areas became very important after 1950. The general concentration of Arizona's *G. barbadense* production in the eastern highland oases after the Second World War was strongly influenced by the infestations of verticillium wilt in these oases (Hathorn 1951, 13-29; McGowan 1961, 124).
High Nighttime Temperatures and Flower Development. Unlike *G. hirsutum*, flower development in *G. barbadense* is hindered when nighttime temperatures remain above 86 degrees Fahrenheit [30 degrees centigrade] (Cams and Mauney 1968, 52). This is an important factor discouraging the production of *G. barbadense* in Arizona's lower oases where nighttime temperatures during the summer can remain very high.

Access to Labor

Labor access represented, prior to the mechanization of the harvest, a primary bottleneck to cotton production. For a little over half a century, Arizona cotton growers were annually faced with the task of delivering large contingents of cotton pickers to the cotton fields during the harvest. Indeed, the Arizona cotton agribusiness system was once described as a "labor-obsessed industry" (Padfield and Martin 1965, 245; and cited in Barrera 1979, 116). The system of labor delivery, however, was so efficient that the distribution of cotton production in Arizona was formerly influenced only slightly by access to labor for the harvest.

Extreme seasonal labor demands exist only for crops such as cotton, "... whose man-hour requirements per acre vary sharply at different stages of the production cycle" (Schwartz 1945, 17). The *American Cotton Handbook* states: "One person can plant, chop and cultivate more acreage of cotton than he can reasonably expect to gather" (Merrill et al. 1949, 120-1). This imposes a seasonal pattern of labor use throughout the planet's unmechanized cotton lands, where extra labor is usually only required during the cotton
chopping and harvest seasons. The general labor scarcity imposed a limit on the expansion of cotton in Arizona, so that very early Clothier (1908, 431) recommended of cotton production: "Because of the uncertainty of labor conditions, operations for the present should be largely of an experimental nature, and the plantings should be limited to small acreages." Kearney and Peterson (1908, 57) reasoned that the availability of labor was the primary obstacle to the development of a commercial cotton landscape. In fact, the flow of labor - through serendipitous circumstances and concentrated recruitment - was usually sufficient and labor accessibility was rarely a critical factor in cotton planting decisions. Exceptions to this rule are the early concentration of *G. barbadense* in the Salt Oasis and the general reduction in cotton production in 1944 as I elaborate in Chapter 7.

In addition, the spatial pattern of cotton production in Arizona might have been influenced by differential access to two major labor pools: "Okies" and Mexicans. Mexican nationals were legally employed for the cotton harvest from 1917 to 1930 and again from 1942 to 1965. The period of most intense Okie migration and intense recruitment coincided with the 1930 to 1942 break in legal hiring of Mexicans. Eastern and central cotton producers had an advantage from 1930 to 1942; border area producers were slightly favored during the periods when Mexicans were legally employed - before 1930 and after 1942.

**Okies.** Okie is a general term referring to depression migrants from the south-central states. During most of the period of
hand harvest, from 1912 to 1965, impoverished migrant Okies traveling from the dust-bowl to the West Coast through Arizona made up a large share of the cotton pickers. The period of most intense Okie migration was in the 1930s when approximately 6,000 Okie families a year, as many as 400,000 individuals, passed through Arizona (McWilliams 1944, 82-85).

All cotton growers in Arizona did not have equal access to tap into the migrant Okie labor stream. Eastern districts were at an advantage because they had first chance at hiring the westward bound migrants. Growers in the large central oases of the Salt and middle-Gila Rivers, where in 1937 about 85 percent of Arizona's cotton acreage was located, had the twin advantage of being located along a main route through Arizona and belonging to the growers' association which made collective recruitment economical. Growers in small oases off the main path were at a decided disadvantage during the Okie era. A cotton grower in the Sahuarita area of the upper Santa Cruz Oasis, for example, had to drive his own truck to Oklahoma to get pickers in 1937 (Brown and Cassmore 1939, 68-69).

Mexicans. The practice of legally importing Mexican workers operated at a high federal subsidy and access to this sure and cheap supply of labor gave an advantage to cotton growers in the border counties of Yuma, Santa Cruz, and Cochise. In a 1959 study of four counties, braceros worked heavily in the border counties, Cochise and Yuma, where they respectively represented 43.9 and 63.7 percent of the cotton picking force. In Maricopa and Pinal Counties, however, respectively only 14.4 and 10.0 percent of the cotton pickers were
braceros in 1959 (ASES 1960b, 31). In Santa Cruz County, a border County with likely high employment of braceros, and well off the Okie trail, cotton production was virtually absent after 1965; this was probably influenced in part by the termination that year of the bracero program.

**Differential Harvest Demands and the Distribution of Cotton.**

A major difference between *Gossypium barbadense* and *G. hirsutum* relates to harvest labor demands. The cotton harvest bottleneck was most acute for growers of *G. barbadense*, which has smaller, harder to pick, bolls that also must be picked more carefully than those of *G. hirsutum*. After staple length, the primary morphological distinction between the two species is in regards to the tenacity with which the fiber adheres to the seed. *G. barbadense*, because its fiber does not adhere tightly to the seed and to preserve the fiber quality, can and must be ginned on roller gins. *G. hirsutum* fiber adheres tightly to the seed and must be ginned on saw gins (Aiken 1973, 196-99; Lewis and Richmond 1968, 8; Street 1957, 5-7).

The different ginning technologies contribute to the picking cost gap between the species. Roller ginning does not eliminate the trash [fragments of leaves, bracts, etc.] from the lint; so *G. barbadense* must be picked very meticulously. Saw ginning eliminates trash very well; so *G. hirsutum* need not be picked so carefully (Clothier 1908, 429-30; Kearney and Peterson 1908, 54; Thompson and Wood 1919, 271). Consequently, it takes more time to harvest a pound of *G. barbadense* than a pound of *G. hirsutum*. Kearney and Peterson (1908, 128) guessed, based on conditions in the Southeast, that an
average worker would pick \textit{G. barbadense} at about two-thirds the rate of \textit{G. hirsutum}. Because of the labor gap between the species, in Texas during the Jacksonian period a cotton grower could only expect each slave to work 3.5 to 4 acres of \textit{G. barbadense}, as compared with 12 to 15 acres of \textit{G. hirsutum} (Ashcroft 1961, 147). The different picking rates translate into different harvest costs. The average harvest costs from 1917 to 1932, for example, were $22.50 per acre or $35.52 per bale for \textit{G. barbadense} and $15.25 per acre or $19.72 per bale for \textit{G. hirsutum} (Hathorn 1951, 71-73). In a 1928 survey of the Salt Oasis the harvest represented the major capital input: 40 percent of total \textit{G. hirsutum} production costs and 49 percent of the total \textit{G. barbadense} production costs (Clark 1931, 662). In the mid-1950s it was calculated that pickers harvested \textit{G. barbadense} at about 70 percent of the rate of \textit{G. hirsutum}. However, Barr (1955, 8) reported that it would require a wage for \textit{G. barbadense} twice that of \textit{G. hirsutum} to induce pickers to switch to the long-staple cotton.

The original location of Arizona's \textit{G. barbadense} industry in the Salt Oasis was due, in part, to the proximity of Pima Indian labor. Similarly, the harvest labor gap between the cottons impressed itself on the demographic landscape of the antebellum south as just prior to emancipation the highest slave to master ratios were found in the Sea Islands, areas of concentrated \textit{G. barbadense} production (Epstein 1977, 253; Rose 1976, 115-16). The labor shortages in the early 1940s were indeed exacerbated by the coincident high production of the labor-demanding \textit{G. barbadense}. 
Factors Affecting Interspecific Cotton-Planting Decisions

Generally, the competition for irrigated Arizona cropland is between small grains, alfalfa, and cotton. In cotton producing areas, where small grains and alfalfa are more or less supplementary to cotton and not depended on as primary income source, the competition for land is primarily between G. hirsutum and G. barbadense. Estimated relative dollar returns to the grower, a product of price, yield, and cost differences, are the principal factor in determining which species to plant and accounted for about 95 percent of the variation in interspecific cotton planting decisions around 1950 (Hathorn 1951, 3-4, 15). Besides the price differential, and the factors that I discussed above, growers had to consider other factors in the decision to plant G. barbadense or G. hirsutum, which generally favored G. hirsutum. An Eloy-area grower acknowledged in the mid-1980s that G. barbadense continues to have drawbacks over G. hirsutum: "It's more difficult to grow, . . . It is a longer season cotton (than upland [G. hirsutum]), and generally needs one or two more irrigations and maybe another spray for insects. It also costs a little more to gin" (cited in "The 'Other' Cotton" 1986, 31). Besides which, G. barbadense is treated differently by lending institutions, benefits from cross-pollination, and was historically legislated differently.

Differential Returns

G. barbadense generally offers a substantially higher price than G. hirsutum, but also substantially lower yields and higher
production costs. The yield and production costs are generally
constant and predictable but cotton prices can vary widely between
the planting and harvest seasons. Growers generally make their
planting decisions by gambling on future cotton prices. Thus, in the
late 1920s Salt Oasis cotton producers had a tendency to shift back
and forth from species to species with fluctuations in cotton prices
but rarely made this changes in time to benefit financially. The
advice to growers was to base interspecific planting decisions
"... on the outlook for the current year rather than upon the
price received for the previous year" (UAAES 1928, 34). Matlock and
Clark (1934, 50) discuss this complex issue of alternate cotton
strategies:

... there has been a battle for supremacy between Pima [G.
barbadense] and upland [G. hirsutum] ever since the latter
type of cotton came into prominence in the Salt River Valley
in 1923. Many people understand the reasons why cotton
growers in the valley plant a larger acreage of short staple
varieties, but at the same time they believe the reasons are
not well founded.

Common objections to Pima are that it costs more to grow,
more to pick, and more to get it ginned and when these things
are done there is much less to sell. Then there is the
longer growing season required, the difficulty of getting
Pima well picked, and the objection to the quality of the
final product commonly expressed by the mills, whether
justified or not.

But the survey data show that with the 2 to 1 price ratio
existing during the past few years Pima growers ordinarily
can meet every objection and still finish the season ahead of
upland growers.

According to Brown and Cassmore (1939, 50), this tendency of growers
to shift from species to species diminished somewhat during the later
1930s, yet cotton farming in Arizona remained a highly speculative
enterprise.
Lending Policies

Lending agency policies had an impact on interspecific cotton cropping decisions and the cotton landscape as the financiers were hesitant, because of associated market uncertainties and economic risks, to finance the production of *G. barbadense* (Hathorn 1951, 23).

Cross-Pollination

Pesticide use is another factor in the general decline of *G. barbadense* relative to *G. hirsutum*. The pesticide revolution is directly implicated in the widespread reduction of pollinating insects (Carson 1962, 73-74; Rudd 1964, 101-02). Cotton is generally self-pollinating. However, *G. barbadense*, unlike *G. hirsutum* does respond with higher yields as a result of cross-pollination (Werner et al. 1979, 33).

Farm Programs

*G. barbadense* was not until the early 1950s subject to the same lucrative farm program benefits that *G. hirsutum* enjoyed since 1932. Of all the U.S. agricultural programs, the *G. hirsutum* cotton program has been the most controversial and costly, and *G. hirsutum*'s status as a federally regulated crop was pivotal in the stability of cotton growers' incomes (Weber 1972, 1-2, 79). However, *G. barbadense* was the favorite crop to shift to in seasons that *G. hirsutum* was restricted. *G. hirsutum* acreage was restricted during the years 1932-1936, 1938-1941, and 1950. With legislation implemented in 1954 both species were subject to restrictions. The direct result in Arizona during restricted years was the extensive
planting of *G. barbadense* on new lands, particularly in Pinal County, which lacked allotments for *G. hirsutum* production. Thus there are times that *G. barbadense* acreage expanded, even though cotton prices alone might not have favored this (Barr 1942, 277; 1943, 1; 1950, 10; Hathorn 1951, 25; Horton 1941, 80; Pressley et al. 1940, 73-74). The desire to maintain high levels of cotton production during periods when *G. hirsutum* was restricted represented a major factor in the endurance of *G. barbadense* production in Arizona.

These are the factors that generally influence the distribution of cotton production within Arizona’s cotton production region. In any particular year, the distribution of cotton is affected by factors — such as the price of cotton and the costs and availability of production inputs — that influence the profitability of cotton production. The process by which cotton expanded into new areas is best understood with reference to the process of oasis development, as I discuss in the following chapter.
CHAPTER 6

OASIS DEVELOPMENT

Oasis development, particularly because of the reclamation imperative to plant cotton which ensures that cotton production will concentrate in recently developed areas, is important for understanding the areal distribution of cotton in Arizona at different times in history. In addition, from time to time land has been reclaimed in Arizona for the express purpose of producing cotton. This was the case with the Goodyear farms. At times the relationship has been smeared entirely. For example in 1949 growers were planting record amounts of cotton with the intention of establishing cotton histories and much land was reclaimed for this purpose, as I discuss in Chapter 7. From another perspective, however, growers in 1949 were reclaiming record amounts of land with the intention of establishing irrigation histories and cotton was planted on this land. Clearly the relationship runs both ways and each way. In a sense, the acts of reclamation and cotton production in Arizona are inseparable facets of the same general enterprise.

The first oasis lands in Arizona were irrigated with surface water. Oasis development with surface water was nationalized with the passage of reclamation legislation and the development of reclamation projects. Political and technological change - along with a period of low rainfall - led to the widespread development of pumplands. Later political developments have allowed for the
production of cotton on state land and freed Colorado River water for
Arizona users and allowed for the development of cotton lands on
Indian reservation under long term leases. Figure 4 indicates the
development of irrigated acreage in the Arizona counties that contain
the cotton production region, where irrigated acreage historically
and currently represents over 90 percent of Arizona's total irrigated
acreage. Figure 5 indicates the extent of Arizona's oases and amount
of irrigated land per county. Figure 6 is a reference map showing
significant settlements and streams.

Water Resources of Arizona

Oasis development consists of the application of water to
desert land. Water, not land, is the primary limiting factor in
Arizona's agricultural development. Irrigation water for agriculture
comprises about 90 percent of all the water used in Arizona and the
arid West in general (Comeaux 1981, 256-57; Foster and Wright 1980,
85; Frederick 1982, 186; Hecht et al. 1977, 10; Shabecoff 1989; Towne

1. The data for this graph are annual from 1889 to 1982
except for the following missing years: 1890-1898, 1901-1904,
assemble as detailed a time series as possible, but but as these data
are from different sources, they are not necessarily totally
congruent. According to Frederick (1982, 38-39), data from different
sources frequently lack congruency due to differences in
definitions. Thus, the data for the years 1900, 1905, 1910,
1913-1965 indicate "irrigated acres." Data for 1966-1969; 1971-1972,
indicate "irrigated acres." I avoid census data from 1969 to 1974
because it was gathered by mail-response surveys and acreages are
seriously under-reported (Frederick 1982, 44-45).
* Total = the cotton counties: Maricopa, Pinal, Yuma, Graham, Pima, Cochise, Santa Cruz, Mohave, Greenlee.


Fig. 4. Development of Irrigated Acreage in Arizona: 1889-1982 | Graph
Sources: (ACLRS 1972, frontispiece; USBC 1984b, 123).

Fig. 5: Distribution of Irrigated Acreage in Arizona: 1982
Source: (Hecht and Reeves 1981, 4, used with permission)

Fig. 6. Significant Streams and Settlements | Map
calculated the total annual water supply in Arizona at 3,628,000 af of surface flow and 765,000 af of groundwater. The first was an overestimation based on records gathered during wet years; the second, however, was an under-estimation based on a maximum pump-lift of 50 feet. By the late 1940s, pumps were delivering as much as 1.7 maf of groundwater annually to cotton and other Arizona crops from wells as deep as 300 feet (Barr 1946a, 2). The distinction made between groundwater and surface water, a handy academic or legal tool, is blurred in reality. About 30 percent of U.S. surface water is supplied by groundwater from springs or seepage. In turn, the percolation of surface water from streams, canals, and reservoirs recharges the aquifer (Frederick 1982, 81).

Precipitation in Arizona has the high temporal variability typical of the arid lands; an area that averages 10 inches a year might actually range between 5 and 15 inches a year (Comeaux 1981, 230; Mann 1963, 8-9). Precipitation variations have long had an impact on oasis development in Arizona. Between 1276 and 1299 Arizona experienced its most severe drought in a 2,000 year long dendrochronological record. This drought is implicated as a major factor in the decline of the Anasazi, Mogollon, and Hohokam cultures in the 13th century (Comeaux 1981, 69-75). The early settlers in modern Arizona were not used to the highly variable patterns of desert precipitation and, seeking short-term profits, those who came west to "make the desert bloom" had the very opposite affect of making the landscape more desertic. These producers exploited
Arizona's fragile oases with agricultural practices designed in, and more appropriate to, the well-watered forestlands of northwest Europe and eastern North America. Unschooled in irrigated agriculture and unused to the year-to-year precipitation verities of arid climates, they expanded settlement during periods of heavy precipitation as if water were not a potentially limiting factor (Clawson 1963, 431; Dobyns 1978, 28; Padfield 1971, 40).

Arizona's agricultural settlement proceeded in a series of flush and crash cycles of expansion and consolidation. Wet periods were generally accompanied by a flurry of optimistic settlement. The dry periods that inevitably followed invariably initiated widespread farm failure, farmland amalgamation, and the development of new irrigation technologies and the expansion of irrigation works. In a general pattern exhibited throughout the arid west, first the readily accessible surface water was appropriated. Further expansion required government intervention to finance and construct dams and reservoirs to capture flood waters for use during the dry season. The next step was the development of groundwater resources. As groundwater overdrafts occurred state governments were forced to implement legislative controls (Frederick 1982, 110). As Wiley and Gottlieb (1982, 178) report:

Arizona's farmers tended to use the existing water supply as quickly and inefficiently as possible. Farmers feared future shortages - competition for water use from copper companies, Indians, or urban interests. So farmers used water in order to claim water, Since agriculture utilized about 90 percent of the supply, their practices had created a cycle wherein rapid and inefficient use created a fear of shortage, which in turn led to the push for new supplies.
Oasis Development with Surface Water

Oasis development with surface water in Arizona was generally accomplished through the institution of the federal reclamation project, the first of which was the Salt River Project. Without the system of Reclamation Bureau reservoirs, short periods of low rainfall were a primary limiting factor in the development of the agricultural landscape. The area of farmland in the western United States irrigated entirely or partially with reclamation water increased from 400,000 acres in 1910 to 3,000,000 acres in 1930. By 1940, 7 of the 25 million acres of irrigated lands in the trans-Mississippi West were served by the Bureau of Reclamation (Nash 1973, 165; Warne 1973, 17). By 1980, 11 million acres—almost 20 percent of the western United States' irrigated lands—were irrigated with Bureau of Reclamation water (Frederick 1982, 66, 215). Arizona's second reclamation project was the Yuma Project, the San Carlos Project on the middle Gila was next; this was followed by the Gila Project on the lower Gila. This represents the development through reclamation projects of all of the surface water irrigated oasis land in Arizona with the major exception of the upper Gila Oasis, which, because of the upper Gila's ample flow, was developed and sustained without federal intervention. Oasis development with Colorado River water was hindered until the early 1960s by litigation concerning the proper allocation of the Colorado's water. The last reclamation project— the Central Arizona Project—is a system of canals, tunnels, and pumping stations the delivers water from the Colorado River to the oases of south central Arizona.
The Salt River Project

The damming of the Salt was considered as early as 1889, but because of the enormous expense, this was not accomplished until federal funds were made available for the project through the Reclamation Act of 1902 (Comeaux 1981, 243-44; Merrill 1975, 46-9; Robinson 1919, 300; Zarbin 1986, 37). Phoenix, Mesa, and Tempe in the Salt Oasis of Maricopa County were loci of intensive agricultural development. In 1889 there were about 35,000 irrigated acres in the Salt Oasis. This represented over half of the irrigated acreage in the entire Arizona territory (USBC 1902, 825).

Boggs (1895, 14) warned that agricultural settlement in Arizona had expanded to its sane limits and that further development would be possible only by increased surface water diversion from the Colorado or the development of pumplands. A generally wet period from about 1893 to 1897 allowed expansion of irrigated acreage in the Salt Oasis to expand to over 100,000 acres (Forbes 1911, 11). At this time the normal flow of the Salt River was not sufficient to deliver a steady and sufficient supply of water to all of the Oasis' canal works. The expansion of the Salt Oasis had reached the point where a reservoir was necessary so that water from the wet years could be saved for use in dry years (Wagoner 1970, 422). Arthur Powell Davis (1897, 79) warned that the expansion of agriculture in the Salt Oasis were caused by the misconception that wet conditions during the 1890s were permanent.

Davis was proved a prophet when a very serious drought, the worst in anyone's memory descended on southern Arizona in 1897. Yet
the irrigated area of Maricopa County, with most of it still in the Salt Oasis, nearly tripled between 1889 and 1899 to just slightly less than 110,000 acres (McClatchie 1902, 67, 105-06). By 1902 the irrigated area of the Salt Oasis expanded to 120,000 acres (Means 1902, 287). The expanding settlement clashed with the decreasing rainfall to generate severe economic consequences for settlers (Marr 1927, 69). As the rivers and canals dried, at least a third of the Oasis' farmlands were idled. Livestock died in droves and orchards withered. Water became such a precious commodity that the canals were patrolled by horsemen armed with rifles. Many farm families packed up and moved away from Arizona, convinced that Salt Oasis settlements dependent on river water were destined to fail (Comeaux 1981, 231; McClatchie 1902, 67; Merrill 1975, 46-49; Sheridan 1986a, 239; Wagoner 1970, 423). A result was an "alarming drop" in the population of Phoenix (Stevens 1954, 20). The water shortages generated by the great drought led to discussions of the need for a dam and reservoir on the Salt River (Davis 1903, 9).

Some large-scale producers at this time, notably Dr. Chandler, had wells and were able to ride out the drought (Zarbin 1986, 37). The great drought broke with severe floods in 1905 and 1906 which destroyed the earthen and timber dams that had hitherto diverted water from the Salt into the canals. The twin problems of flooding and the need to 'save' reclaimed lands made a reservoir system on the Salt a perceived necessity (Mann 1963, 133; Sheridan 1986a, 239; Smith 1986, 65; Wagoner 1970, 423; Zarbin 1986, 38-39). As I mentioned, boosters such as Chandler and Heard actually became
very wealthy by buying up failed farms at dirt-low prices and selling them for a tidy profit once they had been irrigated at the tax-payers' expense. Boosters generally had a very important role in the expansion of agriculture in the Salt Oasis and development of the Salt River Project.

McClatchie (1901, 323-24) estimated that the proposed dam and reservoir would increase the maximum possible irrigated acreage from 110,000 to 122,000 acres. With more efficient distribution, irrigation, and cultivation practices, he thought that the Oasis might be expanded to a maximum of 180,000 acres. This was considerably less than the enormous expanses being promoted. Apparently to little avail, McClatchie (1902, 139) made the following warning about over-development:

A serious danger, when a storage reservoir is contemplated, is that the amount of land which may be properly irrigated, when the reservoir is in existence, may be over-estimated. No greater misfortune could befall the Valley than a mistaken attempt to irrigate a considerably larger area than the increased water supply would warrant. All would go well during years of abundant water supply, but during years of scanty rainfall the suffering would be far greater than ever experienced heretofore.

Pragmatism lost out to boosterism. By 1909, with the dam not yet even finished, there were nearly 200,000 irrigated acres in the Salt Oasis (USBC 1913, 85). B.A. Fowler, a Glendale-area rancher and booster who moved to Arizona from New York in 1893 for his health (Smith 1986, 17), was a primary hero of the reclamation epic and gained the honorific "Father of the Reclamation Act" for his lobbying efforts (Peplow 1970, 72; Robinson 1919, 301). In a 1909 bid to attract settlers, Fowler (1909, 6-7) pegged the maximum irrigated
area within the Salt River Project at a staggering one million acres. The projection of highly inflated acreage figures is the essence of boosterism. Fowler's source was likely to have been Hodge, who in 1877 calculated the maximum possible irrigated area in the Salt Oasis at one million acres (Hodge 1962, 43). As for the territory, an early experiment station bulletin judged that Arizona's surface water alone, if proper reservoir sites were developed, was adequate to irrigate 18,235,000 acres (Stolbrand 1891, 4), and Governor Brodie, in 1905, boasted that Arizona had 10 million acres of potential farmland (Smythe 1907, 251-52).

In 1901, with the aid of the National Irrigation Congress executive chairman George H. Maxwell [a.k.a. the "Militant Evangelist of Reclamation"] Salt Oasis water users created a committee, with Fowler as chairman, to look into the question of reservoir development (Peplow 1970, 72; Robinson 1919, 302). In the spring of 1901, with the Salt a trickle, Fowler went to Washington to help plead Arizona's cause to Congress (Wagoner 1970, 424). The Tonto Dam Site, one of 5 sites proposed, was chosen for the first National Reclamation Project (Robinson 1919, 303; Smith 1986, 33). Through the strenuous lobbying efforts of Maxwell and Fowler the Reclamation Act contained special provisions allowing for privately held land to receive the benefits of federal reclamation, a provision absolutely vital to the development of the Salt Oasis but absent from the original draft (Peplow 1970, 67-71; Smith 1986, 22-23; Wagoner 1970, 425; Zarbin 1986, 89).

The government demanded that about 140,000 acres be put up as
collateral before it would begin to build the Salt River Project. The Salt River Valley Water User's Association, an amalgamation of local canal companies representing 4,000 landowners, was formed in 1903 with Fowler as the first president (Comeaux 1981, 244; Forbes 1911, 60; Mann 1963, 133-34; Robinson 1919, 302-03; Sheridan 1986a, 1 239-40; Smith 1986, 17, 45; Wagoner 1970, 425). Work began in 1905 and the Project was operable by 1912 (Comeaux 1981, 244-46; Merrill 1972, 48; 1975, 65-72). The dam was named after President Theodore Roosevelt, who officiated at its dedication (Merrill 1970, 2 140; Robinson 1919, 305-06; Wagoner 1970, 430). The Roosevelt Dam, partially operable by 1910, stored the waters of the Salt so that they could be distributed in a continuous even flow, thus low rains in the summer of 1910 did not have serious economic consequences because of the water already stored up in Roosevelt Lake (Sellers et al. 1985, 17).

The Salt River Project was designed to fulfill multiple purposes, including water storage for irrigation, flood control, and the generation of hydroelectricity for pumping groundwater and domestic purposes (Smith 1986, 2, 78-79; Thompson 1986, 22; Wiley and

1. The actual building of the dam was accomplished through the efforts of imported Italian stonemasons (Merrill 1970, 141) and native Apache laborers (Barrows 1913, 281; Blanchard 1907, 226).

2. In the early planning stages the dam, because of its location at the confluence of the Salt River and Tonto Creek, was called the Tonto Dam. Tonto is Spanish for "fool" and this might have been a factor in the name-change.
Gottlieb 1982, 176). The generation of hydroelectricity was made valuable by the recent technological developments in the transmission of electricity over long distances, allowing one power source to serve an area of up to 125,000 square miles. As planned, about a third of the power produced was to be used to pump groundwater, the rest for mining, residential, industrial, and other uses (Barrows 1913, 284).

Under the Reclamation Act, members of the Project were required to repay to the government the large investment expended (Beadle 1916, 468-69). The Arizona Republican, published by booster Dwight Heard, was an important vehicle for dispersing reclamation propaganda. Concerning the matter of repayment, the paper stated that the project would pay for itself, "and after the ten years when title to the project has passed to the association the annual dividends to the farmers will make the county taxes look like popcorn money at Christmas time" (cited in Zarbin 1986, 148). The Salt River Project did not actually pay for itself but was subsidized by further legislation, which provided for the extension of the pay-back period from 10 to 50 years, and allowed for water costs to be subsidized by electric power revenue generated by the projects (Berkman and Viscusi 1973, 132-33; Frederick 1982, 66-68; Mann 1963, 404; Smith 1986, 93-112). The debt was finally paid off in 1955 and title to the Project was passed to the Users' Association (Mann 1963, 134; Wagoner 1970, 430).

The Reclamation Bureau boasted that the Salt River Project represented, "Horatio Alger's Theme on a magnificent scale - not the
rise of an individual, but of a community of over one-third of a
million people - is found in the story of the irrigation development
of the Salt River Valley of central Arizona" (cited in Mann 1963,
135). Many Arizona banks failed as the immense cotton crop and low
cotton prices of 1920 resulted in a deficit equal to the entire
construction costs of the Salt River Project (McGowan 1961, 37, 84-5;
McWilliams 1944, 73; Thompson 1986, 23). Thus, despite efforts to
the contrary, the Salt River Project was almost entirely taken over
by speculators by the late 1920s (Reisner 1986, 122).

Countering the general growth of the Salt River Project was
the rise of saline water which led to temporary cotton land
idlement. In 1918, and as a consequence of heavy irrigation, 80,000
acres of Salt River Project land had a water table within 10 feet or
less of the surface. The salt problem was particularly acute in the
area west of Tempe where much farmland was idled. A consortium
composed of the Salt River Project and the Independent Tempe Canal
Company, with the assistance of the Reclamation Bureau, sank drainage
wells to lower the water table so that the salts would leach down.
The drainage water was conveyed out by canal to reclaim new lands
(Comeaux 1981, 230; Fireman 1982, 226; Smith 1925, 282-83; UAAES
1928, 14-15). Thus since 1926 there was a decrease in total salts
carried by wells in much of Maricopa county (Barr 1948, 5). The
salts were in fact simply conveyed out to exacerbate the salinity
problems in the lower Gila, as I will discuss.
The Yuma Project

Arizona's second reclamation project was the Yuma Project, authorized in 1904 and completed with the construction of the Laguna Barrage on the Colorado River in 1909 and a siphon [completed in 1912] to convey water from the diversion point on the California side of the Colorado to the higher Arizona side (Mann 1963, 135; McClintock 1916, 441; Robinson 1919, 307-08; UAAES 1932a, 5; Wyllys 1950, 264). The Yuma Project was originally planned to irrigate 130,000 acres: 20,000 acres in the Wellton-Mohawk Oasis of the lower Gila, 53,000 acres in the Yuma Oasis of the lower Colorado, and 40,000 acres on the Yuma Mesa (Forbes 1911, 65). The Yuma Mesa and Wellton-Mohawk divisions were dropped from the Yuma Project and developed later as the Gila Project. With the completion of the Yuma Project and the first cotton boom, irrigated acreage in Yuma County expanded from 9,000 acres in 1910 to 52,000 acres in 1920 (Arizona Academy 1967, 76). There were 43,000 irrigated acres in the Yuma Project in 1931 (UAAES 1932a, 5-6). In 1955 there were 45,539 irrigated acres in the Yuma Project, about 85 percent of the potential. By the early 1960s, the Project was almost paid off and the Project was passed from the Reclamation Bureau to the Yuma Valley Water Users' association (Mann 1963, 135).

The San Carlos Project

The proposal for federal aid for the San Carlos Project was made ostensibly on behalf of the Pima Indians to revive their agriculture. The plans called for 100,000 acres to be irrigated in
the project [80 percent by surface water and 20 percent by groundwater] to be divided equally between the Gila River Pimas and the non-Indian settlers in the vicinity of Florence and Coolidge (Comeaux 1981, 186; Mann 1963, 146, 174; Officer 1971, 53; Ortiz 1973, 253-54; UAAES 1931, 9-13; WPA 1940, 19; Wyllys 1950, 264).

Coolidge, which became a very important cotton town, was founded in 1926 to house the dammers. The Coolidge dam on the Gila River was completed in 1930 (Comeaux 1981, 213; Lamm and McCarthy 1982, 182; Wyllys 1950, 264). Extending upriver from the dam is San Carlos Lake which has been filled to capacity only once since its completion and has at times been completely dry (Dobyns 1978, 26; Mann 1963, 146, 174). Settlement of the San Carlos Project began around 1930 and starting around 1936 large tracts of pumplands [powered with Project hydroelectricity] were developed in the vicinities of Eloy, Stanfield, and Magma (Barr 1946a, 1). The development of the San Carlos Project was disrupted during a dry period from 1938 to 1940 (Hundley 1975, 298), and the total irrigated acreage of Pinal County declined almost 50 percent during the late 1930s (Arizona Academy 1967, 76). Further developments in Pinal County were accomplished with pumped groundwater. In the mid 1950s the San Carlos Project served less than 15 percent of the farmland and even at this the paltry capacity of the San Carlos Reservoir occasionally resulted in crop losses during dry years (ASES 1957, 3).

The Gila Project

Approximately 11,000 acres were irrigated with groundwater in
the lower Gila Oasis in the early 1930s. Around this time, and as a partial consequence of the Salt River Project drainage wells, the salinity of well waters reached dangerous levels of 6,000 mg/l and some wells went dry, thus agricultural production in the area entered on a serious decline (Fradkin 1981, 302-04). The Gila Project, consisting of two main divisions, the Wellton-Mohawk and the Yuma Mesa, was approved by Congress in 1937. Besides its function as a rescue operation, the Project was presented to the general public as a tactical maneuver to counter the acceleration of settlement across the border in Mexico, and bolster the United States' claims to Colorado River water. According to a special commission report in 1936, the Project would "... preserve a water resource for eventual development of an empire of national importance" (cited in

1. The Yuma Auxiliary Project, constructed to facilitate the irrigation of the Yuma Mesa, was completed in 1923. By 1931 there were 1,500 irrigated acres of Mesa land (UAAES 1932a, 5-6), and by 1946 there were 5,500 irrigated acres on the Mesa (Barr 1947, 5-6). In 1947 the venture was reauthorized as the Yuma Mesa division of the Gila Project (Mann 1963, 135-36). Irrigated acreage on the Yuma Mesa hence expanded modestly apace so that by 1953 there were 15,000 irrigated acres on the Mesa (Barr 1954, 14), about a third under citrus (Barr 1955, 3).

2. There is a long tradition in Arizona of paranoia concerning Asian settlement in northwest Mexico. For example, a 1911 article in the Tombstone Prospector was headlined, "Are Japs Planning Strategic Move? - Securing Magdalena Bay Coaling Station in Sonora Gives Rise to Alarming View of Future Plans - May Be the Part of a Far Seeing Policy" ("Are Japs Planning Strategic Move" 1911). Prominent Arizonans who opposed the Colorado River Compact of 1922 frequently invoked the spectre of "Asiatic colonies" being nurtured in Sonora by any Colorado River water allowed to cross the border (Hundley 1975, 162; Mann 1963, 82-83).
The authorization of the Gila Project was also an under-the-table payment in a stand-off between federal and state governments. The Parker dam, on the Colorado River just below its confluence with the Bill Williams River, was completed in 1939; its primary and original purpose was to divert water into the All American Canal for metropolitan southern California (Comeaux 1981, 253; Peplow 1958, 313-14). Fearing that California would take Arizona's water, Governor Mouer in 1934 mustered a regiment of the Arizona National Guard in a paramilitary operation to intimidate the federal dammers (Berkman and Viscusi 1973, 107; Fradkin 1981, 189-90; Hundley 1975, 294; Mann 1963, 85-86; Reisner 1986, 266-68). Mouer dropped his protest with the enactment of new federal legislation specifically authorizing the Parker Dam (Mann 1963, 85-86). In unofficial negotiations Mouer ceased hostilities in exchange for the promise of federal funds to develop the Wellton-Mohawk Oasis (Fradkin 1981, 190).

Work was retarded by the Second World War and Congress officially reauthorized the reclamation of the Wellton-Mohawk Oasis [along with provisions for development of the Yuma Mesa] in 1947 and the first deliveries of Colorado River water came in 1952. Since this was justified to Congress as a "rescue operation," the first water was delivered to the old farmlands in the vicinity of Roll, while water deliveries to the more recently-settled Araby area, downstream, were to be delayed for several years (Barr 1948, 4; 1950, 3; 1951, 4; Barr and Seltzer 1952, 4; Fradkin 1981, 302-03; Mann
The expansion of farmland in the Wellton-Mohawk Division [including the reduction of several thousand acres of pumplands] proceeded rapidly with a cotton boom in the early 1950s to over 23,000 acres in 1954 (Barr 1954, 14; 1955, 3; Barr and Seltzer 1953, 4). In 1959, about 80 percent of the Project was cropped in the standard cotton-alfalfa-grain triad, at proportions of 18 percent cotton, 43 percent alfalfa [hay and seed], and 39 percent grains. By 1963, 54,000 of the projected 75,000 acres in the project were developed. By 1960 salt problems caught up with the growers in the Project and resulted in a second wave of crop failure which was only alleviated by federal intervention and more drainage wells (Wishart and Nelson 1963, 3, 8).

The salts were once more transferred downstream, where they jeopardized cotton production in northwest Mexico. The desalinization plant constructed to treat the Wellton-Mohawk drainage water was constructed after the ratification of the Colorado River Basin Salinity Act of 1974. This was ostensibly done to meet treaty obligations with the Republic of Mexico, however the major lobbying force was the Anderson-Clayton cotton company which needed to protect its substantial cotton interests in Baja California Norte (Fradkin

1. Although cotton is generally heavily planted on newly reclaimed lands, the Wellton-Mohawk Division was developed during a period when both species of cotton were restricted and allotment transfers were not possible until the mid-1960s.
Fradkin (1981, 302) writes:

It was difficult to imagine an area with a worse record of irrigated agriculture. That crops are still grown on some 65,000 irrigated acres along the Gila River is a tribute to the persistence of the Reclamation ethos through one disaster after another. The lesson that should have been learned was that the area was not suitable for such agriculture and should have been abandoned to the surrounding desert many years ago. But this was not the western way. It would have meant the repudiation of an institution that was judged to be basic to the West — an institution around which a number of myths had grown, including the myth of its own inviolateness.

Colorado River Water Litigation

With the exception of some pumplands in the lower Gila Oasis, Yuma County's croplands until the mid-1940s were irrigated entirely with Colorado River water. At the same time, reclamation by surface water in all counties save Mohave and Yuma had reached a limit of expansion (Barr 1946a, 1-2; 1946b, 9-10). Further use of Colorado River water by Arizona irrigators was hindered until the early 1960s by an unresolved dispute over the allocation of the River's water.

In 1952 the Arizona Interstate Stream Commission, which was created in 1948 to prosecute Arizona's claims to Colorado River Water in the courts and Congress, filed a Supreme Court suit against California. The central contention dealt with the definition of Arizona's annual allotment of 2.8 maf of Colorado River water in the Boulder Canyon Project Act of 1928. Arizona contended that the water that fell on the state as precipitation and was collected in the reservoir system of the Gila watershed should not be deducted from its allotment. California maintained that the water in storage in the Gila system reservoirs, which would have flowed into the Colorado
without the reservoirs, should be deducted from Arizona's allotment. The suit was settled in 1963; instrumental towards the settlement was the "California compromise," which Arizona agreed to only to expedite approval for the Central Arizona Project. California capitulated to Arizona's interpretation in return for absolute rights to its own allocation of 4.4 maf. California water users are guaranteed their full share, at the possible expense of Arizona users. In return, Arizona was granted almost total rights to its water in surface storage, between 1 and 1.5 maf per year, plus its 2.8 maf Colorado River water allotment (Berkman and Viscusi 1973, 108-16; Hundley 1975, 282-306; Mann 1963, 89-96; Reisner 1986, 266-70, 305-06; Sheridan 1986a, 243; UAAES 1964, 6; Wiley and Gottlieb 1982, 44).

Before the 1963 ruling, Arizona received Colorado River Water only for the Yuma and Wellton-Mohawk areas, because of rights of prior appropriation, and on the Colorado Indian River Reservation because of special water rights accruing to Reservation land under the Winters Doctrine (Mann 1963, 127-28). The resolution of this suit allowed further appropriations of Colorado River water to Arizona farmlands and influenced the expansion of oasis lands - and cotton lands - in Yuma, La Paz, and Mohave Counties.

Pumpland Development

Pumpland development accelerated because of a confluence of several economic, physical, technological, and political factors. The national depression severely slowed the process of reclamation in Arizona (Smith 1933, 134), and an extended dry period from 1938 to
1940 rendered the state's reclamation reservoirs nearly empty, seriously inhibited the development of oases with surface water, and encouraged an expansion of groundwater pumpage (Comeaux 1981, 246; Hundley 1975, 298). In 1941, 32 inches of rain fell in the mountains, a 41 year high (Barr 1957, 4-5).

The increased pumping combined with the low rainfall and lowered reservoirs to result in severe power shortages in 1939 and only the enormous rains in 1941 saved Arizona's electricity users from a severe power shortage that year. The rains filled the reservoirs, making electricity cheap and encouraging an expansion of pumplands, especially in Pinal County. The drought resumed after 1941, along with an increase in groundwater pumping (Barr 1945, 1; 1946a, 2; 1947, 5-6; Dunbar 1977, 7; Mann 1963, 99). The average annual precipitation on the Salt-Gila watershed from 1916 to 1956 was about 20 inches. The period from 1942 through 1956 was very dry, with an average of only 17 inches of mountain rain. A 41 year record low rainfall on the Salt-Gila watershed came in 1956, when only 12 inches of rain fell in the mountains (Barr 1957, 4-5). A result of this long decline in rainfall was a general shift away from surface to groundwater and from hydroelectricity to natural gas for pumping power. Between 1941 and 1945 the amount of groundwater used in Arizona agriculture doubled and as of 1944 the pumped groundwater used on Arizona crops exceeded the surface water used (Barr 1945, 1; 1946a, 2).

Pumpland development proceeded apace until an enormous surge in the late 1940s and early 1950s that accompanied an increase in
cotton production. As Dunbar (1977, 13) writes,

With cotton prices reaching a twenty-six-year high in October of 1946, men with money began reclaiming more of the desert — 10,000 acres in Pinal County in 1946 — drilling more wells and pumping more water. Since this economic activity was accompanied by a continuance of the drought, water tables continued to decline and pumping lifts increased.

Annual groundwater pumpage in Arizona went from .884 maf in 1941, to 1.717 maf in 1944, to 2.8 maf in 1948 (Barr 1950, 2). Much farmland in 1951 was only cultivated during times of high cotton prices and loose government controls. When the cotton plants were young all of the pumps were run constantly at full capacity. This caused the water table to drop, wells to dry, and a subsequent drilling spree to save the crop (Inskeep 1951). In the cotton boom year of 1953 groundwater pumpage shot to about 4.8 maf, about 70 percent of all the water used for irrigation (Barr 1954, 3; Mann 1963, 3; Rehnberg 1953, 5; Stevens 1954, 92). Although the drop in precipitation rates and expanding agricultural development were very important factors, the revolution in groundwater pumping must also be referenced within the contexts of technological and political changes.

Technological Changes

The maximum distance water could be lifted by the early mesquite wood fired pumps was only 50 feet. By around 1915, mesquite was largely replaced by petroleum as a pump-fuel, or hydroelectric power where available. The petroleum powered pumps had lower attendance costs and more power than the steam pumps and water could be lifted much further (Rehnberg 1953, 5; Smith 1909, 406; Woodward 1904, 464). Deeper pumping, however, was not possible until
breakthroughs in high-speed engines and turbine centrifugal pump
technologies in the mid-1930s (Dunbar 1977, 7; Frederick 1982, 73).

The use of electricity for pumping groundwater is influenced
by the availability of hydroelectric power (Frederick 1982, 148). In
1909 most Arizona growers still used steam or petroleum powered pumps
(Smith 1909, 408); only very wealthy individuals such as Chandler had
the capacity to generate their own hydroelectric power. Electricity
became increasingly available to rural Arizonans after 1909.

Hydroelectric generators attached to the Salt River Project, and
later the San Carlos Project, were practically the only sources of
electrical power for pumping groundwater in the central oases
(Comeaux 1981, 246-47; Mann 1963, 97). The period of cheap
electricity ended around 1947 when dwindling water storage in
reservoirs and expanding pumplands caused electrical power shortages
and many pumpers switched to natural gas (Barr 1948, 6). The use of
natural gas for pumping groundwater, as with electricity, is more
limited by access than cost factors, thus 61 percent of the total
U.S. gas-serviced pumplands are found in the southern plains, the
nation's major natural gas production region (Frederick 1982, 148).

In 1948 there were 300 gas-powered pumps, mostly in Pinal County,
that delivered water to 100,000 acres, and Pinal County growers used
three times as much gas as they had in 1947 (Barr 1949, 1-5). Broad
extensions of natural gas lines through the irrigated areas of Pinal
and Maricopa Counties from 1948 through 1950 brought natural gas
power to many more cotton farms (Barr 1951, 3-4).
Political Changes

Legislation implemented in Arizona to control groundwater pumping was ineffective until the early 1980s, indeed, the early laws actually worked to promote the expansion of pumplands. Agribusiness entities worked strenuously to protect their right to mine groundwater just as the boosters worked very hard to establish the reclamation projects. In Arizona the groundwater was originally allocated on the basis of the English common law rule of absolute ownership. However, as Dunbar writes, "... in arid regions where water was used in large quantities for irrigation, the rule did not protect the property rights of one's neighbors. The only recourse they had was to drill deeper and deeper" (Dunbar 1977, 8). According to Fredrick (1982, 109),

When water was abundant relative to demand, the states played little role in its use. As the first farmers began to settle in the valleys close to streams, they diverted the natural flow of the stream to irrigate their fields. To give greater security to irrigators and to control conflicts between rival diverters, states developed the doctrine of prior appropriative water rights, of which the basic principle is 'first in time, first in right.'

Since the advent of widespread pumpland development in Arizona in the early 1940s and the concurrent drawdown of the water table, there was an increasingly recognized need for legislation to regulate pumping of groundwater (Greisinger and Barr 1941, 290-1; Mann 1963, 43). A big push came in 1945 when the Bureau of Reclamation demanded that Arizona pass groundwater legislation as a prerequisite for consideration of the Central Arizona Project (Dunbar 1977, 11-12; Mann 1963, 49-50). As Barr (1946b, 12) wrote, "under
present laws the farmer who puts in the largest pumps with the greatest lifts and runs them the longest gets the most water. The state must adopt a groundwater law if land now watered from wells is to be protected."

The major faction opposing an effective groundwater code was Arizona's formidable agribusiness lobby. Dunbar (1977, 14-15) writes,

Vegetable, citrus, and cotton growers had invested considerable sums in land, wells, pumps, and other equipment; many had come from outside of the state, particularly from California, to exploit the land and water resources of the Arizona desert. They faced financial ruin if their use of groundwater was drastically curtailed.

The principals in the Arizona agribusiness alliance are the utilities, the railroads, and the 3 'C's - copper, cattle, and cotton. Stocker writes of this inauspicious alliance:

They work together in a tightly-knit, efficient and generously financed combine, often behind fronts with such guileless-seeming names as the Arizona Tax Research Association. With one or two exceptions they have the support of the state's press. Their principal instrument is the Arizona Legislature, which consistently plays McCarthy to their Bergen (Stocker 1950c, 5; cited in Mann 1963, 72-3).

The 1948 ground water code was intended to limit pumping in designated groundwater critical resource areas. However, through the efforts of the agribusiness lobby the code was watered down so

1. The 3 'C' cliche is the standard, for example (Glover and Rees 1964, 5). Wyllys counts 4 'C's, adding climate to denote tourism (Wyllys 1952, 121). Other cliche mongers have added citrus and speak of Arizona's 5 'C's (Comeaux 1981, 318-9; WPA 1940, 87). Hecht et al. (1977, 12), indicating a diversification of Arizona's economy, count as many as 9 'C's.
that it only prevented the irrigation in groundwater critical areas of previously untilled lands. Existing wells could be deepened as the water table dropped and the code did little or nothing to reduce total groundwater pumpage (Comeaux 1981, 235; Inskeep 1951; Mann 1963, 52-53). As one state representative described it, the 1948 code was "... as weak as restaurant soup and should have been sent from the senate with crutches" (cited in Dunbar 1977, 17; Mann 1963, 51-52).

Indeed the 1948 code promoted the expansion of pumplands in areas not as yet designated critical to establish "irrigation histories" in anticipation of future restrictions (Mann 1963, 53-66). The Eloy area was the first to be declared critical in 1949, by 1951 much of Pinal County's farmland was so designated (Mann 1963, 52-53). From 1948 to 1953, incidentally the cotton boom years, the Code was hardly enforced at all. From 1954 on the enforcement was tightened somewhat (Mann 1963, 54). Table 3 indicates pumplands that experienced extraordinary growth between 1947 and 1953. The expansion in these areas represents about 72 percent of the total expansion of irrigated lands in Arizona from 1947 to 1953 (Barr and Seltzer 1953, 4-5).

Maricopa County

Pumplands outside the Salt River Project, irrigated at first mostly with groundwater pumped with power from the Project, expanded to 20 percent of the county's total cropland in the late 1920s, 40 percent in the early 1930s, and 50 percent in the late 1940s (Barr
TABLE 3  
Significant Oasis Developments: 1947-1953

<table>
<thead>
<tr>
<th>Location</th>
<th>1947</th>
<th>1953</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maricopa County</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Hassayampa Oasis</td>
<td>0</td>
<td>1,500</td>
</tr>
<tr>
<td>The Centennial Wash and the Harquahala Plains</td>
<td>0</td>
<td>11,000</td>
</tr>
<tr>
<td>The Waterman Wash and Rainbow Valley</td>
<td>0</td>
<td>9,500</td>
</tr>
<tr>
<td>Maricopa section of Queen Creek Oasis</td>
<td>10,000</td>
<td>25,000</td>
</tr>
<tr>
<td>Deer Valley</td>
<td>10,800</td>
<td>22,000</td>
</tr>
<tr>
<td><strong>Pinal County</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The vicinity north of Case Grande</td>
<td>0</td>
<td>45,000</td>
</tr>
<tr>
<td>South of the San Carlos Irrigation District</td>
<td>0</td>
<td>90,000</td>
</tr>
<tr>
<td>Maricopa-Stanfield Oasis</td>
<td>24,260</td>
<td>85,000</td>
</tr>
<tr>
<td>The Queen Creek-Magma Oasis</td>
<td>6,800</td>
<td>30,000</td>
</tr>
<tr>
<td><strong>Pima County</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Avra Valley</td>
<td>0</td>
<td>13,000</td>
</tr>
<tr>
<td>Area South of the Rillito Creek</td>
<td>1,000</td>
<td>7,000</td>
</tr>
<tr>
<td><strong>Yuma County</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hope, Salome and Bouse Wash Oases</td>
<td>0</td>
<td>11,000</td>
</tr>
<tr>
<td>Dateland area</td>
<td>870</td>
<td>3,000</td>
</tr>
<tr>
<td><strong>Cochise County</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kansas Settlement, south of Willcox</td>
<td>300</td>
<td>18,000</td>
</tr>
<tr>
<td>Bowie-San Simon Oases</td>
<td>600</td>
<td>12,000</td>
</tr>
<tr>
<td><strong>Total Gain 1947-1953</strong></td>
<td>+329,170</td>
<td>54,630</td>
</tr>
<tr>
<td></td>
<td>383,000</td>
<td></td>
</tr>
</tbody>
</table>

Source: (Barr 1954, 14-6).
1948, 16-17; Matlock and Clark 1934, 50; UAAES 1928, 7). Pumplands in the mid-1960s comprised about 63 percent of Maricopa County's total irrigated area (Arizona Academy 1967, 101). During the 1940s there were substantial pumpland developments in the Queen Creek Oasis, along the Agua Fria River, in Deer Valley, and elsewhere in the County (Barr 1946a, 2; 1948, 3-4). The cotton boom/ pumping spree brought a considerable expansion of pumplands in the western end of the County (Barr 1954, 14).

Pinal County

Between 1939 and 1941 Pinal County's irrigated cropland increased by more than 100,000 acres. Water deliveries from the San Carlos Project in 1946 were less than 40 percent of those in 1943 yet in this period there was a net increase of 10,000 acres for the County. Pumpland development in Pinal County continued through the late 1940s, especially north and south of Eloy and in the Stanfield area. About a third of the irrigated land in Pinal county in 1947 was served directly by the San Carlos Project; a little more than half of it was farmed by non-Indians and a little less than half was on the Gila River Indian reservation. About 15 percent of the County's total cropland was located in the Stanfield area of the lower Santa Cruz, the rest in the vicinities of Casa Grande,

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1. In 1940 growers in the Casa Grande area were still supplied at least partially with surface water from the Picacho Reservoir (WPA 1940, 19).
The cotton boom/drilling spree influenced an enormous expansion in Pinal County's irrigated acreage — from 200,000 to 310,000 acres between 1947 and 1953. This development was all pumplands; San Carlos Project farmlands actually declined between 1947 and 1953 — from 32,000 to 22,500 acres on the non-Indian portion and from 27,400 to 17,500 acres on the Indian portion (Barr 1954, 14-16).

Pima and Santa Cruz Counties

Under the influence of the 1919-1920 cotton boom, and largely through the efforts of the Tucson Farms Corporation, the irrigated cropland [all pumpland] in Pima County expanded to 15,000 acres in 1918 and to 22,000 acres in 1921 (Arizona Academy 1967, 74).

Pumplands in the Cortaro bottomlands near Marana were developed after 1920 (Schwalen and Shaw 1957, 74-75, 103). A speculator from Mississippi acquired the Canoa land grant [a Spanish Land Grant] just prior to the First World War and in 1916 sold the north half to the Continental Rubber Company which planned to grow guayule, a shrub native to Mexico, as a substitute for rubber. By 1920 Continental had 1,100 acres under guayule; however a drastic drop in rubber prices temporarily ended hopes for a guayule industry in Arizona and this land was idled until the early 1950s. Beginning in 1951 the Continental Oasis was resurrected, additionally new pumplands were developed in the south half of the Canoa land grant [in the Green Valley] (Schwalen and Shaw 1957, 99-100; Wagoner 1975, 166-72). From 1947 to 1953, the pumplands in the Sahuarita-Continental area
expanded from 9,000 to 14,000 acres (Barr 1954, 16).

In 1947, about 60 percent of the approximately 30,000 acres of irrigated cropland in Pima County were located north of Tucson, mostly in the Marana-Cortaro area; the remaining 40 percent were located south of Tucson, primarily in the Sahuarita-Continental area. In addition, about 800 acres were tilled by Tohono O'odham farmers in the vicinity of the San Xavier Mission (Barr 1948, 17). During the 1947-1953 boom/spree, Pima County pumplands doubled. Besides the areas noted, less significant expansions occurred in the Marana-Cortaro area and south of Tucson, including the San Xavier area (Barr 1954, 16).

The lands on the far upper Santa Cruz, on Baca Float No. 3 [an old Mexican land grant] were irrigated with groundwater beginning around 1920, but the irrigated area remained fairly small until the mid-1930s (Schwalen and Shaw 1957, 74-75, 103). Pumplands in Santa Cruz County expanded from 3,500 acres in 1947 to 5,500 in 1953 (Barr 1954, 16).

Graham County

Growers in Graham County mostly maintained their fields with the perennial flow of the upper Gila River, but dry conditions in the late 1930s caused an expansion of groundwater pumpage in the upper Gila to replace the diminished surface water resources (Barr 1946a, 2). New pumplands were developed after World War II. The irrigated croplands in Graham County, mostly in the upper Gila Oasis and the Cactus Flats Oasis and some in Graham County's share of the Sulphur
Springs Oasis, jumped from 35,000 acres in 1947 to 42,000 acres in 1953 and then to more than 50,000 acres in the late 1960s (Arizona Academy 1967, 88, 101; Barr 1954, 16).

Cochise County

The Sulphur Springs Oasis of Cochise County has a growing season of only about 180 days (Towne 1986, 14), and significant cotton developments in this area awaited the development of earlier maturing cultivars. In the late 1940s, there was substantial development of pumplands throughout the Sulphur Springs Oasis which contained about 88 percent of Cochise county's croplands, the other 12 percent being located in the non-cotton growing San Pedro Oasis (Barr 1948, 4, 17). A modicum of Cochise County cotton lands are located in the far easterly San Simon and Bowie Oases where settlement began around 1911 (James 1917, 399-400). Total pumplands in Cochise County expanded between 1947 and 1953 from 23,000 to 85,000 acres (Barr 1954, 14).

Yuma County

The expansion of oases in all of the areas that I have described peaked in the 1950s. The notable exception is Yuma County, where irrigated acreage is still expanding. Some of this is pumpland, and some Indian and Project lands. From 1920 to 1930 Yuma County's irrigated acreage increased by 12,000 acres, to 64,000 acres; but in the next 10 years the County's irrigated land expanded by only 3,000 acres (Arizona Academy 1967, 74-88). With the Yuma Project nearly at maximum and the decline of agriculture in the lower
Gila Oasis, reclamation in Yuma county [and incidentally cotton production] largely stagnated for about two decades until the late 1940s, when the state's most significant oasis developments occurred in Yuma County (Barr and Seltzer 1953, 3).

Oasis development, mostly pumplands, accelerated from 67,000 acres in 1940 to 100,000 acres in 1950 and the cotton boom and drilling spree pushed the County's irrigated area to 162,000 acres in 1953. By 1960, the County's irrigated area exceeded 200,000 acres (Arizona Academy 1967, 88, 101). These pumplands were developed despite pump lifts of 250 to 300 feet and their future expansion was judged dependent on the resilience of the aquifer and crop prices (Barr and Seltzer 1953, 4-5). In 1947, about 59 percent of Yuma county's irrigated land was in the Yuma Oasis; about 27 percent was in the lower Gila Valley, especially the Wellton-Mohawk Oasis; about 6 percent of the county's irrigated cropland was in the Yuma Mesa; and about 7 percent was on the Colorado River Indian Reservation (Barr 1948, 16).

By 1957 Yuma was the second most important agricultural county in the state, leading in the production of cantaloupes, alfalfa seed, Bermuda-grass seed, and lemons; and second in the production of lettuce, alfalfa hay, grapefruit, and oranges. Cotton production, which had dipped seriously for numerous reasons [principally, I believe, because of the stagnation of oasis expansion], rebounded substantially with the accelerated oasis development (Barr 1957, 1-2). While elsewhere in Arizona oasis development reached its limit of expansion long before, Yuma County's
irrigated area expanded with a cotton boom in the early 1980s to nearly 268,000 acres in 1982 (Census 1984b, 156). Many factors contributed to the phenomenal growth of Yuma County oasis lands from the late 1940s to the present: the completion of the Gila Project in 1947, the planting spree of 1949, the drilling spree that began in 1949, the cotton boom of 1951-1953, the establishment of federal laws in 1955 granting permission for the long-term leasing of Indian land, the resolution of Arizona versus California in 1963, which allowed further diversions of Colorado River water, and the provisions in the 1965 farm bill that allowed cotton allotments to be sold and transferred across county lines.

Cotton Developments on Public Land

There has been significant development of cotton lands in Arizona on public land, either state land or federal land held in trust for American Indians - the reservations. The undervaluation of public land for leasing represents a significant factor in the vitality of the Arizona cotton industry.

State Land

Much pumpland development, particularly in Pinal County, was on land leased or recently purchased from the state (Inskeep 1951). In 1950 there were 29,000 acres of state land leased for agriculture in Arizona ("State to Raise Farm Land Fee" 1950). The State Land Department which oversees the leasing of state land for agricultural production was also responsible for the administration of the early groundwater pumping regulations. Even as groundwater critical areas,
such as in the Eloy area, were being established, the State Land Department granted changes in the leases in these areas from grazing to irrigated agriculture and allowed the lessees to drill new wells. The department charged specifically with the enforcement of the Code enabled its most flagrant violators to continue to mine groundwater. The State Land Department was equally ineffective in enforcing the code outside its own offices (Mann 1963, 124, 151-52).

In 1939, 7 percent of the 99,190 irrigated acres in the Casa Grande area were leased from the state, and about 76 percent of this land was planted to cotton. Some state land was leased in very large parcels by individuals who assigned their lease rights as security to obtain loans to cover the costs of reclamation and sublet the land in smaller parcels to cotton growers (Greisinger and Barr 1941, 281, 290). In what Darnton (1940) describes as the "neatest get-rich-quick scheme of the century," some cotton producers did very well by manipulating a double subsidy [cheap rental rates and lucrative AAA payments] out of the state and federal government. In one example, a cotton producer leased a section [640 acres] of state land for an annual rent of $1 an acre. The grower put about 81 percent of the section under ditch and plow, the rest was reserved for roads, farm housing, irrigation ditches, etc. With financing from a pump company, two pumping plants were installed at a cost of $17,000. The grower's net income after the first season, after production and harvest costs, was $45,000. Additionally, the grower received $6,000 in AAA payments. With costs amounting to $17,840 [the land rental of $640, the $17,000 for the pump works, and a $200 county property tax
on the well] the grower was left with a profit of $33,160 in the first season.

Much of the pumpland development in Pinal County was on land leased from the state for $5 to $7 per acre per year or purchased from the state for $15 an acre. The money went into a fund to help pay teachers' salaries and operate state educational institutions. Many of the lessees produced cotton and made profits exceeding $200 an acre a year (Inskeep 1951). Salt Oasis farm land in the late 1950s generally rented for $90 to $110 an acre a year (Barr 1957, 2,7). In the early 1950s, farm land in the Salt Oasis generally sold for an average of $375 an acre (Barr 1951, 2; 1955, 3), Yuma Oasis farm land sold for $300 to $400 an acre (Barr 1951, 3). Even if the actual value of the state land was only a fraction of the value of the leased and sold lands above, the subsidy value of state land was clearly enormous.

Arizona cattle ranchers also got rich by leasing and purchasing state-owned land at very low rates [3 cents an acre annual rental and $3 an acre for sale]. These farm and ranch land scams were first uncovered through the efforts of a group of Arizona school teachers. The teachers estimated in 1950 that the undervaluation of state-owned ranchland cost the educational fund $1,000 a day (Stocker 1950a). The undervaluation of state-owned cotton lands similarly represented a significant subsidy to the Arizona cotton industry at the expense of the state's school children. The subsidized use of state-owned farm land represents an important reason that cotton production in Arizona is as profitable as it is.
Indian Land

Indian land is proving an increasingly important element of the Arizona cotton landscape. The Indian nations and communities of Arizona occupy 19 separate "reservations," federal land held in trust for the Indians and administered by the Bureau of Indian Affairs [BIA], a branch of the United States Department of the Interior. These reservations [indicated in Figure 7], which comprise nearly 30 percent of Arizona's total land, are of generally low agricultural potential, but some areas are suitable for grazing and farming (Mann 1963, 169-70). A new stage in the development of Indian resources commenced in the mid-1950s with the legislative innovation of long-term leasing.

Despite the urgings of the BIA, the 20th century Pimas have not generally been as keen to plant cotton as their Indian ancestors or non-Indian contemporaries. Even if the Indians wanted to produce cotton, they were never granted the necessary financial credit and extension services. The Pimas generally left their land in pasture and much of it was eventually leased out to non-Indian cotton producers (Officer 1971, 65). In 1930 Indians served by the San

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1. This statistic and the following map do not include the new Yaqui Indian reservation southwest of Tucson, which was established in 1978 (Spicer 1980, 257).

2. Some Indian land is also held by individual Indians in the form of "allotments." The administrative and economic restraints on reservation and allotted land are, however, generally similar (Kickingbird and Ducheneaux 1973, 19-20).
Fig. 1. Indian Reservations of southwestern United States

LEGEND
- City and Towns
- Indian Reservation Boundaries

Source: (Officer 1971, 49, used with permission).

Fig. 7. Indian Lands of Arizona | Map
Carlos Project put only about 14 percent of their land under cotton (UAAES 1931, 6-10). By 1939, only 4 percent of the Indian portion of the Project was cropped to cotton, 69 percent was in alfalfa, and 27 percent was planted to other crops (Greisinger and Barr 1941, 281). The exception to this tendency is represented by tribal cotton farms such as on the Ak-Chin and Fort Mohave Reservations; most other cotton planted on Indian land in Arizona is on leased land.

Many reclamation projects were presented before Congress with some benefits, generally token, accruing to local Indians. The saying on Capitol Hill was that a reclamation project stood a better chance of being passed if it was presented "under an Indian Blanket" (Berkman and Viscusi 1973, 151). Two of Arizona's major reclamation projects, the San Carlos, and the Colorado River Indian, were constructed and maintained by the BIA but have generally been of only nominal benefit to the Indians (Mann 1963, 145-46). Similarly, the Yuma Project was originally presented as an aid to 700 Yuma Indians "... in the irrigation of their land, divided between themselves and white settlers" (McKlintock 1916, 442), but the Yuma Indians saw very few benefits from the Project (Officer 1971, 54-55).

Indian lands are particularly valuable because very special water rights accrue to them by virtue of a 1908 Supreme Court ruling, the Winters Doctrine. Indians - or more accurately the federal government through the BIA - are senior appropriators and have absolute water rights. Under the Winters Doctrine, Indian lands get water first; if there is a water shortage those with absolute rights suffer last. In the 1963 Supreme Court ruling in the case of Arizona
versus California the Winters Doctrine was reaffirmed; Indian lands on the five Colorado River reservations would be the first and last to receive their share of the water (Berkman and Viscusi 1973, 153-55; Comeaux 1981, 233-34; Frederick 1982, 125-27; Hundley 1975, 303; Mann 1963, 15; Reisner 1986, 270-71). This ruling has far-reaching consequence for the future of water use in Arizona. Immediately, it allows for the unbridled development with Colorado River water of the Mohave and Colorado River reservations by long term lessees. Absolute rights to highly subsidized water from the Central Arizona Project make Indian lands particularly attractive.

Long-term leasing of Indian lands is a modern reality and an age-old dream. In 1901, Arizona Governor Murphy recommended to the Secretary of Interior,

... that water-storage projects be constructed, by the government, with canals leading to lands allotted to the Indians in suitable localities. By this plan, Murphy thought that most of the Indian reservation lands, with the possible exception of the Navajo, could be sold and settled by whites (Wagoner 1970, 363).

With the advent of long-term leasing, Murphy's plan is essentially being carried out. Until the mid-1950s laws generally prevented leases of Indian land for durations of more than 5 years. Largely through the efforts of southwestern legislators, particularly Senators Goldwater and Chavez, a bill was passed and signed into law in 1955 that allowed 25 year leases of Indian land. Subsequent legislation allows 99-year leases of many Indian lands, including most of the Indian land in Arizona. These 99-year leases are especially attractive to urban and industrial developers,
particularly because of the appurtenant absolute water rights as guaranteed under the Winters Doctrine (Hammett 1986).

By the mid-1950s about 63 percent of the nation's Indian agricultural lands, generally the most productive, were leased out to non-Indians (Downing 1985, 18-19). DeLoria's (1974, 6) comment about the manipulation and exploitation of 19th century Indian land legislation holds true for the 20th century as well: "... behind the naive ideas of the Eastern liberals lay the greed of the Western exploiters waiting to gain from the new policy before the liberals could understand what had happened." Leased Indian land can carry a very high subsidy value. Before the reduction of leasing and development of the Ak-Chin Farms, one man leased land for $10,000 and subleased it for $50,000 (Thurber 1988). In 1968 the gross value of agricultural production on the Colorado River Indian Reservation was nearly 16 million dollars but returns to the Indians were only about 12 percent of this. By 1968, more than 10 percent of Arizona oasis land was located on Indian reservations, much of it leased to non-Indian cotton producers (Officer 1971, 62, 69). Currently, over 15 percent of the cotton land in Arizona is on leased Indian land or tribal farms.

Because of the absolute water rights guaranteed by the Supreme Court, Indian lands will increase in agricultural importance. As Wiley and Gottlieb (1982, 234) write, "... the Winters Doctrine gave the Indians a powerful claim, at least on paper, to much of the water in the arid West." The publication Arizona Agriculture - Now and a Vision for the Future predicts that
Indian lands, particularly because of their absolute rights to CAP water, will represent an increasingly important element of Arizona's agricultural landscape (UACA 1986, 182). Indeed, there is currently under consideration a plan to create a cotton farm of approximately 9,000 acres on the San Xavier District of the Tohono O'odham nation. Watered by Central Arizona Project water, the farm would be a joint project of the Bureau of Reclamation and the Tohono O'odham Nation (Bureau of Reclamation 1988). There is, however, considerable opposition to this planned cotton farm by San Xavier District residents and there are questions as to its future. Five Arizona Indian reservations have significant cotton acreages: the two Piman reservations on the Gila and Salt Rivers, the Maricopa Ak-Chin Reservation to the west, and the Fort Mohave and Colorado River Indian Reservations on the Colorado River.

_Gila River Indian Reservation._ The San Carlos Project was justified as a means to rejuvenate the Piman agrosystem, which it in fact did not. Despite the 50-50 proposition, during the 1930s only about a quarter of the San Carlos Project lands were Indian farmed (Greisinger and Barr 1941, 281; UAAES 1931, 6-10). There are numerous reasons why the Project failed the Indians: the Pima farmers were generally not involved in the planning process; they did not get extension services; they were not extended sufficient credit [reservation lands could not be mortgaged, and allotted lands could only be mortgaged with great difficulty]; land tenure was difficult to assess; allotments were too small for efficient production; and there were no soil surveys carried out so that much land put under
ditch was not appropriate for crop production. Generally, however, the major problem in the failure of the rejuvenation of the Piman agrosystem continued to relate to access to water. The lands which were to get project water were never precisely designated. Additionally, the Pimas' original irrigation canals were hand-dug and thus hand-maintainable. When subsumed in the San Carlos Project the canals were enlarged to the degree that ditch cleaning required heavy equipment which required capital. The Pimas were required to make annual cash payments for their Project water, but the fragmented Piman agricultural landscape prevented efficient irrigation and production sufficient to generate the capital for these payments. Meanwhile, pumpland developments by non-Indians on the Project's periphery led to local groundwater decline that caused some of the Pima farmers' wells to fail. This combined with the general inadequacy of the San Carlos Project to result in widespread crop failure (Hackenberg 1955, 74-83; Mann 1963, 146, 174; Officer 1971, 63-65; Ortiz 1973, 254).

In 1949, the Pimas retained an attorney to try to get the government to finance the development of Pima pumplands. In 1950, the Pima war-hero Ira Hayes was sent to Washington to plead his case.

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1. Hayes was one of the soldiers that raised the U.S. flag on Iwo Jima, as depicted in the famous photograph and statue. His post-war fate and his people's water problems were balladized by Peter LaFarge: "Yeah -- call him drunken Ira Hayes -- but his land is still as dry, And the ghost is lying thirsty -- in the ditch where Ira died" (La Farge 1962, 2).
people's case, to no avail. Finally, in 1953 the Pimas took it upon themselves and drilled 4 wells, financed with revenue from the limited Reservation cropping operations (Ortiz 1973, 254–55). Thus between 1947 and 1953, the Pimas' pumplands expanded from none to 1,850 acres. Of the 17,500 acres irrigated in the Indian 'half' of the San Carlos Project in 1953, about 66 percent were leased to non-Indians (Barr 1954, 14–15). In 1968, 17,000 acres of Gila River Indian Reservation land were farmed by Indians; 19,909 were farmed by non-Indian lessees (Officer 1971, 69). In the early 1980s there were about 80,000 irrigated acres on the Gila River Indian Reservation, much of which continues to be leased by non-Indian cotton growers (Comeaux 1981, 186).

**Colorado River Indian Reservation.** The Colorado River Indian Project, located on the Colorado River Indian Reservation about 100 miles north of Yuma, was the scene of significant oasis development only after the Second World War (Mann 1963, 173). In 1920 the BIA submitted a report proposing the construction of the Headgate Rock Dam and the reclamation of 104,000 acres of Reservation land. The Colorado Indian Reclamation Project was approved by Congress in 1935 and the dam was completed in 1941 (Fradkin 1981, 263–64; Lamm and McCarthy 1982, 185; Officer 1971, 54). The Project's first

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1. This was during the 1947-1953 drilling spree and it might well have been that the Pimas - under the advise of their new attorney - were making a bid to preserve their right to use groundwater under the new and untried groundwater legislation.
'settlers' were the Japanese and Japanese-American evacuees at the Poston relocation complex (Baily 1971, 80; Cosner 1978, 42; War Relocation Authority 1942, 20).

Barr (1946b, 29) mentioned the possibility of settlement of the Project by non-Indian veterans of the recent war, provided there was a change in leasing policies. By 1949, in addition to the lands established for the local Indians and some relocated Hopis and Navahos, about 550 acres in the project were being, "... developed through improvement leases of ten year duration without limitation as to race of lessee" (Barr 1949, 5). Reclamation on the Reservation expanded rapidly so that by the mid-1950s about 40,000 acres were under ditch and plow, and plans were to expand to the goal of 100,000 acres (Barr 4, 1951; 1954, 14; 1955, 3; 1957, 2; Barr and Seltzer 1952, 2). The long-term leasing legislation passed in 1955 had a profound impact on the potential for expansion (Officer 1971, 67-9). Further development was shelved, however, pending resolution of Arizona's suit against California concerning rights to Colorado river water (Mann 1963, 146, 173).

In 1964, a side product of the resolution of the court battle between Arizona and California granted the Colorado Indian Reservation enough Colorado River water [with absolute rights guaranteed by the Winters' Doctrine] to irrigate more than 100,000 acres (Officer 1971, 67-69). Development accelerated (ASES 1969, 5) and between 1964 and 1970 over 40,000 acres were leased on long-term bases to non-Indians. About 24 percent of Yuma County's total farmland and 23 percent of the County's total cottonlands in 1968
were located on the Colorado River Indian Project. The total irrigated area in the Project in 1968 was 48,019 acres, about 88 percent of this land was under lease to non-Indian cotton growers, only about 12 percent was farmed by Indians (Officer 1971, 67-70). Most of the Project's irrigated lands continue to be leased by non-Indian cotton growers (Josephy, 1986, 191). In 1988 there were 80,000 acres of irrigated farmland on the Reservation, nearly all of it leased to non-Indian cotton producers (Thurber 1988).

Salt River Indian Reservation. There were in 1947 about 12,000 acres of irrigated cropland on the Salt River Reservation - about one third leased to non-Indians (Barr 1948, 16-17). The irrigated cropland on the Salt River Reservation, including both Indian and leased lands, increased from 1,140 acres in 1947 to 3,850 acres in 1953 (Barr 1954, 15). In the summer of 1988 there were about 11,595 irrigated acres in the Reservation, 95 percent of this land was leased out, and about 75 percent of the leased land was under cotton (Washington 1988, personal communication).

Fort Mohave Indian Reservation. Most of the cropland in Mohave County is located in the Fort Mohave Indian Reservation. Cotton acreage remained very sparse and spotty until the boom year of 1953 when 1,050 acres of G. hirsutum were planted. As for total irrigated acreage in Mohave County - there were less than 2,000 acres irrigated from 1900 through the mid-1950s. In 1957 the irrigated area was expanded to 6,000 acres (Arizona Academy 1967, 88, 101). This expansion was allowed by the long-term leasing legislation that was passed in 1955. Agricultural development accelerated again
around 1975, in part as a consequence of the availability of Colorado River water after the 1963 ruling in the case of Arizona versus California. In the summer of 1988, there were about 11,540 irrigated acres on the reservation, part of it in a 3,000 acre tribal farm with about a third under cotton. The remaining 5,350 acres of farmland are leased, and about two thirds are under cotton (Algots 1988, personal communication).

Ak-Chin Indian Reservation. The Ak-Chin Farms represent a major exception to the rule of the dominance of long-term leasing in the agriculture on Indian reservations in Arizona. In 1947, the Ak-Chin Indian Resrvation had 4,690 irrigated acres – 94 percent of them leased by non-Indians (Barr 1948, 17). Irrigated cropland on the Reservation increased to 11,172 acres in 1953 (Barr 1954, 14). About this time, as the Ak-Chin community's executive director, Leona Kakar, remembers, "... we took a good look at the situation and realized we were working on our own land for others. ... we started taking over leases when they expired in the 60s and we worked up to 11,000 acres. Then the water table started dropping, and so did the acreage" (cited in Thurber 1988). The Ak-Chin farm, which was established in 1962, includes all of the 6,000 acres of oasis land in the community and employs 150 community members (Comeaux 1981, 186; McGregor 1987). With the water table decline, a 15 year fight for water rights commenced which culminated in an allotment of CAP water to sustain the Ak-Chin farmlands. CAP water was first delivered to the Ak-Chin farms in 1987 (Thurber 1988). In the summer of 1988 there were about 16,500 acres in the Ak-Chin farm, about a third
under cotton (England 1988, personal communication).

The expansion and decline of the Arizona cotton production region has been largely dependent on the process of oasis development. As I have discussed, oasis development in Arizona is generally followed by cotton production. The imperative to produce cotton would diminish after a period of perhaps ten to twenty years as the initial sunk costs of reclamation are paid off. Other financial pressures to produce cotton, however, might remain. As the reclamation debt is settled the agrosystem would possibly diversify, with a greater emphasis on perennial crops. This seems to be the case in the upper Santa Cruz Oasis which dropped out of cotton production in the mid-1960s and where pecan orchards are now a major element of the agricultural landscape.
CHAPTER 7

THE EVOLUTION OF ARIZONA'S COTTON PRODUCTION REGION: 1912 TO 1987

Arizona's commercial cotton production area did not grow smoothly but evolved by a series of starts and stops, as indicated in the graph in figure 8. The period of commercial cotton production in Arizona can be generally divided into three periods: a period of genesis from 1912 to 1920, a period of expansion from 1921 to 1953, and a period of maturity from 1954 to the present.

Genesis: 1912-1920

The year 1912 was a watershed in Arizona's agricultural development. The completion of the Roosevelt Dam and statehood which it hastened (Barrows 1913, 284) set Arizona "... at the beginning of a period of agricultural transformation" (Forbes 1911, 3). This coincided with the release of a cotton cultivar that was developed especially for the Southwest. Cotton production expanded very little in the first five years as important details - such as arrangements for financing and labor recruitment; the organization of growers to maintain seed quality; the establishment of transportation, ginning, and storage facilities; the establishment of a government cotton classing office to provide a basis for sales; and links with the eastern cotton markets - had to be worked out for the system to function (McGowan 1961, 36). Most of these were provided with the entrance of Goodyear and the other tire companies in 1916.
Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 8. Planted Cotton Acreage: 1912-1987 | Graph
Low cotton prices before World War One were met by small cotton acreages, both in Arizona and nationwide. In 1916, with prices improving and the promise of wartime demand looming on the horizon, the nation's (Fite 1984, 93-94) and Arizona's cotton acreage both increased substantially. The price received for *G. barbadense* passed 50 cents a pound in 1917 and cotton production became the major industry of the Salt Oasis (Collins 1918, 36; McGowan 1961, 63) and Arizona's major crop (Comeaux 1981, 264). With more acreage in cotton than any other crop, Arizona fulfilled Baker's definition as part of the cotton belt (Baker 1927, 65). Padfield (1965, 156) writes: "Thus at two independent points in time – separated by a thousand years – Arizona's climate and exploitable river water had become the basis of a cotton ecology."

In 1919 almost a quarter of Arizona's farmland was planted to cotton, about 80 percent of it *G. barbadense* and the rest *G. hirsutum*. *G. barbadense* growers received as much as $1.30 per pound for their 1919 crop; some growers made as much as one-third of a million dollars from their 1919 cotton crops and many went "Pima Crazy." Optimistic rumor mongers spread the news that the 1920 crop would sell for as much as $1.50 per pound and most of the Salt Oasis farmlands were put under cotton (Martin 1966; McGowan 1961, 84-85; McWilliams 1944, 73; Thompson 1986, 23; WPA 1940, 82). A vigorous campaign by the county extension agent and others to promote a diversified agrosystem fell on ears that had been thoroughly deafened by the cotton boom; 95 percent of the Maricopa County Extension Agents' calls in the boom year of 1920 were about cotton problems.
(Davis 1958, 6-7). Figure 9 indicates the extent of planted cotton of planted cotton acreage in Arizona counties in 1920.

Several factors are important in interpreting the rapid growth of Arizona's commercial cotton production region: developments in cotton breeding, the establishment of markets, and the rise of a cotton farming mentality. The distribution of the cottons within the incipient production region can be partially attributed to the areal distribution of labor availability along with the desire to maintain one-variety cotton production communities.

Cotton Breeding Developments

Arizona's commercial cotton landscape owes its genesis largely to the efforts of the USDA plant breeders who developed the American-Egyptian strains of G. barbadense. The center of genotypic diversity for G. barbadense is in northwest South America; cultivated and wild forms of the species occurred throughout much of pre-Columbian northern South America, the Caribbean, and southern Central America (Lee 1984, 8-9). Post-Columbian dispersals to southeast coastal North America and the Nile Oasis of North Africa resulted in two new land races: Sea Island and Egyptian. The Sea Island crop was devastated by the Mexican boll weevil and American-Egyptian cotton was developed as an alternate domestic source of premium long-staple cotton fiber.

In response to the rapidly increasing demand for a domestic source of long-stapled cotton fiber, certain individuals, the USDA, and Land Grant colleges in cotton producing states set about the task
Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 9. Planted Cotton Acreage: 1920 | Map
of developing an Egyptian-type cotton industry for the U.S. late in the 19th century. This development accelerated rapidly around 1900 with the advent of scientific cotton breeding, an innovation made possible by the re-discovery of Gregor Mendel's work on plant genetics and made necessary by the invasion of the Mexican boll weevil (Brown and Ware 1958, 124; Lewis and Richmond 1968, 12). In 1867 and 1871 the USDA tried to introduce Egyptian cotton to the southeastern United States but the arid-adapted cultivar did not do well in the humid Southeast and the experiments failed. Further experiments in the 1890s also failed, but they caught the attention of the USDA's first cotton breeder, Herbert Webber, who initiated field plot research in 1898 and concluded that, due to the short growing seasons and high precipitation, Egyptian cotton was inappropriate for the Southeast (Hathorn 1951, 10; Kearney and Peterson 1908, 33-34; McGowan 1961, 51). The Southwest was targeted as the area to grow the Egyptian cotton, especially along the Colorado River, because it was perceived as a climatic and edaphic homologue to the Nile River Oasis (Forbes 1902, 206; Kearney and Peterson 1908, 8).

1. The G. barbadense cottonseed that comprised the genetic base for the early American-Egyptian cultivars in Arizona was collected in Egypt by plant explorer David Fairchild. Webber, who happened to be a good friend of Fairchild, was among the first to receive the seed (Fairchild 1938, 141-42; Hathorn 1951, 8-10; McGowan 1961, 51-53; Peplow 1958, 332, 542; Robinson 1919, 313; Stevens 1954, 33). As I mentioned in Chapter 3, Dr. Chandler also conducted early experiments with Fairchild's seed.
In 1900 Webber grew a small amount of Egyptian cotton at the USDA experimental station on the Yuma Indian Reservation (McGowan 1961, 51). In the summer of 1902, under Webber's direction, systematic experiments with Egyptian cotton were carried out in the Southwestern U.S. and another USDA researcher, Thomas Kearney, visited Egypt to research the culture of Egyptian cotton and returned convinced that the venture could work in Arizona (Hathorn 1951, 10; Working and Kearney 1920, 5). Test plots of several different varieties of Egyptian cotton were grown at the Yuma experiment station, and at three other experiment stations in New Mexico, California, and Texas. The cotton breeders drew selections from the four test plots and planted them out in the same plots during the spring of 1903. In 1904 and 1905 plantings were confined to the New Mexico and Yuma stations. Chance selection took place, as for these two years the cotton at the Yuma Station was wiped out by flooding on the Colorado River. The 1906 planting, with seed from the New Mexico station, was all at Yuma (Kearney and Peterson 1908, 37).

In 1908 the largest area to date, about 40 acres, was planted to the Egyptian cotton: 5 acres at the Yuma station, 19 at a second USDA cotton breeding station that had been established at Sacaton [a short walk from Snaketown] on the Gila Indian reservation, and the rest chiefly by Yuma area growers. A progeny row from a 1907 selection proved "decidedly superior in productiveness, earliness, and length and quality of the fiber," to the parent stock and the new cultivar was christened "Yuma" after its station of origin.
After three years of increase the seed was released to growers in the spring of 1912 (Hathorn 1951, 9-10; McGowan 1961, 58-9; Padfield 1965, 153-54; Pressley et al. 1940, 43).

The Yuma cultivar of G. barbadense was released in 1912, coincident with the opening of the Salt River Project. Roughly 530 acres were planted with the seed, distributed as indicated in Table four.

<table>
<thead>
<tr>
<th>G. barbadense in the Southwest: 1912</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt Oasis ------------------------- 32 growers, 303 acres</td>
</tr>
<tr>
<td>Yuma Oasis ------------------------- 19 growers, 44 acres</td>
</tr>
<tr>
<td>Sacaton, Gila River Reservation ------ Pima farmers, 29.5 acres</td>
</tr>
<tr>
<td>Imperial Valley, California --------- 25 growers, 122 acres</td>
</tr>
<tr>
<td>[plus 20 students planted one-half acre each]</td>
</tr>
<tr>
<td>Hechicera, Sonora, Republic of Mexico --- 30 acres</td>
</tr>
</tbody>
</table>

Source: (Scofield 1913, 21).

Pima cotton, earlier maturing and with better and longer fiber than Yuma, was developed from a breeding program begun in 1907 at the USDA Experiment Station at the Pima Indian town of Sacaton, hence the name "Pima" (Collins 1918, 29; Comeaux 1981, 264; Hathorn 1951, 9; McClatchie and Coit 1916, 70; McGowan 1961, 63-77; Robinson 1919, 314; Working and Kearney 1920, 1). The task of increasing the stock of Pima cottonseed was given in 1916 to the Tempe Exchange,

1. With a standard increase rate of 50 times per season (Barr 1949, 6), the 275 acres planted in 1916 would have yielded enough seed to plant 13,750 acres in 1917.
a cotton growers' cooperative that had its own ginnery (McGowan 1961, 77; Robinson 1919, 314; Working and Kearney 1920, 7). James (1917, 437) wrote, "... so wonderfully does it [the Pima cultivar] grow that it seems no wild vision to prophesy that the next few years will see the Salt River Valley one of the greatest cotton growing regions of the United States."

In 1917 the Pima seed was released to cotton growers who planted about 21 percent of Arizona's G. barbadense acreage to the new cultivar. Those receiving the seed entered into an elaborate contract designed so that the Tempe Exchange retained control of the Pima seed stocks. Pima immediately demonstrated its superiority by selling for between two and six cents more per pound than Yuma cotton of comparable grade (Collins 1918, 30-35). By 1919 Pima was the only cultivar of G. barbadense grown in Arizona (Thompson and Wood 1919, 265). Until 1916, G. barbadense had not been grown successfully at elevations of over 1,500 feet. The Pima cultivar came to harvest earlier than the Yuma cultivar [though still not as early as G. hirsutum], which allowed G. barbadense production to expand into higher elevations such as in the upper Santa Cruz Oasis (McClatchie and Coit 1916, 70; Thompson and Wood 1919, 274-75).

1. As I discuss later in this chapter, the Tempe Exchange growers also had the advantage of Pima Indian cotton pickers, the best in Arizona. The high quality of Pima relative to Yuma could be partially attributed to the highly skilled Pima Indian pickers who happened to be associated with the new Pima cotton cultivar which was concentrated in the Tempe area.
Markets and Marketing

Prior to the dominance of cotton, Arizona growers produced grain, fodder, vegetables, fruits, and dairy products for mostly local markets. Production of such export commodities as ostrich plumes and beet sugar was economically marginal. As Collins (1918, 59-60) noted, "while it is not entirely accurate to state that the local or State market is the principal one for products from this area, it is true nevertheless that the local market plays a much more important part than in many other irrigated districts." Here is Forbes' description of Arizona's agricultural markets on the eve of the genesis of the cotton production region:

A large trade in valley products is maintained with the several thriving mining towns of Arizona, which consume large quantities of baled hay, grains, fruits, dairy products, and vegetables. Much finished stock reaches Kansas City, and more distant eastern markets receive oranges, cantaloupes, honey, and other agricultural commodities from Arizona through farmers' shipping associations (Forbes 1911, 20).

Cotton, however, firmly shifted the growers to a reliance on distant and difficult to predict markets. Cotton is the most important crop plant in international trade and the most affected by global fluctuations in supply and demand (Case 1929, 335). According to Weber (1972, 5), "the demand curve for cotton is typically price-inelastic. As such, small percentage changes in the cotton supply bring about relatively large percentage changes in cotton prices." Cotton has often been a strategic military material and the cotton industry is singularly responsive to war. The Union Navy's blockade of Confederate ports during the Civil War boosted interest in cotton production in the Pima villages of Arizona, and in Mexico,
southeastern Utah, Egypt, and Peru, where cotton production [with *G. barbadense* seed imported from Arizona] almost doubled between 1914 and 1923 (Rosenfeld and Jones 1927, 508). Peruvian *G. barbadense* production boomed again during the Second World War (Hathorn 1951, 12; McGowan 1961, 29, 80). Indeed, to connote cotton's important role in the Civil War, Scherer (1916, 257) dubbed the crop "the sinews of war." McGowan (1961, 110) used the same phrase in a discussion of *G. barbadense* production during the Second World War.

The First World War, and other factors, both increased the demand for, and decreased the supply of, *G. barbadense* in the United States. There was a greatly increased demand for long-staple cotton as a belting material for the recently developed high pressure pneumatic tires and the war caused the military demand for *G. barbadense*, for both tires and biplane wings, to increase. During World War I, U.S. spinners were cut off from their Egyptian suppliers because of the German Navy's discouragement of trans-Atlantic shipping and the meager domestic U.S. production of Sea Island cotton was all but eliminated by the boll weevil infestations. An ultimate consequence was the expansion of the *G. barbadense* cotton industry in the Southwest (Collins 1918, 29; Hathorn 1951, 11; McGowan 1961, 79–84; McWilliams 1944, 73; Reed 1952, 31; Schetter 1976, 2; Thompson 1986, 23; UAAES 1928, 19; 1932b, 19; Wyllys 1950, 331). In a direct transfer of technology, many idled roller gins from the Sea Islands were shipped to Arizona where the *G. barbadense* industry was just booming (McGowan 1961, 3–6).

The Tempe exchange, established in 1914, was Arizona's prime
center for cotton transactions with eastern textile mills. In 1916 a cotton brokerage firm was established at Tempe to facilitate the marketing of Arizona cotton (McGowan 1961, 75, 82), and by 1918 Tempe, with the only large open cotton market in the Salt Oasis, was adjudged to be the commercial center of the area's cotton industry (Collins 1918, 37).

Cooperative marketing of the crop was first organized by the Southwest Cotton Committee of the USDA which sent an agent to the eastern U.S. and to Europe in 1914 to arrange to sell the crop. The declaration of war in August, however, ended this marketing program (Martin 1915, 11). The entry of the tire companies greatly simplified marketing as about 85 percent of the Arizona G. barbadense crop from 1917 to 1920 was utilized by the tire companies (McGowan 1961, 80-81).

The Cotton Farming Mentality

The adoption of cotton production as a way of economic life required the acquisition of a cotton farming mentality. According to Spencer and Horvath (1963, 81), "A farming 'mentality' . . . refers to the totality of the beliefs of the farmers over a region regarding the most suitable use of land in an area." The early Arizona cotton producers were gambling innovators.

Sixty percent of the land planted to the new cultivar was in the Salt Oasis, and this are also had the largest proportion of first adopters. It is significant that the innovative cultivar was most readily adopted by newly arrived growers in a rapidly developing
oasis in an era of boosterism. Herbert Atha, recently arrived to the Salt Oasis from New Jersey, was the Southwest's largest *G. barbadense* producer in 1912. He produced about a third of that year's total crop and marketed it through friends in the New Jersey thread industry (McGowan 1961, 62-63). Long-settled growers in a well established agricultural region were less inclined to be innovative. According to Bogue (1958, 1-2), "tradition-bound groups hesitate to alter their farming methods, while innovation occurs more rapidly in groups where emphasis is upon individualism and personal success."

The fictional growers of *G. hirsutum* in Scarborough's *In the Land of Cotton* (1936, 261), for example, were tradition-bound and not eager to experiment with *G. barbadense*, despite the high wartime prices:

"It's the long-staple cotton they want for ottermobile tires," said Guthrie. "Wonder why more of it ain't grown?"
"Farmers are so darned conservative," said Ben. "It has a lot more lint than ordinary cotton. If I was starting out to make cotton raising my business, I'd grow long-staple Sea Island cotton."
"I ain't goin' to experiment in my old age," grunted Avery.

All agriculture involves a degree of risk, but cotton is truly a gambler's crop. Cotton drastically altered the kind and extent of information necessary to make rational planting decisions in Arizona. Between the planting of cotton in the spring and its harvest in the fall the market price of cotton can fluctuate widely. This lag is accommodated in acreage response models that aim to establish a relationship between the price offered for cotton in a given year and the planted cotton acreage of the next year (Tomek 1972; Tomek and Robinson 1981, 347-49). In California's Tulare basin, as in Arizona, perennial crops are disfavored because they do
not allow the producers to play the market and plant according to changing commodity prices and government policies, as with cotton, taking acreage in and out of production to maximize short-term returns (Preston 1981, 182-83).

Gambling was outlawed by the Arizona Territorial Legislature in 1907 (Robinson 1919, 175). Cotton, Arizona's "roulette and faro crop" (Woehlke 1921, 21), soon filled the niche. Another chronicler of the cotton boom called the 1920 Arizona cotton market a "gambler's paradise" ("Cotton Men Support G.O.P. Candidates" 1920). Scarborough (1936, 319) elucidates the gambling theme very clearly in the following interchange between a tenant cotton grower and a cotton buyer concerning the low cotton prices in 1920:

"You take a gambler's chance, you farmers. You gamble on the weather, on drought and flood, on that billion-dollar bug, the boll weevil, on the pink boll worm, on wars and peace and what not. And on the law of supply and demand. Well, that's hit you this year."

"I'll say the dice is loaded on us now!" cried the farmer, his haggard face twisted with emotion. "Who forced the price down on us this year? You cotton speculators livin' in the cities! You bloodsuckers, you vampires, living off'n our toil! You men that never held a hoe in your hands, that never plowed nor planted nor chopped cotton! That never broke your back to pick it in the blisterin' heat! You -- you're the gamblers!"

More currently, Stiles (1980) writes, "To be an Arizona cotton farmer, you need the nerves of a riverboat gambler. You've got to play the odds, to take the big chance when numbers look right."

Although the returns from cotton production in Arizona are still liable to vary substantially, the federal cotton programs instituted since 1933 have reduced the risk of cotton production significantly. As for innovation, Arizona cotton producers are very
ready to adopt new technologies but they habitually plant cotton and generally hesitate to try alternate crops.

The One-Variety Community and Labor Availability

Cotton planted in Arizona until 1921 was largely segregated by species because of the "one-variety community" agreement, an Arizona innovation which was called "... one of the outstanding movements in cotton growing in recent years" (Merrill et al. 1949, 116). The need for segregating *G. barbadense* from *G. hirsutum* to maintain seed purity was known from the field trials involved with the breeding programs at Yuma in 1905 and 1906; the idea was first advanced to Arizona farmers by the USDA Committee on Southwest Cotton Culture (McGowan 1961, 58-61). Carl Scofield (1913, 27-28), the committee's chairman, told Salt Oasis cotton growers that by cooperation

... in maintaining the purity and quality of their seed supply and in carefully handling and harvesting their crops, to develop a reputation for their cotton which will be a commercial asset of great value. Such a result would be impossible if several different kinds of cotton were grown in the same region.

The distribution of the cottons was predicated on the distribution of available labor. Kearney and Peterson (1908, 57) engineered very early to employ Arizona's Indians to harvest cotton:

Cotton picking ... can be satisfactorily performed by the cheapest class of labor. Under certain conditions some of the agriculturally inclined Indians might make very good pickers. In the event of cotton culture being developed on a commercial scale, Indian families could probably be employed to do the picking at a reasonable cost. If the industry becomes established in this region, the cost of picking will probably be reduced in proportion as the population becomes denser and the pickers more adept.
The cotton grown in the Tempe and Mesa areas of the south Salt Oasis in 1912 was picked mostly by Pimas. The lint from this area classed out a full 2 grades higher than any other G. barbadense produced in 1912. The quality was attributed by a USDA cotton marketing consultant to the expertise of the Pima pickers (Martin 1915, 2; McGowan 1961, 68). The Pima's skill and care in picking cotton can be attributed simply to their long tradition of agricultural excellence. Pima wheat farmers were highly productive until the Florence usurpation and the high quantity of production was matched by high standards of quality. In 1876 the Pima farmers' wheat crop was described as being prepared for market, "... in a manner that would be creditable to the best eastern farmers" (Hodge 1962, 161). Similarly, Piman wheat was described in 1881 as "... much superior to that of the whites, both in cleanliness and quality" (Hamilton 1966, 100). The demand for cotton harvest labor, as I mentioned in Chapter two, signaled the end of the Pimas' forty years of famine.

Scofield (1913, 25-28) noted that the labor shortages in the Imperial Valley of California drove the cost of picking the 1912 crop up to $3.50 per cwt, while the Salt Oasis crop was picked by Indians

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1. The Tohono O'odham pickers, like their Pima cousins, were excellent cotton pickers. The growers consistently voiced a high regard for Tohono O'odham pickers as they could be counted on to pick cotton very cleanly and leave none in the field. At least two-thirds of the growers that hired Tohono O'odham pickers in 1950 said that they would, if they could, hire exclusively Tohono O'odham pickers (Dobyns 1950, 118-19).
for $2.00 per cwt. To facilitate an efficient use of available
labor, he recommended that in the segregation of the Arizona cotton
landscape into one variety communities the Salt Oasis should be
given over to *G. barbadense* so as to be in proximity to the most
Indians. In the Yuma Oasis, because of the dearth of Indian labor,
the less labor intensive *G. hirsutum* was to be grown. In general,
the Salt, Santa Cruz, and middle Gila Oases grew Pima (*G. barbadense*)
exclusively, farmers in the Yuma and Upper Gila Oases grew
principally the Mebane cultivar of *G. hirsutum* (Thompson and Wood
1919, 266). In the Salt Oasis from 1918 to 1921 the Pima cultivar of
*G. barbadense* was the only cotton grown (McGowan 1961, 36; UAAES
1928, 19).

**Expansion: 1921–1953**

Between 1921 and 1953 cotton production in Arizona expanded
to its largest extent and the Arizona cotton production region
approached its mature form. After World War One military demand was
eliminated and simultaneously U.S. markets were flooded with cheap
Egyptian cotton (McGowan 1961, 37, 84–5; McWilliams 1944, 73;
Thompson 1986, 23). The price margin between the cottons narrowed to
seven cents in 1922, enough to cause growers to plant more *G.
hirsutum* than *G. barbadense*, and *G. hirsutum* achieved a dominance in
Arizona agriculture that it has held ever since (Hawkins 1930;
Kearney 1926; Thompson 1986, 23; UAAES 1928, 22). By the late 1920s
price conditions were such that *G. barbadense* returned on a
significant though limited basis. Hence *G. barbadense* has generally occupied a small [roughly 10 percent] proportion of Arizona's cotton lands. *G. barbadense* acreage has generally expanded for wartime demands, and when federal legislation imposed limits on the production of *G. hirsutum*. Price relationships after 1933 generally favored *G. hirsutum* over *G. barbadense*. The average differential of return during the period from 1933 to 1950 was $13.00 per acre in favor of *G. hirsutum* (Hathorn 1951, 11, 16).

Arizona cotton growers operate with high reclamation costs that tend to hinder downward acreage adjustments in response to changing demand conditions. Thus the 1929 depression did not have an immediate impact on cotton planting decisions (Hathorn 1951, 22-23). Although production costs dropped along with market prices, the second dropped faster than the first, so that in many depression years the costs of production for both species exceeded the price received for the crop and the growers suffered a net loss (Matlock and Clark 1934, 10-21; Smith 1933, 131). The depression led to a severe crisis in 1931 when Arizona's cotton industry finally collapsed (Brown and Cassmore 1939, 50).

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1. The late 1920s resurgence of *G. barbadense* would not have been possible if the manager of Goodyear Farms hadn't saved and increased pure Pima seed that had been stored by the Tempe Exchange from the 1918 crop (McGowan 1961, 120).

2. Following the lead of Louisiana Governor Huey Long, W.P. Hunt of Arizona was one of the few cotton state governors to acquire a supply of cotton stationery and promote its use in state agencies in an effort to generate demand for the fiber (Snyder 1984, 70-72).
Figures 10 through 13 indicate the extent of planted cotton acreage at some key years during this period: 1932, 1937, 1944, and 1953. In 1932 the extent of planted cotton acreage in Arizona was at nadir influenced by the cotton crisis. The farm programs instituted in the early 1930s effectively controlled planted cotton acreage. In 1937, however, the controls were lifted and Arizona experienced a second cotton boom. From 1943 through 1946 truck crops proved more profitable to Arizona growers than cotton and the state's total cotton acreage fell off until recovery began in 1947 (Barr 1944, 9; 1946a, 4-5; 1947, 2). The generally poor returns for cotton and the specifically poor returns for G. barbadense, varietal degradation of both species, and the anticipation of severe harvest labor shortages, resulted in the diminished 1944 planted cotton acreage. The diffusion of the new Arizona Acala 44 in 1951 gave renewed vigor to the Arizona G. hirsutum industry and contributed to the expansion of cotton (Barr 1954, 7; "King Cotton Retains Role as Top Crop" 1954). High cotton prices (Dunbar 1977, 19) and the wartime lifting of cotton acreage restrictions engendered a third cotton boom in 1953 - a year of record planted cotton acreage.

The area of most significant expansion of cotton production during this period was in Pinal County, where the most significant oasis expansion also generally took place. Dunbar (1977, 7) writes:

As the nation emerged from the Great Depression, relatively good prices for cotton, together with government subsidies, encouraged entrepreneurs in Arizona and neighboring states to expand the acreage devoted to this fibre. Expansion was particularly rapid in the lower Santa Cruz Valley, where production of cotton tripled from 1934 to 1944.
Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 10. Planted Cotton Acreage: 1932 | Map
Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 11. Planted Cotton Acreage: 1937 | Map
Each ** Represents 1,000 Planted Acres of *G. barbadense*

Each • Represents 1,000 Planted Acres of *G. hirsutum*

Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 12. Planted Cotton Acreage: 1944 | Map
APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 13. Planted Cotton Acreage: 1953 | Map
In Pinal County in 1951, where the Arizona Groundwater Code prevented the expansion of irrigated acreage into the areas hitherto not irrigated, nearly every inch of ground that had ever been cultivated and that could be irrigated was put under cotton (Inskeep 1951).

Cotton production in Yuma County, however, went into a temporary decline during this period for numerous reasons, the stagnation of the reclamation process, particularly poor seed stock maintenance systems, and severe insect problems because of the lack of killing frosts. Also interesting is the growing specialization of Graham County in G. barbadense production. This is attributable to such agronomic and biotic factors as I discussed in Chapter 5. Other factors important to interpreting the pattern of cotton land expansion during this period are cotton breeding developments, and particularly the varietal deterioration of each species; changing markets and marketing channels; the farm programs instituted since 1933; wartime marketing conditions; wartime labor shortages; and the post-war markets and farm programs.

1. Cotton growers in Pinal County were traditionally on the leading edge of agribusiness development in Arizona. The early use of machines was concentrated in Pinal County where in 1950 100 to 125 machines were used to harvest 20 percent of the crop (Dobyns 1950, 127). In 1950, 233 machines were used in Arizona to harvest 10 percent of the crop (ASES, 1950, 32). In 1952, about 78 percent of all Arizona cotton growers used credit, while that year in Pinal County about 97 percent of cotton growers used credit (Vanvig 1955, 19).
Cotton Breeding Developments

In each species there were breeding developments that resulted in cultivars specially adapted to different elevations. This was important in the expansion of significant cotton production into higher growing areas, such as in Cochise County. Despite a general improvement in yields, there was a marked varietal deterioration of each species of cotton during this period. This had a direct impact on the markets and demand for Arizona-grown cotton.

G. barbadense. Until 1933 Pima was the only cultivar of G. barbadense grown in Arizona. Seed of a new variety of G. barbadense, called "SxP" because of its derivation from a cross between the popular Egyptian cultivar Sakellaridis and Pima, was released for increase from the Sacaton station in 1934. In 1937 about a third of the state's G. barbadense acreage was SxP, and by 1941 the switch from Pima to SxP was complete. SxP had a 13 percent higher yield and earlier harvest than Pima; however, SxP proved less desirable than Pima because of a shorter staple length (Barr 1942, 379; Hathorn 1951, 9-10; Pressley et al. 1940, 44).

Amsak, a cross between SxP and the Egyptian cultivar Sakel, was first grown commercially in 1943. Amsak offered an even earlier harvest than SxP, which was advantageous for its success at higher elevations. Amsak became the cultivar of choice for G. barbadense growers in the upper Gila Oasis and the cotton growing areas around Las Cruces, New Mexico and El Paso, Texas. In the lower cotton growing areas of Arizona SxP, by virtue of its superior yields, remained the favorite (Hathorn 1951, 9-10; Pressley et al. 1940, 56).
Pima 32 - developed from Pima, SxP, Sakel, and Ashmouni - was first released in 1948; Pima 32 averaged yields 44 percent higher than those of SxP and within 3 years most of the Arizona's *G. barbadense* acreage was Pima 32, the rest Amsak (Barr 1950, 11; 1951, 7; Hathorn 1951, 10, 29; McGowan 1961, 114).

By the late 1930s the quality of Arizona *G. barbadense* fiber was on the decline and this was an important factor in the decline of *G. barbadense* production during the 1940s. The decline in grade was partly attributable to the degradation of the Pima stock by chance hybridization and crossing with *G. hirsutum* and other cultivars of *G. barbadense* (Pressley et al. 1940, 39, 49). The fundamental problem, however, resulted from a lack of genetic diversity. The *G. barbadense* cultivars developed to this time in Arizona - Yuma, Pima, SxP, Amsak, and Pima 32 - were derived from essentially the same Egyptian stock and were maintained by a strict pedigree system that resulted in a loss of genetic variability (Niles and Feaster 1984, 209). The total state production of *G. barbadense* dropped to 300 acres in 1947, over 75 percent in Graham County. Barr (1947, 10) was driven to prematurely announce that *G. barbadense* "... ceased to be an important crop in Arizona." *G. barbadense* production resurged for political and economic reasons, but the crop's integrity was not really redeemed with the release of the Pima S-1 hybrid cultivar in 1954.

*G. hirsutum*. The Durango cultivar of *G. hirsutum* was planted during the early commercial period (McGowan 1961, 69, 84). When *G. hirsutum* gained dominance over *G. barbadense* in the early 1920s, two
cultivars of *G. hirsutum* were in competition: Mebane and Acala. The high prices being received by Salt Oasis farmers for *G. barbadense* cotton caused Yuma county farmers to defy the one-variety community agreement and plant about 3,000 acres of *G. barbadense* in 1919 resulting in confusion of seed stocks. To alleviate the confusion, seed of the Mebane Triumph variety of *G. hirsutum* was imported from Texas in 1919, with the intention of increasing the seed stocks so that by 1921 all of Yuma County's cotton lands could be planted to it (Thompson et al. 1920, 447). Around 1923, falling prices received for *G. barbadense* caused a state-wide shift to Mebane (UAAES 1932a, 17; Matlock and Kennedy 1935, 327).

The Acala cultivar of *G. hirsutum* — which is now the basis of the southwestern cotton agribusiness system — was derived from seed collected near the village of Acala in southern Mexico 1906 and inadvertently preserved (Lewis and Richmond 1968, 13; Timothy 1972, 647). Based on field trial performances demonstrating high yields, a suggestion was made in 1924 to adopt Acala on a statewide basis (Cook and Martin 1924, 2), and by the next year Acala was the only cotton planted in Pima county ("Farming in Pima County" 1926). By 1928 about 90 percent of Maricopa county's *G. hirsutum* acreage was Acala (UAAES 1928, 19).

Although *G. hirsutum* growers throughout most of Arizona's cotton lands generally embraced the Acala cultivar, Yuma-area *G. hirsutum* producers eventually either returned to Mebane or planted the newly introduced Stoneville. In 1932 a small supply of pure Mebane seed was released by the Yuma Valley Experimental Farm for
increase. Sufficient seed was available by the following year to plant several hundred acres and by 1934 more than one half the cotton acreage in the Yuma area was planted to Mebane. The Stoneville cultivar was also introduced to the Yuma area in 1932 and by 1934 it occupied one third of Yuma's cotton lands. However, Stoneville gins out trashy so it was already in disfavor by 1935 (Matlock and Kennedy 1935, 327-8). Mebane and Stoneville are both generally inferior to Acala and the tendency in Yuma County to either cling to the old inferior cultivar or plant the new inferior cultivar contributed to the significant decline of cotton production in Yuma County during the second half of this period.

There was also a marked deterioration of the quality of G. hirsutum produced in the Acala growing areas outside of Yuma County. In California and New Mexico, unlike Arizona, there were growers' associations which fostered the improvement of selected strains of Acala and promoted the production and distribution of adequate supplies of pure seed each year for planting. Arizona Acala growers, however, were not organized and planted either seed shipped in [mostly from California]; or home grown and gin run seed. The first was expensive and not well adapted to the Arizona climate; the second was mixed in with other seed and mongrelized, and so fostered varietal deterioration and a decline in the quality of the G. hirsutum.

1. The Stoneville cultivar of G. hirsutum, popular in the eastern U.S., was developed early in the century (Brown and Ware 1958, 53-59).
hirsutum crop by 1935 (Matlock and Kennedy 1935, 289, 327-28). The cure promoted to Arizona G. hirsutum growers to counter the varietal deterioration was the adoption of a pure seed planting program to improve the quality of the cotton ("Arizona Cotton Growers" 1940). Maricopa County cotton growers, through the newly formed Pure Cotton Seed Association, which was sponsored by the University of Arizona and the Cooperative Extension Service, developed high quality Acala seed stocks by 1941 (Horton 1941, 80).

Acala 1517 was developed for New Mexico in the 1930s and soon became the standard cultivar for New Mexico and Arizona's high eastern oases (Barr 1949, 8; Brown and Ware 1958, 62). The New Mexico strains performed poorly at lower elevations while the California strains performed poorly at high elevations. In the late 1940s G. hirsutum growers in Maricopa, Pinal, Pima and Yuma counties planted the Santan and Shafter strains of Acala which were highly productive, big-bolled and well-adapted to the lowlands; G. hirsutum growers in the elevated eastern counties [Graham, Greenlee, and Cochise] grew varieties of New Mexican Acala, which generally had longer and stronger lint than the California Acalas (Barr 1948, 5; Thomas 1948, 4, 23). The development proved a boon to the cotton industry, as Barr (1947, 8) noted of the Acalas: "The extra-white upland cotton grown under irrigation in Arizona, California, New Mexico, and west of the Pecos River in Texas has become an increasingly important factor in American production."
Markets and Marketing

*G. barbadense* and *G. hirsutum* are marketed differently to different markets. The first is a specialty crop in competition with foreign producers. The second is a basic crop in competition with domestic and foreign producers.

*G. barbadense*. The depressed post-war cotton market presented profound marketing difficulties. The Arizona Pima Cotton Growers' Association rallied in 1921 to effect an orderly liquidation of the 65,000 unsold bales of *G. barbadense* hanging "like a sword of Damocles" over the market (McGowan 1961, 103). The association adopted a cooperative marketing plan that included compulsory ironclad five-year purchase contracts. In 1924 there was a revolt within the association against the strict contracts and the plan was dropped. By the late 1920s part of the crop was sold at the ginneries, and part through the Growers Association, which persisted until 1929 when it was dissolved with the depression (McGowan 1961, 105-8; UAAES 1928, 27).

Fiber quality is influenced by the quality of ginning and Arizona ginners took several years before they consistently turned out high grade fiber. The appearance of the fiber was not initially an issue since most of the crop went into tires. The development of low pressure tires eliminated the demand for *G. barbadense* by the tire industry and so in the mid-1920s Arizona ginners had to improve their technique because the crop went mostly into fine textiles (Martin 1915, 3-4; McGowan 1961, 80-1, 108-9; Pressley et al. 1940, 76; UAAES 1928, 27). The recently popular semisynthetic cellulosic
fiber rayon generally replaced cotton as a cording material (Street 1957, 80). During the 1930s and until the Second World War the U.S. *G. barbadense* crop was consumed domestically, mostly for fine textiles, and did not actually compete with the Egyptian *G. barbadense* crop, which was used for sewing thread (Hathorn 1951, 24). Around 1937, the *G. barbadense* growers began making an effort to advertise the quality of Pima fabrics for fine shirtings and dress goods, and thereby increase the demand for their product (WPA 1940, 82). Just before the war Arizona's *G. barbadense* crop found another utilization as a material for typewriter ribbons (Horton 1941, 82).

Arizona *G. barbadense* growers as early as 1920 backed Republican representatives to Washington in an effort to get tariff legislation that would protect Arizona's *G. barbadense* crop from the Egyptian competition ("Cotton Men Support G.O.P. Candidates" 1920). Import tariffs on *G. barbadense* were imposed in 1930 and import quotas in 1939 (Hathorn 1951, 24-5; McGowan 1961, 15-7). The growers, however, were ultimately victimized by manufacturers who held oligopsony power over *G. barbadense* production. As McWilliams (1944, 74) writes, "The price of long-staple cotton is fixed by a few manufacturers and several of these manufacturers also produce cotton."

*G. hirsutum*. Because of varietal deterioration, by 1935 the quality of *G. hirsutum* fiber was in disfavor by domestic and European spinners (Matlock and Kennedy 1935, 327), and 80 percent of the crop was marketed to Japan ("Spinning Difficulties" 1936). By 1940, nearly 95 percent of the *G. hirsutum* crop was exported to Japan (WPA
1940, 82). At this time, Arizona growers were faced with mounting competition from Brazil, where because of a superior cotton product growers had captured much of the Japanese export market from the United States, and a USDA agent promoted improvements in the Arizona cotton crop in order to "head off fascist Brazil" ("Arizona Cotton Growers" 1940).

The situation was somewhat more complex. On the one hand Japan's shift in 1940 from Arizona to Brazilian cotton might have been strongly influenced by prevailing changes in the geopolitical climate. In addition, in 1934 "night-riders" harassed and endangered the lives of Japanese and Japanese-American farmers and their families in the Salt Oasis. These actions caught the critical attention of Japanese businessmen who purchased U.S. cotton as well as Japanese government officials (Sato 1973) and the Japanese rejection of Arizona cotton in 1940 might have been in partial retaliation. Of course, with the declaration of war the following

1. An editorial in the Daily Star offers a grim perspective on the incidents and Governor Mower's irresponsibility in dealing with the situation:

   It is just such comparatively insignificant incidents, such expressions of racial hatred, that create the causes of war, and if not war, of armament races. The munitions investigation in Washington becomes a puny affair, when as hearings go on, this string of incidents in the Salt River Valley furnishes sales arguments for the munitions makers. When the executive authority of the state fails to take prompt measures to quash such movements, it is not long until they grow, engender new bitterness, complicate our foreign relations, and eventually lead to war ("The Japanese" 1934).

As Stocker (1950c) notes, Bill Matthews, then general editor of the Star, was a remarkably enlightened individual.
year the Japanese market was entirely inaccessible to U.S. cotton.

The Farm Programs

An understanding of the cotton programs is prerequisite to understanding the evolution of the U.S. cotton belt after 1932. G. hirsutum production was first controlled in 1933 and controls for G. barbadense were not implemented until the 1950s. Indeed, the restrictions on G. hirsutum production encouraged the production of G. barbadense as an alternate crop – as I mentioned in Chapter five.

Repeated efforts to control the cotton acreage or price and so elevate the value of the crop failed until the passage of the Agricultural Adjustment Act in the spring of 1933 (Blanpied 1984, 7; Fite, 1984, 93-129; Zimmermann 1951, 332). This legislation had, and continues to have, far-reaching consequences in the evolution of the Arizona cotton agrosystem – not all of them socially desirable. According to a report chaired by former U.S. Secretary of Agriculture Bergland, "there is little doubt that some of the programs that have resulted from this ad hoc, crisis-oriented policy making have subsequently exacerbated problems of farmers or, over time, produced unintended and unwanted consequences for the farm sector as a whole" (Bergland et al. 1981, 101).

The Agricultural Adjustment Administration, formed to implement the new legislation, was charged with the objective of adjusting the country's cotton production by a system of acreage control restrictions and incentives (Richards 1934, 1-2; Vogeler 1981, 163; Zimmermann 1951, 332). A cotton plow-up program was
instituted in 1933 as an emergency measure to reduce the cotton surplus; the national goal was to reduce cotton acreage by one third (Fite 1984, 129-31; Richards 1934, 9). About 16 percent of Arizona's 1933 G. hirsutum cotton acreage [based on the difference between planted and harvested acreage] was plowed up. Growers in most counties plowed up from 12 to 14 percent; however, Pinal County growers plowed up about 27 percent of the cotton (ACLRS 1966, 30-1). The high plow-up rate in Pinal County might be somehow related to the area's recently settled status. In contrast, the longer-settled Chandler area cotton growers plowed up almost none of their cotton (Stevens 1954, 67).

The AAA had a most profound impact on cotton region development as the system of price supports and acreage allotments acts directly on shaping and maintaining the cotton landscape. When the legislation is in effect the cotton landscape is, to use Hart's term, "fossilized" by federal legislation (Hart 1977, 311). Three of the state's four cotton booms [in 1937, the early 1950s, and the late 1970s early 1980s] resulted directly from a rescinding of federal planting restrictions. In addition, the programs

... almost certainly fostered the continued growth in the size of farm firms, caused the program benefits to be capitalized into land values, at times promoted production beyond market needs or the producers' best interests, and sometimes fostered a less-than-efficient allocation of resources (Bergland et al. 1981, 102).

The Commodity Credit Corporation [CCC], formed in 1933 with the AAA, is essentially a government-subsidized market for agricultural producers. The CCC supplies interest-free loans to
producers of cotton and other restricted commodities at guaranteed levels, the support price. These loans are available for crops grown within AAA guidelines and the crop is used as collateral. If cotton prices go above the loan level, producers can sell their crop on the open market. If prices drop below loan levels, producers can keep the loan and forfeit the crop, letting the government take the loss. In essence, under unfavorable price conditions growers simply sell their crop to the government at a guaranteed support-price (Fite 1984, 132; Vogeler 1981, 163-64). Over the years the program has undergone substantial changes but this is still the basic mechanism.

The price-support programs have been generally for storable, non-perishable, commodities such as cotton (Blanpied et al. 1984, 116-17; Tomek and Robinson 1981, 201). From 1933 until 1948, the price supports were closely linked to the parity price (Tomek and Robinson 1981, 282). Parity for cotton is attained when the price received by a cotton grower for a unit amount of cotton buys as much as in the period from 1910 to 1914, when cotton growers last enjoyed favorable returns (Barr 1942, 368; Blanpied et al. 1984, 7-8, 117-18; Richard 1934, 2). Since Arizona's cotton industry was not yet fully developed during the 1910-1914 period, the average price of cotton in Arizona from 1925 to 1939 was assumed to bear the same relationship to Arizona parity as the average 1925-39 U.S. price for that cotton bore to U.S. parity. For example: in December of 1941 the parity price for a pound of middling G. hirsutum in Arizona was calculated at 17.7 cents. The actual price received was 17.35 cents; growers who planted within their allotments had the option of selling their
cotton to the government for 17.7 cents per pound (Barr 1942, 368). Thus the support price, not the actual market price, became the more important factor governing cotton planting decisions (Barr 1947, 10). High price-supports for *G. hirsutum* cotton were continued at 90 percent of parity until they were cut to 75 percent and lower after 1954 (Blanpied et al. 1984, 110-11).

The AAA was fairly effective in limiting cotton acreage and production but it was declared unconstitutional by the Supreme Court and was supplanted by the Soil Conservation and Domestic Allotment Act of 1936 (Blainpied et al. 1984, 116; Hardin 1952, 108; Street 1957, 45). The 1933 AAA benefited mostly large landholders, with few benefits accruing to tenant farmers; the 1936 SCDAA was designed to alleviate this problem (Fite 1984, 143). The 1936 SCDAA, however, was not very effective in the central goal of limiting cotton acreage and acreage nationwide increased from the target goal of less than 30 million acres in 1934 to a peak in 1937 of 34 million acres (Street 1957, 45). Spurred on by high prices and allowed by the lifting of restrictions, Arizona's *G. hirsutum* acreage shot up over 100,000 acres in 1937. This was Arizona's second cotton boom, as indicated in the map in figure 12. The runaway cotton landscape of 1937 led the government to pass stronger legislation in 1938, which remained in effect until 1943 when the restrictions were rescinded because of the Second World War (Blanpied et al. 1984, 116-18; Horton 1941, 82-83; Street 1957, 45).
Wartime Marketing Conditions

The production of both \textit{G. barbadense} and \textit{G. hirsutum} responded dramatically to the extraordinary marketing conditions of the Second World War.

\textbf{\textit{G. barbadense}}. The outbreak of war in Europe caused a perception in Arizona as early as 1940 that \textit{G. barbadense} prices would skyrocket as they had during World War One (Barr 1942, 277; Pressley et al. 1940, 73). In February of 1942, with \textit{G. hirsutum} acreage still restricted, the demand for \textit{G. barbadense} intensified because the government declared the crop vital to the war effort—1 for barrage balloons, machinegun belts, glider wings, and parachute fabric—and embarked on a defense purchasing program that resulted in a large and rapid increase in planted \textit{G. barbadense} acreage. In addition, \textit{G. barbadense} was temporarily declared a basic crop, eligible like \textit{G. hirsutum} for price supports (Blanpied et al. 1984, 119; Hathorn 1951, 25; McGowan 1961, 110; Street 1957, 69). The support price relationship established by the government in the early years of WWII pegged the price of \textit{G. barbadense} at 2.42 times the price of \textit{G. hirsutum} (Barr 1951, 9).

Spurred by the well-supported and favorable prices and calls for increased wartime production, \textit{G. barbadense} production surged in

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1. Spokesmen from the United States Army claimed that \textit{G. barbadense} fiber was particularly necessary as a substitute for Chinese silk which was used in making barrage balloons for directing field artillery fire (Mitchell 1982, 112).
1942 (Barr 1944, 9). Arizona's 1942 *G. barbadense* crop of 130,000 acres [which has not since been exceeded] met over 40 percent of the national production goal, and represented about 75 percent of the actual production. In 1943 the State War Board of the USDA urged the planting of 100,000 acres of *G. barbadense*. At the end of 1943, however, there was enough *G. barbadense* cotton stockpiled and supplies from Egypt were assured so the special purchase program was discontinued (Barr 1943, 7). After 1943, the rescinding of *G. hirsutum* restrictions and cessation of the wartime *G. barbadense* production incentives led Barr to correctly predict that *G. barbadense* would decline and growers would shift much of their cotton lands over to *G. hirsutum* (Barr 1944, 8; 1945, 5). Thus the war-time economic and political climate resulted in an expansion of *G. barbadense* production despite the reduced quality of the crop. With the military demand reduced and the policies relaxed, *G. barbadense* acreage plunged to the 300 acre 1947 low that I mentioned.

*G. hirsutum*. The two World Wars each acted to increase the domestic demand for *G. hirsutum* cotton, moderately during the First World War and substantially during the Second, but the first war did not curtail cotton exports as did the Second World war, which eliminated both the European market for U.S. cotton in general and the Japanese market for Arizona cotton in particular (Street 1957, 46; Zimmermann 1951, 332). Since Arizona growers were cut off from their Japanese markets in December of 1941, most of the state's *G. hirsutum* crop was sold into government loan holdings at the parity price (Barr 1942, 374). The acreage restrictions on *G. hirsutum* were
lifted in 1943, and the State War Board urged Arizona growers to plant 100,000 acres of *G. hirsutum* in 1943 and to shoot for a maximum of 140,000 acres to meet wartime fiber demands (Barr 1943, 7).

Production declined, however, in 1944; this was a consequence of low demand for cotton and subsequent low cotton prices as well as the anticipation of an acute labor shortage. After the Second World War Barr (1946b, 17) recommended that efforts be made to reestablish the east Asian market for Arizona *G. hirsutum*.

Labor Shortages and the Decline of Cotton Production in 1944

Generally during the period of hand harvest - 1912 to 1965 - the supply of harvest labor to Arizona cotton farms was fluid enough that labor availability did not grossly influence the extent of planted cotton acreage. An exception was the 1944 decline in planted cotton acreage which was due in part to an anticipation of harvest labor shortages that was spurred by real harvest labor shortages in 1942 and 1943 (Barr 1944, 8).

The decline in harvest labor supply has a complex history. During the 1930s the need for seasonally employed labor, due mostly to tractorization and monocropping with cotton, increased in larger proportions than the demand for regular farmhands. Harvest labor demands were made even more acute by the practice of growers to consistently over-recruit in order to keep wages repressed. In peak cotton years, such as 1937, growers tended to panic and over-estimated their need for pickers by as much as 100 percent. In addition, to make early markets and avoid late-season rain and hail
damage, growers sought constantly to shorten the picking season. There were never, from the agribusiness perspective, too many cotton pickers in Arizona during the cotton harvest (Brown and Cassmore, 1939, 51-55). Street (1957, 200) writes that complaints of labor shortages are "... often more of an expression of heightened anxiety about crop losses ... and of unwillingness to meet competitive wage rates than of an actual condition of labor unavailability." During the early war years, however, the harvest labor shortages were quite real. The western United States was generally dominated by wartime production drives, and wartime agricultural labor shortages in the west were particularly acute (Nash 1985, 41). Draft deferments were issued for farm workers in both world wars, though these were generally used only to retain family farm labor and regular farm hands and migrant farm workers were not exempted from the draft (Schwartz 1945, 26).

The practice of cotton growers to 'over-tool' with labor in order to insure a prompt harvest and low wages back-fired in the early 1940s when real labor shortages began to develop. By this time, the United States Employment Service had caught on to the growers' strategy and took it into account in estimating labor demands based on growers' requests. Through 1941 and much of 1942 the cotton growers' cries for pickers [like those of the "Boy Who Cried Wolf"] were belittled by the Employment Service (Nash 1985, 49). Arizona's wartime cotton picker shortage was aggravated by the large amount of harvest-labor intensive G. barbadense that had to be picked (Mitchell 1982, 112). To top it off, the flow of impoverished
Okies - who had hitherto picked the lion's share of Arizona cotton - was abruptly shut off. Much of the 1942 crop went unharvested (Hathorn 1951, 25), so that the cotton landscape in late December reminded one observer of a "white Christmas" (Caruso 1973, 340). The bracero program was reinstated in 1942 (Nash 1985, 48-51; Tetreau 1942b, 30) and Japanese-American evacuees were also enlisted for the 1942 crop. Italian POWs helped tide the industry through 1943 until the sharp rise in the supply of German POW cotton pickers, who helped save Arizona's cotton crop in 1944 and 1945.

**Okies.** The flow of Okies across Arizona, which had supplied most of Arizona's cotton harvest labor since the early 1930s dwindled with wartime gas and tire rationing and then ceased entirely (Street 1957, 197). Arizona farmers' first real labor shortages in many years hit in 1941. Some rubber was still available at this time and most of the pickers were migrant Okies. The harvest was accomplished by extending it into February of 1942. In 1942 rubber rationing made tires unavailable and curtailed Okie migration [except by train or truck], and many resident pickers were mustered into the war. The extension of the harvest period had the effect of restricting the plantings of winter grains in 1943. The shortage of cotton pickers was even more acute in the fall of 1943 (Barr 1942, 372; 1943, 7; 1944, 2-5; Tetreau 1942b, 3-5, 29; 1943, 1-2).

**Evacuees.** The labor demanded to construct the Rivers relocation camp for Japanese-American evacuees exacerbated the 1942 labor shortage (Caruso 1973, 338-9). On June 15 the Rivers camp was about 75 percent complete and over 1,100 people were employed in its
construction with more expected to be needed in order to finish the job on schedule ("Sacaton Japanese Camp Job Rushed" 1942). Cotton growers shouted foul and declared that the labor demands of camp building triggered a cotton picker shortage. Thus there was a very early movement by cotton growers to muster the evacuees for the harvest (Caruso 1973, 338-9). By the end of August of 1942, the Rivers camp had a population of 5,000 with plans to bring in 10,000 more ("5,000 Japs" 1942), and by late September evacuees from the Rivers camp were already "helping" in the cotton fields ("Japanese Helping" 1942). According to a former resident, cotton pickers were also recruited to a limited extent from the Poston camp (Omachi 1985).

The program of mustering evacuees for the cotton harvest was actually called off in November, 1942 when the U.S. Army decided that it was not cost-efficient to have, as in one case, 830 armed infantrymen standing guard over 160 evacuee cotton pickers (Caruso 1973, 340). The exclusion zone, which prevented Japanese-Americans from residing in southern Arizona, had been relaxed to allow the evacuees to harvest the cotton crop but the line was reestablished because, according to a congressional delegation, "the Japs would not and did not pick the cotton . . . They have clearly demonstrated their attitude and there is no longer any reason why the lines should not be reestablished" (cited in "Resettlement of Japs" 1943). Attitude is a reflection of circumstance. Ms. Omachi, then a teenager, remembers that the evacuees were told that the relocation was for their own protection, but she thought this did not explain
the blacked-out windows on the train that took her from the west coast to Poston, nor why the guns of the guards on the camp's perimeter were pointed inwards. Initially, the idea of picking cotton seemed fun and a good way to get out of the camp for a day. Ms. Omachi remembers her one day in the cotton fields as less than fun and, having picked only 20 pounds, not very profitable (Omachi 1986). In 1943, the evacuees were not involved in the general cotton harvest; they did, however, plant and harvest 40 acres of *G. barbadense* for seed to meet the acute wartime production demand ("Changes Made For Jap Camp" 1943).

**Italian POWs.** In 1943 Italian Prisoners of War were employed as cotton pickers in Arizona, these were replaced by German Prisoners of War in 1944 and 1945. In 1943, the peak picking force of 17,000 consisted of 40 percent Arizona residents, both farmhands and seasonal pickers; 15 percent were migrant pickers who were shipped in by truck and train; 9 percent were braceros; and 35 percent were Italian POWs. By March of 1944 Italy had sued for surrender and, with the Italian POWs transferred to less punitive labor in California, Arizona cotton producers were still uncertain whether or not allied advances in Europe would result in enough German POWs being delivered to labor-starved Arizona in time to harvest the 1944 cotton crop (Tetreau 1944, 4-5). This anticipation of a harvest labor shortage at planting time had a direct bearing on cotton planting decisions and was an important factor in the 1944 decline of cotton acreage (Barr 1944, 8).

**German POWs.** The allied invasion of Normandy in June was a
boon to the Arizona cotton industry as it resulted in a flood of German POWs, without whom the cotton crop might have gone unharvested (Barr 1945, 5-6). Harvest labor demands also plunged in 1944 because of the sharp decline in G. barbadense production. In addition, the German POWs proved to be much more productive cotton pickers than the Italian POWs. The POW pickers earned the standard rate of $2.00 per cwt for G. hirsutum and $4.00 per cwt for G. barbadense. However, the federal government only allowed individual POWs to keep a maximum of $.80 per day, the pay of a U.S. army private. Anything earned over this amount went into a fund to defray the cost of running the POW camps. Italian POWs would only pick enough to make a pillow of their sack and then nap between the rows. The Germans were more productive because they would often ease the boredom of prison life by betting among themselves to see who could pick the most cotton (Banks 1984; Krammer 1976, 69; "POWs Were in Guarded Condition" 1978, 58). German POWs became so important to the maintenance of cotton production in Arizona that the Cooperative Extension Service issued an instructional circular in German on cotton picking (Halvorson 1962, 204). Armistice and repatriation eliminated the supply of German POW cotton pickers before the 1946 harvest (Clark 1985; Krammer 1976, 71-2).

Post-War Cotton Markets and Programs

Until 1953 G. barbadense was not subject to acreage restrictions. This, along with the fact that the cottons served different markets, contributed substantially to fluctuations in
planted cotton acreage.

G. barbadense. During the late 1940s, when Arizona's G. barbadense industry was nearly extinct, U.S. cotton mills requested that the Tariff Commission authorize supplementary imports of G. barbadense (McGowan 1961, 125). In 1950, however, the species bounced back strongly in 1950 when the restrictions on G. hirsutum caused many Arizona producers to shift lands to G. barbadense production, as they had in restricted years past (Barr 1950, 10; Hathorn 1951, 25-6; McGowan 1961, 110, 156). In 1951 the USDA announced a purchasing program for G. barbadense to meet the demands expected to be generated by the Korean War. Southwestern growers were urged to produce 75,000 bales and prices were guaranteed at over $1 a pound. This represented a price ratio of 2.7 to 1 in favor of G. barbadense. Despite these favorable economics, and perhaps because of an uncertainty of the labor supply, and certainly because of the lifting of planting restrictions on G. hirsutum, Arizona growers only planted 22,000 acres of G. barbadense in 1951 (Hathorn 1951, 26).

G. hirsutum. It was widely recognized that the G. hirsutum acreage would be restricted in 1950, and producers thought in 1949 that their ability to plant cotton in future years would be predicated on the "cotton histories" they could establish during 1949 and they generally planted as much as they possibly could. As Prunty (1951, 191) reports, "thousands of acres were planted in every segment of the South with no hope or expectation of harvesting them completely. Many fields were picked only once. In January, 1950,
open cotton on the stalks could be seen in field after field in every large cotton production district in the South." This was no less so in Arizona where in 1949 more land was planted to cotton than ever before ("Arizona Cotton Slash" 1949). The total area reclaimed in Arizona between 1948 and 1949 - 100,000 acres - was almost equivalent to the difference in planted cotton acreage between 1948 and 1949 - 103,000 acres.

In December of 1949, cotton farmers nationwide voted in favor of the reinstatement of a return to acreage controls. Arizona producers, having what they believed to be firmly established cotton histories, were among those voting overwhelmingly in favor of the action. The growers went on their 1949 planting spree under the impression that their 1950 allotment would be established at a 20 percent reduction from the 1949 acreage. However, the 1950 allotment was instead pegged to the 10-year average set during the pre-war years 1932 to 1942 ("Arizona, Nation Okay Cotton Acreage Slash" 1949). Arizona's 1950 G. hirsutum allotment was established at 232,000 acres, dictating a 40 percent reduction from the cotton acreage of 1949 (Barr 1950, 6). The United States' entry into the Korean War, however, caused an immediate curtailment of restrictive legislation from 1951 until 1954 when the restrictions were reimposed (Fite 1984, 194; Weber 1972, 16). In 1953, largely influenced by the lack of restrictions, the largest acreage of cotton ever - 695,000 acres - was planted in Arizona.
The cotton production of Arizona receded after 1953 to about 400,000 acres and then began to decline again after 1965 until it bottomed out in 1967. The decline was due mostly to the lucrative benefits offered for cotton acreage idlement in the 1965 Farm Bill. The pink bollworm posed a large enough threat to cotton production after 1965 that growers were happy to comply fully with the provisions of the 1965 Farm Program and cut their cotton acreage dramatically. Yet another factor that made total compliance an attractive option was the 1965 termination of the bracero program, which had given an advantage to cotton producers near the border. In Santa Cruz County, a border county with likely high employment of braceros, cotton production was virtually absent after 1965 - this might have been influenced by the termination of the bracero program. The map in figure 14 indicates the extent of cotton production at the 1967 nadir. Cotton acreage in Arizona began to expand again in the early 1970s and peaked in 1981. Other factors influencing changes in the cotton production region during this later period are cotton breeding developments and the changing political and market systems.

Cotton Breeding Developments

Cotton breeders during this period were faced with the task of developing cultivars that were adapted to a machine harvest. In addition, there was a strong imperative to increase the average yield per acre to maximize the production per allotment and reduce the
Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 14. Planted Cotton Acreage: 1967 | Map
length of the growing season to combat the pink bollworm and conserve water.

_G. barbadense_. As I mentioned, the grade of Arizona-grown _G. barbadense_ had deteriorated by the late 1930s because of a narrow genetic base. Hybrid Pima S-1 cotton seed, released in 1954 after two decades of development, had a very diverse genetic base. The Pima S-1 cultivar included germ plasm from four sources: Sea Island, Pima, Tanguis [all _G. barbadense_], and Stoneville [ _G. hirsutum_]. In addition to being well-adapted to machine picking, Pima S-1 became very popular because of its high yields — more than a 120 percent increase over Pima 32 (Barr 1955, 6; Gardner 1963, 257-58; McGowan 1961, 114; Niles and Feaster 1984, 209). However, Pima S-1 had an average staple length 1/16 inch shorter than Pima 32 and the support price was diminished by about 5 percent to 54 cents a pound (Barr 1956, 7). Pima S-1 was heavily promoted in 1957 by the Supima corporation (Seltzer 1958, 6) and by 1958, about 86 percent of the state’s total _G. barbadense_ acreage was Pima S-1 (Brown and Ware 1958, 56). Pima S-2 seed was available in 1962, promising higher yields, faster ginning, and better adaptation to machine picking due to short stature (UAAES 1962, 16). The cotton breeding program proceeded along, Pima S-6, released in 1983, Pima S-6 out-produced Pima S-5 by 4 to 18 percent, in addition to maturing about 10 days earlier (UACA 1984).

_G. hirsutum_. Acala 44 was developed for Arizona in the late 1940s out of Acala 1517 and Santan Acala. By 1951 there was adequate seed to plant Acala 44 over Arizona’s entire _G. hirsutum_ allotment
In 1952, the Marana district was practically a one-variety community planted to Acala 44 (Barr and Seltzer 1952, 6). The developments of the new Acala cultivars - Arizona Acala 44 and California Acala 4-42 - gave renewed vigor to the southwestern cotton industry. Previously discounted, now *G. hirsutum* cotton produced in the Southwest was highly regarded (Barr 1951, 6-7; 1954, 7; "King Cotton Retains Role as Top Crop" 1954).

The new Acala cultivars held sway over the southwestern cotton lands until the mid-1950s when vigorous sales campaigns of the Delta and Pineland Company of Mississippi caused southwestern farmers to begin to shift to the inferior Deltapine cultivar (UAAES 1962, 16; Lewis and Richmond 1968, 13). The Deltapine company, with enormous holdings on level delta lands, yearned for harvest mechanization; the development of a machine-harvestable cultivar, a tall plant with few low spreading branches and bolls that mature within a relatively short time of each other, was a priority for the corporate cotton breeders (Prunty 1962, 168). The boasts in favor of

1. Acala 4-42 was developed in California from Acala 1517 stock as a result of trials begun in the mid-1930s. In compliance with a state one-variety community law, California cotton farmers shifted production entirely to Acala 4-42 in 1949 (Brown and Ware 1958, 62; Lewis and Richmond 1968, 13; Street 1957, 154).

2. Around 1910 British cotton processors found difficulty in obtaining Egyptian cotton and established the Deltapine plantation in Mississippi to ensure a steady supply of high-quality cotton fiber (Prunty 1962, 154).
Deltapine included higher yields, earlier maturity, less rank growth, ease of mechanical harvest, and a slightly higher gin turnout. In the early 1960s, over 70 percent of Arizona's cottonlands were under Deltapine. There were well-founded worries that the new Deltapine cultivar would deteriorate the position of Arizona cotton in the market. Indeed, the Deltapine lint graded out lower than the Acalas because of graying from leaf-mold fungi and shorter staple lengths. Most damning, Deltapine is susceptible to verticillium wilt. The first defense in plant pathology is the use of more tolerant cultivars, such as the Acalas, to which growers returned (UAAES 1962, 16; 1963, 17; Lewis and Richmond 1968, 13).

Markets and Farm Programs: 1954-1965

During this period G. barbadense growers were granted the same sort of farm program benefits as G. hirsutum growers. With the exception of the special provisions during the beginning of World War Two, G. barbadense was not classified with G. hirsutum as a basic crop until 1950, and so had its price supported at anywhere from zero to 90 percent of parity (Barr 1950, 10). After 1954 G. barbadense was subject to acreage restrictions (Barr 1954, 5-6), with prices supported at 75 percent of parity (Barr 1956, 6-7). Arizona's 1951 and 1952 G. barbadense cotton crop went into the military stockpile purchase program and the 1953 and 1954 crop went into the CCC loan (McGowan 1961, 124).

In 1954 Arizona producers were allotted 288,000 acres of G. hirsutum and 16,000 acres of G. barbadense (Barr 1954, 5-6). G.
barbadense growers complied quite closely, planting only 16,500 acres in 1954, as compared with 41,900 in 1953. G. hirsutum growers, however, were less compliant, planting 414,500 acres in 1954. The total amount of land taken out of cotton between 1953 and 1954 was roughly equal to that put into barley and grain sorghum (Barr 1955, 2). The acreages planted to both G. hirsutum and to a somewhat less extent G. barbadense were effectively kept within limits established by cotton histories and adjusted by the government from 1954 through 1965 (Barr 1957, 7-8; Seltzer 1958, 6-7; UAAES 1962, 6; 1963, 11; 1964, 7; 1965, 8-9; 1966, 10). There were fears locally that the small G. barbadense allotments would render the industry extinct so the Supima Association of America lobbied successfully to increase the allotment to its 1962 level of 42,000 acres (UAAES 1962, 16).

The G. barbadense industry in the early 1950s was characterized as highly unstable and subject to wars, depression, and government intervention. Because of this instability, domestic spinners did not rely on southwestern G. barbadense (Hathorn 1951, 7). The market conditions for Arizona G. barbadense, however, altered dramatically in the mid-1950s. Egypt, which then produced half the planet's G. barbadense crop, shifted the market for Egyptian cotton from the United States to Czechoslovakia as part of a general shift in political relations. This had the effect of significantly boosting the demand for domestic supplies of G. barbadense (Barr 1957, 8; McGowan 1961, 10, 19-21). Thus although G. barbadense was now a basic crop and eligible for the federal loan program, very little of the Arizona 1957 G. barbadense crop went into the loan
because of the increased domestic demand (Seltzer 1958, 7).

The Food and Agricultural Act of 1965

The Food and Agriculture Act of 1965 contained several provisions radically different from the past. For one, there was a shift from price supports to direct payments. Under this incentive program cotton acreage was reduced significantly as producers had to withdraw at least 12.5 percent of their base allotment from production to qualify for benefits. Producers had the option of withdrawing up to 35 percent of the base allotment, that is to plant only the domestic allotment [which equaled 65 percent of the base allotment] to receive the maximum allowable diversion payment. Under the inducement of the new program, planted cotton acreage in Arizona in 1966 was down to the lowest level in 20 years. The nation's 1966 cotton acreage, 9.6 million acres, was the lowest since the close of the Civil War. Low planted cotton acreages [possibly influenced by the pink bollworm infestations] continued through the late 1960s (UAAES 1966, 9-13; 1967, 13-16; 1968, 5; 1969, 6-7; Weber 1972, 20-22). The severe reduction in cotton acreage prompted a shift to a more diverse cropping regimen and citrus, vegetable, sorghum, barley, safflower and sugar beet acreage increased as cotton acreage declined (ASES 1969, 5).

A major innovation in the 1965 legislation was that after 1965 allotments could be bought, sold, leased, and transferred across county lines. Thus, beginning in 1966 there were a considerable number of G. hirsutum allotment transfers and transactions. In 1969
this liberty was extended to *G. barbadense* allotments also. These provisions allowed the consolidation and amalgamation of allotments to form larger farming units and it also allowed a redistribution of cotton production away from the older settled areas with depleted aquifers into less hazardous and lower-cost production areas within the state, particularly the newly reclaimed areas in Yuma County (UAAES 1966, 9; 1967, 13-14; 1968, 5-7; 1969, 6-7; Weber 1972, 36). The regulations regarding cotton allotment transfers also allow cotton production to shift out of areas that are becoming urbanized with resultant gains in land-related production costs - which would otherwise "retire" the allotments for good - leading to a permanent decline of cotton production (Kelso et al. 1973, 226). This was a primary factor that allowed Yuma County's cotton production to expand along with its general oasis expansion. The 1965 Food and Agriculture Act, originally due to expire in 1969, was extended for another year to 1970 (UAAES 1969, 4-5).

The Pink Bollworm and the Decline of Cotton

Although cotton pests have long had a certain impact on cotton planting decisions, the direct influence of variations in pest outbreaks on variations in planted cotton acreage was relatively minimal until the late 1960s when monocropping and the increased use of fertilizers, water, and particularly pesticides led to a true ecological crisis in the Arizona cotton lands. The widespread participation in the 1965 Farm Program by Arizona growers was encouraged by heavy pink bollworm [*Pectinophora gossypiella*]
infestations. Pink bollworms were first noted in the eastern counties of Arizona in 1926. Infestations were relatively localized until 1965 when the worm swept across the Arizona cotton landscape and into California. Since that time the pink bollworm has been the most serious cotton pest in the Southwest (Smith and Reynolds 1972, 398; Telford 1957, 23; Werner et al 1979, 13; Watson 1985, 24).

In 1932 there were still only very limited pink bollworm infestations in Arizona's eastern oases (UAAES 1932b, 20). In 1948 the pink bollworm was still only a potential pest in Arizona cotton, kept easily in control by the usual methods of federal and state inspection and quarantine, sanitation and seed sterilization, avoiding ratoon cotton, in addition to the recent innovation of dusting with DDT (Thomas 1948, 21-26). Pink bollworm sightings in Arizona generally increased in number and widened in distribution during the late 1950s (Roney and Wene 1959, 5-7, 23; Seltzer 1958, 10; Telford 1957, 23-25).

As the pink bollworm densities increased, more pesticides and other control procedures were employed. Technology remained one step ahead of nature for a time and as late as 1962 the annual report of agriculture in Arizona was able to optimistically announce that the pink bollworm eradication program was "on the verge of complete

1. The fledgling Arizona cotton industry only narrowly escaped pink bollworm infestation from a 1914 shipment of cotton seed from Egypt and the state and federal governments imposed strict quarantine policies to prevent infestation (Morrill 1918, 180).
success" (UAAES 1962, 14). Despite increasing applications of pesticides pink bollworm caused cotton yields to decline 16 percent in 1964 (UAAES 1964, 10). In late 1965 pink bollworm populations surged, causing widespread damage in 1966 and reducing cotton yields in some areas by more than 50 percent (UAAES 1967, 16). After this, controls were attempted by the direct application of huge amounts of pesticides. This was very costly to growers, both in direct pesticide costs and the increased damage from the resurgence, due to the destruction of predators and acquired pesticide resistance by pests, of secondary cotton pests such as cotton leafperforators, spider mites, and tobacco budworms. The control for pink bollworm - as for cotton pests generally - has been accomplished since the early 1970s by integrated pest management [IPM]. Pesticides are now applied more judiciously, in concert with cultural and biological controls, in an attempt to avoid such outbreaks (Watson 1985, 24).

The magnitude of the massive pesticide campaign against the pink bollworm is evidenced by the fate of Arizona's apiculturalists and guano bats. Average honey yields in Arizona, measured in pounds per colony per year, dropped from 73.2 pounds in the period 1950-1966 to 53.2 pounds in the period 1967-1980 (ACLRS, 1966, 128; 1969, 58). The number of apiculturalists in Arizona dropped by half between 1967 and 1970 (Merrill 1975, 63-4). In the early 1960s, there were upwards of 25 million guano bats [Tadarida brasilensis], agriculturally valuable as both a fertilizer source and pest control, nesting in a cave on Eagle Creek, a tributary of the Gila River in Graham County. By 1968, as a consequence of massive pesticide abuse,
there were only about 30,000 guano bats in Eagle Creek Cave (Cowgill 1987).

The New Sinews of War

The United States was heavily involved in a war in Viet Nam during the late 1960s and early 1970s, however, unlike the dramatic cotton planting responses to the Civil War, World War I, World War II, and the Korean War, there was no expansion of cotton in Arizona during the Viet Nam War. This was probably because of the growing competition from synthetic fibers, which was yet another factor in the general decline of the Arizona cotton landscape during the late 1960s and early 1970s. As the per-capita U.S. consumption of cotton fiber declined from 25.2 pounds in 1966 to 18.5 pounds in 1973, the per-capita consumption of synthetic fibers increased from 20.2 pounds to 41.9 pounds (UAAES 1967, 16; 1969, 15-6; Walter and Zentner 1975, 14; Weber 1972, 22).

The Surplus Crisis

The lack of federal restrictions during the 1940s generated an enormous cotton surplus. The sharp reduction in production in 1950, as stipulated by the new legislation, combined with the increased domestic demand as generated by the war in Korea, caused a sharp rise in cotton prices and temporarily alleviated the serious cotton surplus problem in the United States. In 1955, because of a continuing downward trend in cotton exports nearly 30 percent of Arizona's G. hirsutum crop went into the CCC loan (Barr 1957, 7), and the total carryover stocks were enormous. With acreage restrictions
reimposed, the carryover stocks were reduced from the record 1956 level. The surplus was greatly reduced by 1960, price-support levels were raised, and the stage was set for another surplus crisis (Weber 1972, 11-16, 19-20).

In 1963 and 1964, unusually high proportions of Arizona cotton of both species moved into the government loan instead of commercial markets (UAAES 1963, 17; 1964, 10-11). By 1966, total carryover stocks were at new record levels (Weber 1972, 20). Because of the switch in emphasis from price supports to direct payments in the Food and Agriculture Act of 1965, there was a substantial reduction of surplus *G. hirsutum* stockpiles (UAAES 1966, 9, 13; 1967, 13-14; 1968, 5; 1969, 6-7; Weber 1972, 20-22).

Farm Programs in the 1970s

Continuing productivity gains, declining markets, and inadequacies in the distribution of program benefits forced continuing revisions of cotton programs, particularly for *G. hirsutum* (Weber 1972, 79). The Agricultural Act of 1970 was highly controversial; for the first time in two decades, cotton growers were allowed to plant all of the cotton they desired as long as they satisfied the new set-aside requirements (Palmer 1971, 1-2). The set-aside requirements gave growers greater freedom in planting decisions and represented a marked relaxation of restraints of the past (Blanpied et al. 1984, 129).

The federal farm program, which had remained essentially intact since its inception as part of the New Deal, was very nearly
dismantled by Earl Butz, Secretary of Agriculture during the Nixon administration. Direct support payments were discontinued and most acreage restrictions and support payments were removed. The 1973 Farm Bill replaced the old support price system with a system of much lower "target prices." This essentially lowered the cushion and bailed out farmers only when market prices dropped deeply. Growers responded immediately and planted cotton "fence-row to fence-row" in 1974 and continued a high level of production in succeeding years (Blanpied et al. 1984, 135; Fite 1984, 267; Foster and Wright 1980, 85; Stiles 1980; Vogeler 1981, 184). Vogeler (1981, 184) writes that Butz sold off all government-owned storage bins, which held the 'surplus' that the government had bought over the years. His 1973 bill, which expired in 1977, removed the government from agricultural marketing entirely. The law compensated farmers only if prices dropped disastrously and only at a fraction of their production costs.

In fact, the demand rose not because of policies but an unusually high world demand [particularly from the Soviet Union, the People's Republic of China, India, and Africa generally] for U.S. agricultural products (Vogeler 1981, 184). The lucrative world market for U.S. farm products temporarily masked the impact of the 1973 rise in petroleum prices, which greatly increased production costs because of the heavy reliance on petroleum-based pesticides, fertilizers processed with natural gas and groundwater pumped with natural gas (Vogeler 1981, 119). Ironically, since synthetic fibers are largely petroleum-derived, the rise in petroleum costs also improved the market position of cotton (Walter and Zentner 1975, 14). Figure 15 contains a map indicating Arizona's inflated 1974
Each • Represents 1,000 Planted Acres of *G. barbadense*

Each • Represents 1,000 Planted Acres of *G. hirsutum*

Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 15. Planted Cotton Acreage: 1974 | Map
cotton acreage. Arizona land under cotton, finally exhibiting the impact of the sharp rise in petroleum prices, declined below 300,000 acres in 1975. Demand exceeded supply; high cotton prices and the absence of restrictions generated a flurry of cotton production (Stiles 1980). Cotton in Arizona rebounded strongly and shot to nearly 560,000 acres in 1977.

The Food and Agricultural Act of 1977, in effect from 1978 through 1981, entirely eliminated acreage restrictions (Cunningham 1978, 7-9). Vogeler writes, "The Food and Agricultural Act of 1977 was designed, consequently, to provide stability once again for farm income in an uncertain market. The government would make 'deficiency' payments to farmers when the market prices for commodities fell below congressionally established 'target prices'" (Vogeler 1981, 185). High cotton prices, caused in part by sparse precipitation in the rain-fed cotton lands of eastern Texas, made the Arizona crop very profitable. Stiles reported, "... if ever there was a gambler's season in cotton, this was the one. This year the gamblers won big. So big that Arizona is producing more cotton than ever" (Stiles 1980). In 1981, cotton acreage in Arizona expanded to a level that, although not a record, represents the zenith of a fourth cotton boom - as depicted in the map in figure 16.

Payment-in-Kind

The high production of 1981 went to market in the midst of a recession and much of the crop went into the CCC loan, causing the surplus to expand considerably. In 1982, despite a 15 percent
Each • Represents 1,000 Planted Acres of G. barbadense

Each • Represents 1,000 Planted Acres of G. hirsutum

Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 16. Planted Cotton Acreage: 1981 | Map
acreage reduction and 21 percent voluntary cut in acreage, high yields and low prices generated an even higher surplus. A new farm program was implemented in 1981 but the deteriorating economic conditions forced a policy reversal with the new goal of cutting the nation’s cotton acreage in half and reducing the government surplus by direct payments and a "Payment-in-Kind" program. Under the PIK program, implemented in 1983, growers idled one of every three acres and received commodities from government surplus equal to what would have been produced on the idled acreage (Blanpied 1984, 15-16, 152; Sears 1983, 1).

The plan backfired utterly when it turned out that there was not a sufficient surplus of cotton available to meet the high demand created by widespread participation in the PIK program. The cotton held as collateral by the CCC was not available because it was still legally owned by individual producers that had not yet forfeited their loans. As a USDA official noted of the PIK cotton program - "We goofed, early on, we thought we had enough -- and found that we didn't" (cited in Blanpied 1984, 20). The USDA rectified the situation, after a fashion, by requiring cotton growers participating in the PIK program to take out price support loans on their 1983 crop which were to be allowed to spontaneously default, the growers would keep the money [having basically sold their cotton to the government] and the government used the acquired cotton to pay growers that enrolled in the PIK program, "These farmers grew the crops which they received as payment for not growing more" (Blanpied 1984, 19). As a consequence of heavy enrollment in the lucrative PIK program, cotton
acreage contracted to only about 320,000 acres in 1983, as indicated in the map in Figure 17.

Farm Programs in the Late 1980s

Over 80 percent of Arizona cotton growers enrolled in the 1985 cotton program which required them to idle 30 percent of their cotton lands, (Boice 1985). In 1986 there was near belt-wide participation in the *G. hirsutum* program. *G. hirsutum* growers were essentially strapped into a system where their planted acreage was not decided by them at all. They planted just enough to maintain their histories and receive their $50,000 maximum allowable payment per commodity per grower (Cavanaugh 1986).

During the late 1980s the most interesting development is the strong resurgence of *G. barbadense* because of the de-fossilization of *G. barbadense* allotments in 1984 and the development of the superior Pima S-6 cultivar. Growers who cut their *G. barbadense* acreage by 10 percent were eligible for benefits, but few growers enrolled in the program because of the favorable *G. barbadense* prices and the possibility of increasing their acreage base (UACA 1984).

The trend continued and 1986 was a "wildcat" planting year for *G. barbadense*. Many growers complied with the *G. hirsutum* program and grew *G. barbadense" wild," skirting the program to gamble on the favorable world market where they could make well over the $50,000 per farm in possible cotton program benefits. At the extreme, many growers planted as little *G. hirsutum* as needed for farm program compliance and as much *G. barbadense* as they possibly
Each • Represents 1,000 Planted Acres of G. barbadense

Each • Represents 1,000 Planted Acres of G. hirsutum

Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 17. Planted Cotton Acreage: 1983 | Map
could. Since the 1986 legislation lacked a cross-compliance clause for the cottons, growers planting "wild" *G. barbadense* did not risk losing the benefits accruing for their compliance in the *G. hirsutum* program. As an Eloy-area grower with 500 acres of *G. barbadense* in 1986, significantly more than his 125-acre base, remarked, "Pima [*G. barbadense*] is the only commodity that you can grow outside the program and still realize a profit" (cited in "The 'Other' Cotton" 1986, 28). Others were more cautious; A & H [Ms. Adler and Mr. Hancock] farms of Wenden in La Paz County planted within the program for both species because of high annual water costs of as much as $350 an acre ("The 'Other' Cotton" 1986, 31). By 1987, as a consequence of these economic and political factors, the *G. barbadense* acreage was expanded to a scale unmatched since the early 1940s; *G. hirsutum* acreage in Arizona declined until 1986, then recovered somewhat in 1987, as depicted in the map in Figure 18.

**The Dominance of Cotton Production in Arizona Agriculture**

Cotton has dominated Arizona's irrigated landscape for over seventy years. Figure 19 is a graph that compares planted cotton acreage to total irrigated acreage, indicating cotton's varying dominance in Arizona agriculture through time. Since cotton gained its foothold in 1917 the acreage under cotton in Arizona [at least for years with available data] has not fallen below 20 percent of the total irrigated acreage. The ratio of cotton to total acreage, incidentally, is roughly equivalent to the ratio of the amount of water used for cotton versus the amount of water used for all
Each • Represents 1,000 Planted Acres of G. barbadense

Each • Represents 1,000 Planted Acres of G. hirsutum

Source: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

Fig. 18. Planted Cotton Acreage: 1987 | Map
Sources: APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987 and Fig. 5

Fig. 19. Planted Cotton and Irrigated Acreage: 1913-1982 | Graph
agriculture - and thus essentially for all water uses. In other words, since 1917, the production of cotton has annually consumed between 20 and 50 percent of all of the water used in Arizona. The record of planted cotton acreage is moreover a very conservative indicator of the impact of the cotton production system on land and water use in Arizona. This is because additional land and/or water is used in the cotton production system but not directly for cotton production; land is fallowed and water is wasted, and water and land are used for other crops - alfalfa, grains - planted in rotation with cotton. Cotton production dominates Arizona's agricultural landscape, resulting in a cotton production region and rendering Arizona into a cotton state.

The primary reason for cotton's dominance continues to be the fact that cotton growers continue to decide to plant cotton. Yet the process of arriving at a cotton planting decision has undergone an intrinsic metamorphosis. As the cotton production system of Arizona became increasingly industrialized and 'scientific,' cotton planting decisions, and so variations in planted cotton acreage, generally became more and more dependent on factors extralimital to the basic cotton production system: variations in farm programs, variations in world supply and demand of cotton, and variations in production costs, particularly of petrochemicals. At the same time, variations in planted cotton acreage became less dependent on intrasystemic production factors, such as variations in the labor supply, variations in water availability, variations in the quality of available cottonseed, and indeed, variations in the actual - and
perhaps nonpecuniary - desire of growers to continue to plant cotton. This shift was accompanied by the evolution of Arizona's agribusiness system, which guides, as a "vegetable lamb" to the killing ground, the decision to plant cotton in Arizona.
CHAPTER 8

THE EVOLUTION OF ARIZONA'S COTTON AGribusiness System

Various agribusiness or proto-agribusiness entities - such as the Spanish missions and presidios, the U.S. army, Carl Hayden and his fellow grain traders, the boosters such as Chandler, Heard and Fowler, corporations such as the Goodyear and Tucson Farms, the Mormon merchants of Mesa, landlords and other suppliers of production inputs, and post-farm gate processors, particularly ginners - have been significant in Arizona agriculture for nearly three centuries. Agribusiness has dominated Arizona agriculture since the advent of commercial cotton production in 1912. The grip of agribusiness on Arizona agriculture tightened significantly with the rampant industrialization of the cotton production system that accompanied and followed the Second World War.

Each acre of cotton planted continues to be the result of someone deciding to plant an acre of cotton. Yet the cotton planting decisions are formed within an increasingly strict matrix of obligations and possibilities. The growers' decisions to plant cotton are increasingly foregone conclusions. The beneficiaries of this conclusion are increasingly not the cotton growers, with the exception of large and vertically integrated/diversified growers, but the suppliers of production inputs and processors and marketers of the crop, the entities that are backward- and forward-linked to the actual process of growing cotton plants. As the Arizona cotton
production region is the result of cotton planting decisions, and the process of making cotton planting decisions has really passed from the puppet growers to puppeteer agribusiness entities, the evolution of the cotton production region must be referenced within the context of the evolution of Arizona's cotton production agribusiness system. Every subsystem of the agrosystem has undergone changes which act to raise production costs and raise the non-farming sector's interests in the production of cotton in Arizona and tighten the vice that forces growers to continue to produce cotton.

Nested Systems of Colonial Domination

The colonial power structure of an agribusiness system bears an essential and intriguing resemblance to other social systems which agribusiness encompasses [interethnic and intergender] and which contain the agribusiness system: interregional, and international. The salient feature of a colonial system at any scale is that a colonized entity - the third world, the West, small and medium-sized producers, labor, or women - lack power and so have the value of their efforts exploited by a colonizing entity - men, management, the large growers and the sectors of the agribusiness system that are backward- and forward-linked to farming, management, the East, and the industrialized countries. After World War Two agribusinesses, along with other western capitalists, began to gain economic freedom from eastern capitalists. At the same time as the system of interregional colonialism was breaking down, empowering agribusiness, the agro-industrial complex tightened its grip on the farming sector.
In other words, right around World War Two agribusiness gained from above and below.

International colonialism is the standard. In the international division of labor, there is a group of countries — the "third world" or "less developed countries" — which remain as sources of labor and raw materials for the industrialized "more developed countries." The colonizers reap the benefits of the colonized sectors' wealth and the colonized are deprived of the capacity for self determination. This is the basic relationship at all scales of colonialism.

Even as the United States is generally a colonizing entity, there is an interregional colonial relationship within the country. The westward expansion of the United States was prompted generally by the interests of eastern capitalists — both of the agrarian Southeast, some of them cotton producers, and the industrial Northeast, some of them cotton processors (Barrera 1979, 18). Thus the settlement of the West was accomplished by a process of "economic colonialism" (Caughey 1974, 13-14; Nash 1973, 109; Smith 1986, 6; Wilson 1962, 5). Barrera (1979, 60) writes of the early 20th century West,

The pattern of regional specialization in agriculture and mineral extraction that had developed in the nineteenth century continued to characterize the area, with a definite lag in the development of industry when compared to the rest of the country. Since the southwest exports agricultural and mineral products to the rest of the country, and imports manufactured goods, some writers have referred to the economic pattern as 'regional colonialism.'

The colonial grip on the West has somewhat weakened over
time. According to Barrera (1979, 62) the period of very intense
interregional colonialism lasted until about 1930. Nash (1973, 6-7)
finds the break occurring right around World War Two:

In the course of the twentieth century, the development of
the West passed through at least two stages. Between 1898
and 1941 the relationship of the West to the East was not
unlike that of a young colony and its mother company. That
arrangement did not wholly cease by the time of World War II
but the conflict helped to transform the West so that in the
succeeding three decades the region became a pace-setter for
the nation.

Yet, according to Caughey (1959, 10), the interregional colonial
relationship in the late 1950s was by no means eliminated: "The
regional output . . . is predominantly extractive, and the West
continues to be the kind of colony that the mercantilists before Adam
Smith would have hailed as ideal." Wilson (1962, 5), however, does
note a general trend towards the economic and political empowerment
of Arizona in the early 1960s:

Like many of the underdeveloped lands which are trying to
outgrow colonial status both politically and economically, Arizona is attempting, with moderate success, to throw off
the yoke of economic colonialism. Too many decisions for Arizona have been made in New York or Washington, D.C.,
rather than in the state itself.

The primary thrust of this chapter deals with the evolution
of Arizona's 'colonial' agribusiness system of cotton production. As
presented by Vogeler (1981), agribusiness systems bear important
points of similarity to bona fide colonial systems. The colonizers
[backward- and forward-linked, non-growing, sectors] deprive the
colonized [small and medium sized farmers] of the capacity for self
determination and reap their wealth. At the historical pivot of the
Second World War the inter-sector colonialism of agribusiness
increased just as interregional colonialism decreased.

Within the agribusiness system there is yet another colonial relationship. The "colonial labor system," as defined and delineated by Barrera (1979), flourishes in the arid Southwest and works through such processes as occupational stratification and a dual wage structure. In this relationship, politically, economically, and/or socially powerless laborers generally play the colonized to a powerful management's colonizer. The parade of people that have picked cotton in Arizona - Indians, Mexicans, African-Americans, Puerto Ricans, Filipinos, Okies, Chicanos, evacuees, POWs, housewives, and high school students - bear one main point of commonality. Cultural circumstances, either serendipitously for management or manipulated by management, rendered them powerless enough to make the miserable job of picking cotton an attractive employment option.

The colonial labor system declined in importance within the Arizona cotton agribusiness system as the harvest was mechanized, roughly between 1950 and 1965. Of course, the exploitation of labor remains status quo for non-mechanized crops in Arizona. With the mechanization of the harvest, growers lost power over the one sector of the production system which they could formerly control and manipulate. The growers fell simultaneously further under the 'colonial' power of backward-linked implement and fuel suppliers. The decline of the colonial labor system was thus accompanied by an increase in the strength and complexity of the system of agribusiness colonialism.
Finally, within farm and farm labor families, women are generally the 'colonized' to the men's 'colonizers.' In the old cotton belt South, according to Case (1929, 339-40) "Many a cotton farmer's wife makes a regular 'hand' in the field during the planting and chopping season and again during the picking season, going to the house an hour or so early at noon and in the evening to get the meal ready." In other words, women work harder and thus subsidize the operation of the farming family. The same is so for farm labor families; according to Dobyns (1950, 55, 69), women in Tohono O'odham cotton picking families generally picked less cotton than their husbands, yet they in fact worked harder because of the large amount of time taken up by reproductive tasks that keep the family system operable. These tasks include cooking and cleaning which were made all the more difficult because of the poor quality of cooking and cleaning facilitates in the cotton labor camps.

Lopping off the 'top' and 'bottom' colonial systems and retaining the central three for discussion, the interregional colonial system and the colonial labor system both deteriorated between 1945 and 1965. This twin systemic deterioration was very important to the quantum evolution of Arizona's agribusiness system during this period.

The Hearth of Agribusiness

The agribusiness hearth of origin is in the western United States. Nash (1973, 299) writes,

The peculiar form of highly mechanized large-scale commercial agriculture that developed in the twentieth-century West set
the pace for farmers everywhere in the U.S. if not, indeed, throughout the world. . . . Carey McWilliams aptly termed western farms as 'factories in the fields.' The creation of big agriculture in America, for better or for worse, was a distinct western contribution.

Western agrosystems tend to be more capital intensive than elsewhere in the country. As Vogeler (1981, 264) writes, "The penetration of capital in the form of industrial processes and labor relations into agriculture is much more advanced in California and in the irrigated West in general than . . . in most of the rest of the United States."

The agribusiness tradition in Arizona has deep roots. The Pima Indian wheat farmers in the 19th century were locked into a colonial agribusiness system, dominated by and working to the advantage of agribusiness men like Charles Hayden.

Perhaps the most distinctive factor of western agrosystems is that they are irrigated. According to Worster (1984b, 60):

Wherever intensive, large-scale irrigation has appeared, farming has quickly become a factory operation, mass producing for a mass-consuming market. Since at least the 1930s, the irrigated farms of the Southwest and the West Coast have led the nation in adopting the industrial mode, and they have forced farmers elsewhere to keep pace or drop out. Irrigation farming is expensive, requiring large amounts of capital investment; where there is no subsidy, only a small number of farmers can afford it. Once agriculture has started down that industrial road, it is not easy to stop: water works are followed by pesticides, chemical fertilizers, armies of stoop-and-pick laborers, and a high degree of mechanization.

The largest, most capital intensive and highly mechanized farms are in the southwestern United States, although not all southwestern farms are large, capital intensive, and highly mechanized (Gregor 1979). Those in the heart of the Arizona cotton
production region generally are. Wendell Berry (1981, 63) observed cotton production districts of Arizona's lower Santa Cruz Oasis and commented:

This is modern industrial farming in its purest form: enormous, costly fields, dependent for their productivity on large machines, fossil fuels, chemical fertilizers, insecticides, and herbicides. Precarious as these dependencies are anywhere, in Arizona (as in the Southwest generally) another even more critical dependency is added: fossil water.

Nearly every sector and facet of the agribusiness system underwent a revolutionary change in the years during and following the Second World War; "beginning in World War II, there occurred a technological revolution in farming, characterized by heavily increased use of machinery, fertilizers and scientific methods, greater specialization in one crop, concentration of production in larger units, and sharply increased productivity" (Blanpied 1984, 112).

In Arizona, cotton farms grew larger as small and medium-sized producers were squeezed out of the picture. Cotton yields per acre skyrocketed, changing the relationship between an acre of planted cotton and other elements of the system. In addition, the rising yields were accompanied by significant boosts in the utilization of other inputs, particularly water and chemical fertilizers. As water tables fell and energy prices soared the cost of irrigation rose sharply. Land prices - due to speculation and competition - also soared. As growers adopted the whole palette of agricultural chemicals - pesticides, fertilizers, herbicides, and defoliants - they encountered substantial additional costs. Harvest
mechanization and attendant changes in ginning technologies also raised costs, as well as further transferring power away from the growers. The ultimate consequence is a quantum shift in power away from the growers and to the backward-linked suppliers and the forward-linked processors of Arizona's cotton production system. The growers still make the planting decisions, but these growers are now generally either agribusinessmen themselves - as those with very large operations - or they are so intrinsically locked into the agribusiness system that they are essentially employees of agribusiness.

Cotton Farms

According to Vogeler's *The Myth of the Family Farm: Agribusiness Dominance of U.S. Agriculture* (1981) small and medium-sized growers are generally victimized by the agribusiness complex; large growers, however, are closely linked into the system and enjoy its benefits along with the other non-farming sectors. While farming is archtypically and traditionally a way of life and a way of living, the function of a typical Arizona cotton farm is simply to convert an assortment of inputs into a saleable crop in the most economic fashion possible. Farming is generally an economic activity. The differences between a small family farm and a large agribusiness farm are of scale, strategies, and ethics.

Thomas Kearney and William Peterson (1908, 57) actually preferred that the cotton be grown in two to five acre patches on small, diversely cropped family farms, so the crop could be
cultivated and harvested by the farm families. Arizona's first cotton boom, however, brought farms as large as 2,000 acres (McWilliams 1944, 74; Woehlke 1921, 23). Cotton producers in 1920 were caught "between a rock and a hard place." This idiomatic phrase means to be on the brink of bankruptcy and probably originated, according to Hendrickson (1986, 216-17) "... in Arizona during a financial panic early in this century." Chances are good that it was coined by a Salt Oasis cotton producer in 1920. Much of the boom land in 1920 was unsuitable or ill-prepared for cotton farming. The combination of falling cotton prices, falling cotton yields, and heavily mortgaged, very expensive, farmland caused a cycle of farm failure and amalgamation so that between 1920 and 1925 Arizona's farm population dropped by 25 percent (Davis 1958, 7; McGowan 1961, 89-90).

Depression-era economics furthered the process of farmland consolidation. Rural Arizona, having recently shifted from a diversified subsistence and commercial agrosystem to a dependence on a cash crop, suffered greatly from the great depression. This led to another cycle of farm failure and consolidation. Here is Smith's (1933, 132-33) description of the effect of the depression on Arizona's cotton growing districts:

The realization that indebtedness was mounting, that their equity in the land had disappeared and personal assets, such as livestock and farm equipment, were fading away, with living standards reduced to low levels, has weakened the morale of the farmers. In hundreds of cases they have given up and abandoned their farms. In some cases they remain because there is no place for them to go. Others remain, hoping for some sort of miracle which will save to them their farms.
The consequence was a continuation of the trend towards large holdings worked by hired labor. Of a sample of 181 tenant farmers in 1929, only 36 percent were still farmers in 1936; 35 percent had become wage laborers (Tetreau 1938b, 181). In the mid 1930s Arizona led the nation in the percentage of farms reporting more than 10 farmhands, 2.4 percent, the next highest was California with 1.3 of its farms employing 10 or more farmhands, while the national average was .2 percent (Tetreau 1940a, 203).

There were some small cotton farms in Arizona. Those within the Salt River Project were kept within the 160 acre limitation and a little cotton was grown by African-American and Chicano tenant farmers on 10 to 20 acre plots, but by the late 1930s Arizona cotton farms were mostly large-scale operations. Almost one half of Arizona's 1937 cotton crop was grown on only a few farms of 1,000 acres and larger. Half of Pima county's cotton was planted on two farms, one of which was previously a whole development district of small farms [I believe the old Tucson Farms development] that went bankrupt during the depression (Brown and Cassmore 1939, 52; McWilliams 1944, 75). In a 1939 survey of the Casa Grande area, 419 farmers controlled a total of 132,000 acres. Sixty percent of the producers controlled less than 210 acres each and 66 percent of the land was in farms of 430 acres or more. Although federal reclamation laws limited land purchases in the San Carlos Project to 160 acres, they did not prevent the subsequent transfer of ownership. Transfers allowed Project area farms to increase somewhat in size, yet farms in the pumplands remained significantly larger. Project farms ranged
generally between 100 and 200 acres, while farms in the pumplands were between 320 and 640 acres (Greisinger and Barr 1941, 284-88).

In the early 1940s one half of the state’s cropland, mostly in Maricopa and Pinal Counties, was farmed in units of 380 acres or larger. Arizona’s 20,150 farm operators in this year were 40 percent Indians and 60 percent non-Indians, who controlled about 90 percent of the total cropland (Barr 1942, 372). In 1946 the total number of farm and ranch units in Arizona had dropped to 18,000, the number of Indian farmers remained the same as in 1942, 8,000; the number of non-Indians, however, had dropped over 16 percent to 10,000 in 1946. About 75 percent of Arizona’s irrigated farms in 1946 were operator-owned. Part-owner farms, where some of the land is leased and some owned, tended to be larger than owner-operated farms. Professionally managed farms tended to be the largest (Barr 1946b, 13-14). Large-scale cotton growers had the advantage of economies of scale and helped cause the demise of the few small cotton farms in the state: “Placed in competition with the large-scale operators, the small cotton farmer is at a hopeless disadvantage” (McWilliams 1944, 74).

Tractorization was an important factor in the growth of Arizona cotton farms. In Arizona, as in the southeast, the tractor diffused more readily to the larger cotton farms (Musoke 1981, 362; Thompson 1941, 257). As Mr. Llewellyn, the wealthy owner-operator in Scarborough's novel, comments, "I can use tractors and machinery that a small farmer couldn't afford" (Scarborough 1936, 167). Pima Indian farmers, with small allotments and little capital to invest in tractors, were put at a disadvantage by tractorization (Hackenberg
1955, 70). In addition, tractorization encouraged and allowed the expansion of farm size (Coleman-Cooke 1965, 25; Darnton 1940).

Arizona cotton farms began to grow sharply in size around 1930 when tractors allowed single growers with hired labor to operate larger farms (UAAES 1932b, 19). According to the WPA (1940, 85) guide to Arizona:

Machine farming has been adopted widely in Arizona, and this has an inevitable effect of increasing the size of the farm unit and decreasing the number of owner-operators. To farm most efficiently, a farmer must have tractors and other expensive equipment. Once he has acquired such equipment, he naturally wants to expand his acreage sufficiently to keep it busy and reduce his overhead; so he is in the market to buy or lease more ground.

In the late 1940s a cotton farm needed from 35 to 50 acres under cotton to profit from tractorization (Fite 1984, 188). Non-tractorized small farms had some of the same sunk costs as tractorized large farms, principally the farm buildings (McWilliams 1944, 74-75). Thus there were certain economies of scale to be gained from the increase in farm size allowed by tractorization. In Arizona and throughout the rest of the cotton belt, tractors generally helped accelerate the replacement of small tenant, share-cropped, and owner-farmed operations with large-scale industrialized farms worked by wage labor (Darnton 1940).

Like tractors, mechanical pickers are large investments and need to be operated at capacity for economically efficient operation. Thus their ownership by individual growers dictates large farms (Street 1957, 246). The seasonal capacity of the early mechanical cotton pickers was between 200 and 250 acres (Barr 1951,
3, 7). This imposed an acreage threshold for the adoption of mechanical pickers. In Arizona machine picking was more profitable on large farms of over 100 acres, and hand picking on smaller farms (Al-Sharkarji 1954, 42). Larger farms also offered longer runs of employment for human cotton pickers and were thus at a competitive advantage for labor. Many Arizona growers who purchased cotton picking machinery during the boom years of the early 1950s found themselves very seriously over-tooled when restrictions were imposed in 1954 (Vanvig and St. Clair 1954, 13-15).

As farms grew in size and decreased in number the tendency towards specialization in cotton production by large farms continued. In the Casa Grande area in 1939 the percentage of land under cotton generally increased and the percentage of alfalfa land decreased with larger farms. Farms of 1,710 acres and larger had, on the average, 73 percent of the land under cotton and 14 percent under alfalfa. Middle-sized farms [210–1,709 acres] were 63 percent cotton and 26 percent alfalfa. Small farms, under 209 acres, were about 51 percent cotton and 37 percent alfalfa (Greisinger and Barr 1941, 284–88). More than one-half of Arizona's 1955 cotton crop was produced on large farms averaging 417 acre of cotton (Barr 1956, 1). Cropping specialization became the norm because of new and expensive

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1. A grower in the Southeast in 1949 needed 100 acres of cotton or more to justify the purchase of a mechanical picker (Fite 1984, 188). Cotton growers in California's central valley in the 1950s needed from 150 to 200 acres of cotton for economic ownership of a mechanical picker (Street 1957, 227).
crop-specific technologies such as mechanical cotton pickers, and the specialized managerial skills required for 'scientific farming.' The total number of U.S. farms harvesting cotton plunged from 1.2 million in 1944 to slightly more than half a million in 1959 (Blanpied 1984, 114-15).

The average *G. hirsutum* cotton grower in Arizona in the late 1940s had about 172 acres of cotton, compared with an average of about 63 acres in the late 1930s. In 1949 there were 2,033 cotton farms in Arizona. About 32 percent of them were in Maricopa County, and another 32 percent in Pinal County, 17 percent were in Graham County, and the remaining 19 percent were scattered mostly in Yuma, Pima, and Cochise Counties (Barr 1950, 6). The total number of farms in Arizona dropped by 70 percent between 1950 and 1960 and the size increased by 50 percent. Twenty percent of Arizona farms in 1960 had 1,000 or more acres, as compared with only 13 percent in 1950 (UAAES 1962, 5-6).

There were in 1965 about 1,500 farms in Arizona with *G. barbadense* allotments totaling about 40,000 acres and almost 3,600 farms with *G. hirsutum* allotments totaling about 332,000 acres (UAAES 1966, 10). As I have mentioned, the Food and Agricultural Act of 1965 allowed that *G. hirsutum* allotments could be bought, sold, leased, and with restrictions moved across county lines, and starting in 1966 there were a considerable number of allotment transfers and transactions (UAAES 1966, 9; 1967, 13-14; 1968, 5-7; 1969, 6-7; Weber 1972, 36). This allowed small cotton farms to be amalgamated so that between 1965 and 1969 the number of farms in Arizona producing *G.*
hirsutum dropped by half (UAAES 1970, 11).

With the post-war agribusiness revolution Arizona growers had among the highest average net farm incomes in the United States (Nash 1973, 242). For the period from 1958 through 1962 the net annual income per farm in Arizona was $17,475, compared to $3,196 for the country, $9,127 for California, and $4,256 for Iowa (UAAES 1964, 10). Arizona producers in the late 1960s enjoyed the highest gross and net income per farm in the country, and ranked fifth in the nation in average cotton receipts (ASES 1970, 4).

Apologists for farm policies that encourage large-scale farms to the detriment of small family farms argue that large farm operations offer an opportunity for the more efficient overall utilization of valuable resources such as water and land. There are diminishing returns to the advantages of larger operations since economies of scale - savings garnered from larger operations - tend to diminish sharply after a point. The average cotton farm in the United States has about 1,019 acres of cotton. For cotton farms nationwide, 90 percent of the possible savings are captured by farms of 395 acres. To capture all of the possible savings requires a cotton farm of 970 acres (Bergland et al. 1981, 57-9). Indeed, according to Vogeler (1981, 90-92), efficiency of all resource use tends to decline with very large operations. At a point, the diminishing returns per unit of some inputs actually dip downwards for very large operations which are actually less efficient than smaller operations. Nationwide, operations with gross incomes over $30,000 and farms with gross sales of over $40,000 are actually the
least efficient per acre. Smaller operators have a smaller margin of error and simply have to try harder than large operators in order to compete and survive.

Large-scale producers tend to be motivated solely by profit. Family farmers might additionally be motivated by nonpecuniary incentives such as a cultural or personal preference for a certain crop or technology, the desire to be surrounded by an attractive landscape, the desire to create a wholesome environment for raising children, and the desire to maintain the quality of the soil and assure other vital resources for future generations. Second, large-scale farming is such a complex undertaking that management decisions are beyond the ability of any single individual. Third, large-scale producers have greater access to capital which allows them to purchase capital-intensive technologies and expand their farms. Fourth, the managerial complexity and heavy dependence on capital requires that large-scale producers simplify the operation and reduce the risks of income variations (Vogeler 1981, 134). In Arizona this often means planting cotton, the agribusiness crop of choice.

Cotton Breeding Developments and the Yield Per Acre

The new cultivars, along with increased use of fertilizer and irrigation water and other factors, dramatically increased the yield per acre of cotton. With the new hybrid cultivars the growers became dependent on backward-linked seed producers, an industry that is controlled by only a few firms that hold oligopoly power over
Yields for all crops are generally highest in the irrigated arid lands (Grigg 1970, 177). Arizona growers have for many years led the planet in average per-acre cotton yields (Barr 1950, 5-6; 1951, 5-6; 1955, 5-6; 1956, 5; 1957, 6-7; Barr and Seltzer 1952, 6; 1953, 5; "King Cotton Retains Role as Top Crop" 1954; Seltzer 1958, 6; Stiles 1980; UAAES 1963, 16). The yield of both species of cotton in Arizona generally and steadily increased over the years. \textit{G. hirsutum} yields, however, gained much faster than \textit{G. barbadense} yields (Hathorn 1951, 27-29). Besides the new cultivars that made the high yields possible, there were several factors responsible for this revolution in yields: favorable weather, cropland leveling and the better distribution of irrigation water, chemical insect control; fertilizers, improved cultural practices, the use of more water per acre, the shifting of cultivation to the more productive lands in restricted years, and the desire to maximize the yield per allotted acre (Al-Sharkarji 1954, 1; Barr 1950, 5-6; 1951, 5-6; 1955, 5; Hathorn 1951, 27-29). As Vogeler (1981, 163) writes, "farmers can collect money for taking land out of production, they increase the yield on the acreage they do use, and collect at least the support price from the government on all that they raise." Arizona growers turned in all-time world record yields for both species in 1987; averages were 1,410 pounds of \textit{G. hirsutum} lint per acre and 1,126 pounds of \textit{G. barbadense} lint per acre (ACLRS 1988, 10).

The increases in yields were in terms of unit amount of land, while the utilization of resources other than land accelerated. As
Dobyns (1950, 11) writes of the 1950 season, "by mining their soil of essential nutrients and robbing the state's shrinking underground water reserves, Arizona's cotton farmers produced 87 percent of their previous year's crop on only 69 percent of the acreage." The dramatic increases in yield per acre changed the relationship between planted cotton acreage and other elements of the agrosystem.

**Water Costs**

The water duty of cotton - the amount of water annually used per planted acre - rose in Arizona at the same time as water costs rose because of falling water tables and rising energy costs.

**Water Duty**

Previous to the Second World War *G. hirsutum* growers in Arizona used about 3 af of water per acre per year, while *G. barbadense*, because of the longer growing season, had an average water duty of about 3.5 af. Rotating cotton with alfalfa greatly increases the efficiency of irrigation water. For example, *G. barbadense* planted on lands previously cropped to alfalfa in the Salt Oasis had a water duty of only 2.25 to 2.5 af; however soil exhaustion from monocropping resulted in cotton growers applying as much as 4 af annually to these lands (UAAES 1928, 11; 1932b, 9; Brown 1929, 3-4). Monocropping and the profligate diffusion of high-yielding cultivars and fertilizers resulted in a dramatic increase in the water duty of cotton. Commercial fertilizers generally replaced crop rotation as the primary method of maintaining soil fertility. The decreased alfalfa acreage caused an increase in
the water duty of cotton and the increased yields allowed by commercial fertilizers also forced an increase in the water duty of cotton (Goldschmidt 1959, 30; Tucker and Tucker 1968, 201-3). In 1954 recommendations in Arizona were for 3.5 af of water to produce an acre of *G. hirsutum*; in 1955 the water duty was stated as 4 af (Barr 1955, 7; 1956, 6), and by 1962, Arizona growers annually used an average of 5 af on each acre of *G. hirsutum* (UAAES 1963, 18).

The Cost of Pumping Groundwater

The primary source of energy for pumping groundwater until the adoption of natural gas in the 1940s was hydroelectric power from the Salt River and other reclamation projects. In 1917 the responsibility for the operation and maintenance of the Salt River Project shifted from the Bureau of Reclamation to the Salt River Valley Water User's Association (Comeaux 1981, 246; Thompson 1986, 23), and the association became "... one of the most substantial farmers' organizations in the United States" (Collins 1918, 67). The Association operated through proportionate share voting, each acre of land pledged represented a share in the association and thus one vote. Growers were the majority landholders and controlled the voting. Thus they could pack the project board, which determined the prices of both water and electricity. Growers in the Salt River Project were able to manipulate the price situation so that the revenues from sales of electricity subsidized water costs; non-agricultural patrons of the Project, who used little water and comparatively much electricity, were made to underwrite the
irrigation costs of the farmers. The sale of power still dominates Project revenues; in 1977 over 305 million dollars were taken in from power sales but only 5.4 million dollars from water. Project water continues to be very cheap; in 1978 the cost of water was $5 for the first 2 af; and, when available, $15 for the third and $16 for the fourth and fifth (Comeaux 1981, 247-49).

Thus when growers turned to groundwater they found the electricity costs for pumping water to be quite high. Natural gas is generally a much cheaper fuel than electricity, although electric motors are much less expensive than gas motors to purchase and maintain (Frederick 1982, 147-48; Rehnberg 1953, 9-10). In 1946 it cost electricity users about 13 cents for each foot of lift to deliver water to an acre of cotton (Barr 1946a, 3). By comparison, in 1949 it annually cost gas-users only 7 to 10 cents for each foot of lift to irrigate a cotton acre (Barr 1949, 4-5). The water outlook for an area was an important factor in deciding pump power. Electric pumps, which cost less to purchase and more to operate than gas pumps, were judged the best economic choice if the resiliency of the local aquifer was questionable, as in the Bouse-Hope-Wenden pumplands. However, there was in reality a tendency for gas powered wells to be located in the areas with higher pump lifts (Rehnberg 1953, 12, 21).

There was a significant difference between the rate policies of the electric and gas companies. Most of the gas was provided by a single company at a rate graduated by monthly consumption and volume users received a significant savings. Although some users received a
graduated rate for electricity purchases, most electricity was sold at a straight rate per kilowatt hour, giving no advantage to volume users as gas did (Rehnberg 1953, 9). The diffusion of natural gas technologies contributed to the growth of cotton farms, in addition natural gas was more readily adopted by large-scale growers. Possibly because of competition from gas companies, electric rates for groundwater pumping were lowered for 1951 and producers who operated their pumps full-time received quantity discounts (Barr 1951, 4).

Growing concerns about the rising water costs because of the falling water table were overshadowed after 1973 by the spectre of skyrocketing energy costs that stood to make pumping uneconomic. The price of natural gas increased about 4 times between 1970 and 1982. Despite this, natural gas continues to be the cheapest available source of energy for pumping groundwater (Frederick 1982, 138-47), since electrical energy prices for pumping groundwater also increased dramatically after 1974, more than doubling by 1976 (Carr 1977, 24-26). Table 5 indicates past and projected future energy costs for pumping groundwater:

**TABLE 5**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>$3.43</td>
<td>$13.86</td>
<td>$27.72</td>
</tr>
<tr>
<td>Electricity</td>
<td>$22.55</td>
<td>$26.64</td>
<td>$53.28</td>
</tr>
</tbody>
</table>

Source: (Frederick 1982, 144-45).
The declining water table combined with the rising energy prices to significantly boost water costs; for example one Cochise County cotton grower had yearly water bills that increased from $300 in 1972 to $3,500 in 1985 ("Cochise County Farms" 1985).

**Land Costs**

The costs of land also increased substantially over the years. For a long time the value of farmland in Arizona was pegged to the value of agricultural production. In the 1940s and 1950s speculation and competition from non-agricultural land users began to drive land values above their agricultural worth.

Arizona's privately held "wild lands" in 1888 were selling for $5 to $10 per acre and improved farmland sold for between $15 to $40 per acre (Bancroft 1962, 596). Due to the acceleration of Arizona's agricultural development there was a general increase in the sale price of Arizona farmland. For example, with the development of nearby mining towns which provided markets for farm produce, farmland in the upper Gila that sold for $25 to $30 an acre in 1890 brought $50 to $100 an acre in 1900 (Williams 1937, 57-58).

Salt Oasis farmland in 1900 was valued at about $30 an acre and the completion of the Salt River Project brought land prices to about $100 an acre (Barrows 1913, 284). This land sold for $150 to $350 an acre by 1918 (Robinson 1919, 304) and during the 1919 boom year Salt Oasis cotton lands sold generally for $350 to $500 an acre with some sales at $600 an acre (Barr 1944, 4; Woehlke 1921, 22). After dipping deeply during the depression, farm and ranch land
prices in Arizona rose rapidly during and following the Second World War (Barr 1946b, 16, 28). In the early 1930s, Salt River Project farm land generally sold for $100 an acre. By 1943, much of this land sold at $250 to $300 an acre or more (Barr 1944, 4).

According to Barr (1945, 3-4; 1951, 2; 1955, 3) from the mid-1920s to about 1955 the price of an acre of farmland in the Salt Oasis was pegged "rather definitely" to the amount of gross revenue expected to be produced from that acre. However, beginning in the early 1940s an additional factor in the rise of farmland prices was a growing trend towards land as an investment (Barr 1944, 4). This was joined in the mid-1950s by the increasing demand for recreational and residential land. Hence returns to agricultural producers became increasingly insufficient to justify land costs (Barr 1956, 3). The value of Arizona farmland continued to climb through the 1960s (Arizona Academy 1967, 12). The value of farmland inflated above its agricultural worth - due to speculation and competition from non-agricultural users - through the years and contributed mightily to the "cost-price squeeze." Rising land values during the 1970s supported a flurry of mortgaging for farm expansion. With the 1980s "farm crisis," land values began to fall off as many farms failed and farmland glutted the market (Blanpied 1984, 153; Fite 1984, 226; Galston 1985, 54).

**Agricultural Chemical Costs**

With the agricultural chemical revolution, yields rose, but so did production costs, so much of the extra capital generated went
to the chemical companies, mostly for pesticides and fertilizers (Barr 1951, 7). Indeed, cotton growers use more pesticides than anyone. During the 1960s and 1970s about half of all of the pesticides used in the United States were applied to cotton fields (Atkins 1978, 446; Brown 1974, 16; Metcalf 1980, 221; Newsom and Brazzel 1968, 377; Smith and Reynolds 1972, 390).

Many factors contributed to the increase in chemical costs of cotton production: the pesticide treadmill with its increasing demands for pesticides, general inflation, the increasingly complex chemical input, the new high yielding cultivars that require substantial fertilizer applications, the mechanization of the cotton harvest that requires the application of herbicides and defoliants, increased development costs because of new regulations and the steep rise in petroleum prices in the early 1970s. Table six indicates the rapid expansion of agricultural chemical costs per acre of cotton in Arizona from 1945 to 1962.

The rise in chemical costs was influenced by the increasing costs of pesticide development and the steep rise in petroleum costs in the early 1970s. In the race against pest resistance, pesticides have become increasingly complex to synthesize. DDT and other early chemicals are produced by a very cheap one step process. Later chemicals required more steps with concurrent cost increases. The synthetic pyrethroid allethrin, for example, is produced by a 13 step synthesis and costs $40.50 per pound. Also, because of the increasing awareness of ecological degradation, the screening costs for new pesticides rose dramatically. In 1956 an average of 1,800
TABLE 6  

Costs of Agricultural Chemicals

<table>
<thead>
<tr>
<th>Year</th>
<th>Pesticides</th>
<th>Fertilizers</th>
<th>Herbicides</th>
<th>Defoliants</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1945</td>
<td>$4.00</td>
<td></td>
<td></td>
<td></td>
<td>$4.00</td>
</tr>
<tr>
<td>1951</td>
<td>$11.00</td>
<td>$12.00</td>
<td></td>
<td></td>
<td>$23.00</td>
</tr>
<tr>
<td>1958</td>
<td>$16.00</td>
<td>$21.50</td>
<td></td>
<td></td>
<td>$37.50</td>
</tr>
<tr>
<td>1962</td>
<td>$22.60</td>
<td>$25.25</td>
<td>$6.65</td>
<td>$5.60</td>
<td>$60.10</td>
</tr>
</tbody>
</table>

Sources: (Barr 1943, 8; 1946, 10; Barr and Seltzer 1952, 8; Seltzer 1958, 9; UAAES 1962, 15).

1. The data for 1945 and 1951 represent recommendations, however beginning in 1958 the tables for cotton production costs and returns in Arizona included the following disclaimer: "The amounts of fertilizer and insecticide shown are not necessarily recommendations by the University, but rather are estimates of average amounts actually used by Arizona farmers" (Seltzer 1958, 9).
carefully, lest the costs exceed the benefits (Price 1976, 12-14).

Only a few companies, closely linked to the petroleum industry, control agricultural chemical production and wield oligopoly power over cotton producers. This is particularly so with the chemical fertilizer industry, as Vogeler (1981, 110) writes:

The nitrogen fertilizer industry, using natural gas as its most important raw material, ... tends to be concentrated in the hands of a few large producers, and most of the large producers are either oil companies or have energy interests. In 1977, the eight largest producers controlled 41 percent of the production capacity for anhydrous ammonia. This oligopolistic control has allowed agribusiness firms to increase the price of this product beyond the increased costs of energy, and the profits have been extracted from farmers. Between 1970 and 1974, the cost of energy used in ammonia production increased by 49 percent while the cost of fertilizer went up 141 percent. Ammonia producers were receiving investment returns of 30 to 65 percent during 1973-1974 while the average U.S. industry received 11 percent and farmers received 4 percent.

Cotton producers are now locked into a system that requires the use of agricultural chemicals, the primary beneficiaries are the businesses that manufacture and supply the agricultural chemicals.

**Cotton Harvest Systems**

With a hand harvest the growers had power over one element of the system, labor. Management set its own labor costs and much of the capital expended to pay pickers was distributed back into the local economic system. With harvest mechanization the growers lost their power over the harvest element as they themselves fell under the oligopoly power of the machinery and fuel suppliers and related businesses. These backward-linked entities set harvest costs and very little of the capital expended on the harvest is now locally
distributed. The mechanization of the harvest added an enormous commitment to continue to grow cotton, particularly because of the crop-specificity of the expensive harvest technology.

Labor Supply Systems

Before the mechanization of the harvest there was a dominant goal was to have as many cotton pickers in Arizona as possible at harvest time so as to be able to fix wages and keep harvest costs down. The labor system worked by manipulating situations of existing poverty and government policy to consistently and generally deliver a steady and sure stream of labor for the cotton harvest in Arizona. Agribusiness entities have always had an interest in delivering a steady stream of labor for the Arizona cotton harvest. These aspects of the colonial labor system in Arizona cotton production – the dominance of management over labor and the interests of non-farming entities in the availability of cotton harvest labor – are amply illustrated in an examination of the place of Mexicans, African-Americans, Okies, POWs and "extraordinary labor" in Arizona's historic cotton agribusiness system.

**Mexicans.** By 1917, the same war that caused the expansion of cotton in Arizona also led to a shortage of cotton pickers. Collins (1918, 35-36) reported, "In all likelihood the labor problem will remain one of the serious problems connected with cotton culture in the Salt River Valley." In response to requests from agribusiness interests, such as Goodyear (Parker 1917, 14), Mexicans were rendered exempt from bans that had been enforced against alien laborers in the
United States. Most of Arizona’s 1917 crop was harvested by 2,500 Mexican cotton pickers (Brown and Cassmore 1939, 4, 64; McWilliams 1944, 73).

The intentional stranding of Mexicans was very important to the vitality of the Arizona cotton industry. About 35,000 cotton pickers were brought to Arizona from Mexico between 1918 and 1920. The pickers were transported to Arizona but were to pay for their own return passage to Mexico. By and large, however, the cotton growers defaulted and the pickers were stranded in Arizona. Of the 13,093 Mexicans that were brought into Arizona for farm work in 1919, nearly 65 percent were not paid for their labor. Even more were stranded in 1920; many growers went broke after the debacle of 1920; others intentionally withheld payment in order to strand the Mexicans in Arizona so as to diminish future recruitment costs and keep wages low. The scene was repeated every fall throughout the 1920s, with an annual average of 6,000 Mexicans stranded in Arizona (Barrera 1979, 72; Brown and Cassmore 1939, 64-65; McWilliams 1944, 73-78; Miguélez 1986, 209; Sheridan 1986b, 209).

As I mentioned in Chapter 5, the Mexican labor flow was reinstated as an emergency measure in 1942 and codified in 1951 with Public Law 78, an executive agreement between the United States and the Republic of Mexico enacted in response to the labor demands from the high cotton production. By the terms of P.L. 78 the braceros were a supplementary labor force brought in to prevent crop losses when the local supply was insufficient (ASES 1954, 21). Technically, producers were not eligible for the bracero program unless they were
experiencing actual labor shortages, yet they were able to fix wages at a low enough rate to discourage domestic workers and so deliberately create the labor shortages necessary to make them eligible for the bracero program (Barrera 1979, 118). According to Moore (1965, 97), "Subtle schemes have been worked out to get rid of domestic workers when their presence threatens to discount a 'labor shortage'."

**African-Americans.** The interaction between social and agribusiness systems is exemplified by the racist complex revolving around the association of African-Americans and cotton picking. Racism, and the association of cotton with African-Americans, might have been an inhibiting factor in the westward diffusion of cotton production. Although there is no direct evidence for this in Arizona, there is for the Texas High Plains and California's Central Valley. The rise of cotton culture in Arizona was in fact accompanied by a sharp rise in the African-American population of the state. The racist reaction to this was the rise of the Ku Klux Klan in Arizona.

Essential to this phenomenon is the equation in a bigoted mentality that connects African-Americans with cotton. For example, Fort Huachuca, in southern Arizona, was a training base for

1. Among loggers in the Pacific northwestern U.S., "cotton picker" is a slang term for African-American; in the western U.S. generally, "cotton picker" means rube; in California "cotton picker" signifies any Texan; among cattle workers of west Texas, "cotton picker" refers to someone from east Texas (Cassidy 1985, 796).
segregated regiments of African-American soldiers during the Second World War (Comeaux 1981, 126). In 1942, a very labor critical year, one Arizona cotton producer took these soldiers for granted as an available pool of cotton pickers, and alternative to the Japanese-American evacuee pickers: "Fortunately, right here in the state are large numbers of colored soldiers, boys who were raised in the cotton fields down south. They know how to pick cotton, like to do it, and would rather be in the sunny fields of Arizona than on guard duty" (cited in Caruso, 1973, 340). A graphic example of occupational stratification is found in figure 20, a photocopy of a map included with Goodyear Farms' official 1953 history, showing the Wigwam resort and its environs (Goodyear 1953, 38). Cotton pickers and shepherds are dark-complexioned. Golf pros and caddies,

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1. Cotton picking is neither fun nor easy. In addition to the dexterity necessary to remove the boll with a minimum of trash, picking cotton is physically damaging and punishing, particularly because of lacerations and puncture wounds by the very sharp cotton bracts to the area of skin directly behind the fingernail. By the picking season's end, cotton picking fingers are usually seriously infected (Mary Bell Clark 1986, personal communication).

2. The Wigwam resort, first established for the use of Goodyear executives, was opened to the general public in 1929 and became a very popular guest ranch (Smith 1948, 90-2). The epithet attached to the Hassayampa dates from prospecting days when this was an active mining area and relates to the desire by prospectors to keep their claims secret (WPA 1940, 162; Barnes 1960, 183). The cotton pickers depicted in the map are carrying the cotton in baskets, a practice long absent from the antebellum South (Epstein 1977, 163) and never present in Arizona. Cotton was gathered 100 pounds at a time in a bag that is slung over the shoulder and dragged behind, leaving both hands free to pluck ripe bolls (Dobyns 1950, 8). Also note the intrusive elements of Hollywood Indian material culture.
Source: (Goodyear 1953, 38).

Fig. 20. The Wigam Resort and Environs | Map.
pilots, cowboys, and tractor drivers are light-complexioned.

The dominant prejudice linking African-Americans and cotton led to a popular fear by racists that the development of a cotton production region would lead directly to a migration of African-Americans. In the Texas High Plains in 1900, one incipient cotton grower was forced to plow up his crop by community members who conjectured that, according to a county history, "the cotton industry would bring in the negro, and at that time the population of the county was one hundred per cent American born white people who were determined to keep it so" (cited in Green 1973, 110). Similarly, the efforts of Woford Camp, a young cotton agronomist from South Carolina [and a champion cotton picker in his youth] sent by the USDA just before the First World War to promote the culture of *G. barbadense* in California, were hampered by the bigotry of people such as Edward W. Wickson [former dean of the University of California's College of Agriculture, agricultural textbook writer, and editor of an influential agricultural newspaper] and B.H. Crocheron [Extension Director for the University of California]. Both Wickson and Crocheron preached that cotton would stimulate a migration of African-Americans to California (Briggs and Cauthen 1983, 37). Crocheron followed Camp on his extension rounds and administered the growers: "Don't plant cotton. It will ruin California economically and socially. Orientals can't pick cotton because their fingers are too short, too delicate" (cited in Briggs and Cauthen 1983, 42-43).

Cotton was indeed an important factor in the migration of African-Americans to Arizona. From 1900 to 1930 there was an immense
wave of African-American migration from the rural southeast to urban areas in the north and western United States, including Phoenix, Arizona. The African-American population of Phoenix increased over 3 times between 1910 and 1920, the most of any large western U.S. city during this period (Taylor 1977, 7-10). Indicating the establishment of a significant African-American population, the first Arizona chapter of the NAACP [National Association for the Advancement of Colored People] was established in Phoenix in 1919 (Goff 1970, 106).

Arizona's African-American population increased sharply between 1910 and 1920, from two to eight thousand, while the state's total population increased by only about 60 percent (Harris 1977, 54).

This large migration was generated both by push and pull factors. The Mexican boll weevil [Anthonomus grandis] wiped out Sea Island cotton by 1920 the weevil was spread to the western edge of the old cotton belt in Texas, leading to vast unemployment and out migration, and contributing to the development of Arizona's G. barbadense cotton industry (Brown and Ware 1958, 203; Case 1929, 339; Street 1957, 39). Many of these disenfranchised tenant farmers and sharecroppers were attracted to Arizona to pick cotton during the boom years by the Arizona Cotton Growers' Association's recruitment campaigns in the east, especially Oklahoma (Comeaux 1981, 195;

1. Hart (1977, 308), however argues that the impact of the boll weevil on African-American migration from the rural southeast is exaggerated and that increased urban and military labor demands during the First World War had a greater impact.
Padfield and Martin 1965, 234). For example, a black attorney from Oklahoma who had moved to Phoenix in 1916 was contracted by the Association to recruit a "trainload" of African-American cotton pickers from Oklahoma for the 1920 Arizona cotton harvest (Harris 1983, 8-9). Because of intense racism that developed, particularly in the Phoenix area, African-American migration to Arizona was slowed after 1920.

Racism was hardly absent from the Arizona Territory. Most of the settlers in southern Arizona from 1854 until the Civil War were from the South; this area was declared part of the Confederacy in 1861 and remained so for a short time (Robinson 1919, 125, 139). Orthodox Mormonism, in theory and practice, is patently racist (Limerick 1987, 325-26). An anti-miscegenation law that barred intermarriage between whites and "Negro or Mongolian partners" was passed by the territorial legislature in 1901 and actually remained law until 1962 (Miller 1986, 10-11). Housing, schools, and other facilities in Arizona were generally segregated before statehood and in 1912 segregation became law. Generally, African-Americans and Indians were segregated from whites and Chicanos. Arizona's school system remained segregated until gradual integration began in the

1. For example, according to the Book of Mormon (Mormon 1985, 66) the generally dark complexion of American Indians, relative to Europeans, is because the Indians' ancestors rejected the word of the Mormon God, who "... did cause a skin of blackness to come upon them." Until President Kimball's "revelation" in 1978, African-Americans and other dark-complexioned people were barred from the Mormon priesthood (Limerick 1987, 325-26).
early 1950s (Roberts 1973, 349, 358).

On the other hand, the southwestern frontier offered certain opportunities for African-Americans that were generally absent in the east. African-Americans were very well represented at all levels of frontier society, as homesteaders, miners, cowboys, merchants, service workers, lawyers, doctors, publishers, hotel owners, land speculators, and business tycoons. The sector generally offering western African-Americans the most opportunities was the military. African-American regiments [the "buffalo soldiers"] were a major element of the U.S. military presence in the Arizona Territory during the Indian Wars (Harris 1977, 28-38; 1983, 11-20; Comeaux 1981, 123, 194; Taylor 1977, 7).

In the balance, prior to 1912 the Phoenix area was, relative to elsewhere in the country, fairly racially tolerant. None other than Booker T. Washington (1911, 913) visited Phoenix in 1911 and declared: "I would not have people believe that there is not racial prejudice in Arizona, as elsewhere in this country, but as yet such prejudice as exists has not fixt itself in institutions." Among the most significant, if not the most significant, of racist institutions is the Ku Klux Klan. The Klan in Arizona was very powerful by 1921, and I believe that this was an indirect consequence of the

1. General Oliver Howard, who came to Arizona as head of President Grant's Peace Commission in 1871 and was the top-ranking officer in the southwestern theater, was African-American (Dale 1949, 99).
introduction of commercial cotton production and the attendant migration of African-Americans to Arizona.

The Ku Klux Klan had a very early function as a tool of southeastern cotton interests. In 1908, night-riders threatened violence on farmers that did not hold their cotton for 10 cents a pound, and they rode again in 1920 to try to get farmers to hold their cotton for 40 cents a pound (Fite 1984, 66, 103). The nationwide depression that occurred at the end of the First World War engendered increased interracial tensions. During this period, the Ku Klux Klan gained in prominence east of the Mississippi; yet, according to Nash (1973, 110), the Klan was scantly represented in the trans-Mississippi West and was essentially absent from the western United States by 1923.

Arizona represents a major exception to Nash's characterization of the Klan in the West. A federal investigation of the Klan in 1921 revealed that in Maricopa County practically the only justice was Klan justice. Klan membership roles included the Maricopa County Sheriff, the Mayors of Phoenix and Tempe, the judges [including one Superior Court Judge], prominent Masons, and many other influential people. At its zenith, the Klan made it their pleasure to harass African-Americans, Catholics, Jews, and Mormons both in the Salt Oasis and statewide (Abbey 1973, 14-15; Sheridan 1986a, 244-45). The KKK-infiltrated police force could have had an enormous role in repressing African-American migration. A Florida police magistrate [certainly a bigot, but not neccessarily a Klansman] remarked matter-of-factly:
We don't give them a chance to make trouble. Sure we lock them up quick and fine them more than we would the local people, but we have to — it's the only way to keep them in hand . . . If a local person drove without a taillight, I'd make it ten dollars and costs, or maybe warn them. If a nigger migrant does it, I make it twenty-five and costs. It's the only way we can keep them under control (cited in Moore 1965, 142).

In 1921, the Klan paraded openly in the streets of Phoenix and four acts of violence were attributed to them, although only one of the incidents ever went to trial: a young African-American man, for the apparent transgression of touching a white woman's elbow while helping her step down from his shoe-shine stand, was kidnapped off the street in downtown Phoenix and driven out to the countryside where he was pommeled, sustaining permanent injuries. Two men were tried for the crime, one of them a newspaper editor, but they were not convicted by the Klan-dominated local courts (Abbey 1973; Harris 1977, 48-50; Merrill 1978, 247). In 1922, the Mormon principal of the Lehi school was abducted from his home, beaten, and burned on his face with acid. The case went to trial, but because of behind-the-scenes Klan maneuvering, the perpetrators were found not guilty (Merrill 1978, 174-76). In 1923 Klan activities began to spread to elsewhere in the state, directed especially against Chicano [Catholic] mine workers. In 1924 several children from Tombstone were injured when the Klan set a bomb off at a Catholic-sponsored benefit dance. The Klan was a primary issue in the 1924 race for governor, Hunt defeated the Klan-backed candidate and Klan activities diminished somewhat, though not entirely (Merrill 1978, 248). In 1927, for example, the Klan burned crosses on "A" mountain [just
across the Santa Cruz River from downtown Tucson] to intimidate the African-Americans and Chicano Catholics living in Tucson's barrios (Míguez 1986, 212).

By 1923, it was evident to the grower's association that the restrictions banning Mexican labor from the United States, which had been lifted because of the First World War, would be reinstated. The association began to generate a mailing list of white cotton pickers from Texas and Oklahoma who had worked in Arizona in the past (Brown and Cassmore 1939, 65). In the late 1920s, growers began to advance fuel money to white families to come to Arizona and pick cotton (McWilliams 1944, 79). This racial emphasis was clearly a consequence of the Klan's dominance.

Okies. In the early 1930s the role of agribusiness entities in manipulating the flow of labor grew stronger. With the elimination of Mexican cotton pickers in the late 1920s the local Cotton Growers' Association began the organized recruitment of Okie farm families from the dust-bowl. In 1933 the recruitment duties were taken over by the Farm Labor Service [FLS], which was organized and financed not by the cotton growers but the ginners. The ginners had a strong vested interest in the health of the cotton industry as they were both the primary suppliers of cotton production credit and the processors of the cotton crop (Brown and Cassmore 1939, 74-5; McWilliams 1944, 82-5). The FLS maintained its power until 1944. This was possible, according to McWilliams (1944, 82-3),
by reason of the almost incestuous relationship that existed in Arizona between the FLS and the United States Farm Placement Service. The two organizations occupied the same offices; shared the same stenographer; and until Senator La Follette turned the spotlight on Arizona, the FLS actually used the free franking privilege of the federal agency. The manager of the FLS testified before Senator La Follette's study commission that the purpose of the labor service was "... to obtain a labor supply so large that picking and ginning could be finished in the shortest possible time. That meant, of course, small total pay to each picker. But enough, in many cases, to get the picker and his family to California" (cited in Darnton, 1940).

The FLS capitalized on poverty by targeting the heart of the dust-bowl and the east-west highways to lure Okies for a season in the Arizona cotton fields. Nearly a quarter of the migrant cotton pickers in Arizona in 1937 were in the state because they had heard about high cotton picking wages and pleasant conditions through radio and newspaper advertisements and handbills (Brown and Cassmore 1939, 30, 38, 69). Arizona was to the Okies a promised land. The ads and handbills promised a pleasant climate, good wages, and 300 to 400 pounds a day for "good pickers" (McWilliams 1944, 83). Two hundred pounds of cotton per day was the standard rate for an average to good picker (Dobyns 1950, 128; Thomas 1948, 83) and the unrealistic claim was dropped from the following year's ads (Brown and Cassmore 1939, 69). To be sure, growers and recruiters were not the only ones guilty of exaggerating the amount of cotton that one could harvest in a single day. Some cotton pickers in the vicinity of Eloy informed Olson (1956, 41) that they generally picked 400 pounds of cotton in a
Better than average pickers, the anthropologist learned, could pick 700 to 800 pounds of cotton in a day. A survey conducted in 1950 indicated that only 6 pickers out of sample of 2,000 were able to harvest more than 450 pounds in a day, and this pace could only be sustained for a few days in a row (ASES 1950, 18).

POWs. POWs were vital for the wartime cotton harvest, and the distribution of POW camps demonstrates the far-reaching influence of the cotton interests. The war department had several criteria for locating POW camps, one of the most important of which was that they be located outside of a "black-out area" which extended 150 miles from international borders and 75 miles from seacoasts (Krammer 1976). Figure 21 is a map which shows the location of all but fifteen minor POW camps in Arizona, location data for which are unavailable. It is noteworthy that the camps identified were actually all located within the black-out area. Clearly, the interests of agribusiness superceded even the interests of national security.

Let's Pick the Cotton Week. In 1953, a promotional campaign

1. There is a long-established folk tradition of boasting about cotton picking ability. A prison blues epic by J.B. Smith (Smith 1965) of Texas contains the following lyric: "Well, but me and my partner . . . and my partner's friend - oh we could pick more cotton . . . than your gin can gin." This is also the theme of Ledbetter's famous song "Pick a Bale of Cotton." As the singer remarked, "Now this was when I was around Dallas, Texas, pickin' cotton. I was picking a thousand pounds of cotton a day. And the way you get a thousand pounds of cotton a day, you've got to jump around to get it. You can't fool around and pick a thousand pounds of cotton a day" (Ledbetter 1962, 56).
More than 4,000 POWs

1,000 to 4,000 POWs

400 to 1,000 POWs

Fewer than 400 POWs

Sources: (Banks, 1984; "POWs were in Guarded Condition" 1978, 58; Spidle, 1975, 65).

Fig. 21. POW Camps and the Blackout Area in Arizona | Map
to recruit Arizonans otherwise not employed in agriculture to meet
cotton harvest labor shortages disclosed the importance of an
efficient harvest of cotton production to backward- and forward-
linked entities. The scheme was to make the Arizona public aware of,
and take pride in, the importance of cotton to the state's economy.
At the behest of the Cotton Grower's Association, the newly formed
Cotton Promotion Council, and the Arizona State Employment Service,
Governor Pyle declared the last week of October, 1953, as "Let's Pick
the Cotton Week," and launched a massive public relations campaign
utilizing the press, radio, and television to lure extraordinary
labor into the cotton fields. Opening ceremonies were presided over
by the 1949 National Maid of Cotton, who presented Gov. Pyle with a
shirt of Pima cotton. The Maricopa Sheriff's office and Phoenix
Police Department were assigned to recruit winter visitors
[colloquially "snowbirds" (Beaudry 1989, 33)] for the cotton
harvest. Off-duty military personnel were also enlisted as cotton
pickers. As a result, the week saw a 10,000 bale jump in harvested
cotton over the week before, additionally, demands for braceros were
reduced (ASES 1954, 12-14).

The organizers of "Let's Pick the Cotton Week" represent the
entire range of agribusiness interests. The organizational
conference was chaired by the Cotton Grower's Association, the newly
formed Cotton Promotion Council, and the Arizona State Employment
Service and brought together a telling panoply of backward- and
forward-linked agribusiness organizations: the Arizona Cotton
Ginners' Association, the Arizona Agricultural Chemicals Association,
the Arizona Motor Transport Association, the Arizona Implement
Dealers' Association, the Southern Pacific and the Atchison, Topeka &
Sante Fe Railroads, the Arizona Bankers Association, the Association
of General Contractors of America, and the Arizona Chamber of
Commerce (ASES 1954, 12-14).

The Flow of Capital and Cotton Harvest Technologies

The mechanization of the harvest represented a major power
shift within the cotton agrosystem, as Parsons (1986, 380) writes of
California's San Joaquin Valley, the closest counterpart to the
Arizona cotton production region: "Nothing has changed the structure
of valley agriculture quite so much as mechanization." The wage paid
for picking a pound of seed cotton during the 1940s was generally
pegged at about 10 percent of the price received for ginned cotton
(Barr 1942, 376; 1943, 8; 1944, 9; 1945, 7; 1946a, 10; 1947, 9; 1948,
17; Thomas 1948, 18). During the 1930s, harvest costs represented
less than 40 percent of the total production costs of cotton in
Arizona [not accounting for seed deductions]. By the 1940s, however,
harvest costs constituted more than 40 percent of the total
production costs. The increased costs were sparked by wartime and
post-war labor scarcity and encouraged a shift towards mechanical
harvesting (Barr 1950, 7).

1. At this, a unit amount of cotton for which a picker
received 3.3 cents [since it takes about 3 pounds of seed cotton to
yield one pound of ginned cotton] ultimately sold for one dollar.
Capital Flow and a Hand Harvest. Unlike production costs of other inputs, much of the working capital that was spent on labor was channeled directly back into the local communities. Also, people, unlike machines, run on promises and are cheated out of their wages in numerous ways. For example, one of my grandfathers immigrated from Sweden early in the century and found his first employment in the United States on a ranch in North Dakota. He worked two years and received no pay because he had only negotiated the job verbally and had not signed a written contract. Machines do not have free will and cannot be exploited, but humans can.

Humans, unlike machines, regurgitate production costs in many ways. Cotton pickers without their own sacks had to rent them for 25 cents a day (ASES 1958, 58) and could be induced to purchase a soda, cold or not, at ten cents a pop on a hot afternoon (Dobyns 1950, 74). Many Okie cotton pickers in the upper Gila Oasis in the 1930s were paid in scrip that was redeemable only at the local stores, a situation not unlike that of the Pima wheat farmers in territorial Arizona. One resident interviewed by Sayers (1979, 93-4) remembered:

... when these cotton pickers would come in these little bitty communities, why, the stores would open up and the kerosene and the crackers and the dill pickles would go like crazy to feed these folks. And that was a factor that you can't get one of these [local farmers] to admit: it was a big economic thing to have those folks in here. A lot of them would come in here and they were the crop followers. They might pick prunes in California and cotton here and corn someplace else and so on. But the trick was to sure pay them

1. Whenever I saw him, starting when I was about four, the first thing he used to ask me was "Have you joined a union yet?"
while they're here but try to see that they spend it here so it doesn't all move. And they did: they spent their money. There were very few of them that took their money home with them. They were hard-drinking people (cited in Sayers 1979, 93-94).

Similarly, Olson (1956, 27-29) relates a dependence in the mid-1950s by Eloy merchants on cotton pickers:

The stores in this section are centered on serving the migrant. The several second hand stores sell used clothing, bedding, cotton picking sacks, magazines, cooking utensils, suitcases, and furnishings. The cafes serve short order, counter meals, and the grocery stores sell food supplies to those migrants who do their own cooking. The auto repair garages are full of run-down, prewar cars, belonging to the migrants. The taverns are patronized almost exclusively by the single male migrants.

Where the role of cotton towns in siphoning off the pickers' wages was passive, labor contractors actively squeezed capital out of labor. Arizona labor contractors in the early 1940s received their profits [for the effort involved in row-bossing the crew, and weighing the cotton] in one of two ways. Some contractors received 10 cents per cwt of cotton picked by their crews. Other contractors made their legitimate profits solely from transportation and concession revenues. The workers from the Phoenix shanty town often traveled between 30 and 40 miles a day to and from the cotton fields, for which they paid a contractor 15 cents each way; lunch wagons were also arranged by the contractor. Workers who did not ride in the contractor's truck, or buy his lunch, could not work in the fields that he contracted (McWilliams 1944, 88). With inclement weather the cotton could not be picked but the pickers still had to eat. Thus did enormous commissary debts accrue to the rained-out pickers (Nash
Labor contractors were generally considered by the cotton pickers to be very dishonest. Scale doctoring was a common complaint; another tactic employed by some contractors was to get the cotton pickers drunk and steal their cotton (Olson 1956, 42-43).

The bracero program offered an enormous potential for profits. The Farm Security Administration administered the bracero program in 1942 and the all the agreements were carried out. In 1943, however, administrative responsibilities were turned over to the War Food Administration, essentially a consortium of growers' associations. Although living conditions for the braceros remained adequate, wages were "farcical" (McWilliams 1968, 265-67). Braceros were cheated of their wages in a variety of ways, as one remarked, "There is no use going to work, . . . We do not make any money anyway. When we weigh in the cotton, instead of deducting four pounds for the sack, they deduct ten. They cheat us" (cited in Moore 1965, 93). There were those who made considerable dishonest profits through "feeding" the braceros. The law stipulated that the commissaries for braceros be nonprofit operations that charge braceros $1.75 a day for food. This was to cover only food costs, operation costs, and a fair wage for the contractor. Dishonest contractors, by stressing a diet of rice, beans, and tripe, found that they could "keep a man alive" for about 75 cents a day. Some of the camps housed 1,000 men—so a contractor running one of these camps could make, above the legal salary, as much as $1,000 a day (Moore 1965, 93). Some of the contractors operated vertically integrated businesses that tapped into the workers at every pore, a
situation very similar to the relationship between agribusiness and growers. The Emergency Committee to Aid Farm Workers, a volunteer group that included Carl Sandburg, John Steinbeck, and Steve Allen, issued the following charge:

Immense profits have been made from furnishing meals to braceros 'at cost.' This is the primary reason labor contractors - the same labor contractors who are supposed to be 'excluded' from the program - fight among themselves for the privilege of feeding braceros, pay kickbacks to association managers, and wine and dine officials. A contractor near Tracy, California, made over a quarter of a million dollars from the 'nonprofit' feeding of braceros in the space of a few years. The manager of a bracero camp in Santa Barbara has developed an ingenious improvement over the techniques of garden-variety operators. He has set up a catering firm which provides meals in his camp. He is president of the catering firm. And he has established a wholesale grocery firm which sells foodstuffs to the catering firm. He makes his profit three ways (cited in Moore 1965, 153).

Corruption was endemic in such situations; the residents of the Poston evacuation camps went on strike to protest the inferior food and it was then disclosed that the procurement officer was purloining provisions for personal profits (Cosner 1978, 44).

Capital Flow and a Machine Harvest. Many opportunities to regain harvest costs were lost with the mechanization of the harvest. The mechanical harvest also entailed some additional costs, as indicated in table 7, as well as other financial considerations, such as repairs, operating costs, depreciation and obsolescence (Vanvig and St. Clair 1954, 2-3). The technology improved as labor costs rose. Torrential rains in 1983 forced some cotton growers to hire human pickers, who received $35.00 per cwt, while machine-picking at the time cost less than $4.00 per cwt (Volante 1984).
TABLE 7

Costs Associated With Machine Harvest of Cotton and not With a Hand Harvest [Dollars per Acre]

<table>
<thead>
<tr>
<th>Cost</th>
<th>Dollars per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine picking costs</td>
<td>28.32</td>
</tr>
<tr>
<td>Defoliation</td>
<td>4.50</td>
</tr>
<tr>
<td>Extra ginning charges</td>
<td>3.64</td>
</tr>
<tr>
<td>Grade losses</td>
<td>6.37</td>
</tr>
<tr>
<td>Field losses</td>
<td>36.89</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>79.72</strong></td>
</tr>
</tbody>
</table>

Source: (Vanvig and St. Clair 1954, 8-9).

Cotton picking machines are expensive crop-specific investments that, once acquired, encouraged the endurance of the cotton landscape (Barr 1944, 9; 1950, 9; Comeaux 1981, 267). In 1957, cotton pickers cost an average cost of $12,000 per machine ("Machines Help Speed Pima Cotton Harvest" 1957). In the early 1960s cotton pickers cost upwards of $15,000 each (Halvorson 1962, 204). High-end mechanical cotton pickers topped out in the mid-1980s at $138,000 a copy (Robbins 1985).

Post-Harvest Systems

Ginning is the process of separating the cotton fiber from the cotton seed and the cotton ginnery "... encompasses both the final stage of agricultural production and the initial stage of the manufacturing process" (Aiken 1973, 96). Figure 22 indicates the pattern of ginnery development in Arizona and demonstrates that gInneries are generally constructed as a reaction to cotton expansion [for example 1919-1920] and idled in response to cotton decline, as between 1920 and 1921.

Fig. 22. Ginnery Development in Arizona: 1919-1985 | Graph
The Third Ginning Revolution

Aiken (1973, 210) identifies three revolutions in the development of cotton ginning services and technologies. Pre-Civil War cotton ginneries were usually located on and served individual plantations and required 100 to 250 bales annually for efficient operation. After the Civil War and until World War Two the annual capacity of ginneries grew to 500-1,500 bales. Post World War Two ginneries have an annual capacity of 3,000-10,000 bales. The ginneries of the second revolution were generally single-functioned and privately owned. Post-World War Two ginneries, however, are often owned by agribusiness firms with interests integrated throughout the system such as cotton oil milling, cotton storage, and fertilizer processing and sales. As Aiken (1973, 210) writes, "under the umbrella title of 'cotton ginner,' one usually encountered a cluster of business activities in which the gin, though central, was not always monetarily dominant." In Texas, where the cotton gin is the "hub of the cotton growing community," the ginner purchases the farmers' fiber and seed, sells cotton seed for planting, offers current market information, and assists the farmers in securing workers and equipment (Cotton Economic Research 1966, 39). In Arizona, the ginneries' position in the cotton agribusiness system became very significant as the ginning companies were primary sources of cotton production loans and bankrolled the FLS which was responsible for recruiting labor for the Arizona cotton harvest (Darnton 1940; Vanvig 1955, 20-24, 45; McWilliams 1944, 82-83).

The third ginning revolution was instigated primarily by the
mechanization of the harvest. The essential harvesting element of mechanical cotton harvesters is a wetted and rotating rubber spindle. Machine-picked cotton is wetter as well as trashier than hand-picked cotton and requires special ginning technologies - driers and lint cleaners - to compensate. Together, lint cleaners and cotton driers improve the grade of machine-picked cotton by one-half to two-thirds of a grade (Street 1957, 150-51). In the early 1950s, about 41 percent of Arizona ginneries were fully equipped with driers, lint cleaners, and other new technologies, 36 percent were partially equipped with the new equipment, and only 18 percent, generally the older ginneries, had no lint cleaners or special equipment at all (St. Clair and Roberts 1956, 7-8). The adoption of the special technologies, along with such technologies as standard-density presses and automatic bale samplers, raised ginning costs and lent even more importance to the ginning companies.

Cotton Driers. Seed cotton that is damp will not gin properly. This was a problem in the humid southeast where, because of rainy spells and heavy dew, an effort was usually made to dry the seed cotton before attempting to gin it (Brown and Ware 1958, 374-77). Cotton driers were developed in the mid-1930s and by 1946 nearly half of the active ginneries in the United States were drier-equipped ginneries; these handled about two-thirds of the nation's crop (Street 1957, 149-50). In Arizona, however, the arid climate obviated the necessity for drying until the advent of machine picking. Because of the wetted spindles, machine-picked cotton is at least one percent wetter than hand-picked cotton. In Arizona in the
mid-1950s, generally, all machine-picked cotton was run through driers, but only half of hand-picked cotton (St. Clair and Roberts 1956, 15-17; Johnston N.D., 41-43; Vanvig and St. Clair 1954, 7). By the mid-1960s, practically all of the United States' gins were equipped with driers (Pendleton and Moore 1968, 472).

**Lint-Cleaners.** Because of the trashy nature of machine-picked cotton, the adoption of picking machines required another concurrent ginning innovation, the lint cleaner (Barr 1951, 7; Jepsen 1954, 1-2; Johnston N.D., 41, 47-49; Street 1957, 147-49). Lint-cleaning effectively transferred a task that had been formerly accomplished in the field, trash removal, to the ginnery, rendering the ginneries' part in the cotton agrosystem even more important than formerly (Barr and Seltzer 1952, 6). In 1950, only 5 percent of the nation's ginneries were equipped with lint cleaners. However, indicating the widespread diffusion of picking machines in the western states, 22 percent of western ginneries were equipped with lint cleaners in 1950 (Street 1957, 150). In 1951 Arizona led the entire cotton belt in the use of lint cleaners, with 79.2 percent of ginneries lint cleaner equipped (Johnston N.D., 56). In 1951, 85 percent of Arizona's machine-harvested cotton was lint-cleaned, compared with 44 percent of hand-harvested cotton (St. Clair and Roberts 1956, 10).

**Post-Ginning Systems.** The post-World War Two technological revolution was also felt in the post-ginning operations. After the cotton is ginned and before it can be marketed the bales of lint must be compressed to a standard density, sampled, and warehoused.
Formerly these operations were performed at a separate post-ginning facility - the compress-warehouse. With the ginning revolution, these operations were transferred to the ginnery, furthering still the ginners role in the agribusiness system.

Early marketing of the cotton crop was hampered in part because there was as yet no cotton compress in the state (Collins 1918, 36; Martin 1915, 5-6) and the condition of Arizona's Pima cotton crop was deteriorated by railroad compression plants in Oklahoma and Texas. In 1925 a modern compressing and warehouse plant was established in Phoenix which established that city as the concentration point for most of Arizona's cotton. In addition, the plant qualified as a federally bonded warehouse, and receipts issued by the plant were accepted as collateral for loans at all banks (McGowan 1961, 108-09).

By 1941, Arizona had 2 compress warehouses, both located in Phoenix, representing a total investment of about 2 million dollars (Horton 1941, 80). The cotton boom forced an expansion of compress warehouses and one new facility was built in 1951 and 3 more in 1952 to bring the state's total number of compress-warehouses to 6 (Barr and Seltzer 1952, 6; 1953, 6). The compress-warehouses served as

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1. Phoenix in 1930, though still relatively small with a population of only 48,000, was the functional hub of the Salt Oasis urban framework (Sargent 1975, 1).

2. There was also a considerable expansion of the capacity of Arizona's cottonseed product mills with the cotton boom of the early 1950s (Barr and Seltzer 1952, 6; 1953, 6).
concentration points for cotton from several ginning areas so lots of uniform quality could be assembled to fill specific large orders (Hathorn and Johnson 1949, 20). At high-volume ginneries, however, the cotton was sorted in the gin yard. The ginneries that adopted the warehouse's role as a storage facility also had to adopt standard density presses and automatic bale samplers to turn out marketable bales (Street 1957, 152).

Cotton bales formerly had to be cut into and sampled several times between ginning and marketing. This repeated sampling caused the bales to take on a shabby appearance and many in the business felt that the samples taken were not representative. Automatic bale samplers were designed to provide a representative sample and obviate the need for cutting into the bales (Brown and Ware 1958, 418-9; Street 1957, 152). One of the nation's first 3 automatic bale samplers was installed at the Gilbert ginnery in 1953 (Barr and Seltzer 1953, 6).

Hathorn and Johnson (1949, 3-11, 20-21) strongly advocated the adoption by ginneries of the standard density press as a means to improving production efficiency and the competitive position of Arizona's cotton crop. The chief advantage was more economical transportation; other advantages of standard density presses included the facilitation of grading, sampling, and storage of the crop. The diffusion of the standard density press allowed a dramatic shift in the path taken by the cotton after the ginner. With the old low density presses, ginners had to convey the ginned low-density bales to one of the state's compress-warehouses for sampling, grading,
high-density pressing, and sorting. With the new large-capacity, standard-density equipped ginneries the cotton [after compressing, grading, and sorting] could be transported from the ginnery directly to any of several destinations: local compress-warehouses as before, or port-area compress-warehouses, domestic mills, or central markets.

The Ginnery as a Commitment to Cotton Production

As the ginneries increased in size and complexity, they also increased in cost. Around 1940, the average Arizona ginnery represented an investment of about $60,000 (Horton 1941, 80). By the early 1950s, standard ginneries cost about $100,000 each. Ginneries fully equipped with lint cleaners, driers, hull extractors, pink bollworm machines, and other new technologies cost about $150,000 each (St. Clair and Roberts 1956, 51). In the early 1980s, a new ginnery built at the town of Pima in 1982 cost $2,100,000 and an upgrade on the Safford ginnery cost $600,000 (Dale 1983). The ginners, traditionally integrated throughout the cotton agrosystem [i.e. credit, labor control], have an enormous commitment to cotton production in Arizona and are very important to the continuing endurance of the Arizona cotton production region.

The service area of a ginnery must be large enough and have sufficient density of production to support the operation, but small enough to allow economical transportation of the fiber from farm to ginnery (Aiken 1973, 217). Figure 23 is a map showing the distribution of active roller, saw, and dual ginneries in Arizona in December of 1986. The distribution of types of ginneries clearly
Sources: (USDA Marketing Service Office roles of cotton ginneries, Yellow Pages, and telephone interviews in December, 1986).

Fig. 23. Active Cotton Ginneries in Arizona: December, 1986 | Map
mirrors the distribution of the species of cotton in Arizona. The ginneries were originally located in response to cotton production, and their presence represents a strong commitment to continued cotton production.

The Triumph of Agribusiness

The intensive industrialization and capitalization of Arizona agriculture increased existing pressures for a quick and sure source of capital, for reclamation, leasing, and financing, as well as introducing new demands for capital for such things as machinery, fuel, chemicals, and extra ginning costs. Thus the economic imperative to plant cotton in Arizona was generally strengthened as the agribusiness system grew more complex and sophisticated.

A primary factor in the technological revolution in Arizona cotton production was the Farm Program, which limited acreage while rewarding production. Growers planted within their allotments and simply intensified production by substituting inputs other than land, such as new high-yielding cultivars, agricultural chemicals, and particularly water into the production system to raise the yield per acre (Barr 1950, 9; Smith and Reynolds 1972, 399; Vogeler 1981, 166-68; Weber 1972, 1-2). The irrigated nature of Arizona agrosystems — which was a primary factor in the genesis of agribusiness — was also important in Arizona's agribusiness revolution. The farm programs were designed to limit production by limiting acreage, yet the use of Arizona's most vital resource — water — was not actually restricted in any way.
Southwestern oases, the hearth of agribusiness, remain at the heart of the agribusiness revolution. Industrialization of the Arizona cotton industry accelerated sharply during the early 1940s (McWilliams 1944, 74-75). As Barr (1956, 1) reported in the mid-1950s:

The industrialization of agriculture is probably nowhere more pronounced than in Arizona. The cotton farmers' ambition to grow two bolls of cotton where only one grew before is being achieved. Mass production techniques, labor saving devices, and greater use of machines and chemicals are some of the steps that are turning rural farms into industrial plants.

Contract farming and the increased employment of custom operators [for crop dusting, field preparation, defoliation, mechanical harvest, etc.] were important factors influencing the growing specialization of agricultural production (Barr 1950, 5). Two processes very important to the evolution of agribusiness are "commodification" and the advent of "petro-farming."

Commodification

"Commodification" refers to the "... transformation of social activities which were not previously in the market place into market commodities" (Downing 1985, 21). Horses which can be reproduced on the farm are replaced by tractors that must be purchased; home-grown hay to feed the horses is replaced by purchased gasoline to run the tractors; river mud, manure, and nitrogen-fixing crops are replaced by commercial fertilizers; natural or cultural pest and weed controls are replaced by expensive pesticides and herbicides, and so on. The inevitable progression of this system is towards the further disempowerment of the growers. Downing (1985,
19) writes,

Productive activities which were once managed, directed, and owned by the farmer are now widely differentiated among specialists. Hybrid seeds, most of which will not reproduce, must be purchased annually from multinational seed companies. Farms specialize in a few crops. Farmers pay others for preparing their land, and spraying pesticides and herbicides, or they purchase expensive machinery and equipment. Labor is seldom exchanged and rarely provided without cost by kinsmen. Products are sold 'at the farm gate', sometimes long before they are harvested. From there, they enter a multilayered transport, processing, and marketing system. . . . agricultural production is sustainable only insofar as it remains tied to energy and industrial supply lines over which farmers have little control.

Petrofarming

The impact of factors such as commodification, industrialization, and the falling water table on increasing the capital demands of agriculture in Arizona - and so the imperative to produce cotton - was multiplied by the increased use of petroleum products. The typical U.S. style petroleum-intensive agrosystem has been characterized as "petrofarming." Petroleum is an important element of pesticides, and is used to power tractors, mechanical cotton pickers, crop dusters, and the trains and other vehicles that carry and distribute inputs and outputs throughout the system.

Natural gas is used to process nitrogen fertilizer; to pump groundwater. The quadrupling of petroleum prices between mid-1973 and 1974 had a particularly profound impact on cotton producers

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1. As Nabhan (1984, 172-3) writes, "fossil fuels were used to pump fossil water laid down during the Pleistocene to irrigate crops adapted to humid conditions; these crops seemingly made the deserts bloom."
because of the heavy use of agricultural chemicals (Fite 1984, 227-28; Walter and Zentner 1975, 10-12).

Directly or indirectly the energy consumption of U.S. agriculture stands at about 2.27 quadrillion BTUs annually. Nitrogen fertilizers - because of the natural gas needed to process them - represent almost a third of the total energy consumption. According to Lovins et al. (1984, 73):

The energy embodied in chemicals and equipment - indirect energy use - is not much less than direct use. About forty million tons of fertilizer are applied to America's fields each year - approximately 330 pounds for each person in the country. The feedstock, manufacture, and transportation of fertilizers consumed 0.65 quads of energy in 1978. Similarly, pesticides are a fossil-fuel based system of control, for a full 80 percent of the one billion pounds spread annually comes out of oil wells.

All things considered, when the energy consumption of the whole production cycle, backward-linked, production, and forward-linked sectors, is considered, much more energy from fossil fuels than directly from the sun goes into the final agribusiness product (Harmon 1976, 41). This points up a major inefficiency of petrofarming, since, as Staffan Pelin notes, "... it may well be that the biological processes are many magnitudes of order more efficient than the industrial ones" (cited in Logsdon 1984, 7).

The Cost-Price Squeeze

Increased yields brought a higher gross income, but also much higher production costs. As production costs rose faster than commodity prices the growers found themselves in the increasingly tight grip of a "cost-price squeeze." From the agribusiness
perspective, backward-linked suppliers and forward-linked processors were merely capturing a larger share of the cotton dollar.

Production costs began to rise faster than commodity prices during the early 1940s (Barr 1944, 3). As Downing (1985, 20) writes, "Increased reliance on the purchase of substitutes to counteract land degradation coupled with increased competition for non-agricultural land use and rising labor costs have forced farmers to invest greater and greater amounts of capital to maintain their high levels of production." In 1947 the total costs [production and harvest] for producing a bale of *G. hirsutum* cotton on an acre in Arizona stood at about $85 (Barr 1948, 6). As the new technologies [pesticides, fertilizers, herbicides, picking machines, etc.] diffused, and labor, water, and land costs increased, costs for producing a bale of *G. hirsutum* on an acre rose from $105-114 in 1950 (Barr 1950, 7-9) to $156-166 in 1952. In 1952 it cost growers from $174 to $184 to push production to 1.5 bales to an acre. Since some costs do not increase proportionately with yields, producers who got 2 bales to an acre made more than twice what those producing 1 bale an acre made (Barr and Seltzer 1952, 6). In 1955, the cost of growing 1.7 bales of *G. hirsutum* on an acre [the state average for that season] averaged about $200 (Barr 1955, 6). Higher yields, higher labor wage rates, higher water costs, and farm machinery costs brought the total costs for producing 1.8 bales of *G. hirsutum* on an acre in 1956 to between $221 and $275 (Barr 1956, 5).

Through the late 1950s, cotton production costs continued to edge upwards, yet the returns to management still made cotton farming
very attractive (Seltzer 1958, 8). The situation became less favorable to growers as the costs of industrialized production approached the value of the production, generating a "cost-price squeeze" (Fite 1984, 226). During the early 1970s, as production costs soared with the sharp rise in petroleum costs, the cost-price squeeze on growers tightened (Blanpied et al. 1984, 135; Downing 1985, 18).

With the rise in production costs, Arizona's net agricultural income decreased as a share of the gross. In 1942, Arizona growers and ranchers grossed $107,000,000. Of this total, 43 percent [$46,000,000] represented the net returns to management (Barr 1943, 2). Of the 1955 Arizona gross agricultural income of $335,000,000, net returns to some 10,000 owners, tenants, and professional managers equaled $100,000,000, about 30 percent of the gross (Barr 1956, 2-3). By 1960, the total income had risen to $474,700,000 [the gross income plus $2,200,000 in AAA payments]. The growers' share fell to less than 24 percent. In 1965, the total was $545,600,000 [including $7,500,000 in AAA payments], the growers' share was less than 20 percent. From 1970 through 1985, total annual income [including AAA payments] for Arizona's agricultural growers increased from an average of $824,000,000 [1970-1973], to an average of $1,973,000,000 [1983-1985]. During these 16 years, net returns to the growers have averaged about 22 percent of the total (ACLRS 1979, 63; 1987, 6).

Production costs rose as the production system gained in complexity. The consequence is a farm crisis and a triumph of agribusiness.
The Farm Crisis, the Triumph of Agribusiness, and King Cotton

Inflated farmland values, rising water duty, dropping water tables, commodification, and rising energy costs, set growers up for a farm crisis in the early 1980s. As the position of growers deteriorated that of the rest of the agribusiness system grew in strength. The intensified capitalization of the Arizona cotton industry strengthened the financial institutions' already strong position. According to Vogeler (1981, 112),

Financial institutions are another set of agribusiness input firms; the input they provide is capital. As farmers expand their farm production, they have to rely increasingly on nonfamily and nonfarm sources of finance. This development has allowed lending institutions to gain considerable control over the decisions farmers make. As the power of financial institutions has grown, the power of farmers has declined.

In the early 1970s, U.S. producers borrowed heavily to expand their operations and used their farmland as collateral - thus the total farm debt rose from $54 billion in 1971 to $120 billion in 1978 and $212 billion in 1985. Of the total 1985 U.S. farm debt, 48 percent is short-term non-real estate debt, undertaken to finance current operations or forestall farm failure; 52 percent of the total is long-term collateralized real estate debt (Galston 1985, 49; Vogeler 1981, 112). As Galston (1985, 50) writes:

Farmers undertook this debt burden on the assumption that inflation would remain high, markets would continue to grow, and commodity prices and land values would keep rising. But by the end of 1979, inflation had become intolerable. The Federal Reserve Board shifted to a tight-money, anti-inflationary stance. The collision between this policy and rising U.S. budget deficits produced soaring real interest rates, which hit American agriculture with cataclysmic force.
About 10 percent of U.S. growers went out of business in 1985 alone ("Abandoned Arizona Farms Show U.S. Trend" 1985). According to Galston (1985, 49), "today, tens of thousands of farmers are poised on the brink of bankruptcy, unable to repay their debts. Within two years, hundreds of thousands may well be driven off the land -- the largest agricultural shakeout since the Great Depression."

The agribusiness perspective on the farm crisis, however, is refreshingly optimistic, summed up in 1981 by the director of the commodity department for the Indiana Farm Bureau: "I think the whole thing is going to make the farmer a more sophisticated businessman" (cited in Berry 1981, 21). Vogeler (1981, 3) writes, "capitalism has indeed worked, but not for the benefit of the remaining family and tenant farmers, agricultural workers, food consumers, and small towns dependent on agriculture."

There is not, appearances to the contrary, a worldwide agribusiness conspiracy. However, agribusiness firms and related interests "... do share a similar perspective - that short-term profit maximization is the key to success" (Vogeler 1981, 106-07). As Vogeler (1981, 106) writes, "To ensure maximum total profits, agribusiness has an incentive to create strong control over the farm production process to acquire an adequate and timely supply of uniform quality farm products" (Vogeler 1981, 110). Growers that are not large and integrated agribusiness entities are increasingly locked into a system of quasi-colonial domination by agribusinesses. As Berry (1981, 23-24) writes,
It is well understood by now that there is a limit of technological scale, of farm size, of expenditure and indebtedness beyond which the farmer enters a kind of mental paralysis, having simply no choice but to continue to do as he has done until the bank closes him out. He cannot change because he has no margins to turn around in. At this point he is literally dancing to a tune called by an economy that has always (as he sees too late) proposed his failure as the price of his participation.

King cotton is a tyrant. The truth is seldom voiced, but there are many drawbacks to cotton production. A rare statement in an article from the October, 29, 1909 edition of the Arizona Daily Star implores farmers in the Rillito Oasis north of Tucson:

Believe in yourself; sow burr clover and alfalfa. . . . Be cheerful and hopeful; economize on the little things and do not be extravagant with the bigger ones; make cotton subserve your interests rather than be subservient to cotton; work hard and play hard — these are attributes of the successful southwestern farmer (Knipe 1909).

This tacit sentiment was probably behind cotton being essentially left out of the special issue of the booster magazine The Earth (1909). Scarborough's (1936) novel offers a prolonged and vivid testimony against cotton.

According to McWilliams the introduction of commercial cotton production to Arizona had devastating implications, although with due respect, and without rejecting his essential argument, I believe that agribusiness penetrated Arizona agriculture well before 1912:

In the story of large-scale cotton development in Arizona, these processes are graphically demonstrated. For the irrigated valleys of the state, once prosperous small-farming communities, have become desert sweatshops. By 1912 the early settlers had created, at great expense and hardship, a well-balanced, self-sufficient agricultural economy which fitted the natural limitations of the region.
'Alfalfa,' it was said, was 'the valley's mainstay.' The dairy industry, supplemented by melons and cantaloupes and produce crops, made for rural prosperity. The family-sized farm was intact; there was no farm-labor problem; nor was there a public-assistance or rural-health problem. Overnight this economy was violently uprooted and supplanted with a large-scale industrialized type of agriculture. Today, Arizona is an object lesson of the ravages that such an economy can work - [not only] in rural communities, but to human beings - when it is permitted to develop unchecked and unregulated (McWilliams 1944, 72-3).

Similarly, Tetreau states, "Markets and machines definitely threaten the family-size farm in Arizona's irrigated areas. Commercialized and mechanized farming experts and operators exploit land and water resources, using cheap money and cheap labor to the exhaustion of soil fertility and often to the detriment of local institutions" (Tetreau 1940a, 203; cited in McWilliams 1944, 75).

There are numerous labor 'problems' involved with cotton, as with any crop with a significant gap between peak seasonal and regular labor demands. Bigots might have rejected cotton out of disdain for the laborers that would follow to work the crop. I mentioned this possibility earlier in this chapter in relation to African-Americans, cotton, and the Ku Klux Klan. Humanitarians did not like how cotton pickers had to live. Residents and public health officials feared that unhealthy cotton pickers would infect communities. These problems of the cotton productin system essentially vanished with harvest mechanization, only to be replaced by the problems of agricultural chemical use. Cotton, as I mentioned, uses more agricultural chemicals than any other crop. These are potentially dangerous to field workers and residents, and
indeed every member of the ecosystem in which the agrosystem is couched.

Yet cotton is planted, and hence the cotton production region tends to endure. This is because cotton production is a habitual behavior. Small farmers in eastern Paraguay, formerly cotton monocroppers, realized that cotton was actually an "addiction" and made a self-determined effort to break free from its grip by shifting to the production of a diversity of crops for subsistence and sale.

Paraguay's small farmers started to plant cotton extensively during the late 1960s, when it began to displace tobacco as the cash crop of choice. Annual production exploded between 1967 and 1986 from 26,700 to 343,200 metric tons. The crop was well suited to small-scale farming and offered, for a time, the promise of higher profits than tobacco. But in recent years, declining prices for cotton and increasing prices for agricultural inputs have trapped small farmers in a remorseless cycle. To pay for the increasingly expensive insecticides and fertilizers needed to grow cotton, farmers have mortgaged their crops in advance to middlemen, often on unfavorable terms. To get out of debt, campesinos have planted more cotton, reducing the acreage available for subsistence crops. The shortage of subsistence crops forced them to seek day labor to earn money to buy food. Day labor, in turn, reduced the time available for planting and tending both subsistence and cash crops. The cycle reached its most crucial point each year from October to December - enshrined in popular lore as Karai Octubre, or Lord October, the cruelest month - when money from the last cotton harvest had been spent and the first subsistence crops were yet to arrive (Bray and Borda 1988, 18).

Cotton is the crop of choice for some large and vertically integrated producers and the sectors that are backward- and forward-linked to production - the landowners and water companies; seed, chemical, and agricultural implement suppliers; ginners, warehousers, shippers, spinners, and manufacturers, and financial
lending institutions – but for many Arizona growers, cotton is increasingly the 'crop of compulsion.' My last chapter concerns factors that will be important in the future of Arizona's cotton production region.
CHAPTER 9

THE FUTURE OF ARIZONA'S COTTON PRODUCTION REGION

Several factors will be essential in the future of Arizona's cotton production region: subsidies, markets, farmland idlement, availability of water, and technological changes that allow production to be sustained despite declining water supplies. It is possible that cotton will give way to alternate crops if farm programs are cut and markets for Arizona cotton are eliminated. Except for a shift to a new cropping strategy to replace cotton as the way to the quickest and highest agricultural returns, the agribusiness system of Arizona will remain essentially intact.

Subsidies

Cotton production in Arizona relies on substantial government subsidies. Without these taps into the nation's collective wealth, cotton production in the state would soon wither. Subsidies enter through almost every subsystem of the cotton production process. Labor for the cotton harvest was often delivered to Arizona by the government. State land and Indian land carried a substantial subsidy. Technological developments carry a large subsidy through the USDA and the Land Grant College system. I will confine my discussion to the substantial subsidies to the cotton agribusiness system of Arizona delivered through the reclamation projects and the farm programs.
Reclamation Subsidies

Federal reclamation, intended to foster the growth of family farms, represents an enormous subsidy and a factor in the endurance of cotton in Arizona. Because of the subsidized water, federally reclaimed land has a real value that is much higher than the price paid for it by project participants (Reisner 1986, 148-9). The subsidy is defined as the difference between the full costs - comprising all financing, construction, operation and maintenance costs - and the value of projected and past payments from project participants. Farmland in the Wellton-Mohawk division of the Gila Project carries the highest subsidy of all the nation's reclamation projects, calculated at a one-time value of $1,787 per acre (Frederick 1982, 68-69). Financing costs are almost entirely absorbed by the government through low interest loans. Agricultural water users generally cover maintenance and operating costs, but only about 3 percent of the construction costs which were met with revenue from the sale of hydroelectricity (Frederick 1982, 117-18). At present, agricultural users pay only $20 to $50 per af for reclamation project water. As an indication of the magnitude of the subsidy, non-agricultural users pay the commercial rate of as much as $1,000 per af (Shabecoff 1989).

The total compounded reclamation subsidy since 1902, as of the mid-1980s, is calculated at $9,800,000,000. In 1986, taxpayers subsidized federal irrigation projects for $534,300,000. Federally subsidized crops such as cotton were produced on 37 percent of the 9.9 million acres of reclamation land in 1986. A bill currently
under consideration would force growers of subsidized crops using
reclamation water to relinquish their reclamation subsidy and pay the
full price for their water. In Arizona about 40,000 acres of project
land would be affected. The increase in annual water costs for
cotton growers would encourage a reduction of cotton on project lands
("Taxpayer Money Spent to Water Surplus Crops" 1988).

Farm Program Subsidies

The farm programs are critical to the existence of the
Arizona cotton production region. Arizona cotton producers are
located at the vertex of the United States' two major farm subsidy
belts. They are in the 'reclamation belt' of the arid and semiarid
West, and they are also in the cotton belt and receive substantial
farm program payments. The farm programs are so important in Arizona
that the allotment - the right to produce cotton and receive benefits
- has become the critical resource in the endurance of the Arizona
cotton production region.

Intersecting Subsidy Belts. The cotton programs were
designed to aid cotton growers in the rain-fed east but cotton
growers in the arid west generally benefited more. As McWilliams
(1944, 89) writes,

Cotton growers in Arizona and California, with per acre
cotton yields three times the national average and relatively
low production costs, were milking policies that were
designed to save cotton farms in badly eroded and depressed
districts of the old cotton belt, particularly Oklahoma and
Texas - the 'dust bowl.'

The confluence of reclamation and farm program subsidies
helps make agriculture in the arid West very profitable. In the
early 1970s, AAA benefits for cotton irrigated with Bureau of Reclamation water totaled from $47,000,000 to $104,000,000 annually. This support to western cotton growers put distressed eastern cotton growers at an economic disadvantage and represented one factor in cotton's growing dominance in the Southwest and general devolution from the Southeast. The cotton acreage in the old cotton belt dropped by one third between 1944 and 1964 while cotton acreage irrigated with reclamation Bureau water concurrently increased by 300 percent (Berkman and Viscusi 1973, 19-20). Worster (1984b, 63) writes,

What was added to cropland with one hand was taken away by the other, although in both cases eastern farmers did some of the paying, sending their tax money to the more arid region, then suffering from the low commodity prices brought about by the resulting overproduction, then shelling out reduction incentives.

**Benefits.** The farm programs are generally favorable to large growers and growers of cotton; large cotton growers enjoy a particular advantage. Although cotton revenues represented only a little over a quarter of Arizona's total 1941 gross agricultural income of $80,000,000, the total AAA benefit payment to Arizona growers in 1941 was $3,800,000, almost three quarters went to cotton growers (Barr 1942, 370-74). In 1963 about 11 percent of all U.S. farms had annual sales exceeding $20,000,000 each. These farms received payments averaging $2,391 each, accounting for 54.5 percent of the total payments. However, the 42.5 percent of all farms averaging less than $2,500 in annual sales received average payments of only $51 each (Padfield 1971, 44). Large cotton farms, quite
naturally, benefited the most. In the U.S. in 1961, two corporate cotton farms received payments of $2,000,000 each. Thirteen large cotton farms received about $650,000 each; 322 cotton farms got a little more than $110,000 each; and 70 percent of the nation's cotton producers received only about $60 each in government payments (Moore 1965, 72).

These payments that I have discussed are only the tip of a very large iceberg as they do not account for the enormous hidden benefit accruing from the price support system. The iceberg surfaced, after a fashion, when the 1965 legislation shifted emphasis from price supports to substantial direct payments for up to 35 percent of the acreage diverted from the base or regular allotment (Weber 1972, 21). For the nation as a whole, subsidy payments nearly doubled between 1964 and 1968 to almost $3,500,000,000. By 1972 a record $4,300,000 was spent by the nation's taxpayers on farm subsidies. The average payment ranged from $1,220 for small growers to $6,646 for the largest (Vogeler 1981, 164). Widespread participation in the farm program after 1965 resulted in total direct payments of almost $40,000,000 annually, $156,600,000 for the period 1966-1969, when the cotton payments consistently represented over 80 percent of Arizona's total farm program payment, far more than cotton's share of total farm income, total farmland, or total irrigation water consumed (UAAES 1967, 13-14; 1968, 6-7; 1969, 6; 1970, 6).

Individual cotton growers often received more than $500,000 each in direct payments. By comparison, grain producers generally
received payments of less than $150,000. In 1969, half of the total nationwide subsidy payments were for cotton. Over 80 percent of those receiving direct payments of over $210,000 were cotton producers. Not surprisingly, the largest payments in 1969 for crop subsidies went to areas with large high-production cotton operations. In 1968 and 1969, 34 individual producers nationwide received direct subsidy payments in excess of $20,000 each. The 34 operations were distributed in 10 states: 12 in Texas, 5 in California, 4 in Mississippi, 3 in New Mexico, 2 each in Arizona, North and South Carolina, and Washington, and one each in Louisiana and Oregon. The J.G. Boswell Company of California received the most, over $3,000,000 in 1968 and over $4,300,000 in 1969, the four other California operations also received very large payments. After one operation in Mississippi, the 7th and 8th highest benefiting operations in the nation were in Arizona. The Farmers Investment Company of Maricopa County received direct payments of $504,389 in 1968 and $673,410 in 1969. BKW Farms of Pima County received $331,512 in 1968 and $350,607 in 1969 (Vogeler 1981, 173-75).

The direct payment provisions of the 1965 Act drew sharp criticism, especially because of the very large payments to large producers. For this reason a direct payment limit of $55,000 per commodity per producer was instituted in the Agricultural Act of 1970 (Blanpied 1984, 130; Weber 1972, 22-24). There were worries at the time that the limitation would force producers to "butcher" their farms in order to make the most from government payments. In fact, the large producers simply transferred allotments and land titles
among family members to preserve the ability to maximize payments
elderly Mormon in the upper Gila Oasis commented disdainfully on the
cotton program:

Here six years ago they started to pay these guys so much money [in federal subsidies], it amounted to right around 50
dollars an acre on the short staple cotton. Just giving it to
them. My bishop out here got 60,000 dollars out of it. Two
kids from the valley went over to Phoenix and bought farms
and they got practically the same amount. Why, it was just a
giveaway, a lot of foolishness (cited in Sayers 1979, 10A).

Allotments. A major factor in the evolution and endurance of
the Arizona cotton industry is the desire to establish and maintain
"cotton histories" in order to retain the lucrative tap into federal
coffers. The desire to maintain cotton histories represents a major
factor in the endurance of cotton in Arizona, although the specific
regulations vary from year to year. For example, this was a primary
reason that growers continued to plant cotton when prices were down
and restrictions were not in effect in the early 1940s (Barr 1945,
6). Cotton histories also had to be sometimes maintained during
restricted periods. In 1950 each producer had to plant the entire
yearly allotted acreage of G. hirsutum in order to retain the
allotment (Hathorn 1951, 25). In the AAA of 1970,

Each producer's base allotment was based on the past five
year cotton history. Any producer failing to plant at least
90 percent of their base allotment would lose from their
allotment an amount proportionate to the percentage under
planted up to 25 percent in one year. Any producer
underplanting their base allotment by 25 percent or more for
three years stood to forfeit the entire allotment (Palmer
1971, 1-2).

The AAA allotment, being essentially a license to grow
cotton, gave value to cotton lands and gained a capitalized value of its own (Weber 1972, 1). The rent paid for good cotton land with allotments in the Casa Grande area went from a high of $10 an acre in the non-restricted 1937 season to $22 an acre during the 1939 cotton season, when restrictions were in effect (Greisinger and Barr 1941, 288). In cotton growing areas of Arizona land was frequently leased, bought and sold on the basis of cotton allotments, with relatively little consideration to other farm assets. For example, some farms in the Salt Oasis were rented at $90 to $110 an acre with the rent applicable only to the allotted acres (Barr 1957, 2, 7). As Seltzer (1958, 5) writes, "The value of the cotton acreage allotment has been capitalized into the value of the land to the point where the prospective purchaser is really bidding for an allotment rather than for the land itself." In the early 1960s the value of a 1-acre cotton allotment, based on the difference in value between comparable farmland with and without allotments, ranged from $1,500 to $2,800 in Maricopa County and from $500 to $1,200 in Yuma County (Barfels 1967, 60).

A clear demonstration of the value of the cotton allotment was the widespread practice of skip row planting of cotton - alternating four rows of cotton with four rows of fallow land - originally developed as a soil conservation method in the mid-1950s and popular from 1956 to 1968 because of a special provision in the farm programs. During the period from 1956 to 1968 skip row planting was desirable because it allowed producers to maximize production per allotted acre, while other resources were actually used with less
efficiency. Under the 1956 AAA regulations, farmers practicing skip row planting were able to count half the total acreage against their allotment (Barr 1955, 6; 1956, 5). Other inputs were used with less efficiency. The yield per actual acre of field land devoted to cotton production, of course, drops considerably. Pesticides could not be applied only to the planted rows, so the yield per unit amount of pesticides was diminished (Smith and Reynolds 1972, 381). In 1956, between 30 and 35 percent of the cotton lands of Pinal and Maricopa Counties were skip row planted (Barr 1957, 7-8; Seltzer 1958, 9-10). The special regulations regarding skip row planting were rescinded in 1968 (UAAES 1968, 6).

With the 1965 farm program, there was a devaluation of cotton allotments in Arizona because the legislation reduced the per-acre profit potential of cotton production (Weber 1972, 79-81). However, the fact that the 1965 legislation allowed allotments to be transferred, bought, and sold allowed cotton lands to amalgamate and shift away from urban areas with high land costs and areas with seriously depleted aquifers with very high water costs and into lower-cost production areas within the state (UAAES 1966, 9; 1967a, 13-14; 1968, 5-7; 1969, 6-7; Weber 1972, 36). Without the legislation, many of the allotments would have been forced to be "retired," leading to a decline of cotton production (Kelso et al. 1973, 226). As long as the cotton programs endure and cotton planting decisions for Arizona continue to be essentially made in Washington, D.C., Arizona will be a cotton state. It would be hard to imagine large-scale cotton production in Arizona without the
subsidies offered through the farm programs. I believe that if the benefits from the farm programs for cotton production were entirely eliminated the decline of *G. hirsutum* production in Arizona would shortly follow. *G. barbadense*, however, is a specialty crop, unique in the United States to the Southwest. Even without the farm programs, there will probably be a continuing significant production of *G. barbadense*, probably concentrated in Graham County.

**Increasing Competition and Alternate Crops**

Cotton production in Arizona will decline as foreign competition increases. The recent publication *Arizona Agriculture – Now and a Vision of the Future* contains a prediction that throughout the remainder of the 20th century cotton production in Arizona, because of increasing competition from Chinese and South American producers and reductions in federal supports, will generally decline (UACA 1986, 182). Cotton production in the People's Republic of China more than doubled during the early 1980s, and the PRC now leads the planet in cotton production [28.7 million bales in the 1984-5 growing season]. The United States is a far second [12.982 million bales], and the Soviet Union is not far behind [11.876 million bales] (ACLRS 1986, 96).

Most Arizona cotton continues to be destined for east Asia and much of it returns to the United States, value added, as consumer goods (Comeaux 1981, 236). This puts the well-being of the Arizona cotton production industry ironically at odds with the well-being of the U.S. cotton processing industry. Thus "there is considerable
pressure on the U.S. government to protect the cotton industry from
the cotton processing industry in the Far East. However, any
restrictions on the importation of cotton goods would have
substantial detrimental effects on Arizona cotton markets" (UACA
1986, 69).

Vegetable crops, particularly lettuce, are second to cotton
in importance in Arizona agriculture (UACA 1986, 129). Given the
elimination of the farm programs or the markets for Arizona cotton,
the agribusiness cropping system of choice in Arizona might shift to
vegetables ("Economy is Greener Thanks to Vegetables" 1989, 8). This
will alter certain parts of the system, for example labor demands
would increase, but the general power structure of the agribusiness
system will remain essentially intact. If cotton prices or cotton
programs were to alter so dramatically that the crop no longer
offered the highest and quickest returns, there would be a shift to
the crop that does. Be it cabbages or kumquats, the essential
agribusiness strategies would continue to be followed.

Farmland Idlement

Idled farmland results in a local cessation of cotton
production. Farmland is idled when, for any one or several of a
variety of reasons, such as urban encroachment, salinity, rising
water costs, state law, or tumbleweeds, it becomes unprofitable to
farm a piece of land or more profitable to use the land for something
else. In the short-term, farmland idlement will result in spatial
shifts in cotton production, since the cotton allotments will simply
be sold to producers in areas such as the expanding agricultural oases in Yuma County.

Urban Encroachment

Urban encroachment is responsible for some farmland idlement as rising land values make cotton production unprofitable. By the mid-1950s, one-fifth of the original 240,000 acres of irrigated land in the Salt River Project were in subdivisions or other non-agricultural uses (Barr 1956, 3). The initial urban encroachment in the Project, however, was mostly on feed lots and citrus orchards, and cotton lands were relatively unaffected until the late 1960s (ASES 1969, 5). An exception is Sun City. In 1959 the Del Webb company entered an agreement with the J.G. Boswell Cotton Company to develop several thousand acres of former cotton lands in the northwest Salt Oasis into the planned retirement community of Sun City. On adjacent cotton lands, Sun City West was developed in the late 1970s (Wiley and Gottlieb 1982, 1845). Of 242,000 acres historically under ditch in the Salt River Project only 87,000 acres were farmed in 1984 (UACA 1986, 41). Similarly, the retirement community of Green Valley was founded in 1963 on the south half of the old Spanish Canoa Land Grant on the upper Santa Cruz (Comeaux 1981, 216). By the late 1970s, some cotton growers' children in the upper Gila Oasis were selling their inherited farmland to developers (Sayers 1979, 105).

Salt

Land is also idled, as I have mentioned in the cases of the
Salt and lower Gila Oases, because of problems of salt build-up and water logging that cut productivity. For example, at first the new land opened in Pinal county was very productive but by the middle 1940s cotton yields dropped off dramatically. Barr (1946a, 3) attributed this in part to the accumulation of alkali in the soil. Salty lands can be profitably put under halophytic cultivars, such as some special cultivars of barley (Webster 1981), but since cotton is particularly salt sensitive, the issue of the usability of salty irrigation water is, in relation to cotton production, a dead end (Frederick 1982, 106-08).

The Falling Water Table and Rising Energy Costs

Water is Arizona's the critical resource and water access will strongly influence the future of land idlement and cotton production in the state. Intensified groundwater pumping during the 1940s caused the water table in Arizona pumplands to begin to drop dramatically (Barr 1949, 2; Dunbar 1977, 13). The average pump lift in the state doubled between 1948 and 1953, due partly to farming expansion in high lift areas, but also to falling water tables in almost all areas. Except for the oases of the upper Gila and the upper Santa Cruz, where the recharge from the periodic stream flow was sufficient for replenishment of the aquifer, pump lifts throughout the state continued to increase through the early 1950s. By the late 1950s, groundwater in Arizona was lifted an average of 270 feet and within a range of 50 to 350 feet. The average lift in Maricopa county in 1956 was 260 feet, and 325 feet in Pinal county
(Barr 1950, 2; 1952, 2; 1954, 3; 1957, 4; Seltzer 1958, 5). The water table decline continued in the early 1960s, depths of 200-300 feet were general throughout Arizona's pumplands and the depth in some localities, particularly the western part of the Stanfield-Maricopa area, began to approach an economic limit - under conditions of current cotton prices and available pumping technologies and costs - of about 500 feet (UAAES 1962, 9; 1963, 9; 1964, 5). The increasing depth to groundwater remains a serious problem throughout the pumplands of southern Arizona and is particularly acute in areas far from stream channels and other natural recharge zones (Comeaux 1981, 239-40; Towne 1986, 9-16, 43).

The dropping water table and rising energy costs, coupled with other factors I discussed, resulted in substantial farmland idlement in the mid-1980s when there were 45,000 acres of abandoned cotton lands in Pinal County and 300,000 acres in Cochise County that were under ditch and cotton in 1965 but not in 1985 ("Abandoned Arizona Farms Show U.S. Trend" 1985; "Dust-Bowl Predictions" 1985). Between 1980 and 1987, over half of Cochise County farms failed. Thomas Dickinson, district director for the Farmers Home Administration, remarked "I see an end to farming as it is being conducted in Cochise County" (cited in "Cochise County Farms" 1985).

Urban Competition for Water

A state bill passed in 1977 allows cities to purchase and idle farmland in order to secure the rights to the groundwater beneath it (Comeaux 1981, 236). The city of Tucson then purchased
[for $80 an acre] almost half of the 25,000 acres of farm land in Avra Valley. There were 25 Avra Valley farms in 1970 and only 8 or 10 in 1977. There were 3 active Avra Valley cotton ginneries in 1976 and only 2 in 1977 (Foster and Wright 1980, 90-3; Sherretta 1977). Arizona's 1980 Groundwater Management Act, which gave Arizona cities until 2001 to establish alternate water resources or face growth curtailment, greatly accelerated the rush for "water farming" (Volante 1989). By 1985 Tucson had purchased and retired 20,000 acres of Avra Valley farmland ("Abandoned Arizona Farms Show U.S. Trend" 1985). In the summer of 1986 I saw some cotton growing in the Avra Valley, although the Avra Valley ginneries were idle.

**Tumbleweeds**

Tumbleweed, an introduction from central Asia, flourishes as a weed on idled farmland and actually might - in a negative feedback loop - force the idlement of adjacent and proximal cotton lands. One Willcox area cotton grower reported that at harvest-time tumbleweeds "... roll through his cotton fields and actually harvest bolls until the wind is blowing around a big white cotton ball" ("Abandoned Arizona Farms Show U.S. Trend" 1985). Thus the returns from cotton production in cotton fields that are within tumbleweed rolling distance from idled farmland are jeopardized.

**Future Prospects for Water Use in Arizona**

Water availability, which is vital to the endurance of the cotton production region, will decline in the long run because of groundwater mining and in the short run because of groundwater
legislation. Factors such as augmentation and conservation of the water supply will somewhat delay the immediate effects of groundwater inaccessibility.

Groundwater Mining

Ultimately, agriculture in Arizona will suffer as groundwater stocks become depleted or get protected by law. The early water laws and institutions in the western U.S. were not intended to limit water use in any way, but rather to give landowners a legal title to their water rights, to encourage the development of water resources, and to minimize conflict among water users. In fact the endurance of groundwater resources is not guaranteed and future access is threatened by the dropping water table and rising energy costs. Through improvement in pumping technologies, however, growers have managed to continue to pump groundwater, although a large public cost is accruing. As Frederick (1982, 213-14) writes, "In terms of achieving a long-term efficient use of the resource, one problem with the current groundwater situation is that farmers' costs do not include the loss to neighboring farmers and future users of depleting an aquifer."

In the early 1980s, groundwater mining – use in excess of recharge – in the 17 western United States exceeded 22.4 maf per year in an average year (Frederick 1982, 82). Political and economic factors have worked to make it desirable, from the agribusiness standpoint, to extract and use groundwater as rapidly as possible, Frederick (1982, 137-8) writes that
individual farmers have no rights to water left in the ground until it is withdrawn. Consequently, the value an individual attaches to water left in an aquifer may be less than its social value, and pumping based on private decisions may use the water at a faster rate than is socially desirable.

Studies done in the mid-1940s indicated that Arizona's groundwater resources were already overdrawn (Barr 1946b, 10). The expansion of Pinal county's cottonlands was in fact made possible by mining the aquifer and the lower Santa Cruz Oasis was the first area in Arizona to display depleting groundwater resources (Greisinger and Barr 1941, 281). Studies in this area in the mid-1930s revealed that pumpage exceed natural recharge by 100 percent and researchers in the late 1930s calculated the annual overdraft in the lower Santa Cruz Oasis at 220,000 af (Dunbar 1977, 7-10). This depletion became acute by 1945 and Barr predicted the ultimate decline of agriculture in the area (Barr 1945, 1-2). The immediate revenue accruing to Arizona growers from the 1948 overdraft was about $35,000,000, roughly equal to 60 percent of the gross income from cotton production in 1948. The public cost is "a water poverty within the state" (Barr 1949, 2). For the state, since the 1940s and until the early 1960s, there was a regular overdraft in excess of 3 maf per year (UAEAS 1962, 9; 1963, 9; 1964, 6). During the 1960s the state-wide overdraft went as high as 4 maf annually (Reisner 1986, 309). In the lower Santa Cruz Oasis in the mid 1960s it was estimated that, since the commencement of widespread pumpland development, 5.5 maf of groundwater had been removed from the aquifer; more than 70 percent of this was overdraft and only 1.5 maf was renewed by recharge (UAEAS 1965, 7).
By the early 1970s, 100 maf had been withdrawn from Arizona's "bank account" of 700 maf of economically recoverable groundwater (Berkman and Viscusi 1973, 122). In the early 1980s Arizona's annual overdraft stood at about 2.2 maf - about 88 percent of the total annual pumpage (Comeaux 1981, 240). This rapid depletion of Arizona's precious aquifer represents a massive public cost that will be charged to future generations (Frederick 1982, 74; Kelso et al. 1973, 10). As stated in a 1965 Arizona Agricultural Experiment Station Bulletin,

... the economic well-being of the state cannot persist for long by drawing on its water inheritance. The state, like any family, must sooner or later begin adding to its water account by increased inflows or by decreased withdrawals; sooner or later, it will be forced to live on its water income, not on its water inheritance (UAAES 1965, 7).

The Carter Administration Central Arizona Project review team stated in its 1977 report, "The declining water table has been one cause of wide fears that Arizona at some point not too far off might simply run out of water or that its growth might have to be severely curtailed" (cited in Fradkin 1981, 260).

The Central Arizona Project

CAP is intended to stall the overdraft, but it will only alleviate the current level of overdraft by two-thirds at most (Fireman 1982, 226; Wiley and Gottlieb 1982, 180). As a 1964 Arizona Agricultural Experiment Station Bulletin warned Arizona water-users, "The evil day of groundwater exhaustion will not be eliminated, only delayed" (UAAES 1964, 6-7). CAP does not create more water, but merely reallocates existing water supplies (Frederick 1982, 102).
The Colorado Compact allocations were based on records taken during a wet period resulting in an inflated estimate of 17.5 maf as the Colorado River's average annual flow. The actual average flow, as estimated in 1953, is only about 11.7 maf. Since Arizona relinquished absolute rights with the California Compromise, it is probable that the 2 maf of river water that CAP is designed for will not be available (Reisner 1986, 272). As other users with absolute rights — Californians, Indians, and Mexicans — divert their full allotments of Colorado River water, Arizona's available share will diminish. Of the total 2 maf allotment, the Reclamation Bureau estimated that the maximum flow in CAP would be only 1.105 maf when the Project opens (then expected for 1979), 500 taf in 1990, 360 taf in 2000, and only 284 taf by the end of the anticipated pay-back period in 2030 (Berkman and Viscusi 1973, 120).

Thus the future of water for CAP is in question. Reisner (1986, 310-12) predicts that CAP water will be too expensive for cotton production anyway, and it might well be that subsidized CAP water will be ineligible for use on subsidized crops such as cotton at all. However, CAP will play a role in the future of cotton in Arizona in that production will probably endure on Indian lands with absolute rights to CAP water, such as reservation lands of the Tohono O'odham Nation and the Ak-Chin Indian community.

Groundwater Legislation

The realization of the groundwater overdraft and the falling water table resulted finally in groundwater legislation which has a
definite and foreseeable consequence in the decline of cotton in Arizona. The groundwater laws passed until the early 1980s were, like straw dogs without teeth, cosmetic and ineffective (Comeaux 1981, 236; Mann 1963, 66; Wiley and Gottlieb 1982, 180). Increased energy costs in the early 1970s and publicity about the overdraft made water a major issue in Arizona state politics again by the late 1970s (Reisner 1986, 269-70; Wiley and Gottlieb 1982, 180). The Carter administration asserted that CAP was intended to stem the groundwater over overdraft and stipulated that an effective groundwater code be passed for the funding of CAP, then 20 percent completed, to be continued. Thus the 1980 Groundwater Management Act, the first state groundwater code with a backbone, was pushed through in order to salvage CAP. Currently, nearly all of Arizona's cotton lands have been designated as groundwater critical and drilling of new wells for agricultural purposes in these areas is strictly prohibited by law. Pumpers are now required to have permits for pumping within specific allocations. These allocations will be gradually reduced to slow the overdraft with an ultimate goal of stabilizing groundwater usage, with pumpage equal to recharge, by the year 2020 (Comeaux 1981, 235-6; Frederick 1982, 135; Wiley and Gottlieb 1982, 180-2). Foster and Wright (1980, 85-6) predict that under the terms of the law, irrigated acreage in Arizona will fall to about 963,000 acres in 1990, and to 815,000 acres in 2000, and will stabilize at about 766,000 acres in 2020. More potential cotton land might exist on Indian lands not subject to pumping restrictions and with access to CAP water. In addition, water conservation measures
might allow a somewhat larger area to be irrigated with the same amount of water.

Water Conservation

There is much room for water conservation in Arizona agriculture. As early as 1884 local newspapers began to carry warnings that growers in the Salt Oasis were squandering the limited water supply by wasting as much as 60 percent of the water that they used (Peplow 1970, 29). In 1925, growers in some areas of Arizona were wasting as much as 80 percent of their irrigation water (Smith 1925, 273). Much early advice for water conservation at this time was very basic, for example Smith's irrigation rule number 16: "Do not irrigate the roads. Your neighbors do not appreciate this. Keep the gophers out of the ditch banks, shut off the water in time, and the highways will not become bogs" (Smith 1925, 293).

One of the more successful, albeit capital-intensive, technologies for conserving irrigation water is the drip-system. The first Arizonan to use drip-irrigation was an Indian. Robinson (1919, 317) describes an elderly Tohono O'odham woman who grew a small garden of onions irrigated by the water that dripped from an olla [a terra-cota water container].

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1. The cover of Forbes' (1911) survey of Arizona agriculture carries a rendering of this scene. Forbes' own home, located at the current site of the building that houses the Department of Geography and Regional Development at the University of Arizona, was surrounded by an extensive garden irrigated by a drip system of his own design, irrigated by windmill-pumped groundwater (Forbes 1906, 103).
Drip-irrigation involves very high sunk costs which prevented the technology from being further developed and diffused until the steep rise in energy costs for pumping groundwater water in 1973 made it economically feasible. The first adopters were growers of perennial tree and vine crops; field crops such as cotton, as they require periodic tillage and other field operations, were not at first amenable to drip irrigation (Comeaux 1981, 261). By 1984, however, there were 20,000 acres of cotton under drip irrigation in Pinal County. Keeping with its status as the cotton belt's innovation field, this area led the nation in drip-irrigating cotton. This was made possible by two locally developed innovations: one that allowed tillage without damaging underground water conduits, the other a portable drip system that could be rolled up at the season's end. Under traditional irrigation, one cotton grower in this area had an annual water-duty of 6.25 af per acre; with drip-irrigation the same cotton land used only 2.5 af per year (Dale 1984).

The rising petroleum prices of the early 1970s also influenced the widespread adoption of short-season cropping systems as a measure for water conservation. The short-season technologies were originally developed in response to the harmful pink bollworm infestations in the mid-1960s in a strategy to avoid mid and late season bollworm outbreaks. Growers, however, were generally reluctant to adopt the new practice since the yields were less than with full-season cotton systems (Willett et al. 1973a; 1973b). By 1980, however, the three-fold increase in energy costs caused wider
acceptance of short-season cropping systems in Arizona (Taylor 1980, 48-49).

The adoption of water-saving technologies lowers the cost of irrigation water per unit of production and growers adopting the technologies can actually maintain their levels of production in the face of declining access to water. Given unhindered access to water, growers can use the saved water to produce more. Thus water conservation, as well as doing nothing towards actually stemming the Arizona's groundwater overdraft, is likely forstall the decline of cotton (Ellis et al. 1984, 18). Without water conservation, increasing water-related costs might have forced a genuine decline in cotton acreage, instead, the technologies will only allow a more economical exploitation of an increasingly precious resource.

Water Resources and the Endurance of Agribusiness

As access to water for agriculture in Arizona declines agribusiness is likely to endure. With rising water costs from increased energy costs and falling water tables, and not taking CAP or groundwater laws into consideration, total groundwater pumpage in Arizona would decline by 906 taf or 18.9 percent between 1966 and 2015; irrigated acreage in major areas would decline a total of 196,000 acres representing a reduction of 28.6 percent in the affected areas. Crop-wise, 79 percent of this reduction would be in low-value per acre crops such as alfalfa, barley, and sorghum; 21 percent in next lowest value crops, wheat, sugar beets, and safflower; "no reduction whatever will occur in areas of the highest
value crops - cotton, field fruits and vegetables, seed crops, and citrus" (Kelso et al. 1973, 228-29). In other words, agribusiness in Arizona shall endure until the water resources are - at least for agricultural intents and purposes - all used up.

Hohokam

"Hohokam" is a word from the Pima Indian language that simply means "all used up." This definition offers a much more accurate description of the archeological evidence of Arizona's ancient cotton growers than do later glosses. Haury (1976, 5) writes:

... some of our [Pima] workmen went to considerable pains to explain to us that the common interpretation was not exactly what the Pima word meant. Literally hokam means something that is 'all used up,' essentially the same as Russell's explanation. A characteristic of Piman languages is the manner of pluralizing the word by duplication of the first syllable. Thus hokam is one thing all used up, and hohokam means more than one. It was pointed out to us that if a tire on one's automobile blows out it is hokam, if two go, hohokam. So, as the Pimas pass by the ancient Indian villages that dot their reservation, they think of them as 'used up.' This interpretation may not be as romantic as the one in general use, but it comes close to saying what the Pimas are thinking.

In this regard, Arizona's last cotton growers and Arizona's first cotton growers will have much in common. The landscape expression of Arizona's cotton production system will linger long

1. Russell (1908, 24), in the first published reference to the word, writes that "Hohokam" means "that which has perished," James (1917, 428) offers "the perished people," Lockwood (1932, 7) translates the term as "the Ancient Ones," Wagoner (1975, 26) uses "the vanished ones," Comeaux (1981, 76) renders it as "those who have gone before," and, according to the Tucson Yellow Pages (U.S. West Direct 1988, EZ 2), "Hohokam" means "those who have vanished."
long after agriculture is vanished from Arizona. At some time in the future, the area of the Arizona cotton production region—a denuded, salt-encrusted landscape, sunken and cracked from groundwater depletion, ecologically shattered from pesticide abuse, and punctuated with the ruins of rural slums that were cotton towns, silt-gorged reservoirs, dead rivers, and relic canals—might be simply described as "all used up."

**Summary**

Despite the considerable interest and long history of cotton production in the area, there was not a bonafide cotton production region in Arizona until 1912. Prior to railroad developments in the late 1880s Arizona growers were essentially cut off from outside markets and cotton production for export was unfeasible. While the rail developments allowed the large-scale production of a crop such as cotton for export, the inception of Arizona's commercial cotton industry ultimately awaited an extraordinary confluence of circumstances that promoted the cotton industry's development: the release of a special cultivar of *G. barbadense* cotton for Arizona, the completion of the Salt River Project, inflated cotton prices, and the interest of tire companies and other businesses in the production of cotton. Corporate cotton farmers, boosters, and quasi-corporations such as the Mormon community strongly influenced the genesis and rapid early development of Arizona's cotton production region.
The need for irrigation creates a demand for cotton, as does the concentration of land ownership by non-resident landlords and the dominating influence of financial lending institutions with interests in cotton production. Technological changes made it less necessary or desirable to plant crops other than cotton. The consequence is a general condition of monocropping with cotton, resulting in a cotton production region in the oases of southern Arizona. In any particular year, the distribution of cotton production is affected by factors—price and costs—that influence the profitability of cotton production. The expansion and decline of the Arizona cotton production region has been largely dependent on the process of oasis development. The imperative to produce cotton would diminish after a period of perhaps ten to twenty years as the initial sunk costs of reclamation are paid off. The agrosystem would then possibly diversify, with a greater emphasis on perennial crops. Other financial pressures to produce cotton, however, might remain.

The primary reason for cotton's dominance continues to be the fact that cotton growers continue to decide to plant cotton. Yet the process of arriving at a cotton planting decision has undergone an intrinsic metamorphosis. As the cotton production system of Arizona became increasingly industrialized and 'scientific,' cotton planting decisions, and so variations in planted cotton acreage, generally became more and more dependent on factors extraliminal to the basic cotton production system: variations in farm programs, variations in world supply and demand of cotton, and variations in production costs, particularly of petrochemicals. At the same time, variations
in planted cotton acreage became less dependent on intrasystemic production factors, such as variations in the labor supply, variations in water availability, variations in the quality of available cottonseed, and indeed, variations in the actual—and perhaps nonpecuniary—desire of growers to continue to plant cotton. This shift was accompanied by the evolution of Arizona's agribusiness system, which guides the decision to plant cotton in Arizona. Cotton is the crop of choice for some large producers and the sectors that are backward and forward-linked to production—the landowners and water companies; seed, chemical, and agricultural implement suppliers; ginners, warehousers, shippers, spinners, and manufacturers, and financial lending institutions—but for other Arizona growers, cotton is increasingly the 'crop of compulsion.'

The elimination of the farm program benefits and mounting competition from China will probably spell the end of large-scale *G. hirsutum* production in the state. The Arizona cotton production region will endure until the costs of cotton production exceed returns. Given an alternate crop, agribusiness would still dominate Arizona agriculture. Agriculture in Arizona will last until water, the vital resource, becomes physically, economically, or legally unavailable. The expression of agribusiness in the Arizona landscape will endure long after agriculture in Arizona is vanished.
APPENDIX A: PLANTED COTTON ACREAGE IN ARIZONA: 1912-1987

This is a document of planted cotton acreage in Arizona and significant cotton counties from 1912 to 1987. Arizona's major cotton producing counties are Maricopa, Pinal, Yuma [and La Paz, partitioned from Yuma County in the early 1980s], Graham, Pima, and Cochise; other significant cotton producing counties are Greenlee, Mohave, Santa Cruz. The Census and Arizona Agricultural Statistics does indicate insignificant and sporadic plantings of cotton in all of Arizona's other counties - Apache, Coconino, Gila, Navajo, and Yavapai (ACLRS 1966, 18-19, 34-35; USBC 1927b, 304; 1936b, 886; 1942b, 409; 1956b, 216-17; 1967b, 184-85; 1977b, IV-29, 77, 83) - but these 5 counties are of vanishingly minor importance and are not part of Arizona's main cotton growing region. Most of these data are culled from the Arizona Agricultural Statistics. This source, however, does not include acreage data by county for the period 1912-1932. Therefore I have reconstructed county data for the early period from various sources. The record before 1933 thus represents in some cases educated estimates.

Sources for Appendix: (ACLRS 1966, 8-37; 1967, 10-15; 1968, 10-11; 1969, 12-17; 1971, 16-21; 1972, 13-20; 1973, 10-15; 1975, 6-11; 1977, 6-11; 1978, 6-11; 1979, 6-9; 1980, 6-11; 1981, 12-23; 1986, 12-17; 1987, 12-17; 1988, 12-17; Brown 1929, 6; Davis 1958, 6-9; Farming in Pima County 1919; 1926; McGowan 1961, 36-37; Scofield 1913, 21; USBC 1920, 12; 1921, 11; 1922a, 9; 1922b, 238-39; 1923, 9; 1924, 9; 1925, 11; 1926, 11; 1927a, 11; 1927b, 304-05; 1928, 11; 1929, 11; 1930, 11; 1931, 11; 1932a, 11; 1932b, 258-59; 1933, 11; UAAES 1928, 28; 1931, 6; 1932a, 16).
### COTTON ACREAGE, ARIZONA 1912–1917

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## COTTON ACREAGE, ARIZONA 1984–1987

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