An Analysis of the Relationship Between Soybean Agriculture and Land-Use Transformation in the South.

George Harry Stopp Jr

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IN THE SOUTH.

The Louisiana State University and Agricultural
and Mechanical College, Ph.D., 1975
Geography

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AN ANALYSIS OF THE RELATIONSHIP
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TRANSFORMATION IN THE SOUTH

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of
Geography and Anthropology

by

George Harry Stopp, Jr.
B.A., University of Alabama, 1967
M.A., University of Alabama, 1971
August, 1975
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Special gratitude is expressed to Mr. Roy Boley and Mr. George Nicholas for their help with the mundane activities of soybean agriculture.

Finally, I would like to thank my wife, Peggy, who so often reminded me that goals must be reached and then helped me reach them.
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ABSTRACT

The purpose of this paper is to discern and analyze the geographical relationships between the recent rapid rise of soybean agriculture and the paralelling changes in land-use practices in a five-state region of the American South. Upon their introduction to New World agriculture in 1918, soybeans were heralded as a promising cash crop alternative to cotton. The South, however, did not take up the culture of this Oriental Wonder on a large scale, and the Midwest adopted soybeans as an integral part of their agricultural pattern. As we seek to determine the reason for southern rejection of soybeans as a profitable addendum to their faltering agriculture, we realize that, due to the lack of mechanization and the small farm size in the South in 1918, the successful culture of soybeans, which gives a relatively low monetary return per acre and therefore must be farmed on a large scale, the South could not adopt soybean culture at that time.

Recently, though, soybean culture has expanded rapidly in certain regions of the South. The explanation of this modern turnaround lies in the agricultural land-use
pattern of the South. Since 1950 both farm size and intensity of farmland use have increased across the study region, and these facts, coupled with acreage restrictions on other cash crops, have almost demanded that soybean culture flourish in the South. Statistical analysis and field experiences substantiate significant correlations between soybean acreage expansion and the above land-use transformations.
CHAPTER 1

Introductory Remarks on Soybeans in the United States

For generations Americans became accustomed to an agricultural landscape dominated by a few major crops, all of which have been a part of the rural landscape since the beginning of the nineteenth century. Some have become important enough to provide identifying names for agricultural regions; thus we find the Cotton Belt, the Corn Belt, and the Wheat Belt as recognizable areas within which a specific crop plays a dominant role. Moreover, each has been a major crop in the United States for almost two centuries. The dynamic expansion of the 1800s was based on such crops, and, with minor exceptions, few crops were added since that time.

Over the past fifty years, however, a new crop has emerged onto the American agricultural landscape. At first this "wonder crop", the soybean, was relatively unimportant but since World War II its culture has mushroomed, making it a major crop in the Eastern United States. Virtually unknown only a generation ago, the soybean is now a familiar crop from Minnesota to Georgia and from New York to Texas (Figure 1).
In fact, soybean agriculture did not prosper at all in the United States until after World War I. The general shortage of fats and oils in the United States during World War I greatly furthered the cause of commercial soybean agriculture; in 1918 nearly 344 million pounds of soybean oil were imported by the wartime United States, thus establishing a domestic need for soybeans and soybean products. This importation total was never exceeded, not even during the war which followed the "War to end all wars." As Table 1 indicates, soybean products imports by the United States have gradually dwindled to zero since the post-W.W.I period.

From this humble beginning the United States took world leadership in soybean production in 1934, surpassing previously leading Mainland China's 320 million bushel output by 21 million bushels. The United States has yet to relinquish its primate soybean status; the 1.27 billion bushels of soybeans grown on 45.8 million acres of farmland in the United States in 1972 represented seventy-three percent of the total world production for that year.

Table 2 demonstrates the relative importance of soybeans within the agricultural system of the United States today. This imported "new" crop is now a close fourth in total acreage among all crops and is a strong second in total crop value.
## TABLE 1

### U.S. SOYBEAN MEAL PRODUCTION, IMPORTS AND UTILIZATION (1,000 T)

<table>
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<th>Year</th>
<th>Domestic Production</th>
<th>Imports</th>
<th>Domestic Use</th>
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<td>1930</td>
<td>98.6</td>
<td>24.0</td>
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<tr>
<td>1931</td>
<td>114.7</td>
<td>18.6</td>
<td>133.3</td>
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<td>1932</td>
<td>84.3</td>
<td>28.3</td>
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<td>1933</td>
<td>73.9</td>
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<td>1934</td>
<td>220.4</td>
<td>64.2</td>
<td>284.6</td>
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<td>613.1</td>
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<td>1963</td>
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<td>1970</td>
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TABLE 2

U.S. CROP ACREAGE AND VALUE - 1972 (1,000s)\(^6\)

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<thead>
<tr>
<th>Crop</th>
<th>Acreage</th>
<th>Value ($)</th>
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<tr>
<td>Hay</td>
<td>59,783</td>
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<tr>
<td>Corn</td>
<td>57,289</td>
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<td>Wheat</td>
<td>47,301</td>
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<tr>
<td>Soybeans</td>
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<td>Barley</td>
<td>39,707</td>
<td>2,014,230</td>
</tr>
</tbody>
</table>

Large scale soybean agriculture in the United States began in the Midwest; Illinois, Indiana, and Iowa have been traditional leaders of soybean production in the United States, ahead of all other states in both acreage and production. Figure 2 indicates that these midwestern states do indeed still lead the country as a whole in soybean agriculture, but this figure also shows that a different region of the country is experiencing a recent rapid expansion in soybean acreage at a rate comparable to that experienced in the Midwest from World War I until the present. Several states in the Deep South are rapidly becoming soybean producers on an important scale. As of 1970, both Louisiana and Mississippi had over one million acres of soybeans harvested within their borders, and several other southern states were approaching soybean-millionaire status.

But it is not the gross amount of soybean acreage in the South which is impressive, for Illinois and Iowa dwarf the soybean harvests of all other states. The southern states are impressive, however, for their
Figure 2 - Soybean Acres Harvested, 1950-1970 in States With Over 1,000,000 Acres
rate of expansion in a very brief, recent period.
Sample rates of acreage increases in the South for the
ten year period 1960 to 1970 are: Alabama, 460 per cent;
Georgia, 704 per cent; Louisiana, 681 per cent; Missis-
ippi, 152 per cent; South Carolina, 200 per cent; Na-
tional Increase, 77 per cent. If we used the years 1940
to 1970, the percentage gain would be even more impres-
sive. In 1940, less than 200,000 acres of soybeans were
harvested in these same five southeastern states. By
1970, over six million acres of soybeans (Glycine max (L))
were harvested in these states, a regional acreage increase
during the same period of over 800 per cent.8

Increases in agricultural production of this
scale are of interest to geographers for it entails loca-
tion and relocation of phenomena upon the landscape.
Soybeans in the field, combines and wheeled bean bins,
grain drying silos, soybean-oil mills, all became more
commonplace elements of the cultural landscape as the in-
cidence of soybean agriculture increased. What landscape
features do we associate with soybean agriculture? Where
would we expect to find a "soybean landscape"? Why do
we find soybean agriculture where we do? How does a
shift to soybean culture affect the traditional landscape
pattern? These are legitimate geographical questions and
will be dealt with, to some extent, in this paper. But
the emphasis will lie upon the latter two problems: why
is soybean agriculture in the United States located where it is today, and what changes has it brought or does it herald for the landscape where it has recently appeared?

Specifically, the purpose of this paper is to analyze the spread of soybean agriculture across the five southern states of Alabama, Georgia, Louisiana, Mississippi, and South Carolina. This will entail a history of soybean agriculture as it developed in Asia and as it spread to the New World where it was introduced initially to the South. It has long been recognized that soybeans are well suited to the climate and soils of the Cotton Belt and to much of the regions bordering on this zone. Why then has this region's potential for soybean agriculture only recently been exploited? Why, of all regions in the United States, has the South been the center of recent soybean expansion of a grand scale? The task of uncovering the reasons behind the South's initial rejection of soybeans and its recent acceptance of the same oriental wonder crop pose the central problem for this study.

The thesis put forth as the paper evolves is that the solution to the problem involves both the economics of soybean agriculture and the way in which soybean farming has articulated with a changing southern agricultural system. Until the southern system underwent substantial changes, changes in land-use intensity
and in general configuration, soybeans were economically unsuited to the South.

As the study progresses and the above ideas are substantiated, this analysis of past events will be used to predict the locations of future expansion of soybean agriculture in the five state region. For the near future at least, the potential for southern acceptance of soybean culture appears unlimited and the landscape transformations associated with this crop, both before and after the fact, are substantial.
FOOTNOTES


CHAPTER II

Domestication of Soybeans and its Early Uses

Oriental Beginnings

The soybean (Glycine max. (L.)) is a native of eastern Asia. The wild form of the plant is Glycine ussuriensis, which occurs in China, Manchuria, and Korea. The first record of its domestication occurs in 2838 B.C. in the northeastern provinces of China. The wild soybean plant is a creeping vine, in contrast to the upright modern soybean plant. The plant became known in China as chias-yiu and was considered one of the muku, the sacred grains of China. The soybean was already an important element of the Oriental diet by 1 A.D., but it was some time later that soybeans reached staple significance, its culture advocated by the followers of another prophet, Buddha.

The spread of soybean agriculture throughout Asia, and particularly to Japan, "coincides quite closely with the spread of Buddhism in 500-600 A.D." Buddhism, because of the meat taboos many of its followers observe, was a major influence in the spread of soybean culture across Asia.
Many of the different types of soybean products and dishes common today in Asia, and known there for thousands of years, resulted from research of Buddhist priests. The Japanese adopted both Buddhism and the soybean, and it is the Japanese word for soy sauce, *sho-yu*, from which we derive our English word soy.

The ubiquity of Buddhism throughout Asia helps us to understand the importance of vegetables in the Oriental diet, but why did the soybean become so vital a part of this diet? The extreme hardiness of soybeans and the wide-range of environments suited to soybean plants may be a partial answer to this question, but equally important is the nutritive constitution of the soybean. The soybean is also a high protein, high energy food (Table 3) and, although early soybean enthusiasts may not have known the chemical make-up of the bean, the survival rate of soybean consumers was no doubt superior to that other vegetarians enjoyed.

Soybeans may be prepared in many ways, some of which are popular not only in the Orient, but in the Occidental world as well. The green bean may be hulled and eaten raw, boiled, or roasted. Dried beans may be boiled or soaked in water and then roasted. Boiled soybeans do not rupture upon prolonged cooking like other beans or peas. Since they do not have a high starch content, soybeans maintain a crisp nut-like consistency and
will not "mush" like other beans, no matter how long they are boiled. These direct methods of preparation are the simplest, but neither are the most common nor traditional forms of soybean foods. Below is a list of some of the soybean-derived foods which have been popular in Asia since the beginning of extensive soybean use, and their popularity helped spread the domestication of the bean across the Orient.

TABLE 3

NUTRITIONAL CONSTITUENCY OF SOYBEANS AND MORE COMMON FOODS

<table>
<thead>
<tr>
<th>Product</th>
<th>% Protein</th>
<th>% Fat</th>
<th>% Carbohydrate</th>
<th>Cal/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>8.0</td>
<td>0.3</td>
<td>79.0</td>
<td>3,595</td>
</tr>
<tr>
<td>Beef</td>
<td>14.5</td>
<td>22.5</td>
<td>-----</td>
<td>2,687</td>
</tr>
<tr>
<td>Mutton</td>
<td>14.5</td>
<td>25.0</td>
<td>-----</td>
<td>2,879</td>
</tr>
<tr>
<td>Bacon</td>
<td>9.5</td>
<td>59.4</td>
<td>-----</td>
<td>5,914</td>
</tr>
<tr>
<td>Milk</td>
<td>3.3</td>
<td>4.0</td>
<td>5.0</td>
<td>712</td>
</tr>
<tr>
<td>Eggs</td>
<td>11.9</td>
<td>9.3</td>
<td>-----</td>
<td>1,353</td>
</tr>
<tr>
<td>Salmon</td>
<td>15.3</td>
<td>8.4</td>
<td>-----</td>
<td>1,455</td>
</tr>
<tr>
<td>Wheat</td>
<td>12.0</td>
<td>1.5</td>
<td>73.0</td>
<td>3,612</td>
</tr>
<tr>
<td>Oats</td>
<td>14.3</td>
<td>1.5</td>
<td>67.0</td>
<td>3,550</td>
</tr>
<tr>
<td>Maize</td>
<td>10.2</td>
<td>3.0</td>
<td>72.5</td>
<td>3,630</td>
</tr>
<tr>
<td>Soybean</td>
<td>42.8</td>
<td>20.0</td>
<td>28.0</td>
<td>4,710</td>
</tr>
</tbody>
</table>

Bean Sprouts: These are made by wrapping dried soybeans in a wet cloth and letting them sit in a warm place until the seeds sprout. The sprouts are then used as a vegetable in soups, sauces, and casseroles.

Soybean Milk (fu chang): This liquid is made by soaking dried beans overnight in water, then grinding the wet beans to a mush. The mush is heated and the liquid, soybean milk, is filtered out by squeezing the mush in a
Cheesecloth bag. This foodstuff was reportedly developed by the philosopher Whi Nein Tze over a hundred years B.C.

Tofu (Japanese) or Teou Fu (Chinese) or Dan Fu (Vietnamese): This is a cottage cheese-like substance made from soybean milk curdled by addition of salt water. Tofu is added to soups and casseroles as a dumpling or deep fat fried. The latter form of Tofu is called aburage in Japan and is sold by street vendors even today. It is a staple in the Japanese diet.

Shoyu (soy sauce): This substance is made by fermenting soybeans and wheat, rye, or millet cooked together. Fermentation is due to a mold from parched wheat which is added to the cooked mixture after it cools. Soy sauce originated in the Chau dynasty (1134-246 B.C.) and has changed little since that time. The sauce, dark brown or black in color, is added to almost all types of dishes and is applied to meats and breads also.

Miso: This dish is a paste made from the residue of fermented rice or barley and soybeans. Miso varies in color and taste according to the preference of the producer; a high percentage of rice in preparation makes the paste light and sweet. The mixture must ferment at least one summer, and an additional summer is said to improve the flavor. The paste is used as a soup base or for pickling vegetables. The Japanese have recently perfected a dry miso soup mix which is very popular on those islands.
Kochu Chana: This is a seasoning mix made from boiled mashed soybeans which are caused to ferment by mixing with an old batch of kochu chana (much as yogurt "starter" is used). The mixture is then stored in sacks which are hung in a special drying shed for two or three months. The dried material is ground into a fine powder, and red peppers and salt are added, and then the powder is aged a few months more. Kochu chana is used as a seasoning for both meats and sauces.  

Throughout Asia local variations of the fermented and non-fermented products mentioned above have formed an integral part of the human diet for thousands of years and continue to do so today. Of the products described, only bean sprouts and soy sauce (shoyu) have been widely accepted by the Western palate. Even these do not form an important segment of the daily diet.

No mention has yet been made of soybean oil or of soy flour, two very familiar commodities in the modern world markets and two increasingly common food products in all countries. But oil extraction from soybeans is a recent innovation compared to the antiquity of the other foodstuffs; so too is the use of soy flour, a by-product of oil extraction.

European Introduction and American Acknowledgment

Soybean agriculture continued to expand throughout Asia, and the variety of foodstuffs made from soybeans
became increasingly important in the Oriental diet. Not only was the soybean used as food, but its various products were the base of many medicines and potions used in Asia. The Western world was without any knowledge of the "Wonder Bean" until the eighteenth century. Perhaps the sheer ubiquity of soybean products kept Asians from bringing the bean to the attention of European explorers. Perhaps the mundane nature of the plant and its derivatives failed to interest Europeans who traveled to the Orient. Whatever the reason, Engelbert Kaempfer, a German Botanist who traveled in Japan in 1691-1692, first brought news of the soybean to Europe in his writings in 1712. The news had little impact on its readers, however, and the soybean remained relatively unknown in Europe.

In 1737 Linnaeus described the soybean in *Hortus Cliffortianus* from plants grown at Harticamp, Holland. In 1739, soybeans were planted as an oddity in the *Jardin des Plantes* in Paris. Since these were a different species from those beans grown in Holland, Linnaeus misclassified them which resulted in two names being assigned to the soybean in 1753. They were called *Pisum sativum* and *Pisum soja* respectively. In 1790, soybeans were first grown at the Royal Botanic Gardens in Kew, England, again, as an exotic.

Despite its introduction into Europe, there was no real attempt to grow soybeans for food outside Asia
even though the Chinese already had perfected a man-powered wedge press for mechanical extraction of oil from soybeans. Given conditions in Europe at the time, the oil would have been a valuable commodity.

Although it was not seriously considered as a food crop, the soybean received some attention in the New World during the eighteenth century. In 1804, James Mease reported that "The Soy-Bean bears the climate of Pennsylvania very well. The bean ought therefore to be cultivated," but his words went unheeded. Several years later, a Cambridge, Massachusetts author suggested that "This plant thrives well in this climate, and perfects its seeds. Its principal recommendation at present is only as a luxury, affording the well-known sauce called soy which at this time is only prepared in China and Japan." In the same journal little more than two years later (November 23, 1831) is an account of the successful culture of soybeans in Milton, Massachusetts. The seeds were obtained from Nuttall.

Another early mention of soybeans in American literature appeared in 1853 with a brief essay titled "Japan Pea". The account relates:

The Japan Pea, in which so much interest has been manifested in this country for a year or two past, from its hardihood to resist drought and frost, together with its enormous yield, appears to be highly worthy of the attention of agriculturalists. This plant is stated to be of
Japan origin, having been brought to San Francisco about three years since, and thence into Illinois and Ohio.

The following year, Admiral Perry's expedition brought back two types of soybean seeds from Japan, which were distributed by the U.S. Commissioner of Patents in 1854. As the nineteenth century ended, experiments with soybeans proceeded across the United States. Cook had success with the beans in New Jersey in 1878 at Rutgers. McBryde tested soybeans at the University of Tennessee agricultural school in 1881 and found "The yield, in view of all the circumstances was a remarkably good one. The plant is both hardy and prolific, and will probably give a heavy crop in a favorable season." By 1890, soybeans had been successfully grown in North Carolina and Kansas on experimental plots. At Cornell University, soybeans were planted in 1882 resulting in a crop "of excellent promise as a forage plant, even if the beans are not acceptable to the palate." This last statement is the prelude of an attitude toward soybeans that has prevailed in the United States to the present. The idea has long been held that soybeans are not "good to eat", perhaps even poison to humans. Sturtevant's quote is especially indicative of the early American approach to soybeans. They are important as a forage crop but should not be considered as a human food source.

With the progression of the nineteenth century, a great effort to expand soybean cultivation in Europe
began under the leadership of Frederick Haberlandt of Vienna, Austria. He predicted that the time would come when the soybean would play an increasingly important role in the diet of the European industrial poor because of its high fat and protein content and the expected low cost of soy products. Haberlandt obtained nineteen varieties of soybean seed at the Vienna Exposition in 1873 and, when four of the varieties he tested produced mature seed in experimental plantings, he then distributed the seed to cooperative farmers throughout Europe. This early attempt at soybean agriculture was not successful in any region of Europe. Probst and Judd speculate that the European climate caused failure of the crop, an idea substantiated by material presented in a previous chapter.

Despite widespread experimentation, commercial soybean agriculture and processing remained centered in Manchuria, China, and Japan until the twentieth century. The first large-scale shipments of soybeans to Europe began in 1900 as England imported several shiploads for use as a starch-free diabetic food. In the same year, soybeans were imported to Holland and Germany for the same prescriptive purpose and for the production of specialty food products. In 1907, almost 500 tons of dried soybeans were imported into England by an oil processor in Liverpool. It was found that the oil was suitable for soap manufacture and that the cake (the pulp left after oil extraction) was a high protein additive for feeding dairy cattle.
Success with this first soybean shipment and a worldwide shortage of cottonseed and linseed brought on the British importation of 9,000 tons of Manchurian soybeans in 1908.17

England enjoyed an early monopoly on large-scale trade in soybeans outside the Orient. They were so successful in disbursing the soy products that several British oil mills switched entirely to soybean processing. The soy industry in other European countries was hampered by import taxes, on beans of all types, meant to protect local agriculture. When these governments realized that soybeans were an important oil source and that few if any soybeans would be consumed as beans, the soybean was given the same tax-free status other oil seeds enjoyed at that time.

European importation of soybeans from both China and Japan balloons to immense proportions in a short time. In 1909, Europe received 412,757 tons of soybeans; 442,669 tons in 1910; and 321,940 tons in 1911. They continued to increase (Table 4).

Since Europe was importing and processing raw soybeans on an increasing scale primarily for oil, the by-products of mechanical oil production became an economic commodity also. Soybean cake and meal trade was lucrative in Denmark, Sweden, Norway, Holland, and northern Germany.18 The cake was first used for cattle feed, but the protein-rich flour (made by milling the cake) soon became an important addition to the diet of industrialized Europe.
<table>
<thead>
<tr>
<th>Product and Country</th>
<th>1912</th>
<th>1913</th>
<th>1914</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOYBEANS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United Kingdom</td>
<td>188,760</td>
<td>$7,630,477</td>
<td>76,452</td>
</tr>
<tr>
<td>Germany</td>
<td>96,068</td>
<td>3,974,837</td>
<td>107,504</td>
</tr>
<tr>
<td>Netherlands</td>
<td>42,373</td>
<td>1,592,690</td>
<td>27,119</td>
</tr>
<tr>
<td>Russia</td>
<td>695</td>
<td>30,250</td>
<td>267,036</td>
</tr>
<tr>
<td>Belgium</td>
<td>1,625</td>
<td>61,095</td>
<td>6,438</td>
</tr>
<tr>
<td>Denmark</td>
<td>412</td>
<td>14,035</td>
<td>4,425</td>
</tr>
<tr>
<td>France</td>
<td></td>
<td>34,318</td>
<td>918,008</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>329,933</td>
<td>13,303,384</td>
<td>523,293</td>
</tr>
<tr>
<td><strong>SOYBEAN OAK</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>23,852</td>
<td>836,269</td>
<td>7,230</td>
</tr>
<tr>
<td>Germany</td>
<td>7,080</td>
<td>252,912</td>
<td>3,260</td>
</tr>
<tr>
<td>Russia</td>
<td>2,059</td>
<td>72,136</td>
<td>21,969</td>
</tr>
<tr>
<td>Denmark</td>
<td>7,620</td>
<td>252,834</td>
<td>15,490</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>46,611</td>
<td>1,414,141</td>
<td>47,949</td>
</tr>
<tr>
<td><strong>SOYBEAN OIL</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Netherlands</td>
<td>4,558</td>
<td>250,422</td>
<td>2,828</td>
</tr>
<tr>
<td>Belgium</td>
<td>2,082</td>
<td>278,569</td>
<td>363</td>
</tr>
<tr>
<td>Italy</td>
<td>2,252</td>
<td>356,006</td>
<td>4,424</td>
</tr>
<tr>
<td>Sweden</td>
<td>1,116</td>
<td>154,434</td>
<td>784</td>
</tr>
<tr>
<td>Austria</td>
<td>617</td>
<td>99,797</td>
<td>1,314</td>
</tr>
<tr>
<td>Germany</td>
<td>10,902</td>
<td>1,450,134</td>
<td>3,090</td>
</tr>
<tr>
<td>France</td>
<td>1,693</td>
<td>249,486</td>
<td>83</td>
</tr>
<tr>
<td>Russia</td>
<td></td>
<td>5,150</td>
<td>508,076</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>95</td>
<td>11,570</td>
<td>455</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>23,220</td>
<td>2,838,848</td>
<td>18,143</td>
</tr>
</tbody>
</table>
This sketchy history of soybean use and dispersion has wound its way to the beginning of the twentieth century, and it has been since 1900 that the bean has achieved its present position of prominence. By the time serious soybean agriculture began in the New World, the original Oriental uses of the crop were still little known or accepted by the West. Oil for soap and cake for dairies were the primary uses of soybean products in Europe during the nineteenth century, contemporary evolution of a seemingly unrelated process created the technological basis for a new soybean product which was to considerably enlarge the beans utility. The following sidelight, describing this evolution, may be retrogressive to some degree, but its relation and importance to the central theme and to soybean industry will soon establish its merit.

Growth of the Margarine Process and Industry

Hippolyte Mege Mouriès was a French chemist of the 1800s. His first contribution to science was an oral treatment for syphilis. Inventions in the field of leather tanning and bread making established Mege's professional reputation and financial future. After financial success was assured, he is known to have dabbled in perpetua mobiliæ. In 1862 he began to experiment with animal fats and was retained by Napoleon III to produce an artificial
butter. Megé soon discovered that fasting cows give milk that did not make butter due to a low butterfat content. Megé concluded that butter fat must therefore be contained in beef suet or beef fat. By heating beef suet to 30-40° C., pressing it, and allowing the liquid extruant to cool, he obtained a fat that melted at 20° C. He then mixed this fat with skim milk, churned the mixture and produced beurre economique ( economical butter), or margarine. This process is still used to produce some margarines in the United States. The product made by Megé, which could be produced at a much lower cost than could butter, was so palatable and economically attractive that laws were passed the same year as its invention to prevent producers of margarine from calling the product butter or using the word butter in association with it. Margarine laws became commonplace in Europe. Despite its development by the French, the Dutch were quick to take up mass production of margarine in order to protect their traditional primacy in butter or now butter-like products (Table 5).

Late in the nineteenth century, the French chemists Sabatier and Senderens discovered that vegetable oils kept their fluid consistency at normal temperatures due to a much lower level of hydrogen compounds than that found in solid animal fats. In 1902 Wilhelm Normann succeeded in
producing hydrogenated vegetable oil, and the essential chemistry upon which the modern vegetable oil margarine industry depends had evolved. Soybeans, of course, were to become the primary source of vegetable oil and thus of margarine for much of the world.

### TABLE 5

**MARGARINE PRODUCTION BY MAJOR PRODUCERS TO 1888 (1,000 T)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Germany</th>
<th>Netherlands</th>
<th>U.S.A.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1874</td>
<td>-------</td>
<td>0.1</td>
<td>-------</td>
</tr>
<tr>
<td>1875</td>
<td>-------</td>
<td>0.2</td>
<td>-------</td>
</tr>
<tr>
<td>1876</td>
<td>-------</td>
<td>0.2</td>
<td>-------</td>
</tr>
<tr>
<td>1877</td>
<td>-------</td>
<td>2.5</td>
<td>-------</td>
</tr>
<tr>
<td>1878</td>
<td>-------</td>
<td>2.9</td>
<td>-------</td>
</tr>
<tr>
<td>1879</td>
<td>-------</td>
<td>4.4</td>
<td>-------</td>
</tr>
<tr>
<td>1880</td>
<td>-------</td>
<td>9.6</td>
<td>-------</td>
</tr>
<tr>
<td>1881</td>
<td>-------</td>
<td>13.4</td>
<td>-------</td>
</tr>
<tr>
<td>1882</td>
<td>-------</td>
<td>18.8</td>
<td>-------</td>
</tr>
<tr>
<td>1883</td>
<td>-------</td>
<td>22.8</td>
<td>-------</td>
</tr>
<tr>
<td>1884</td>
<td>-------</td>
<td>25.1</td>
<td>-------</td>
</tr>
<tr>
<td>1885</td>
<td>-------</td>
<td>27.9</td>
<td>20.0</td>
</tr>
<tr>
<td>1886</td>
<td>-------</td>
<td>29.9</td>
<td>-------</td>
</tr>
<tr>
<td>1887</td>
<td>15.0</td>
<td>33.3</td>
<td>-------</td>
</tr>
<tr>
<td>1888</td>
<td>-------</td>
<td>29.7</td>
<td>-------</td>
</tr>
</tbody>
</table>

**The Beginning Soybean Industry in the United States**

Observers in the United States were not unaware of European soybean imports and the advances made in the production and use of soybean derivatives. Soybeans were first imported in quantity from Manchuria to the United States in 1911. The beans were sold to Herman Meyer, who had opened a small oil and meal mill in Seattle, a small business which was to become the Pacific Oil Mills Company.
a massive oil processing conglomerate. The first few years production of oil from this mill was sold for industrial use, and the soybean cake was merchandised as "Proteina", a high-protein cattle feed. Herman Meyer died a few years later, and his young company abandoned soybean processing for a considerable time.

Extensive soybean agriculture began in Elizabeth City, North Carolina in 1912. After two experimental years the first domestic U.S. soybeans were crushed for commercial purposes by the Elizabeth City Oil and Fertilizer Company in 1915. That year nearly 100,000 bushels of domestically grown soybeans were processed, all in North Carolina or Virginia.22 Havens Oil Company of Washington, North Carolina, alone processed some 30,000 bushels in 1916. But, as these early successes hurried interest in soybeans as a commercial crop, most domestic beans were being sold for seed, and imports of Oriental beans and bean products grew. The wartime figure for soybean oil importation in 1918 is a record for the United States and represents a response to the combined pressure of wartime domestic need and low utilization of domestic beans for uses other than seed (Table 6).

These early soybean successes in the United States mark the beginning of the transition of the traditional pattern of soybean geography into a modern pattern which is only now maturing. Until 1915 soybeans were strictly an Oriental product. Soybean processing had spread to Europe,
but climatic limitations there forced the Europeans to rely upon imported soybeans. Soybean technology had progressed to a point where a variety of products which were economically important to Western Civilization could be made from soybeans, but until the New World proved that it could grow soybeans profitably, farmer and processor of this miracle crop had been several thousand miles apart. Although soybean advocates in the United States were yet to fight an uphill battle for integration of soybeans into traditional agricultural patterns, successful growth and processing of soybeans in the United States opened a door to opportunity for American agriculturalists and began a new and exciting chapter in the evolution of the culture and processing of soybeans.

TABLE 6

EARLY SOYBEAN IMPORTS TO THE U.S. (1,000s)²³

<table>
<thead>
<tr>
<th>Year</th>
<th>Soybeans</th>
<th>Soybean Cake</th>
<th>Soybean Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quantity, Value, lbs.</td>
<td>Quantity, Value, lbs.</td>
<td>Quantity, Value, lbs.</td>
</tr>
<tr>
<td>1910</td>
<td>none</td>
<td>none</td>
<td>unknown</td>
</tr>
<tr>
<td>1911</td>
<td>none</td>
<td>none</td>
<td>2,115</td>
</tr>
<tr>
<td>1912</td>
<td>none</td>
<td>none</td>
<td>2,416</td>
</tr>
<tr>
<td>1913</td>
<td>none</td>
<td>none</td>
<td>7,004</td>
</tr>
<tr>
<td>1914</td>
<td>1,929</td>
<td>49</td>
<td>3,163</td>
</tr>
<tr>
<td>1915</td>
<td>3,837</td>
<td>87</td>
<td>5,975</td>
</tr>
<tr>
<td>1916</td>
<td>3,003</td>
<td>78</td>
<td>10,468</td>
</tr>
<tr>
<td>1917</td>
<td>5,344</td>
<td>132</td>
<td>11,760</td>
</tr>
<tr>
<td>1918</td>
<td>1,433</td>
<td>111</td>
<td>78</td>
</tr>
<tr>
<td>1919</td>
<td>4,368</td>
<td>201</td>
<td>16,988</td>
</tr>
<tr>
<td>1920</td>
<td>3,136</td>
<td>180</td>
<td>29,473</td>
</tr>
</tbody>
</table>
FOOTNOTES


13 University of Kansas, Bulletin 19, Kansas Agricultural Experiment Station (Lawrence: University of Kansas, 1891), and University of North Carolina, Annual Report
of the North Carolina Experiment Station (Raleigh: University of North Carolina, 1882).


18 Piper and Morse, op. cit., footnote 17, p. 22.

19 Piper and Morse, op. cit., footnote 17, p. 19.


22 Probst and Judd, op. cit., footnote 16, p. 7.

CHAPTER III

Establishing Soybeans in the United States

First Attempts

Soybean culture is a relative latecomer to the United States. By the time it did have a serious introduction to American agriculturalists, around the beginning of the twentieth century, the general agricultural patterns we accept as essential to the United States were firmly set. The Corn Belt, the Wheat Belt, the Cotton Belt and smaller regions of specific crop dominance were quite well recognized when pioneers in soybean production introduced a new crop into the American agricultural system. Surely, the question foremost in the minds of early soybean enthusiasts was one of location; where should soybean agriculture succeed and where, within that area, would it be accepted?

Although little was known of the phenology of the soybean upon its introduction to North America, it was decided by most agriculturalists that the South was best suited for soybean culture.

"They have been tested at most of
the state agricultural experiment stations, and it is clear that their region of maximum importance will be south of the red-clover area and in sections where alfalfa can not be grown successfully. The soybean is especially adapted to the cotton belt.

For several years the South was touted as a potentially profitable home for this new crop from the East, which could be useful to that region in many ways. Perhaps the most recommended early usage of soybeans in the South was as a "most desirable hay and forage plant.....soy beans should be given a trial on every farm.....The soybean has been found valuable for hogs, where they are allowed to gather the crop from the field." The added value of this Oriental legume as a soil restoring rotation crop in regions of the South where wheat and rice were grown was early recognized and proclaimed by influential agriculturalists of the time. When disaster struck southern farmers in the Mississippi valley after the flood of 1912, it was recognized that not only could soybeans prosper in still-wet fields, but that they could also produce a crop even though they would be planted a month or more after the recommended time. If the beans could mature in this abbreviated time, they could become a cash crop also, sold as seed.

Earlier in this paper we became aware of the early soybean successes in North Carolina, where not only
the production of beans was profitable but local processing for oil and meal as well. It would seem from this experience that expert opinions were being upheld. The South was indeed a natural region for commercial soybean agriculture. But, as knowledge of the soybean industry spread, a profitable market for soybean seed for planting developed. This seed market proved so profitable, in fact, that no domestic soybeans were available for oil production for the 1916 season.\(^5\) This circumstance was a setback for the domestic soybean industry in the United States, for oil dealers could not expand their demand for domestic oil if its supply was to fluctuate so wildly, moreover, the price of seed beans would surely suffer if the bean's utility decreased. Never-the-less, there was still considerable hope in the hearts of soybean advocates.

"The demand for soy-bean oil, especially in the manufacture of soap and butter or lard substitutes, is keen, and its possibilities in the manufacture of varnish and paints are very great. It is now a strong competitor of other vegetable oils, and the demand for it is constantly increasing, both in this country and in Europe. When the meal becomes properly recognized as a feed material in the dairy and stock sections, there will be practically an unlimited market for it, while as an oil seed the soy-bean offers an excellent opportunity to the South as a cash crop for the planters and a source of oil and meal for the cotton-oil mills, especially in the boll-weevil sections."\(^6\)

And, indeed, Morse was correct, the demand for
soy products was increasing, but the demand was being met by foreign supplies. Table 7 illustrates the relative importance of foreign soybean oil in the United States before the beginning of World War I (before 1916) and during the same war. The yearbook of Agriculture has no citations listed under soy-bean in 1915, it has only one such citation listed in 1916. In 1917, there are eighteen separate listings under the title soy-bean. The soybean was destined to "occupy a larger and more important place in our agriculture and in our food supply." In fact, in 1917, we find agricultural experts exhorting soybean acreage increases across the country, some exhibiting unusual prophetic power by stating that "There is no reasonable possibility of overplanting it." 

TABLE 7
EARLY VEGETABLE OIL IMPORTS TO THE U. S. 

<table>
<thead>
<tr>
<th>Year</th>
<th>Soybean</th>
<th>Palm</th>
<th>Coconut</th>
</tr>
</thead>
<tbody>
<tr>
<td>1913</td>
<td>12,340</td>
<td>50,228</td>
<td>50,504</td>
</tr>
<tr>
<td>1914</td>
<td>16,360</td>
<td>58,040</td>
<td>74,386</td>
</tr>
<tr>
<td>1915</td>
<td>19,206</td>
<td>31,500</td>
<td>63,135</td>
</tr>
<tr>
<td>1916</td>
<td>98,119</td>
<td>40,496</td>
<td>66,007</td>
</tr>
<tr>
<td>1917</td>
<td>162,690</td>
<td>36,074</td>
<td>79,223</td>
</tr>
</tbody>
</table>

By 1918, our soybean oil imports had reached 336,000,000 pounds and the need grew larger for increased domestic production. Yet, production in the South, the prime target of soybean enthusiasts, remained small enough to allow most of the beans grown there to be used for seed
as other regions of the United States began to experiment with and to expand their soybean acreage. By 1920, Illinois and Indiana grew 8,000 and 3,000 acres of soybeans, respectively, all of which were sold locally for seed. By 1922 enough soybeans were harvested in these two Corn Belt states to warrant crushing the crop at the Chicago Heights Oil Manufacturing Company mill in Chicago Heights, Illinois. Domestic production was encouraged by the passage of a tariff of two and one-half cents per pound of imported soybean oil. This small bit of governmental interference on behalf of American farmers was a new phenomenon, but one which presaged the future.

In 1924, Eugene D. Funk of Funk Brothers Seed Company, Bloomington, Illinois, purchased the mill at Chicago Heights. He began an innovative agricultural program there "where we crush soybeans, extract oil and exchange soybean oil meal for beans with farmers as well as buy for cash."

Again, we see the apparent beginning of the great American soybean industry we know exists today, but this time in the Corn Belt states rather than in the South where the North Carolina experiment, initially so successful, had faltered. But this midwestern birth too was to breach. Too few mills were available to institute Funk's plan on a large scale, and midwestern farmers were reluctant to expand their involvement with soybeans if the only market
was for seed locally. To avoid the apparent impending second death of a fledgling soybean industry, H. G. Atwood, president of American Milling Company, and Eugene Funk met with members of the Grange League Federation and farm representatives of Illinois in 1927 to discuss the future of soybean agriculture in their state. At that meeting, the grain dealers agreed to purchase all the soybeans produced in 1928 at a fixed price, thus stabilizing an erratic market. It is felt by many, close to the meeting and to soybeans at this early period, that the Corn Belt soybean industry was begun and saved by this agreement. The European corn borer was becoming an expensive nuisance in parts of the Corn Belt and in certain areas had destroyed as much as seventy per cent of the corn crop and many feared for the future of corn as their chief cash crop. Thus, Midwestern farmers had an added impetus to seek additional cash crops during this period.

A number of factors continued to encourage the shift to soybeans. Corn borer infestations, a severe drought in 1934 which left late-planted soybeans as the only cash crop, and various programs of the Agricultural Adjustment Administration served as stimuli for soybean farmers through the 1930s. A variety of programs instituted by the federal government in 1942 to prepare for war-time needs of fats and oils, including production goals and guaranteed support prices further expanded soybean
agriculture in the United States. By the end of World War II, the United States was a true soybean world power. In 1949, we harvested over ten million acres of soybeans, second only to the China-Manchuria harvest of over seventeen million acres. The total world harvest that year was thirty-one and one-half million acres. The U.S. imported less than 500 pounds of soybean oil in 1949, while it exported almost 296 million pounds of oil and over thirteen million bushels of beans.

The South contributed but little to the bountiful soybean harvest of 1949. The northern states grew 9,346,294 acres of soybeans that year, 93.3 per cent of which (8,760,856) were harvested for beans. The southern states grew 2,919,291 acres of soybeans in 1949 (23 per cent of the total) and only 60.8 per cent of them (1,386,882 acres or 13.6 per cent of the U.S. total) were harvested for beans. Table 8 lists the six top soybean producer states in 1949 and, if we assume Missouri to be a part of the Corn Belt, not a southern state is listed among them. The following map graphically illustrates what we might call the "Soybean Belt" as it existed in 1949 (Figure 3).

The Midwest continued to dominate soybean agriculture in the United States in the years following World War II and, indeed, it is still unsurpassed in soybean acreage today. North Carolina and Virginia, early southern
### TABLE 8

SIX TOP SOYBEAN STATES IN 1949

<table>
<thead>
<tr>
<th>State</th>
<th>Acres Grown</th>
<th>Acres Harvested for Beans</th>
<th>Per Cent Harvested for Beans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illinois</td>
<td>3,287,341</td>
<td>3,135,002</td>
<td>95.0</td>
</tr>
<tr>
<td>Indiana</td>
<td>1,531,111</td>
<td>1,407,356</td>
<td>92.0</td>
</tr>
<tr>
<td>Iowa</td>
<td>1,344,311</td>
<td>1,312,467</td>
<td>98.0</td>
</tr>
<tr>
<td>Ohio</td>
<td>883,598</td>
<td>826,811</td>
<td>94.0</td>
</tr>
<tr>
<td>Missouri</td>
<td>964,029</td>
<td>885,805</td>
<td>92.0</td>
</tr>
<tr>
<td>Minnesota</td>
<td>789,957</td>
<td>753,305</td>
<td>95.0</td>
</tr>
</tbody>
</table>

**Figure 3 - U.S. Distribution of Soybeans Harvested for Beans, 1949.**

Acresage leaders, stabilized their soybean production in the 1930s. Mississippi and Arkansas gradually increased their
soybean involvement in the Mississippi valley, but that part of the South known as the Cotton Belt (incorporated in our five state study region) was still virgin soybean territory. As the larger scaled regional map below shows, very few beans were harvested in the South in 1949 (Figure 4).

Figure 4 - Acres of Soybeans Harvested in the Study Region in 1949.21

![Map showing acres of soybean harvest in the study region in 1949.]

Each Dot = 5000ac.
(U.S Census of Agriculture)

The small quantity of beans that were grown for beans in the five-state area in 1949 were concentrated in the Mississippi valley (Figure 4). Geographers were quick to recognize this intruder in the dust of a distraught cotton-oriented region and some remarked on the crop's
potential for further areal expansion. No one, however, predicted the rapidity with which the South would accept soybean agriculture nor could they foresee the effects this new crop would have on the entire agricultural landscape of the five-state region.

By 1949 the U.S. soybean industry had come of age, but it had not stopped growing, in economic importance or areal extent. In fact, culture of the wonder crop was only beginning to invade the Cotton Belt, its originally chosen home. The region we designated earlier as the Soybean Belt continued to intensify culture of the bean. In 1949 the American farmer harvested slightly over ten million acres of soybeans. In 1959 this total doubled to over twenty-two million acres, and by 1969 it had almost doubled again to just over forty-one million acres. By 1973 this total had grown still larger to almost fifty-seven million acres.

It should be remembered that the large majority of the total planted soybean acreage is represented by these figures for soybeans harvested. In 1969, 97.1 per cent of all soybeans planted were harvested for beans; in 1973 this figure was 98.4 per cent.

It appears that only an economic, ecologic, or climatic disaster can stop or even slow the further spread of soybean agriculture in the United States. The South, particularly the five states of our study region, will be the most active participant in this undertaking. We have
already seen the percentage increases involved with soybean acreage in the study region. The next series of maps presents a graphic illustration of this expansion and adds to our understanding of soybeans by formulating a spatial pattern for viewing (Figures 5, 6, 7, 8).

Figure 5 - Soybeans Harvested for Beans in the Study Region, 1954.24

Each Dot = 5000 ac
(U.S. Census of Agriculture)
Figure 6 - Soybeans Harvested for Beans in the Study Region, 1964. Note that little or no areal expansion occurred between 1954 and 1964.

Each Dot = 5000ac.
(U.S. Census of Agriculture)

Figure 7 - Soybeans Harvested for Beans in the Study Region, 1969. Notice that beans have spread along the Black Belt region and into the Tennessee River section of Alabama.

Each Dot = 5000ac.
(U.S. Census of Agriculture)
Processing Soybeans

Like most agricultural crops, soybeans require more than just planting and harvesting. Ancillary industries sprang up catering to the new agricultural system as it prospered and grew. Perhaps the most important of these is the processing of beans into oil, cake and other products. From soybean field to salad oil the task of processing soybeans entails two major steps: first the oil must be extracted from the beans, then the oil and the solid "cake" must be refined into a wide range of soy products. All plants handling soybeans or soybean derivatives are called soybean processing plants by much of the literature dealing with soybeans, but we should be aware that the facility which
extracts oil from the bean is not the same plant which refines the resultant oil; the former we will call soybean mills, the latter are refineries. Due to the ubiquity of soybean culture and the rapid increase in value of oil and cake over raw beans, soybean mills are more numerous than are refineries. The mill locations are producer-oriented, generally occurring in areas of soybean agriculture. The refinery locations are consumer-oriented, reacting more to market location than to agricultural areas (Figures 9 and 10).

Figure 9 - Soybean Mills in the United States, 1974.
Three systems of oil extraction have been utilized to process soybeans in the United States. The first system, mechanically separated oil from cake by hydraulic press. This crude crushing method was soon replaced, in the Midwest, by the expeller process, which consists of mechanical separation of cake from oil by passing the beans through a series of ever-tightening worm gears or expeller screws with an accompanying increase in heat. This latter method is more efficient than is the simple hydraulic press and, although the first expeller plant was not opened in the
United States until 1929, this process accounted for seventy-four per cent of all soybeans crushed in this country by 1940-41.\textsuperscript{30} A third system of oil extraction, the chemical or solvent process, has become the primary method of treating soybeans. The idea of chemically separating oil from soybean cake was developed in Europe and begun in the United States as early as 1926, but early problems with chemical residues in both oil and cake products slowed acceptance of this most efficient separation process.\textsuperscript{31} By 1949 the solvent extraction process broke down over half the soybeans produced in the United States, and today it is the primary system in use across the world and the only type being built.\textsuperscript{32} The few expeller plants still operating in the United States today are of the thirty to forty ton per day variety and they are decreasing in incidence. The newest solvent plants, made by Krupp Industries in Germany, process up to 2,000 tons of beans per day. (Table 9).\textsuperscript{33}

\textbf{Modern Uses of Soybean Products}

A prime factor supporting the increasing soybean acreage is a continued demand for soy products for both direct and indirect use. Soybeans and soybean products are used across the world, especially as oil and meal products.

Soybean oil may be refined into a large variety of products both foods and non-foods (Figure 11). About two-thirds of the edible soybean oil used in the United States is hydrogenated to some degree, that is they have
TABLE 9
SOYBEAN MILLS IN THE U.S., 196834

<table>
<thead>
<tr>
<th>Location</th>
<th>Total Number</th>
<th>Screw-Press Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Indiana</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Illinois</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>Iowa</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>Missouri</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Minnesota</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Nebraska</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Kansas</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Mississippi</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>Louisiana</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Arkansas</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>North Carolina</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>South Carolina</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Delaware</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Maryland</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Virginia</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Tennessee</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Texas</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>All Others</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>131</strong></td>
<td><strong>33</strong></td>
</tr>
</tbody>
</table>

hydrogen molecules attached to the oleic acids in the oil.35
This is done by a "nickel catalyst" technique and it has been an important addition to soybean technology. Hydrogenated soybean oil can thus be made into hard margarine, soft margarine, or liquid margarine. Soybean oil is not only used for margarine, it is also a constituent of many vegetable shortenings, it is a fat added to milk to change skim milk to whole milk, it is used as an emulsifier in ice cream substitutes (notably in MacDonalds Milk Shakes), and it is the main ingredient in many non-dairy whipped toppings. Lecithin is a soy oil product widely used as an emulsifier and preservative. It improves the processing of chocolate
Figure 11 - Modern Soybean Products
and cocoa, aids consistency control of caramels, nougats, and taffies, and gives clarity to sugary syrups. It is also used in many instant foods as well as in baby foods and is an increasingly important pharmaceutical emulsion.

Soybean oil is also used industrially as a coating for photographic films and as the oil base for paints, varnishes, resins, and plastics. Soy oil paints are especially useful as undercoatings because the dried paint has a sticky or tacky surface so the final paint coat will adhere better. The oil can be used as a resin base for adhesives, and it is a basic ingredient in epoxy glues which form a strong but flexible joint. All types of plastics have been made from soybean oil, including nylon and, in 1966 sixty million pounds of soybean oil (1.3 per cent of the U.S. oil total) were used in the plastics industry. Both linoleic and stearic acids are taken from soybean oil, the former is used to make linoleums and the latter is used in a variety of ways from cake mixes to ore flotation agents.

The solid residual of soybean processing is the cake or flake as the solvent processors call it. As it comes from the processor, soy cake or flake can be used in baking to add protein or as a meat additive or extender. It is relatively tasteless used this way and gives a protein boost to whatever it is added to, even to meats. The flakes may be ground to form soybean meal or grits, then mixed with other ingredients in pellet form to be used as livestock feed supplements in conjunction with corn, forage, or hays.
Over 90 per cent of the soy flake produced in the United States was used to feed livestock.\(^3\) Soy enriched feeds are high in lysine and typtophan, two amino acids which increase growth rates in young animals. Soybean flours and grits are used in all types of bakery products, instant foods, cereals, and canned meats. They are used also as a meat extender and as a protein booster in prepared foods of all types. High protein foods such as WSB (wheat, soy, barley) and CSM (corn, soy, millet) are prepared in the United States from soybean derivatives and other grain products, but they are generally consumed, as a gruel or in dough form, in underdeveloped countries. Isolated soy protein can be spun into a fiber with a pleasing consistency, colored, flavored and used as simulated meat, poultry, or seafood. Bacon-like chips are the most popular form of soy protein meat substitute, but artificial ham slices and sausage links are also available in grocer's freezer compartments. All forms of meat substitutes made from soy protein are richer in protein than is the "real" food they imitate. This isolated soy protein can also be made into textiles, paper, and fiber bristles.

One soy product has not been mentioned for it does not require oil extraction, yet is a relatively modern usage. Full-fat soy flour is made by hulling, toasting, then grinding whole soybeans. The oil is retained in the flour. The high oil or fat content of this flour makes it desirable
for fried breads of all kinds and for doughnuts, since there is little penetration or loss of cooking oil with these flours even when deepfat fried. This flour is also used in pet foods and in human foods where a high fat content is prescribed.

In a very short time soy products, especially oil derivatives, have become the dominant vegetable oil source in the United States (Figure 12). In 1950 soybean oil provided 41 per cent of the vegetable oil used in this country; a similar amount of cotton seed oil was utilized. Lard was then the most important single source of all fats and oils, soybeans accounted for little over 20 per cent of all fat and oil consumed in the United States. By 1972 soybean oil was firmly established as the primate vegetable oil with nearly 73 per cent of that market in the United States. Over 55 per cent of the total fats and oils consumed were soybean oil products. Lard (made from animal fat) is now the second most important fat and oil source but it provides slightly more than one-fourth the supply of these essentials that soybeans do. The figure below examines the way in which soybean and other oil sources were utilized in the United States for a twenty year period.
Figure 12 - Utilization of Primary Fats and Oils in the United States, 1949-1969.
FOOTNOTES


6 Morse, op. cit., footnote 5, p. 111.


10 U.S. Department of Agriculture, Yearbook of Agriculture, 1918.


15 Dies, op. cit., footnote 11, pp. 18-22.
FOOTNOTES (Cont'd)


27 Crop Reporting Service of Alabama, Georgia, Louisiana, Mississippi, and South Carolina, Yearly Crop Summary, 1974.


31 Dies, op. cit., footnote 11, p. 27.


36 Cowan, *op. cit.*, footnote 34, p. 642.


CHAPTER IV

Phenological Requirements and Limits of Soybeans

Introduction

Having traced the evolution of soybeans and the soybean industry, especially its spread across the United States, it is obvious that soybean agriculture has been successful in Asia, Europe, North and South America, but not in all localities (Figure 13). In the United States, the crop has gradually expanded its range since the first crops in North Carolina. A central question of this discussion is, are the location factors associated with soybeans primarily physical or cultural? Are soybeans found wherever climate and physiography allow or are cultural considerations important in limiting the distribution of soybeans? To determine more accurately what does affect the location of soybeans, especially in the United States, it is necessary to properly assess the effect natural variables have on the plant.

The basic physical needs of plants are four-fold: they must have a foundation into which they establish roots for physical support, in most cases the soil; they must
have water to expand their cellular tissue and to give them substance and to act as a medium for intercellular nutritive movement; they must have certain nutrients which constitute the building blocks of cellular tissue; and they must have light, so that photosynthesis of moisture and carbon dioxide into cellular tissue can occur. Each plant species has general requirements of each of the four necessities and, though plants can stand varying degrees of stress (lack of needed ingredients), there are limits beyond which survival is precarious at best.

Figure 13 - Regions of Intensive Soybean Cultivation Across the World.
Soybeans have geographical limits defined by individual climatic and soil parameters, but the systemic picture, that is, the way in which the four basic variables relate to each other and compensate in time of stress, is not so clear for soybeans as it is for some other agricultural plants due to the relative lack of research on soybeans across a wide spectrum of climatic conditions. Knowledge is particularly lacking for the study region encompassed by this paper. A serious attempt to understand fully the soybean and its reaction to environmental factors in the southern United States is, at this writing, underway. The United States Department of Agriculture has commissioned a consortium of universities to gather data on all aspects of soybean growth in order to provide input for a computer controlled soybean model. Perhaps the result of this ongoing work will allow us to gauge the limits of environmental stress common to all types of soybeans in a variety of climatic regions and thus enable geographers to predict more accurately favorable and unfavorable locations for the future spread of soybean agriculture.

The following phenological outline of the soybean suffers without the aforementioned study. It will, however, provide a general outline of the needs of soybeans with respect to the four basic ingredients previously introduced. The final result will be a geographic
delimitation of those regions with a potential for soybean agriculture in North America. Interest will focus upon those limits which would be especially important in the southern United States.

**Soil Requirements**

Soybeans are grown on a variety of soils. In the United States alone, soybean agriculture proceeds in regions of alluvial, podzol, gray-brown podzolic, red-yellow podzolic, chernozems, and prairie soils. In China, soybean agriculture flourishes in alluvial and gray-brown podzolic regions, as well as on mountain soils of podzolic or latosolic zones. In South America, soybeans are grown on red-yellow podzolic-latosolics and on black and dark gray soils of the wet-dry tropics. Latosolic and mountainous latosolic soils in Java also have supported soybean growth in recent introductions. Thus, well-established soybean production attests to its adaptability and wide tolerance of varying soil types (Figure 13).

While soybeans demonstrate an adaptive capacity for a great many soil groups, soil texture has even less influence in the limitation of soybean culture. From the beginning of soybean agriculture in the United States, the lack of specific soil requirements associated with this crop has been well-known. W.J. Morse, a pioneer in
American soybean agriculture, noted "The soil requirements of soybeans are similar to those of corn, but the plants will make a satisfactory growth on poorer soil than corn. The best results, perhaps, are to be obtained in medium loams, although clay and sandy soils may be made to produce good crops."³

Figure 14 - Soil Types in Eastern North America.⁴
of experimental data at the time of his writing, we may
tend to look askance at his lack of limitations on suit-
able soybean soils. Time has upheld his ideas, however,
and we can now even broaden the soil types considered
suitable for soybeans. In fact, modern scientists state,
"The soybean will succeed on nearly all soil types ex-
cept extremely deep sands. Soybeans are better adapted
for production on clay than either corn or cotton. The
crop is also well suited for production on muck." It
is clear that neither soil group nor texture seriously
limits the possibility of successful soybean culture in
a large part of North America (Figure 14).

Soil acidity or pH can affect plant growth
seriously. Not only does soil pH affect the availability
of plant nutrients, highly acid or basic soils can actually
injure root tissues. The pH range among soils is from a
very alkaline pH-9 found in arid or semi-arid regions
to acid pH-4 soils which occur in regions of high moisture
availability. Optimum pH for soybean growth is from 6.0,
moderately acid, to 7.0, neutral. Where soil pH is low
(acid), as in moist regions of the United States, lime
should be applied to raise the pH to an acceptable level,
but soybeans will produce profitably on unlimed soils
throughout the South. Although soil types do not affect
the growth of soybeans, the topography does limit the
location of soybean agriculture. The machinery necessary
to soybean farming in the United States cannot operate efficiently or safely on rugged terrain. Most of the Appalachians are thus not suited to soybean culture and where these mountains extend into Alabama, Georgia, and South Carolina, soybeans cannot prosper.

**Nutrient Requirements**

Soybeans, as do all plants, require certain nutrients for healthy growth. Nitrogen, potassium, phosphorus, calcium, magnesium, boron, iron, copper, zinc, and molybdenum are all necessary for proper plant production and reproduction. These nutrients must be present both in absolute quantities and in the proper ratio with each other. For example, a low zinc content may suffice if soil nitrogen levels are high enough to increase the efficiency with which zinc in the soil is taken up by plants, while a small excess of iron may suppress zinc uptake by soybeans resulting in a zinc deficiency in the plant even though the soil contains an acceptable level of zinc.

The exact nutrient requirements of soybeans are known and, although a careful balancing of nutrient levels could increase soybean yields somewhat, little care for nutrient balance is needed to produce economically remunerative crops of soybeans in North America. The soil in the eastern United States is generally well balanced for soybean culture. Only one nutrient is in consistently
low supply in U.S. soils farmed for any length of time and
this nutrient, nitrogen, is the most important nutritional
determinant of plant growth.

Nitrogen is a basic ingredient in plant protein. Without sufficient nitrogen soybeans or any other green
plant will not grow. Nitrogen is economically important
where intensive agriculture is practiced for it is quickly
deprecated from soil after several seasons of unfertilized
agriculture, and nitrogen repletion is a must in modern
agricultural systems where the soil is constantly farmed
and fields are not given a fallow period. Consequently,
nitrogen fertilizer has become a standard item in the
cost of modern agriculture in the United States. Fortu-
nately, soybeans are provided with a natural advantage
with respect to nitrogen fertilizer requirements. Being
a legume, the plant is provided with its own nitrogen
producing mechanism and does not require artificial ni-
trogen application.

Soybeans, like most legumes, form nodules in
their roots if the proper strain of Rhizobium bacteria
are present in the soil. These nodules act as centers
of bacterial action where nitrogen respirationated from the air
is converted to nitrogen that the plant can utilize. The
amount of nitrogen produced is sufficient for the complete
cycle of soybean plant growth, and no application of com-
mmercial nitrogen fertilizer is necessary for successful
crops. If the beans are plowed under before the plants begin to bloom, most of the nitrogen fixed in root nodules will be added to the soil. This is a common form of green manuring. Forty to 200 pounds of nitrogen per acre is added to the soil if the plants are plowed under at the proper time. However, after the plants begin to bloom, the soybean plant begins using more nitrogen than is being fixed by the bacteria and, as the plant matures further, the nitrogen return from plowing the plants under decreases markedly.

Perhaps as a stubborn attempt to prove that man can always improve upon Nature, many experiments with artificial nitrogen applications on soybeans have been undertaken. These attempts to increase soybean yields by application of artificial nitrogen have proved consistently unsuccessful. Table 10 demonstrates the results of a recent study based on an experiment which called for heavy nitrogen applications to a corn crop which preceded a soybean crop in hopes that the residual nitrogen fertilizer in the soil would increase soybean yields by putting nitrogen in the soil before the plants have a chance to fix their own. Results on four different soil groups were negative.

The proper strain of Rhizobium bacteria is not always present in soils and, if the soybean plants are not to need fertilizer with an outside source of nitrogen,
TABLE 10

RESULTS OF FERTILIZING A FIELD OF CORN WHERE SOYBEANS ARE TO FOLLOW

<table>
<thead>
<tr>
<th>N₂ to corn, lb/ac</th>
<th>Browns-town</th>
<th>Carthage</th>
<th>Hartburg</th>
<th>Toledo</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30</td>
<td>49</td>
<td>44</td>
<td>36</td>
<td>40</td>
</tr>
<tr>
<td>60</td>
<td>30</td>
<td>47</td>
<td>44</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>120</td>
<td>32</td>
<td>48</td>
<td>44</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>180</td>
<td>31</td>
<td>47</td>
<td>42</td>
<td>36</td>
<td>39</td>
</tr>
<tr>
<td>240</td>
<td>31</td>
<td>49</td>
<td>44</td>
<td>39</td>
<td>41</td>
</tr>
</tbody>
</table>

Inoculation of the soil with bacteria is necessary. Inoculation is accomplished either by washing soybean seeds with water containing bacteria or by adding bacteria-laden soil to the seedbin just before planting. Once the proper bacteria have been introduced to the soil, further inoculations are unnecessary for subsequent soybean crops. Bacterial cultures have been available from the U.S. Department of Agriculture since the beginnings of commercial soybean agriculture in the United States, and very few soils require inoculation today.¹⁰

Light and Temperature Requirements

Light, or more specifically day-length and photoperiod, and temperature restrictions on soybean culture will be examined together since they are both closely tied
to insolation regimes. As we will see, these parameters are perhaps the most important phenological delimiters of soybean agriculture in the United States, except for water.

Day length influences the onset of flowering, the duration of flowering, the period from flowering to pod-set, the period from pod-set to maturity, the height of the plant, the number of root nodules produced, and the amount of nitrogen produced in the root nodules of soybeans. The general reaction of a soybean plant to day-length is to increase its vegetative growth as long as photoperiod is increasing and to cease vegetative growth and begin maturity as day-length shortens. In the Northern Hemisphere, day length increases between December 21 and June 21; it decreases between June 21 and December 21. June 21 (summer solstice) is the longest day of the year and, under ideal conditions, this would be the date soybean vegetative growth begins to slow and blossom formation begins. Unfortunately, locally poor weather may delay soybean planting until near or after June 21 (the 1973 Mississippi River flood did this). When this occurs, vegetative growth is not as full as it is normally, but seed formation is not seriously affected, so yields are near normal.

Soybean varieties differ in length of blossoming. Some have small beans within a week of the onset of blooms, while others bloom for more than a month. The former are
ready for harvest in August; the latter do not mature until October or November. To lessen the risk of freeze damage, farmers in high latitudes choose early maturing varieties, while southern farmers choose several varieties so they will mature at different dates, staggering the harvest.

The exact light needs of the soybean remain quite vague. Only one factor associated with photoperiod really affects the geographic distribution of soybean agriculture. This important delimiting factor is the twelve hour day or light period. All soybean varieties will bloom rapidly if day length drops below twelve hours, while vegetative growth almost stops if the days are so short. If a plant emerges from the soil while days are less than twelve hours long, the plant will bloom almost immediately. The result is a dwarfed, unproductive soybean plant. Southern farmers could grow soybeans year-round in some areas if it were not for this dwarfing reaction to short days.

Soybeans can withstand a wide range of temperature extremes. A freeze is not very harmful to soybeans if it is not present for a prolonged period. In fact, frost, if it occurs after the bean pods are mature, may help defoliate the soybean plants and thus speed up the time of harvesting. A temperature of 29°F is necessary for actual cold damage to soybeans to occur. The plant ceases growth below 50°F. Freeze damage does occur, however, and is most prevalent at high latitudes near harvest time. Frost
on mature soybeans can cause pod shattering and bean breakage. The optimum temperature for soybean growth is near 86°F. No maximum temperature threshold at which plant damage occurs has been determined.

One method of demonstrating the relationship between temperature and plant growth is to establish a degree-day total for the crop as has been done for corn, wheat, tobacco, cotton and a variety of other important agricultural plants. A degree-day for a given crop is defined as a day on which the mean daily temperature is one degree above the base temperature, that is, the minimum temperature for growth of the plant. For soybeans this base temperature is 50°F. One day with an average temperature one degree above the base temperature is one degree-day; one day with an average temperature two degrees above the base temperature gives us two degree-days and so on. Although growth and development of the soybean is influenced by temperature, there has been no successful determination of the degree-day requirements for soybeans.\textsuperscript{15}

Growth of soybeans up to the period of maximum pod formation is somewhat related to degree-days, but, after all pods are set, growth is more closely related to total number of days. Therefore time, not temperature, is the independent variable in the last half of the growth cycle of soybeans. Brown developed a system of Soybean Development Units (S.D.U.) which uses daily temperature
to calculate a daily dose of development units. The rate of development unit production is as follows:

<table>
<thead>
<tr>
<th>Degree</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>at 50°F</td>
</tr>
<tr>
<td>16</td>
<td>at 60°F</td>
</tr>
<tr>
<td>27</td>
<td>at 70°F</td>
</tr>
<tr>
<td>32</td>
<td>at 80°F</td>
</tr>
<tr>
<td>33</td>
<td>at 86°F</td>
</tr>
<tr>
<td>32.5</td>
<td>at 90°F</td>
</tr>
</tbody>
</table>

**Water Needs**

An actively growing soybean plant is 85 to 95 per cent water. Since it is a herbaceous rather than a woody plant, water is required not only as a medium for nutrient movement but to keep the soybean plant erect and the leaves turgid.

Experiments have shown the water requirements for soybeans from planting to harvest vary from thirteen to twenty-three inches. These are gross figures of course, since the amount of water needed by any plant is related to temperature, relative humidity, day length, and soil texture at least. If we choose to use a mean of this gross estimate to delimit potential regions of soybean agriculture in the United States, we find about 50 per cent of the country is below the set water availability figure. All of the states included in the study region chosen for this paper are well within acceptable limits.

Irrigation could, of course, expand the range of soybean culture, and experiments with the soybean on
irrigated land in the Central Valley of California have been undertaken. So far, for a variety of reasons, none climatically definitive, soybean agriculture in California is not promising. Economics, rather than climate, is most likely the major barrier to soybean cultivation under intensive irrigation; the return per acre from intensively irrigated soybeans is not high enough to warrant the care they would need in California, Arizona, or western Texas.  

Soybean water-need is most critical during the stages of major vegetative growth and blooming. Specifically, moisture deficit stress is most detrimental to soybean bean production at several stages in the plant's development; moisture overabundance is less of a problem. The plants will not grow in standing water but mucky conditions are suitable. Moisture stress is particularly harmful during the period of germination and during the bloom and pod formation periods. However, moisture stress can be beneficial after the pods are filled because lack of water at this time causes the plants to defoliate, making harvesting easier. It also dries out the beans, which both gives a cleaner harvest and increases marketability of the bean crop.

Heavy rainfall can be particularly harmful to soybeans in the early vegetative stages, when lodging (knocked down plants) can occur easily, and near harvest
time when rain will cause some lodging and shattering of pods. The beans may mold or rot in the pod from late rain. Of course, too much rain during the planting season is detrimental too, but the effect then is on the planting machinery more than on the plant itself. Ideally, the soil should be moist enough at planting time so that the seed will germinate but should not get any rain until after emergence. If rainfall does occur after planting but prior to emergence, weed growth may advance to a point where the emerging soybean plants will be shaded out and fail to mature. Weed growth is a particularly persistent problem in the South, where the warm climate aids their growth and where weed species diversity is greater than in cooler climates.

On the whole, the distribution of soybean agriculture is not greatly affected by moisture availability in the regions of North America which engage in large scale soybean culture. Occurrence of any of the moisture-related maladies previously mentioned cause soybean yields to vary less than 20 per cent per acre. Less hardy plants sustain much more damaging crop reductions with moisture-related problems; a 73 per cent increase in peanuts with adequate water versus those undergoing moisture stress, and corn losses greater than 50 per cent are common with a fluctuation from normal moisture regimes of only 10 per cent.
The two figures below show soybean yields in Illinois and Mississippi from 1951 to 1973 (Figures 15 and 16). Overall soybean yields increased with time in both states, probably due to progress in farming methods. The dashed lined, calculated by the least squares method, represent the general trend in soybean yields (Mississippi has two such trends, one early and one more recent). Any variation from these trend lines can be due to several factors, one of these is climate. As we see, there is no significant variation in yields at any time in either state. Climate, however, was not constant during this period; 1956 was a year of severe drought in both states during the growing season. Palmer Dought Index figures in both states vary from -3 to -6 in 1956 but yields were not affected significantly. More recently, 1973 was a very wet year in both states. Illinois and Mississippi suffered floods which delayed soybean planting until late June or July (normal planting time in both states is May). Yields were not significantly affected by these events in either Mississippi or Illinois.
Figure 15 - Soybean Yields in Illinois, 1951-1973. The dashed line represents the general trend.

Figure 16 - Soybean Yields in Mississippi, 1951-1973. The dashed lines represent the general trend.
Conclusions

If we study the aforesaid information we reach several conclusions about the physiological and climatic limitations placed upon soybean agriculture, particularly in the continental United States. Varietal differences allow cultivation of soybeans throughout the country, as long as sufficient water is available either through precipitation or irrigation. Natural precipitation regimes indicate that, on the average, the entire eastern half of the United States is suitable for irrigationless soybean cultivation. Within that region only photoperiodic differences significantly affect the soybean and, fortunately, photoperiodicity acts to cause progressively early maturity of the soybean plant as latitude increases, thus lessening the effects of freeze damage in northern climes. So far, plant geneticists have been unable to overcome the twelve-hour photoperiod barrier at which all varieties of soybeans will begin to blossom and, since this fact precludes double cropping of soybeans in lower latitudes, we could say that there is a photoperiodic limit to soybean agriculture as well as one defined by moisture availability. Soil and nutrient requirements are not active agents in delimiting the range of soybean culture in the United States.

In general then, the entire eastern half of the continental United States is climatically suitable for soybean agriculture. Except for limitations caused by local
field conditions, or areas where the topography is too rugged for large-scale, mechanized farming, no region within that larger region has any environmental advantage over any other. Climatic deviations, too much or too little water, a late or early freeze, all can affect soybean yields but not to the extent that other field crops are affected. Yet soybean agriculture is not distributed equally across the naturally suitable region; in fact, we find that there are regular patterns of soybean agriculture within the environmentally suitable area (Figure 1, p. 2). The Midwest and the Lower Mississippi Valley have become centers of soybean production. Parts of the Southeast are now beginning to exhibit a belt of soybean agriculture across that region. Based on the evidence presented here, climatic, physiological, or physiographic factors are inadequate to explain the pattern of soybean distribution in the United States. Perhaps the reason the pattern exists is cultural; it may lie in the different economies and land-use traditions within the various sub-region. These will be examined in the succeeding chapters.
FOOTNOTES


2 Personal communication with Dr. D.W. Newsome, Chairman of the Department of Entomology, Louisiana State University.


FOOTNOTES (cont’d)


16 Brown, *op. cit.*, footnote 15, p. 495.


22 Whitt and van Bavel, *op. cit.*, footnote 17, p. 378.


CHAPTER V

Factors Involved in Choosing to Grow Soybeans in the South

Introduction

It is traditional for geographers to study the combined cultural, or human, factors and the physical, or environmental, factors suspected to affect the distribution of landscape phenomena. Therefore, if we account for changes within the economy and the environment, a geographic understanding of soybean agriculture is assured. Environmental factors have not demonstrated a significant amount of control over the location of soybeans within the study region, as the last chapter attests. A large segment of the story of soybean agriculture in the South is economic. There is a wealth of material which deals with soybean costs, yields, capital outlay, gross returns, and net returns. These data are important if we are to understand some of the forces involved with the incidence of soybean agriculture in the United States, and especially the South.
However, as long as we study activities whose primary participants are human, some insight into the individuals involved is of considerable interest and of no small importance. Even though this study encompasses a region too large to undertake an analysis of all personnel involved with soybean agriculture, some insight can be gained by recognizing that people of varied backgrounds, interests, and resources participate in soybean activities. For that reason, this chapter is a series of human vignettes, a few quick glimpses into the experiences and attitudes of soybean farmers in the South. These will consist of narrative descriptions of the manner and sequence by which a small number of bean farmers became involved with soybeans; part of the descriptions will be narrative of the author and part will be transcriptions of interviews with the farmers themselves. The interviews were conducted in situ during the years 1973 and 1974.

**Decision Making by Soybean Farmers**

Prior to our personal introduction to soybean farmers, it will be profitable to examine the decision-making process involved in the adoption of soybeans as a crop in regions where they are not part of the traditional agricultural pattern. Since soybeans are a new crop in most of the South, the farmer who grows them has decided to replace part of his traditional crop and land-use pattern with a new constituent. The factors involved in
this decision are important to our understanding the spread of soybeans across the South. How are farmers introduced to soybeans? Why does the farmer choose soybeans as a crop? What type of farmer is likely to adopt soybean farming? These questions illuminate the human aspect of soybean agriculture and, since human acts affect the cultural landscape, we are very much concerned with the answers to these questions.

The first question we will pursue is that of introduction or diffusion, where does one learn of the importance and potential economic benefit associated with soybeans? The peer group is the primary source of knowledge about soybeans (Table 11).

**TABLE 11**

**THE INITIAL SOURCE OF INFORMATION ABOUT THE IMPORTANCE OF RAISING SOYBEANS IN THREE LOUISIANA PARISHES**

<table>
<thead>
<tr>
<th>SOURCE OF INFORMATION</th>
<th>NON-ADOPTERS</th>
<th>ADOPTERS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pointe Coupée</td>
<td>Pointe Coupée</td>
</tr>
<tr>
<td>Neighbor or friend</td>
<td>45.8%</td>
<td>50.0%</td>
</tr>
<tr>
<td>County Agent</td>
<td>12.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Relative</td>
<td>4.2</td>
<td>20.0</td>
</tr>
<tr>
<td>Impersonal source</td>
<td>12.5</td>
<td>6.7</td>
</tr>
<tr>
<td>Other</td>
<td>4.2</td>
<td>20.0</td>
</tr>
</tbody>
</table>

Given an initial acquaintance with soybean growing, the next step a farmer takes after he has made the decision to begin soybean agriculture is to seek knowledge of the culture of soybeans from a local expert. In most cases, the person sought was the county agent (Table 12).
This fact presents an interesting question; since the county agent is aware of the technology associated with soybeans, and we must assume that he is familiar with the advantages offered by soybean agriculture, why is he not a primary source of innovation? Indeed, soybean culture has been proselytized by the U.S. Department of Agriculture since 1910, and yet the diffusion of the practice of soybean agriculture in the South is due primarily to profitable experiences related by individual farmers to peers or at least to related practitioners of agriculture. From this data we can also conclude that professional interaction is common among southern farmers over more than the local region. Otherwise, if what we have found about innovation holds up, soybean agriculture could not spread at the rates we have demonstrated.

TABLE 12

SOURCE WITH WHOM FARMER DISCUSSED THE TECHNICAL ASPECTS OF GROWING BEANS

| SOURCE               | NON-ADOPTERS | ADOPTERS | | | |
|----------------------|--------------|----------|----------|----------|
| Pointe Coupée        |              |          |          |          |
| Neighbor or friend   | 14.6%        |          | 20.0%    | 17.1%    | 16.1%    |
| County Agent         | 8.3          |          | 43.3     | 48.6     | 41.9     |
| Relative             | 0.0          |          | 10.0     | 0.0      | 12.9     |
| Impersonal source    | 2.1          |          | 3.3      | 8.6      | 0.0      |
| Soil Conserv. service| 0.0          |          | 6.7      | 2.9      | 16.1     |
| Other                | 4.2          |          | 13.4     | 14.2     | 9.8      |
| No response          | 70.8         |          | 3.3      | 8.6      | 3.2      |

Why do farmers accept this new crop? The American
farmer often is portrayed as a conservative, traditional creature whose actions reflect more his heritage than the forces extant within his present milieu, such as supply, demand, world markets, and other assorted economic forces. It was found, however, that economics are indeed at the heart of the stated reasons for adopting soybeans. Table 13 shows that the low input of capital and time and the relatively high profits associated with soybean agriculture are utmost in the mind of a southern farmer who opts to grow soybeans.

TABLE 13

LOUISIANA FARMER'S STATED REASONS FOR GROWING SOYBEANS

<table>
<thead>
<tr>
<th>Times Mentioned</th>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>Good cash crop</td>
</tr>
<tr>
<td>4</td>
<td>Reduced acreage allotment in major crop</td>
</tr>
<tr>
<td>8</td>
<td>Use of idle land, diversification</td>
</tr>
<tr>
<td>8</td>
<td>Best second crop</td>
</tr>
<tr>
<td>5</td>
<td>Other crops unsatisfactory</td>
</tr>
<tr>
<td>47</td>
<td>Soybeans inexpensive and easy to grow</td>
</tr>
<tr>
<td>2</td>
<td>Good rotation crop</td>
</tr>
<tr>
<td>2</td>
<td>Everybody else is growing them</td>
</tr>
</tbody>
</table>

Other conclusions we arrive at include: 1) the educational achievement for adopters was higher than for the non-adopters; 2) the gross family income of the adopters was higher than that of non-adopters; 3) the average farm size was greater for the adopters than for the non-adopters; 4) participation in community organizations was higher for the adopters than for the non-adopters.4

A survey of non-adopters who planned to adopt
soybeans at the time of the above survey revealed that, although the cash potential of soybeans was still utmost in the farmer's mind, a new reason for their adoption had become apparent. Acreage allotment restrictions on other cash crops made the uncontrolled soybean attractive for use on previously idle or uncropped land.

And so we now have insight into some of the social relationships associated with the soybean agriculturalist, and we understand to some degree how a group of farmers interact with themselves and their community when presented with the alternative of soybean agriculture. What follows are sketches of individuals as they have become involved with growing soybeans in the South. The vignettes are not meant to be comprehensive developmental histories of each individual, rather they are presented to afford additional insight into the human side of soybean agriculture in the South. Some of the ideas put forth in the preceding section are substantiated in these individual cases, some will be contradicted. Insight and understanding are gained by both.

**Soybean-Farmer Vignettes**

Most of the following accounts are the words of the author. From time to time, the actual words of the subject will be introduced; they will be set off by quotation marks.

Mr. Roy Boley
Roy Boley was born in Lamar, Arkansas, in 1930. He grew up on a leased farm in Oran, Missouri, where his father grew cotton, corn, soybeans, and wheat. In 1955, Mr. Boley, now married, leased 700 acres of farmland near Oran on which he grew cotton, corn, and soybeans. At that time, he owned his own farm equipment, a one-row cotton picker and a four-row combine. While farming in Oran he made the acquaintance of a Mr. Brukerhoff, an expansive-minded agricultural entrepreneur who owned the Oran grain elevator. As the years passed, Mr. Boley became more impressed with the agribusiness acumen of Mr. Brukerhoff and Mr. Brukerhoff in turn became increasingly impressed with the farm knowledge of Mr. Boley.

Mr. Boley gradually changed his crop pattern at Oran to more soybeans and less cotton while he maintained enough corn acreage for a small herd of forty cattle. When asked why he had switched to soybeans on this first farm when cotton gave a greater gross return per acre, he stated that soybeans were "cheap, but cheap to make 'em too; there's not much difference in net profits."

In 1966 Mr. Boley's landlord died and a legal quarrel over the estate, part of which Mr. Boley leased, ensued. The dispute left Mr. Boley's future in doubt. Aware of Mr. Boley's precarious position, Mr. Brukerhoff chose this time to offer him a change. That year, Mr. Boley sold his farm equipment and moved to Tallulah,
Louisiana where he was to oversee a 10,000 acre farm leased
by Mr. Brukerhoff. The land was devoted entirely to soy-
beans that year (Figure 18).

"The land we had had to be in soybeans. It was
pastureland, it had never had a crop on it. It had just
been cleared and pastured. Now the last year I was there
I grew sixty acres of cotton. I grew 300 acres of wheat
a couple of years....."

While at Tallulah, Mr. Boley learned that grow-
ing soybeans was not quite as simple as he had thought.
He tried to take advantage of the warmer climate in north
Louisiana to make two crops of soybeans per year and he
failed. I asked if he knew why.

"I don't know, its something to do with the
light hours. When I first moved to Tallulah I thought,
man, no frost I could plant beans in August, which I did
about the twentieth of July, I planted some. They grew
up so tall [about six inches] and they started setting
beans [see above, p. 64]. Then they all just died."

In 1971, the owners of the land in Tallulah
decided to speculate with it on the real estate market.
They canceled Mr. Brukerhoff's lease, bought his farming
equipment and put the farm up for sale. Mr. Boley stayed
on at Tallulah, at the request of Mr. Brukerhoff, to work
the farm until a new owner could be found. Two years went
by before the farm was sold, and Mr. Boley continued his
pattern of exclusive soybean farming there during which
time he lived, rent-free, in a house provided by Mr. Brukerhoff, who did not want to lose Mr. Boley's talents as a farm manager.

Mr. Boley moved to Maronguin, Louisiana, in February, 1974 to manage El Dorado plantation which had just been leased by Mr. Brukerhoff. This plantation had been leased immediately before by a Mr. Gibbs, about whom we will learn more later. He had farmed soybeans and corn and run several hundred head of registered Hereford cattle on El Dorado. Mr. Brukerhoff leased only the farmland and a house for Mr. Boley and his family; the pasture was leased to a local doctor.

At El Dorado, Mr. Boley planted 2,000 acres of soybeans and 500 acres of cotton. Cotton had not been grown at El Dorado for sometime and Mr. Boley's few hundred acres was an experiment of sorts since no one for miles grows any cotton today. How and why did he decide to grow cotton? His response was:

"The land. This sandy dry land, and they used to grow cotton here. And the price of cotton."

Did you suggest it or did Mr. Brukerhoff?

"Uh huh. We both did. He's got some cotton up in Texarkana, Arkansas."

How did you decide how much to grow? How much did you want to grow to start with?

"Five hundred acres. The reason for that is to get pickers. I'd a tried it with less, but you can't get
pickers. See my pickers is comin' from Yazoo City, Mississippi. For a few hundred acres I couldn't have gotten anybody to come. If I'd had pickers here I wouldn't have tried but 100 acres."

Figure 17 - Location of soybean farming activities of informants.
You recognized this for good cotton land?

"It's all precision graded. No water stands anywhere. It can rain three inches and in an hour no water will stand. That's what you need for cotton. The place was cleared in the last ten years. They had trees, sleys, but it's all precision graded now."

When I asked Mr. Boley if he would have experimented with a cotton crop had it been his money rather than Mr. Brukerhoff's he was hesitant, indicating perhaps that he would not have taken the risk. He then gave me a breakdown of his finances involved with cotton and soybeans.

**TABLE 14**

**MR. BOLEY'S ECONOMICS OF FARMING COTTON AND SOYBEANS, 1974**

<table>
<thead>
<tr>
<th></th>
<th>Cotton</th>
<th>Soybeans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of growing</td>
<td>$125/acre</td>
<td>$65/acre</td>
</tr>
<tr>
<td>Cost of picking</td>
<td>$35/acre</td>
<td>none</td>
</tr>
<tr>
<td>Net Profit</td>
<td>$197/acre</td>
<td>$119/acre</td>
</tr>
</tbody>
</table>

So while the initial outlay for cotton is much greater than that for soybeans, the potential for profit is also much greater. Mr. Boley did say that his costs could have been much higher if soil depletion or climatic conditions caused an increase in expenditures for fertilizers, herbicides, or insecticides. He does not fertilize his soybeans at all, nor does he use herbicides or insecticides.

Mr. Boley now works with Mr. Brukerhoff for a salary which is described as "comfortable but less than I
made farming for myself. But the risks are not my problem now." Along with the salary goes a rent-free house and a bonus, if the harvest is exceptional. Mr. Boley also helps manage 3,500 acres of soybeans Mr. Brukerhoff has near Morganza, Louisiana. The two operations share farm machinery and thus must coordinate planting and harvesting cycles. Job security for Mr. Boley is assured as long as he continues to operate within an expected range of profit; the range is not specified but "Mr. Brukerhoff and me will know when I'm not doing the job." Successful or not, Mr. Boley faces a life of constant mobility as long as he maintains this association with soybeans and entrepreneur.

Mr. J.T. Gibbs

Mr. J.T. Gibbs is a native of West Memphis, Arkansas. He is fifty-three years old, married, and has two grown, married sons. Mr. Gibbs grew up farming in Arkansas with his father, a sharecropper. He vividly remembers hand picking cotton as a youngster but is reserved about his early past; the life of a sharecropper's son could no doubt be brutal. His primary youthful experiences were necessarily agricultural. At seventeen Mr. Gibbs started work with a pulpwood firm as a logger's assistant. He worked several years as a logger, saved up a small nest-egg, and enrolled in the University of Arkansas in 1941 where he studied agriculture and forestry.

After graduation Mr. Gibbs began a career of
entrepreneurship in agriculture-related activities that was to continue to the present. He leased 1,100 acres of cropland in eastern Missouri in 1947 and grew cotton and soybeans, an equal amount of each. He farmed this land for six years, gradually shifting completely to soybeans and expanding his leased responsibility to 3,800 acres. He owned his own equipment. In 1954 Mr. Gibbs "just got tired of sittin' in one place, lookin' at the same land every year." He gave up his lease, sold part of his farm equipment, and bought bulldozers and other land-clearing equipment. For the next fifteen years Mr. Gibbs worked his way down the lower Mississippi River valley to the Louisiana border following an exciting, lucrative pattern of soybean-related activity. His modus operandi was to purchase or take out a long-term lease on unused, poorly drained timberland. He then cleared the land for agriculture and planted soybeans on this virgin cropland. After a year or two of farming, he would sell or sublet the land for a profit, move further south, far enough away from his last triumph so that his pattern was relatively unknown, and begin the cycle again.

"We would buy up that old soggy bottomland for near nothin'. Them farmers thought I was crazy, most of 'em wanted cash, they figured I was out of some crazy house. I could clear the land enough in one year so I could plant the next. Some times I might just clear part of it, plant
it and clear the rest while them beans was growin'. I had some niggers workin' with me 'til my boys got big enough to help me, then it was mostly a family outfit. I could buy that land for ten or fifteen dollars an acre, clear it, sell the timber to pay for my work, plant them beans, show one good crop and then sell that land for ten times what I paid for it. Course some times I had to pay as much as fifty dollars an acre and I couldn't sell it too high so I wouldn't make as much money on it."

The complete cycle of clearing, planting, and selling of the land took two to four years and involved a great deal of hard, demanding, dangerous work. In 1968 Mr. Gibbs got the chance to settle down near Marlingouin, Louisiana where his two sons could be near and profitably employed also. Charles Dean, an architect from Cleveland, Mississippi, had been contracted by J.K. Nicholson of New Orleans to redesign the landscape of his Eldorado Plantation near Marlingouin. The plantation was completely overgrown with trees and scrub vegetation and, except for a few head of grade cattle grazing on it, was totally unproductive. Mr. Dean asked Mr. Gibbs to oversee the refurbishment of Eldorado, and the agreement they reached included a long-term overseer position for Mr. Gibbs and similar situations for his sons at two nearby plantations.

In two years Eldorado was transformed into a series of precision graded and drained fields suitable for cotton
or soybeans with good pasture for 300 registered Hereford cattle. Mr. Gibbs grew only soybeans on this new cropland, 2,240 acres in all, until he left Eldorado in 1973. His legacy at Eldorado included storage and garages for two six-row combines, tractor drawn grain hoppers, two 350 bushel grain hauling dump trucks, and three 10,000 bushel grain drying storage bins, all bought by the owner at Mr. Gibbs insistence.

Mr. Gibbs left Eldorado "because I'm just not ready to settle down. I got to move again, maybe take my boys along with me." He moved to Dundee, Mississippi, to manage 7,000 acres of cotton, soybeans, milo, and corn.

I last saw Mr. Gibbs in October, 1974. He had a good year at Dundee, 4,000 acres of soybeans, 1,500 acres of cotton, but he did not like working for a salary and was ready to move on. He was "dickerling with a man down by Lafayette for 2,670 acres of new ground. Still got the brush piles on it, but I think I can grow soybeans enough to make it pay maybe even the first year. He and I got to get together on price and lease. I want a five year lease with an option for three more or it's not worth it. I also want a chance at 1,500 more acres he has next to it."

This writer doesn't know if Mr. Gibbs got his land in Lafayette or not. His dislike for "hired work" will doubtless force him to find a more enterprising position whatever the location. And whatever the location, he will
continue to spread the culture of soybeans.

Figure 18 - Brushpiles on Newly Cleared Land in Mississippi. The owner plans to put in wheat by Fall and have soybeans in by Spring.

Mr. George Nicholas

Mr. George Nicholas, Sr. lives in Woodville, Mississippi, just north of the Louisiana boundary between Baton Rouge and Natchez. He is a native of Virginia, and is a graduate of Virginia Polytechnic Institute. He is a qualified electrical engineer. After marriage he moved to his wife's home town, Woodville, and took a job with the International Paper Company at their Natchez plant as a chemist. His job at the plant gave him flexible hours during the workday, and he was able to
help his father-in-law manage a farm of 700 acres near Woodville. After his father-in-law died, Mr. Nicholas took over complete control of half the farm, which is still in his wife's name.

Cotton, wheat, rye grass and clover were the crops Mr. Nicholas grew in the early years. He had as many as fifteen hired hands when he first started farming on his own but, as farm help grew scarce in the late 1950s and 1960s, he stopped farming the relatively labor intensive cotton.

Mr. Nicholas retired from his job at the paper plant in 1974, and he now has only one vocation, farming. In addition to the family land, Mr. Nicholas leases acreage near Woodville, some of which is in Louisiana, over six miles from any of his other fields. In 1973 he farmed 1,100 acres, all in soybeans, but this figure declined to 750 acres in 1974, again all in soybeans. He feels that about 1,000 acres is an optimum size for his equipment but could not get them much land this year because "the competition is too strong. Seems everybody wanted to lease more land this year. They made good last year on beans, and they want to make more now, and they got the money now."

Mr. Nicholas is relatively well equipped to farm soybeans. He owns three large tractors, a Ford five-row combine, a Gleaner six-row combine, and two well-worn dump trucks. He has a five year lease on two 10,000 bushel grain
drying storage bins north of Woodville which some years do not afford enough storage capacity for his harvest, but are usually near adequate.

Figure 19 - Excerpt From the Classified Section of the Baton Rouge Sunday Advocate, February 2, 1975 With an Advertisement for Land Available to Lease for Soybeans.

They only hold about 9,500 bushels each. They would have to stand on their heads to hold 10,000. You
can't fill up that cone top....I had to sell off 6,000 bushels early this year. I knew I was going to have more beans than I had room for. I sold 2,500 in Jackson and 3,500 in Jonesville, didn't lose too much."

If time permits, Mr. Nicholas custom combines for neighbors near Woodville, but this year he was not able to do so, due to rain interrupting his own work.

Do you find that you have a greater capacity to farm now that you have retired?

"Not really. I could go to work any time during a twenty-four hour period, so I had plenty of time to farm. I could work full-time for the paper company and farm 1,500 acres of soybeans too. I'm too old for that now. I can't get help, and I can barely handle the 750 acres I have now. One boy is off to college, and he don't help much; the other one is in high school, and he wants to help but ain't got time. He drives a combine ninety miles an hour. Sometimes he'll chase a rabbit through the field, breakin' beans all over. He'll learn soon though."

Do you farm anything else now besides beans?

"Not much. Not in the summer. Everything else takes too much time, and I cain't do it when I want to. If I cain't get to my soybeans when they get ripe, I'll just wait. They're not gonna get hurt too much. I start pickin' in September, and this year I'm still pickin' in December 1974. These beans were ready in October, but I just
couldn't find time to get 'em. They wait for you though."

Then soybeans is all you are involved with?

"No, I run cattle in the bean field after I cut. The stubble and hulls are high protein and the cows like it. I plant wheat or ryegrass in winter. The soybeans help the wheat to grow."

Do you have a special header (combine attachment) for combining wheat as opposed to soybeans?

"No, I use the same one, just change the screen. The wheat would all fall out of a soybean screen."

Mr. Nicholas does not fertilize the land he leases. He does lime his own fields but no other nutrients must be added for soybeans. The nitrogen left by the soybean crop is sufficient for his winter crop's needs. The year he did not herbicide nor insecticide at all.

"Some years they're insects and weeds both really bad. This year no weeds and no bugs to speak of. I did have one special problem, beavers. I want you to write that in your thesis or whatever. I had beavers eat over two acres of soybeans this year. Then they tunneled into my dam and the thing broke so my pond is a mudhole. I heard of deer eating beans but not beavers, you write that down."

Mr. Nicholas is sixty-two years old. He will probably continue to farm in Woodville until he dies. At least for the near future, soybeans will continue to be his
primary crop. He has plans to buy a new combine, larger
and more powerful in order to farm more beans with the
same manpower. But others in Woodville have the same
idea no doubt, and next year it may be even harder to find
leaseable land. Either way, soybean culture will increase.

Mr. John Nesbit

Mr. John Nesbit (he asked that his real name not
be used, this pseudonym was the author's choice) was born
in Livingston, Alabama in 1933. He has lived his entire
life on a farm near Eutaw, Alabama. As long as he can re-
member, at least three generations of Nesbits have co-
resided on the property.

The farm is 840 acres of "useable" land; "We ain't
got no bad creek beds or bluffs anywhere on the place."
The land has been paid for since 1951 and this fact, coupled
with almost non-existent property taxes in Alabama, leave
the owner with no financial stress associated with keeping
his land. Mr. Nesbit assumed management of the family
farm in 1963 after his father suffered a gunshot wound on
a deer hunt. The elder Nesbit built the farm into a suc-
cessful enterprise based primarily on cotton agriculture
and beef cattle. He also grew corn to feed his cattle and
to feed the several mules which functioned as a primary
draught force until the late 1950s.

"Daddy grewed about sixty acres of corn usually,
just for the animals. We never sold any. He grew 400
to 500 acres of cotton every year, until the niggers quit pickin' good, then he just left more of it for the cattle. He got down to about 300 acres just before he got shot."

How did you make any money with so little cotton? Did you grow anything else?

"Cattle. We started running almost 100 head all year. We had to buy feed and all, there was so many. We had a lot more trees here then and we sold pulp every year."

When did you start growing soybeans?

"The first year I run the place I put in fifty acres. The feed man said he would give a feed discount to anyone who would plant soybeans and sell 'em to him. He would harvest 'em himself for near nothin'."

You now have about 600 acres of soybeans and not very much woodland. What happened to you and the farm since 1963?

"Well I made a little money off that first fifty acres so I planted a hundred the next year. They did fine that year too. Cotton prices went down low for a while, and I had to get a job in town as a carpenter four days a week. When all my good niggers quit I couldn't grow much cotton no more so I started planting more soybeans. They don't take no time like cotton does and I never had to fertilize or spray so they didn't cost much to make. The last few years cotton and soybean prices been up so high I quit my job in town to farm full time."
What happened to the woods?

"I needed to keep growin' my soybeans but I wanted to increase my cotton acreage too. And I knew that the land I had soybeans on was my best cotton land. I cleared all but about twenty acres of woods out and planted soybeans on it while the leaves was still on some of the trees. I went with 300 acres of cotton and 300 acres of soybeans that first year, 1970. I don't grow no more corn, so I just buy feed for my cattle."

Did you still have your soybeans custom picked by the grain dealer?

"No. I bought a six-row combine and a two-row cotton picker, so I can do everything when I want to. It's a lot better that way, cheaper too 'cause I bought those when money was a lot cheaper than now."

You only have a small field of cotton this year, 100 acres you said. Why is that?

"Just 100 acres. This oil problem has made chemicals hard to get. I couldn't get enough fertilizer or herbicide to plant any more cotton, so I just planted it all in soybeans which don't need any. It turned out I could have gotten the chemicals in June, but I didn't have a promise. I might plant more cotton next year. It just depends on the price of cotton and soybeans and whether or not I can get chemicals."

Do you think you will ever go back to cotton and
corn again?

"I don't think so. I might grow fifty acres of corn next year 'cause feed prices are so high but no more. As long as I have land I don't use any other way. I'll grow soybeans on it; they are so easy and cheap to make I can't pass 'em up. I just made a deal for 350 more acres of land joinin' mine. It's all timber; used to be leased by a hunting club. I bought it but I had to leave the timber rights to the old owner. He's goin' to cut the timber this winter, and I hope to have soybeans in there next summer. That will free some good land for cotton if I want it. The land some of my soybeans is on now is real good cotton land."

Is this new land you just cleared good cotton land?

"No, not much. It might be in a few years but 'til I get it broke up real good and get most of the weeds under control, all I can put on it is soybeans. They don't much care where they grow. Don't mind weeds either, if you can cut 'em with a combine."

Mr. Nesbit is obviously quite successful. His farm is well kept, the equipment is in good condition, and he has been able to expand both the scope and intensity of his operation. It is obvious that much of his current success is attributable to soybean agriculture. Farming soybeans gives him a flexibility few other crops afford. They also
demand relatively little of his time, energy, or funds yet assure a substantial financial return. He will, no doubt, continue to grow soybeans in large quantity until the economic inducement to do so is gone.

Steven Seal

Steven Seal is a twenty-six year old native of Woodville, Mississippi. After graduation from Louisiana State University in 1970 with a B.S. in agriculture, he returned to Woodville to help his father run the family business, Seal Ford Tractor. As a farm equipment salesman, Steven is familiar with the agricultural activities in Wilkinson County. Through his equipment sales, he keeps in very close touch with farm practices and trends in the area.

I met Mr. Seal in a soybean field near Woodville; he was combining beans on a custom contract for a regular Ford tractor customer. The man had bought a new Ford six-row combine several months before and, when the machine was not delivered on time, Steven had an obligation to help his customer get in his crop. I asked Steven if such late delivery was a common occurrence.

"Very common. I had five new combines ordered in May, all five paid for in cash. The first one was delivered in September, two in October, and the others won't come in 'til February. I've got six six-row combines coming in this March; five are already sold, and there are three
people bidding for the last one. And these are all loaded, air conditioned cabs, stereo, foam rubber seats."

Why is business in combines so good? Why so many extras on the machinery you sell?

"Everybody is growin' soybeans, and those who have been growin' beans are growin' more. They have to have equipment. And people are working the crop themselves so they want good comfortable equipment. You go downtown Woodville right now; you'll see almost 100 niggers sittin' around, all on welfare. They used to work on farms, but now they won't work for nothin'. So people have to work the land themselves. I know a man who works 1,500 acres up by Natchez; he only has one son to help him. Now a man like that has to have good equipment. I sold him two of the biggest combines and two of the most powerful tractors we make. People can't get help any more so they make up for it with machinery. We used to sell forty or sixty horse-power tractors; now every one we sell has over 100. The combine I sold two or three years ago would cut 400 bushels a day. The new machines will cut 800 bushels, and not break down as much. You don't need help if you got machines."

Do you do any farming of your own?

"I grew 100 acres of beans last year; just figured I would make some money on the side. By the time I leased the land and bought gas and all I just made expenses. You can't work just 100 acres and make anything. I grew 200
acres this year and, after payin' my bills, I have about 3,500 bushels of beans left over so I did pretty well with 200."

Soybeans were selling at $7.81 a bushel the day I talked to Steven Seal. His "left over" beans mean he has a $27,335 profit. A profitable sideline for a twenty-six year old man who recently sold five $29,000 combines and is sure to sell at least one more very soon. Steven seal has a vested interest in soybean agriculture in the South. He is sure that it will continue to expand, at least he hopes it will.

Summary

It should be apparent from these vignettes that people who farm soybeans in the Gulf South are well aware of the potential profits and the financial gamble involved with this crop and are actively expanding their soybean activities where possible. Rural sociologists indicate that the primary reasons for growing soybeans, or more specifically, the reasons for switching to soybeans, are the low capital outlay involved with the crop, assuming the farm is already mechanized, and the almost guaranteed financial return. The interviews showed that the people involved with soybean culture in various parts of the study region obviously function with these ideas as central tenets, and they are actively trying to expand their own personal involvement with soybeans by putting more land into soybeans.
Much of the land they put into beans was idle only a few years before, either wooded or cleared but merely pastured. As we proceed, this pattern of increasingly intensive land-use will become more apparent and the landscape transformation associated with it will take on a more impressive dimension.
FOOTNOTES


2 Jenkins, et al., *op. cit.*, footnote 1, p. 12.

3 Jenkins, et al., *op. cit.*, footnote 1, p. 13.

4 Jenkins, et al., *op. cit.*, footnote 1, p. 18.
CHAPTER VI

Farming Soybeans

Introduction

Each agricultural activity has a specific technology associated with it. This technology may involve a specialized treatment of the soil, a specific field conformation, special dikes or levees, cloth or plastic plant coverings, or simply the farm hardware associated with growing and harvesting a particular crop. The harvested crop may in turn require special treatment also. Grains must be dried, fruits much be packed or processed soon after harvesting, tobacco must be cured, and vegetables must be graded or processed near the fields. Therefore, each crop region has its distinctive elements evident to a landscape observer and these function as keys to the type of crop grown even if the crop itself is not visible. Thus a tall narrow barn with attached heater in south Georgia signals the presence of flue-cured tobacco agriculture. A lone triangular hoist near the road in south Louisiana means sugarcane is grown here. Stacks of round baskets along the road in Chilton County, Alabama indicate the close
proximity of a peach orchard. The actual crop need not be visible in any of these cases.

Soybeans are no exception to the rule. They too have specific equipment and types of activity associated with them which can provide landscape evidence of soybean agriculture. Such keys upon the land are a prime focus of some geographers, and these landscape codes can be an aid to all students of agriculture. They must be fully presented to complete the geographical study of soybean agriculture in the South. The particular pattern of technology and phenomena presented here may very well be specific to the study region. No comprehensive research outside the study region was undertaken, and a search of the literature has not revealed such a work for any other area. If a midwestern soybean farmer finds something strange or perhaps lacking in this presentation, the author is not compelled to apologize, only to restate the arreal scope of the paper.

The purpose of this chapter, then, is to present the physical phenomena associated with soybean agriculture in the southern United States. Visual as well as verbal descriptions will complement each other in hopes that the often inadequate prose will be aided by short pictorial essays.

Choosing Seed

The annual round of soybean culture is similar in
many respects to that of other crops. Planting and harvesting are the two periods of greatest activity. Very little cultivation is involved with soybeans as they grow.

A first consideration for each farmer is his choice of seed. Soybean varieties have different growth rates so the farmer can choose the variety that matures at the proper time. Having planted varieties with varying maturity dates will spread the harvest over a longer period of time. This is true even though early varieties are grown at some yield sacrifice in the South. Staggered maturity dates brought on by planting different varieties reduces the risk of weather damage to the crop and, by staggering harvest needs, equipment demands are lessened.

Earlier maturing varieties are favored in northern regions when fall-planted small grains, such as winter wheat, follow soybeans, but in the South full-season varieties can be grown and still afford plenty of time for fall planting.1 While considering the relative maturity dates of his soybeans, the farmer must also consider the characteristics of the plant just before and after maturity. Lodging resistance is very important in selecting a soybean variety as is rot and shatter resistance. An early maturing variety should be rot and shatter resistant because, due to their early maturation, a wet Fall may force the farmer to leave ripe beans in the field exposed to weather for several months. Lodging resistance is most important for late
maturing varieties, since they must remain in the field much longer than early varieties and the chances for wind damage are thus increased.

The farmer also must consider the characteristics of each field he may wish to plant in soybeans. A well drained field may produce fully with a certain variety of bean, while the same variety of bean may fail on poorly drained soil in a nearby field. Table 5 lists some of the more popular varieties grown in the South and gives their general characteristics. With few exceptions, varietal choice is a result of personal preference by the individual farmer, perhaps based on experience or local peer bias. Figure 21 illustrates the regional recommendations for varietal choice in the study area. Local conditions of drainage or soil may dictate a different seed for a specific field, but generally, the recommendations given in Figure 20 are well based. Other similar varieties may be substituted. Since soybean hybrids have not been successfully developed, a farmer may save part of his own crop for seed purposes, if germination proves satisfactory. The price of seed beans ranges from one to five dollars per bushel above that of beans sold for oil.

Early Growth to Maturity

Soybeans in the Gulf South should not be planted until May, preferably late in the month. If weather and supplies permit, planting should be finished by June. The
**TABLE 15**

**SOME SOYBEAN VARIETIES AND GENERAL CHARACTERISTICS**

**HILL** - Plants are twenty-eight to thirty-six inches tall, have moderate sized stems, heavy foliage and white flowers. It has good resistance to major foliage diseases and lodging. Matures about September 20.

**HOOD** - Plants are thirty to thirty-six inches tall, have moderate sized stems, heavy foliage and purple flowers. One of the heaviest bearing bean varieties popular in the South. It does not hold its seed well and must be harvested at maturity or shatter loss will depreciate its productivity. Matures about October 10.

**LEE** - Plants are twenty-eight to thirty-two inches tall with thin stems, moderate foliage and purple flowers. Yields are average but of good seed quality, and this variety shows very little shattering up to ten weeks after maturity, regardless of weather. Matures about October 20.

**JACKSON** - Plants are thirty-eight to forty-four inches tall, have moderate sized stems, heavy foliage and white flowers. Yields are less than Lee in many areas, but the very tall plant permits easy efficient combining. Matures about October 26.

**BIENVILLE** - Plants are about thirty-eight inches tall with moderate sized stems and very dense foliage which matures quickly to cut weed growth. Very good in poorly drained soils. Purple flowers set high on the stem and assure easy combining of resultant beans. Highly resistant to lodging and shattering which is adaptive to its late maturity date, November 1.

**PICKETT 71** - Plants are thirty to thirty-five inches tall at maturity with moderate foliage. Pods set very low so shattering is above average. Below average lodging resistance and seed quality. Matures about October 14.
soil should be moist enough to cause germination but dry enough to halt growth of any weed seed which might blow onto the freshly plowed surface. Row width is largely a matter of choice, but chemical supplies and limitations on expected outlay for chemicals play a large part in row width selection. Northern farmers have had great success with twenty-one to thirty inch rows. Such narrow rows decrease the period of possible cultivation but, due to the lessened weed problem in colder climates, a single herbicide application can slow weed growth until the soybean plants completely shade over the row spaces and, by themselves, choke out the young weeds. Southern farmers,
however, have a greater weed problem and must allow room for cultivation further into the growing season. For that reason, the forty inch row is common to the South. Under normal conditions in the South, no yield advantage can be expected from planting any closer than thirty-six inches.³ Cultivation begins as soon as the young plants emerge and continues until the plants are large enough to be damaged by a tractor (Figure 21). Beans are cultivated bi-weekly but may be cultivated more or less frequently depending upon the weather conditions. The rule is to cultivate less in dry weather, more in wet.

Figure 21 - Cultivating Soybeans in Louisiana. The tractor here is smaller than normal.
Young soybean plants are similar in appearance and growth cycle to many of the weeds with which they must compete. Thorough soil preparation before planting and subsequent cultivation of the very young plants has kept the weed problem in the fields in Figures 22 and 23 to a minimum. Note in the former photograph that the turnrow also is planted.

Figure 22 - Young Soybeans Near Maringouin, Louisiana. The turnrow in the foreground is planted.

As the plants mature, they complete foliage development in late June, bloom in mid-July, and set beans by the beginning of August. Note how free of weeds the fully grown plants are in Figure 25. A good routine of cultivation
kept weeds out of these growing soybeans.

Figure 23 - Young Soybeans Near Baton Rouge, Louisiana. The solarimeter in the foreground is seven inches high.

Once the plants become too large and row spaces too constricted to permit cultivation without plant damage, the weeds which have survived earlier cultivation and shading by the soybean plants begin to grow and in all too many cases are taller than the beans by harvest time. It is all too typical in the South to see soybean fields dominated by such tall, woody plants as dock, coffee bean, and cockle burr (Figures 26, 27).
Figure 24 - Fully Vegetated Soybean Plants. The sticks are fifty-six inches tall.
Figure 25 - Beans Set on a Soybean Plant. The beans are still green, but they have grown as large as they will get.
Figure 26 - Weeds in a Mississippi Soybean Field

Figure 27 - Dock Weed Stems Left After Beans Were Harvested. These large stemmed plants jam combine cutter teeth and cause frequent stops in harvesting.
When the beans mature, the soybean plant begins to die. Defoliation rates vary with variety, but most soybeans will be devoid of foliage by the time they are ready to harvest (Figure 29). Time of harvest, once the beans are mature, depends upon the availability of equipment, weather conditions, and the moisture content of the soybeans. An early Fall dry spell may lower the moisture content of mature soybeans near or below thirteen per cent, the optimum level for harvesting. If this occurs, the beans can be cut, even though foliage may still be moderately heavy on the plants (Figure 28). The soybean
Figure 29 - Mature, Defoliated Soybeans in Mississippi. Notice the burned tree still standing in the background. This field was cleared only a year before.

Farmer in the Gulf South is very sensitive to moisture levels and, since few county agents can give a quick accurate moisture reading due to the unavailability of precision moisture
testers, small portable moisture level testers are common equipment for soybean farmers. These devices are the size of a lunch pail and will adapt to the electrical system of car or truck permitting them to be taken into the field with a farmer to test his beans in situ.

Regardless of the time elapsed since maturity, soybeans in the Gulf South are not picked until the moisture content is at or below thirteen per cent. Consequently, a wet Fall may mean that beans will lie ripe in the field a month or more before being harvested. If wet weather is prolonged, soybeans may not be harvested until January or February. Once the beans have matured they are in little danger from typical southern weather. The only real danger is a mid-winter warm spell following a cold, wet period when the beans will sprout in the pod on the stem.

Bringing in the Crop

Farm activity increases at harvest time, and it is during the harvest season that most of the technology specific to soybean agriculture in the South comes into use. Large mechanical combines are a common feature along roads and highways in soybean districts at this time. Though they appear slow to an automobile passenger, these machines are an integral part of daily activity in soybean farming regions. Such machines have but one purpose, to harvest grain, and the farmer must maximize field time in order to save fuel and harvest his crop as quickly as possible to
avoid weather damage or to take advantage of a current high price for beans.

The typical combine is a self-propelled machine which cuts the soybean stalk, shreds it, separates the beans, stores them in a bin on the combine, and then dumps the chaf onto the field. Any grain combine can be used to harvest beans, as only a few changes are necessary. A typical combine bin (or hopper) holds only about eighty bushels necessitating frequent unloading.

In Figure 30 we see a five-row combine moving through a soybean field unaccompanied. This particular field belongs to a "small" farmer in Mississippi who has not yet reached the level of financial solvency required to buy additional equipment. With the combine's eighty bushel grain hopper filled, cutting stops while the combine pulls to the edge of the field to unload into a 350 bushel grain bin pulled by a pickup truck (Figure 31). A dump truck may serve the same function (Figure 32).

Valuable combine time can be saved if a tractor-drawn bin is used which moves alongside the combine for unloading without forcing it to stop work (Figure 33). Grain bins designed to go into the field to the combine are easily distinguished, by the tire or wheel size, from those which sit on the edge of a field waiting for the combine to come to them. The tires on the bins in Figures 33 and 34 are large, designed for floatation on soft field
Figure 30 - Combining Soybeans in Mississippi. Note the rolling land.

Figure 31 - Augering Beans From a Combine to a Truck-drawn, Gravity-unloading Bin.
Figure 32 - Augering Beans From a Stopped Combine to a Dump Truck, Mississippi

Figure 33 - Tractor-drawn Bin Following a Moving Combine, Louisiana.
soils while those on bins in Figures 31 and 35 are small, suited only for well-packed dirt or paved roads. The dump truck in Figure 32 is a compromise, the truck can pull into the field but it cannot follow a combine at the slow speed required without miring.

Figure 34 - An Idle Tractor-drawn Grain Bin in Mississippi. Note the very large tires.
Once the grain is out of the combine it must be transported to storage and drying bins, often several miles away. If the grain bin in the field is tractor-drawn it must unload to a truck near the field, for its low road speed requires too much time for the trip to and from grain storage bins (Figure 36). If a wheeled bin has an attached auger, the load is probably destined for a truck. If the bin unloads only by gravity (Figure 31, 34) it can unload directly into a cone for augering to a grain storage bin only (Figure 37).
Figure 36 - Augering Beans From a Field Bin to a Dump Truck, Louisiana.

Figure 37 - Transferring Beans to Storage. The beans move by gravity to the cone in the ground then they are augered from the cone up to the bin.
Whether by wheeled bin or by truck, the beans eventually must go to storage bins for drying. Unloading beans to a storage bin is by gravity. The beans are dumped into a cone-shaped concrete hole, then augered up into the metal bin (Figures 37, 38, 39, 40). The round-lipped holes allow the auger to pivot in any direction so that a small operation (as in Figures 38 and 39), with a minimum of storage capacity, need not alter its basic design if expansion is called for (Figures 40 and 41). Where soybean agriculture is only beginning or where the volume of beans produced does not merit individual on-farm storage and drying facilities, freshly harvested beans may be taken directly to a grain elevator for sale. However, most soybean farmers take advantage of the U.S. Department of Agriculture which provides three and one-half per cent loans with no payment due for three years to farmers for grain bin construction, and the bins pictured here are becoming commonplace throughout the South.

As far as the farmer is concerned, the grain elevator is the ultimate destination for his soybeans except those sold for seed. Most elevators are equipped to handle all size of conveyances. Pickup truckloads of 200 bushels, small dump truck loads of 350 to 500 bushels, and large grain truckloads of 1,500 to 3,000 bushels are processed at grain elevators ranging in size from the smallest to the largest (Figures 42, 43, 44).
Figure 38 - A Tilt-body Dump Truck Unloading Beans to a Grain Bin Via Cone and Auger.

Figure 39 - Close-up of a Truck-to-Cone-to-Auger Transfer.
Figure 40 - A six Bin Storage and Drying Facility, Louisiana. This is just an expansion of the type pictured previously.

Figure 41 - Model of a Typical Southern Soybean Bin Facility.
At the grain elevator the farmer's beans are tested for moisture, splitting, and foreign matter then graded and priced. The price may be one agreed upon six months earlier in a pre-harvest contract, or it may be the prevailing price on the day of delivery (Figure 45). In the last twenty-four months bean prices have been as high as $12 and as low as $4.50 per bushel.
Figure 43 - A Large Grain Elevator in Port Allen, Louisiana.

Figure 44 - Unloading Beans at a Grain Elevator. The whole truck is being tilted to dump its load by gravity.
### Figure 45 - A Representative Scale of Discounts for Southern Soybeans

The elevator operator deducts from the price of the farmer's beans according to the rates on this sheet.

---

**Lapeyrouse Grain Corporation**

**MOBILE - ALABAMA**

**Scale of Discounts — Soybeans**

Applicable on Grades Below No. 1 Yellow Soybeans

— SUBJECT TO CHANGE ON NOTICE —

<table>
<thead>
<tr>
<th>TEST WEIGHT</th>
<th>Per</th>
<th>MOISTURE</th>
<th>Per</th>
<th>DAMAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>54 lb or more</td>
<td>0c</td>
<td>13.7% to 13.8%</td>
<td>1%</td>
<td>2.6% or less</td>
</tr>
<tr>
<td>53.9% to 53 lb</td>
<td>1/2c</td>
<td>13.6% to 14.0%</td>
<td>2%</td>
<td>2.1% to 3.0%</td>
</tr>
<tr>
<td>52.9% to 52 lb</td>
<td>1c</td>
<td>14.1% to 14.5%</td>
<td>3%</td>
<td>3.1% to 4.0%</td>
</tr>
<tr>
<td>51.9% to 51 lb</td>
<td>1/2c</td>
<td>14.6% to 15.0%</td>
<td>4%</td>
<td>4.1% to 5.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.1% to 15.5%</td>
<td>5%</td>
<td>5.1% to 6.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.6% to 16.0%</td>
<td>6%</td>
<td>6.6% to 6.9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.1% to 16.5%</td>
<td>7%</td>
<td>6.1% to 6.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16.6% to 17.0%</td>
<td>8%</td>
<td>6.6% to 7.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17.1% to 17.5%</td>
<td>9%</td>
<td>7.1% to 7.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17.6% to 18.0%</td>
<td>10%</td>
<td>7.6% to 8.0%</td>
</tr>
</tbody>
</table>

**FOR FOREIGN MATERIAL**

Discount — All foreign material in excess of 1% shall be deducted from the gross weight and will not be paid for.

**HEAT DAMAGE**

Discount | 0.3% to 1.0% - 2c per bu. | Any lower grade account Heat Damage subject to agreement between buyer and seller.

| 1.1% to 1.5% - 4c per bu. |
| 1.6% to 2.0% - 6c per bu. |
| 2.1% to 2.5% - 8c per bu. |
| 2.6% to 3.0% - 10c per bu. |

**CROTALARIA**

Discount | 8% of Price plus 10c cleaning charge

**SPLITS**

Discount | 1/4c per bushel for each 1% or fraction thereof in amount of 20%.

**MUSTY**

- BC HEATING — 1c SOUR — 10c HOT — 10c WEATHERED — 2c WEATHERED — 3c

**SOYBEANS**

Soybeans not grading within above limits will be subject to negotiation between buyer and seller. Buyer reserves the right to reject any shipments of sample grade soybeans or soybeans of distinctly low quality.

Soybeans containing any toxic material will be rejected.

Storage will be computed at 1/10c per bushel per day.
From beginning to end, soybean agriculture in the study region follows much the same technical pattern regardless of sub-regional variations in climate or physiography. Varietal choice is the only concession to climate and soil necessary in the South. Individual variations in operational size and financial solvency do have limited influence upon the technology employed but, the pattern of moving beans from field to on-farm drying bins, then to local grain elevators, then to soybean mill or into export

Figure 46 - Loading Soybeans on a Grain Barge at an Elevator in Northport, Alabama. These beans will go directly to Mobile for export or processing.
channels is standard. As soybeans continue their success in the South and the profits they afford place all soybean-related farm equipment within reach of everyone involved, the definitive pattern of cultural detritus or landscape features associated with soybean farming will become more homogenous, thus erasing the few sub-regional or capital-related idiosyncrasies which do exist now.
FOOTNOTES


CHAPTER VII

Some Geographic Hypotheses Concerning Soybeans in the South

Introduction

The preceding chapters present a general history of soybean spread and, with the inclusion of phenological knowledge and the personal experience of soybean farmers, we should be able to make some statements about the causes of recent soybean increases in the South. Unfortunately, we have not yet explained why soybeans are successful in the South now but were not in the past.

It is well recognized that the soybean is an important segment of American agriculture, and, unless some drastic changes take place in the climate or economy of the world, it will continue to expand in the areas where it can successfully grow. The low capital risk required for soybeans and the relatively certain, at least at the present, financial return make it attractive to the farmer. The multiple uses of soy products insure a steadily increasing demand on both the national and the international market. It is obvious that the beans have been attractive to many farmers in the past, and the incentive to grow...
beans is even greater today. For example, the average per bushel price of soybeans in 1930 was $1.34, by 1940 this price had dropped to $.89, yet soybean acreages made rapid increases during that period. By 1950, the price had risen to $2.47 per bushel, a substantial increase in ten years. The price of soybeans stabilized near $2.50 per bushel until 1971 when, in February, the price reached $3.00 and was not to go lower up to the present. Even during the twenty year period of relatively stable prices, soybean acreages doubled, so there must have been some incentive to grow beans. By 1971, soybean plantings in the United States reached 42,000,000 acres, while production climbed to over 1,000,000,000 bushels. In that year soybeans became America's number one cash crop. They were the nation's leading export crop and the largest foreign exchange earner. In 1972, the price of soybeans jumped to $10.00 per bushel in June. The price underwent a slight depression for several months following that, then a rapid climb to $12.00 per bushel in June, 1973. The price has since stabilized at seven to eight dollars per bushel, still a highly profitable plateau. With such an increased potential for profit we can only expect soybean acreages to increase further in the future.

Undoubtedly, such bonanza prices have stimulated soybean plantings since 1972, but they scarcely explain the rapid acreage increases in the past. The doubling
of soybean acres before 1950 occurred during periods of stable soybean price levels. Therefore, while we cannot totally negate the influence prices had upon soybean successes in the United States, other factors must be active in the selection process; otherwise, we would have a closer correlation in time between price fluctuations and acreage changes. It is obvious, too, that factors other than price are active in controlling the distribution of soybeans; otherwise, we would have a uniform distribution of soybean agriculture within the region where soybeans can grow. It is clear by now that soybeans have not been and are not now uniformly accepted in all regions where they can grow, nor where their financial success was predicted. Why then did soybean agriculture fail to catch hold in certain regions, especially in the South? U.S. Department of Agriculture experts, from Washington, D.C. to local agricultural extension agents, sounded the praises of soybean agriculture to farmers in all the states of the Cotton Belt from 1910 to the present. The southern environment is clearly suitable to soybeans, yet, the South generally rejected its culture. Soybeans were a proven profit-maker in the South by 1917, but its incidence in that region decreased soon afterward. The Midwest, definitely a second choice as a home for soybeans, accepted the bean and grew it into a position of agricultural prominence by 1930. Still the South did not accept this new crop.
Replacement Hypotheses

In a pioneer geographical study of soybeans in the South, Professor Merle Prunty recognized the rapid influx of soybeans into the Lower Mississippi Valley after World War II. He felt that soybeans were replacing cotton and corn in southern fields. He listed a full dozen reasons for the bean's acceptance in the South at that time.²

1. Cotton acreage limitations under the Agricultural Adjustment Administration until 1942 which permitted cash crop production of oil beans to gain a toehold.
2. Development of new, highly reliable oilbean varieties, which approximately tripled per-acre yields.
3. Governmental price support for soybeans which increased prices more than fifty per cent.
4. An increased demand for vegetable oil during the war.
5. Increased farm mechanization, especially in the tri-state district.
6. Labor shortages during the war years which did not permit expansion of cotton acreages, but did not affect soybean production since the crop is harvested by machine methods.
7. Soybean cultivation was fitted into cultivation and harvesting of cotton without difficulty, providing fuller use of available labor.
8. Soybean production fitted very well into the share-crop and tenancy land tenure system of the principal (tri-state) producing district.
9. The cotton share-crop system, through its similarity to soybean share-cropping, aided in procuring cultivation loans to begin bean production and stabilized marketing by guaranteeing all participants their shares of profits.
10. Due to its flexibility in planting time, the soybean could be substituted for cotton in event of failure of cotton plantings.
11. The machine cultivation characteristics of soybean production appealed to tenant and share-crop operators, for larger acreages could be handled than with cotton, individual profits were greater, and socio-economic status improved thereby.
12. Net profits from soybean production were comparatively large as a consequence of relatively small production cost per acre.
Many of Prunty's reasons are war-related, the rest are tied to the economic and technological attractiveness of soybeans relative to other crops. Even the wartime measures had other incentives attached to them, i.e. wartime vegetable oil demand, price supports, and lower labor requirements, all of which translate into financial gain. The gist of his hypothesis is that, due to wartime conditions, soybeans suddenly offered the southern farmer a profit he could not realize on the traditional crops, corn and cotton. The result was soybeans replaced corn and cotton in southern fields.

Yet soybeans had always produced a profit to the farmer in the Midwest and surely would have done so in the South, war or no war. The first of Prunty's factors was a novel occurrence in American agriculture, but "natural" restrictions had played much the same role before. "The inroads of the boll weevil, and the migration of over a half million farm people to the North and to the southern cities, attracted by high wages, reduced cotton acreage vary greatly in the Eastern Cotton Belt between 1919 and 1924...."3 We must also remember that Agricultural Adjustment Administration acreage restrictions began in 1933. Although acreages of cotton, the prime money crop in much of the South at that time, were reduced by both factors, the soybean did not begin to make serious inroads into the southern agricultural landscape until much later.
Land-Use Change Hypothesis

Prunty's twelve reasons offer a partial explanation of the South's becoming a soybean producer in 1950, but it was inaccurate to say that the lack of his prerequisites was the reason southern farmers did not accept soybeans in 1920, or in 1930. Why not, then look at the make-up of the agricultural landscape, and examine the southern farm at the time of soybean introduction to see if more light can be shed upon the problem.

A good date to begin such an analysis is 1920, for it was after this time that soybean agriculture took hold in the Midwest. The two modern soybean giants, Illinois and Iowa, had average farm sizes of 134.8 acres and 156.8 acres, respectively. The average size farm in the southern states of Alabama and Mississippi was much smaller than that in 1920, 76.4 acres and 66.9 acres, respectively (Figure 47). Remembering an earlier statement by a modern soybean farmer (who mentioned a 200 acre minimum for commercial soybean farming), we see that the two southern states, in fact all five of our southern states were at a disadvantage to begin with if they wished to begin soybean culture on a successful commercial basis. The percentage of farms greater than 175 acres in the seven states that year was: Alabama, 7.6; Georgia, 8.7; Illinois, 25.3; Iowa, 31.6; Louisiana, 7.0; Mississippi, 7.0 and; South Carolina, 5.9.

While farm size is important, the manner in which
Figure 47 - Farm Size and Percentage of Farm in Cropland for Seven States, 1920, 1949, and 1969.
the available land was utilized is equally important in this case. Illinois and Iowa had 63.7 and 61.0 per cent of their average farm in cropland in 1920 while states like Alabama and Mississippi had only 37.1 per cent and 34.9 per cent of their farmland in crops that year. The two midwestern states have always been relatively large-scale and intensively farmed in comparison to the southern states. Corn was primarily a food crop for local consumption by man and beast in the South in 1920. Considering local corn need, it could not be replaced by a cash crop like soybeans. When we take into account the fact that 45.8 per cent of the cropland in Alabama and 41.8 per cent of the cropland in Mississippi was used for corn in 1920 we realize that the farm systems of these two southern states simply could not have absorbed large acreages of soybeans, or any other cash crop (Figure 48). This left little cropland for soybeans or any other crop except cotton, which did and still does provide the opportunity for a large financial return per acre. Of course cotton could have been replaced by soybeans, for both were cash crops, but cotton was harvested by hand at that time (1920 to 1949) and soybeans, as farmed in the United States, required mechanized harvesting equipment. The South was not mechanized until recently (Table 16). Cotton has consistently offered a greater potential monetary return per acre than have soybeans and, initial costs for switching from hand-picked cotton to mechanically picked soybeans would be high for
Figure 48 - Crop Composition of Selected States, 1920, 1949, 1969.
Figure 48 - (Continued)

IOWA 1949

ALABAMA 1949

MISSISSIPPI 1969

ILLINOIS 1969

IOWA 1989

ALABAMA 1989
soybeans or a comparable cash crop addendum.

What, then, did occur in the pattern of southern agriculture which led to the recent rapid reception soybeans have enjoyed in that region? And what effect has this had upon the landscape of the South, especially within the designated study region taken up in this paper. As we have seen, Prunty felt that social and economic conditions, which altered the capacity to grow traditional southern crops, especially cotton, opened the way for another crop to occupy acreage vacated, thus soybeans became a replacement crop for cotton and corn.

TABLE 16
FARM POWER SOURCES, 1920, 1949, and 1969

<table>
<thead>
<tr>
<th>State</th>
<th>1920</th>
<th>1949</th>
<th>1969</th>
</tr>
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<tbody>
<tr>
<td>Alabama</td>
<td>811</td>
<td>45,751</td>
<td>75,069</td>
</tr>
<tr>
<td>Georgia</td>
<td>2,752</td>
<td>60,269</td>
<td>84,566</td>
</tr>
<tr>
<td>Louisiana</td>
<td>2,812</td>
<td>35,735</td>
<td>63,194</td>
</tr>
<tr>
<td>Mississippi</td>
<td>667</td>
<td>52,393</td>
<td>88,677</td>
</tr>
<tr>
<td>S. Carolina</td>
<td>1,304</td>
<td>30,282</td>
<td>50,115</td>
</tr>
<tr>
<td>Illinois</td>
<td>23,102</td>
<td>234,789</td>
<td>275,203</td>
</tr>
<tr>
<td>Iowa</td>
<td>20,270</td>
<td>240,941</td>
<td>318,998</td>
</tr>
</tbody>
</table>

Another proponent of this "replacement theory" restudied the lower Mississippi valley and restated the idea that soybean acreage expansion in the South has occurred and will "occur mainly at the expense of less remunerative crops." There can be no denying that corn
and cotton acreages have declined in the South, but both cotton and corn acreage losses are less noticeable during the period 1960 to 1970 when soybean acreage increases in the South are greatest (Figure 49). The idea that soybeans have caused these traditional crops to decrease by offering a more suitable replacement is incorrect, at least for the total time period from 1920 or even from 1949 to the present. Prunty's ideas will, indeed, be partially substantiated later but only for those years before 1959, before the big push in southern soybeans. Cotton and corn acreage reductions follow more closely the general reduction in cropland across the region, while soybean acreages act almost independent of these other changes. Notice in Figure 49 that there is a noticeable slowing of cropland losses in the South as soybean acreage began to climb in 1960.

Figure 49 - Acreage Changes in the Five-state Study Region, 1940-1970.
The relationships within the individual states vary. In Louisiana, 945,000 acres of corn and cotton went out of production between 1950 and 1970; soybean acreage in Louisiana at the same time increased 1,593,000 acres. In Georgia, 2,431,000 acres of cotton and corn were lost between 1950 and 1970, while soybean acreage increased only 502,000 acres during that period.10

A casual perusal of this farm data raises some question about the validity of the "replacement theory" in the recent South. In Louisiana, the soybean acreage increases from 1950 to 1970 almost double the cotton and corn acreage losses, so a simple replacement of the latter two by soybeans is impossible. In Georgia, the soybean acreage increase is roughly one-fifth the cotton and corn acreage decrease. So some other factor, or factors, must be in force. The two maps below reveal the ubiquity of cotton and especially corn acreage in the study region in 1949, a near virgin year for soybeans across the South (Figures 50 and 51)(refer back to our map of soybean acreage in 1973, p. 41). It is obvious that the direct spatial replacement of corn and cotton by soybeans has not been and is not now a major trend upon the landscape.

Attempts to explain the landscape ramifications of recent soybean acreage increases on southern farms as merely replacement of one crop with another assume that the overall agricultural land-use system in the South has been a constant. Vitality and variability then are assigned
Figure 50 - Distribution of Corn Harvested, 1949.

Each Dot = 5000ac.
(US Census of Agriculture)

Figure 51 - Distribution of Cotton Harvested, 1949.

Each Dot = 5000ac.
(US Census of Agriculture)
only to components of that system. In the Prunty-Siniard hypothesis the active components must be alike; they all involve field crops, all of which are apparently functionally similar. The idea does not invite speculation about changes in the over-all makeup of the basic unit, the farm. Perhaps component changes are not always the key to understanding the spread of soybean agriculture in the South. This theory certainly does not attain a grasp of important landscape changes. We are now justified to search for systematic changes to provide sufficient insight into what must occur before soybean agriculture can be accepted in the South and then to ascertain the appearance of the resultant agricultural landscape after the transformation to soybean agriculture has occurred.

Preliminary analysis of the overall agricultural land-use system in the United States and particularly in the South began earlier when farm sizes were compared for seven states. To further examine changes in the size and composition of an average farm in the Midwest and in the southern study region we can re-examine Figure 47 above. What was a lopsided farm size comparison in 1920 is nearly equalized in 1969. While farms in both regions increased in size, those in southern states grew at a much more rapid rate. Notice that as the southern farms increased in size they also increased in farming intensity; not only were farms becoming larger, they were enlarging their cropland
constituent. Thus a farm of 1969 which might consist of two or three 1920 vintage farms consolidated into a single unit was much more than just the sum of its parts, it was a new, potentially more productive, parcel of the agricultural landscape with more total acres of cropland.

Along with this increase in size and intensity went an ever-increasing mechanization of southern farms due in part to the size increase and partly to changes in the fabric of southern society. This included a revitalization of the southern plantation from sharecropped segments back to centrally controlled "agricultural factories". Surely we can assume that the increase in farm size which occurred in the South since 1920, and which is still proceeding, heralded a shift away from traditional small-scale southern farming to a larger-scale, more mechanized system that had, for decades, characterized the Midwest. Moreover, we know that farm size increases increase the potential for changes in farming practices and at least three such practices underwent change in the South and opened and are opening the door for soybean agriculture. First was the shift to mechanized farming, the second was the intensification of farming available land since mechanization allowed and the cost of mechanization demanded it, and third was the shift to more cash-crop farming.

This new, large, intensive farm business was a necessary condition for successful introduction of soybean
agriculture to any region. The fact that such conditions existed in midwestern states and not in southern states in 1920 is the reason that soybean agriculture did not grow on the South as it was predicted to do and for which it had the potential. But only after the transformation from small to large farms, from extensive to intensive farmland utilization had occurred in the South did the cultivation of a poor-soil cash crop like soybeans increase markedly. However, once soybeans were reintroduced to the new southern farmer, the soybean itself became a cause of furthering land-use intensification. Farms could be enlarged; woodland or scrubland could be cleared with the express purpose of planting soybeans. The almost guaranteed financial success associated with such moves has been presented before, and these facts have not been unknown to farmers across the South. Income from hardwood forest in the South ranges from $3 to $12 per acre; clearing, discing, chunking, and leveling the same land costs around $100 per acre. Based on a net profit of $30 per acre from soybeans, Williams found that the combined losses accrued above could be paid off in six years of farming soybeans. When we realize that his figures were based on a soybean price of $2.75 per bushel and that the same bushel of soybeans is worth more than twice that today, the economics of clearing land for soybean agriculture are even more attractive. So, while the soybean in the South was an initial benefactor of the transformation of
the land-use pattern in certain areas, the soybean today is itself an agent of change in the total land-use pattern and in the resultant landscape modifications occurring in the study region.

What are some of the landscape changes we can expect as soybean agriculture increases its incidence across the South? First, we know that farm size is increasing; such a phenomenon will not be too apparent since existing fence lines and boundaries seldom change substantially with ownership changes. Second, we can expect the farmstead to undergo some modifications; barns and farm houses will enlarge to accommodate the combines, tractors, and trucks that have been so common in the Midwest and, until recently, so rare in the South. The most outstanding landscape changes will be the decreasing acres of farm woodland and their replacement by cropland, very often filled with soybeans. The overall result will be a southern farm landscape more open and more obviously productive or "used" than it has been in the immediate past.
FOOTNOTES

5 U.S. Department of Agriculture, op. cit.
6 U.S. Department of Agriculture, op. cit., 1920, 1940.
CHAPTER VIII

A Test of the Hypothesis

Introduction

It is known that soybean agriculture in the United States is undertaken on a large scale, and that it requires a substantial amount of mechanization. Corn and cotton culture can proceed without these conditions, and did so in the South until recently. When soybeans were introduced to the American farmer the bean was predicted to be successful wherever corn could be grown profitably, that is, in most of the Eastern United States. The South, particularly that region known as the Cotton Belt, was recommended as the prime site for establishment of this new cash crop. All types of agricultural experts introduced soybeans to the South but the reception was cool, except for some acceptance as a forage crop or a green manure. The reason postulated for this initial rejection is that the typical southern farmer of this early period had neither the available cropland nor the mechanical implements required by soybeans so, though the crop would grow well in the South, the southern farmer could not
grow them profitably. Within the phenologically acceptable region only the midwestern farmer was properly constituted to farm soybeans successfully. Their acceptance in that region has been documented previously.

Recently, though, the South has become an important secondary center of soybean production perhaps soon to fulfill its promise of the 1920s. Obviously, changes have occurred within the southern agricultural system and these have had their imprint upon the agricultural landscape in that region.

If soybean agriculture is related to farm size or to land availability and to farming intensity, or more properly land-use intensity, there will be significant statistical relationships between soybean acreage increases and farm size and land-use intensity. Specifically, there should be a strong positive correlation between soybean acreage increases and increases in farm size, cropland availability, and woodland clearing. In order to fully substantiate the hypothesis, doubt must be cast upon the validity of the "replacement hypothesis" discussed earlier, for it is proposed to those ideas supported by this paper. To do this there should be either nonsignificant results or significant correlations between soybean acreage increases and corn and cotton acreage decreases. Statistics in the following analyses of these variables are produced from county data for the 418 counties in the five states
of Alabama, Georgia, Louisiana, Mississippi, and South Carolina taken from the U.S. Census of Agriculture for the appropriate year.

**Statistical Analysis**

It has been previously shown that overall farm size in the South has increased since 1920. The relationship between the increase in farming and the increase in farm size from 1949 to 1969 is, as expected, highly significantly positive. Based on county data, it is seen that an increase in average farm size of only one acre brought about an increase of 119.5 acres of soybeans to the county (Figure 52). This statistic is based on a simple linear regression analysis. When multiple independent variables (farm size, corn acres, cotton acres, cropland acres) were introduced into the Maximum R-square Improvement Procedure (SAS, 1974), the best one-variable model for prediction of soybean change is farm size. The thesis is obviously intact after this first test.

Although farm size increased over the entire region, the total of land in farms decreased and is still decreasing. The amount of cropland per county, however, has not consistently decreased. Over the twenty year period from 1949 to 1969, a highly significant, positive relationship between soybean acreage increases and cropland availability does exist. The r value of 0.49 supports the contention that other factors are involved (Figure 53). However, if an examination of the same relationship during the
more recent period from 1959 to 1969 is undertaken, a distinctly more convincing result is obtained. For that decade the correlation between soybean acreage increases and cropland availability is a positive and impressive 0.79. For every one acre in cropland added to a county total, 67 percent of that acre was planted in soybeans (Figure 54). This latter statistic is especially impressive, and it supports the contention that the pattern of increasing farmland utilization for the express purpose of planting soybeans is obviously a growing trend.

So, more and more farmland in the South is being pressed into active service, primarily for soybean agricul-
Figure 53 - Plot of the Regression of Soybean vs Cropland Change, 1949-1969.

Figure 54 - Plot of the Regression of Soybean vs Cropland Change, 1959-1969.
ture; thus, it is assumed that farm woodland is decreasing, cleared for tillage. Unfortunately, we are really lacking full information on this phenomenon. Test results comparing farm woodland change to soybean acreage change are insignificant. The central problem with this analysis lies in the availability of data or lack thereof. In 1949 and 1959 it is possible to delineate pastured woodland from non-pastured woodland, but in 1969 the two data categories were merged by the U.S. Department of Agriculture, and there is no census basis for a comparison. The U.S. Forest Service does have figures on woodland cleared for each state, but their statements, based on samples calculated from interpretation of air-photos, are extrapolations from these samples and, even if their data were for counties instead of for a whole state, it would be unsatisfactory for our purposes.

As a partial but interesting substitute, data are available on woodland cleared for one state within the study region, and it was collected by county. By virtue of a special study conducted by parish agricultural agents in Louisiana the amount of woodland cleared from 1962 to 1971 is known, and the relationship between woodland cleared and increases in soybean acreage is positive, with an $r$ of 0.72 (Figure 55). Due to bureaucratic problems such a survey will not be conducted for other states, or for Louisiana in the future, so one can only speculate as to the degree of woodland cleared in the rest of our region. But cropland
increases are, no doubt, the result of woodland clearing and increases in cropland have already been demonstrated for counties in the other four southern states under study.

Figure 55 - Plot of the Regression of Soybean vs Land Cleared, 1962-1970.

![Graph showing regression of Soybean vs Land Cleared, 1962-1970.]

In order to fully examine the hypothesis, there must be a test of the predictive ability of corn and cotton acreage changes in the area as factors in soybean increases. For if the replacement theory is correct, there will be a significant inverse relationship between soybeans and either corn or cotton and probably for both. For the twenty year period 1949 to 1969 the corn-soybean relationship is exactly
opposite that predicted by proponents of the replacement theory (Figure 56). There is a positive correlation of 0.47 between soybean acreage and corn acreage change. Soybean agriculture signals an overall intensification of crop farming, thus, while the entire region may be forsaking corn, those counties accepting soybeans are increasing their corn production as they increase overall crop productivity. This, of course, is an integral part of the thesis put forth here.

Figure 56 - Plot of the Regression of Soybeans vs Corn Change, 1949-1969.
Cotton acreages behave in the general fashion predicted by Prunty and Siniard (discussed earlier) for the twenty year period examined, but an examination of segments of that period show two separate, distinct relationships. In the early period of 1949-1959 soybean acreage increases were apparently occurring somewhat at the expense of cotton acres; an $r$ of -0.64 is calculated. The latter decade exhibits a complete turnaround, however, for the relationship from 1959 to 1969 is a positive 0.12 (p less than .01). Again this is evidence of

Figure 57 - Plot of the Regression of Soybeans vs Cotton Change, 1949-1969.
In increasingly intensive land use for all crops, looming ever more important with time in the study region.

In order to arrive at the best predictive model for soybean acreage increases, and to arrive at the landscape transformations indicated by such acreage increases, a multiple regression analysis was performed using the acreage figures for soybeans, corn, cotton, farm size, woodland, and cropland, again using county census data. The best one-variable model was, as previously mentioned, one utilizing farm size. Soybean Acres = -2367.23 + 119.49 (Farm size change). A positive r value of 0.52 was experienced. The best two-variable model did not include farm size but was that utilizing cotton acreage change and cropland availability change. The model is: Soybean Acres = 8845.6 - 1.54 (cotton) + 0.70 (cropland). A very high r value of 0.91 results from the combined equation, meaning that this model accounts for 82.2 per cent of the variability in soybean acres. With the addition of woodland change (negative) the r^2 value increased to 0.85. Neither the addition of corn change nor farm size improved the equation. These figures represent the twenty year period analyzed previously. There is very little change when the data is broken down into ten year spans, but some of the results are interesting.

For the first ten years, 1949-1959, cotton acreage decrease is the best single predictor of soybean acreage increase (Soybeans = -3064.63 - 0.62 (cotton change);
$r^2 = 0.42)$. Cotton and cropland make the best two-variable combination for the early years but their predictivity is low relative to the earlier two-factor equation. The $r^2$ is 0.69. For the second ten year period cropland provides the best one-variable model. Soybeans = 12,454.38 + 0.67(cropland change). The $r^2$ is 0.61. The combination of cotton and cropland is again supreme. The two-variable model results in an $r^2$ of 0.73.

**Conclusions**

Based on these analyses the hypothesis is upheld. It is especially well received in the more recent time period. Farm size increases and increases in cropland are most assuredly closely related to soybean agriculture. The former is a prerequisite for soybean agriculture acceptance, in fact, it is the cause of a shift to soybeans. The latter is a result of it. The fact that cotton acreage decline is also closely correlated to soybean acreage increase in the early years is not disturbing because it was the initial reaction of farmers, who wished to adopt soybean, to plant in established fields, but cotton acreage losses were not the cause of soybean increases. Even after 1959, when cotton was actually on the rise in soybean areas, the modern replacement advocates have not recognized the tenuousness of their position.¹

The following computer-generated maps present a graphic illustration of the evolution of farm size across the study region. Ruling out those counties along the
Gulf and Atlantic coasts, whose farm size tends to be large due to the low level of use afforded by the marshy or poorly drained soil there, the darkest pattern on the 1969 map (representing the largest farm sizes) fairly closely resembles the pattern we see on our dot maps of soybeans earlier. The next map is of farm size change from 1949 to 1969 (Figure 60). The pattern here is even closer to that of soybean agriculture but this figure demonstrates some predictive value because the switch to soybeans is after-the-fact so those counties with above average farm size increases can be expected to participate even further in the expansion of soybean agriculture across the South. Of particular interest are the changes on the eastern edge of the Black Belt in southeastern Alabama and southwestern Georgia. Soybean agriculture has not reached the proportions here that it has in the Yazoo Basin, the Tensas Basin or in the Prairies of Louisiana (Figure 61). Yet the farm size increases have been nearly as great in the former as in the latter regions. If one were to predict a region with great potential to embrace soybean agriculture, it would surely be here.

The next map (Figure 62) is one of soybean acreage change from 1949 to 1969. The average increase per county for that period is 12,896 acres so those counties in our highest category on the map have had acreage increases of at least 25,792 acres. Since most of the counties represented in the highest category were significant soybean
FARM SIZE 1950

Legend:

- 0-50 acres
- 51-100 acres
- 101-200 acres
- Over 200 acres

Figure 58 - Map of Farm Size Per County, 1949.
Figure 59 - Map of Farm Size Per County, 1969.
FARM SIZE CHANGE 1949 - 1969

MEAN CHANGE 128ac

LEGEND

Figure 60  Map of Farm Size Change Per County, 1949-1969.
producing regions in 1949 already (the Yazoo and Tensas Basins, and Baldwin County in Alabama for instance) it appears that though these regions grew a relatively large number of beans in 1949, they were nowhere near capacity at that time. Assuming that those sections of the study region which have only recently taken up soybeans on a significant scale (the Tennessee River Valley section of Alabama, the Black Belt, the Atchafalaya Basin, and the hills of central Mississippi) will undergo further soybean acreage increases similar to those mentioned above, it is realized that soybean agriculture may have only begun in the South.
SOYBEAN ACREAGE CHANGE 1949 - 1969

MEAN CHANGE 12896 ac.

LEGEND:

Figure 62 - Map of Soybean Acreage Change Per County, 1949-1969.
FOOTNOTES


Conclusions and Predictions

A Look Back

The soybean is an important crop both in Asia, where it has a lengthy history, and in the United States, where it is a comparatively recent introduction. Only in the last thirty years has there been a substantial, spectacular acreage increase in the United States, yet almost six-tenths of the world production of soybeans now comes from this country. There is a steady expansion of domestic and foreign consumption, providing further opportunity to increase acreage in the United States and elsewhere.

The soybean has intriguing characteristics. It is a short-season crop, responsive to photoperiod, with the nitrogen nutrition of a legume. Its seed is rich both in protein and in oil, with uses more diverse than most other grains. It succeeds on nearly all soils with an adequate moisture supply. As knowledge of the plant and experience with its culture have accumulated, per acre yields have steadily but unspectacularly increased. Better
adapted varieties have become available, but the area within which soybeans can profitably be grown has remained relatively constant, although the degree to which they are grown within that region has intensified.

This paper is concerned with the reasons for the differential acceptance of soybeans as a cash crop within that phenologically acceptable region. As the study progressed, we became aware of several geographically significant facts about soybean agriculture in the United States. First, the soybean is not a primary food-stuff in the American diet; the beans must be processed and the resultant meal and oil further refined before creating truly marketable products. Such processing and refining goes on in large, complex, and very expensive mills and factories, thus the soybean farmer neither consumes nor processes his own beans. When grown to maturity, the soybean is purely a cash crop. The technology associated with growing soybeans requires a great deal of mechanization; soybeans have never been farmed or especially harvested by hand to any extent in the United States. As a purely cash crop, with a low per acre net return, in relation to other cash crops, but an equally low capital risk required, soybean farming is truly successful only on a large scale. The minimum acreage for financial success is approximately 200 acres but the rule is to grow them in much larger units. Low-profit is not really the appropriate word to use for soybeans, for they are adaptable
to many poor soils and will stand climatic stress well enough so that, under some circumstances, soybeans are much more profitable than any other field crop. It is this latter fact which has contributed as much to the success of soybean agriculture, especially in the South, as has any other phenomenon. Farm size increases and the intensification of agriculture have led to higher and higher rates of farm land use, so land previously unsuited for agriculture was pressed into service. If the individual land-holding was large, the amount of new cropland was often sufficient to sustain soybean culture and, with their ability to produce under a variety of conditions, soybeans were planted at a rapid pace.

Upon their introduction to the United States, only the Midwest met both the phenologic and agricultural land-use requirements for soybean culture. The Oriental Wonder Bean soon proved its mettle and became a staple in Corn Belt agriculture. As the South accepted twentieth century agricultural practices and began to farm intensively on a large scale, the soybean, which had been waiting in the wings since 1917, was able to occupy a newly created niche within this evolving southern agricultural landscape. Acreage restrictions and environmental constrictions ruled out most other cash crops for this new southern farmer as he sought to maximize the utility of his holdings. The soybean was, and is, preadapted for this purpose. Once the culture of soybeans established
itself as a highly profitable addition to southern agriculture, the soybean became a cause of land-use intensification, not just an effect. Land owners and farmers began to seek land for soybeans rather than seeking crops for idle land. This condition still exists in most of the South today.

A Look Forward

Where will it all end? Will soybeans continue to spread across the South at past rates, or have we reached a point of saturation where prices will fall and acres will decrease? It is doubtful that the demand for soybeans and soybean products will lessen for any extended period or even that it will level off in the near future. The main competitors for the world oil market are soybeans, palm oils, and sunflower oil. Soybean oil comes primarily from the United States and, as we have seen, the supply is expanding each year. Palm oil supplies have been rising steadily and are a stiff competitor with soybeans for international oil markets. Palm oil, however, lends itself to soap production and other industrial uses more often than to food purposes, since the oil has a pungent odor. As more demand is placed upon soybean oil for food purposes, the incidence of palm oil in other oil related or derived products should increase. Sunflower oil comes primarily from the Soviet Union and is highly subject to the vagaries of the Russian climate. The Russians can
flood the world oil market in a good crop year, but it is a rare occurrence for Russia to produce enough oil for export. Fish oil comes primarily from menhaden or anchovetta-like fish caught off the southern United States Gulf shores and on the Pacific coast of South America. The Gulf fishery has practically disappeared and the South American fishery reacts violently to overfishing, so periods of feast are followed by periods of famine. The fish oil supply, therefore, is unsure and, though a bumper catch can temporarily depress soybean prices, less dependence upon fish oil as a staple is assured for the future. Even under ideal circumstances, the fish oil supply is more immediately finite than is that of soybean oil. Peanut (groundnut) oil, cottonseed oil, and other vegetable oils all add to the world oil market but, due to their limited phenologic ranges and the economics associated with their culture, they have not and will not pose a serious threat to soybean oil on the world market in the foreseeable future (Table 17).

<table>
<thead>
<tr>
<th>Year</th>
<th>Soy</th>
<th>Fish</th>
<th>Sunflower</th>
<th>Palm</th>
<th>Peanut</th>
</tr>
</thead>
<tbody>
<tr>
<td>1955</td>
<td>2595</td>
<td>530</td>
<td>795</td>
<td>4070</td>
<td>2025</td>
</tr>
<tr>
<td>1960</td>
<td>3795</td>
<td>490</td>
<td>1225</td>
<td>4101</td>
<td>2305</td>
</tr>
<tr>
<td>1965</td>
<td>4500</td>
<td>875</td>
<td>2910</td>
<td>4360</td>
<td>3285</td>
</tr>
<tr>
<td>1970</td>
<td>6015</td>
<td>1033</td>
<td>3810</td>
<td>4305</td>
<td>3270</td>
</tr>
<tr>
<td>1972</td>
<td>7232</td>
<td>935</td>
<td>4053</td>
<td>6000</td>
<td>3745</td>
</tr>
</tbody>
</table>
Soybean meal is only beginning to emerge as a commodity in great demand. The frightening growth of population in the world has taxed the food supply to its present limit and has driven food prices up to near unacceptable levels in food producing nations, especially in the United States. Animal proteins are physically and fiscally beyond the reach of an expanding number of people both in the United States and in the rest of the world. As this trend continues, the demand for a high protein meat substitute increases. Both fish meal and soybean meal have been pressed into emergency service for hungry people in the past and will become more common in world diets in the future. The availability of fish meal was discussed earlier so again the reliability of the soybean increases its value. Domestic use of soybean meal in the United States has traditionally been as animal feed. Over ninety per cent was thus utilized in 1970, but the portion used as additives to human food has been gradually increasing. Food store chains in the United States now proudly advertise that the protein content of their ground meats has been raised by addition of soybean meal. The resultant lower-priced "hamburger" has been very well received by consumers. The word "soy-protein" appears more and more in prepared food advertisements, an indication both of the need for soybean meal in many foods and of the public acceptance of soybean products by members of the greatest consumer society in the world.
Figure 63 - Projected U.S. Soybean Oil Use (billion pounds).  

Figure 64 - Past and Projected Soybean Meal Use in the U.S. (billion pounds).
Increased demand for soybean products and derivatives will increase the demand for raw beans further. Predicted increases in soybean use in the United States are approximately 20 per cent over the next five years (Figures 63, 64, 65), but this may not reflect world-wide growth in both population and appetite and, indeed, it may be quite conservative for the United States. Between 1972 and 1973, expected United States soybean production jumped 25 per cent. Unless per acre returns are much
higher than usual (and they weren't), this means an extra 11,000,000 acres of soybeans in the United States in one year, much of the increased acreage was planted in the South.

What then of the southern agricultural land-use pattern and the landscape which contains it? Much of the study region has yet to accept soybean agriculture on a large scale. Some of the parts of these five southern states have not even completed the land-use transformation which is prerequisite or inviting to soybean culture, though most are proceeding toward this end at a rapid rate. Agricultural experts predict production increases to level off at 5 to 6 per cent per year in our five southern states for the next ten years.\(^8\) Assuming no appreciable increase in per acre yields this growth translates into a one year increase of almost 1,000,000 acres of soybeans in the five state region. Late reports from state agencies in Alabama and Georgia indicate state soybean production there up 27 per cent and 22 per cent respectively for 1974 alone. Both states report average per acre yields.\(^9\) It is obvious then, that the trend to larger farms with more cropland and less woodland is continuing. The spread of the practices of enlargement and intensification of land-use necessary for soybean culture adoption is now more rapid in the South than it was in the recent past. Active, successful soybean culture is now so close to so many previously undisturbed areas,
and the benefits the bean brings can be seen by farmers not familiar with it before.

It is surely only a matter of a few years before the traditional southern agricultural landscape is gone. The small subsistence farmer is already history, and if present trends continue, we will have to forget the miles of scrub woods, brambles, and broom sedge so common to rural roadsides in the agricultural South. In its place will be the clean geometry of plowed fields, often sterile in winter but green and growing, producing all summer as a new system of agricultural activity demands more and more efficiency from the willing land. The soybean plant will be an important crop that new landscape, and King Cotton will have to yield to another, even more ubiquitous monarch, King Soy.


5 Gaston, op. cit., footnote 4, p. 7.


7 Gaston, op. cit., footnote 4, p. 11.

8 Gaston, op. cit., footnote 4, p. 15.

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