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COTTON GROWING IN COLOMBIA: ACHIEVEMENTS AND UNCERTAINTIES*

INTRODUCTION

The production of American Upland cotton in Colombia, begun only about thirty years ago, has become one of the country's major agricultural industries. Transfer of this crop from North America was favored by the development of production of insecticides in industrial countries, the promotion of national production through a protectionist policy, and an abundance of suitable land that can usually be harvested twice a year. Unfortunately, biological factors have not made the transfer easy. Indeed the adaptation of new seeds to local ecological conditions, the battle against pests and diseases, and sustained control of them, present formidable and continuing difficulties.

As a general policy the Colombian government has relied extensively on protectionism to promote new economic activities. In a limited market so protected, monopolies proliferated; conflicts of interest among them caused serious instability; decisions as to a fair level of prices became political, causing fluctuations in the growth of production; regulatory agencies had to be established, making for additional rigidities in the economic system. At the beginning

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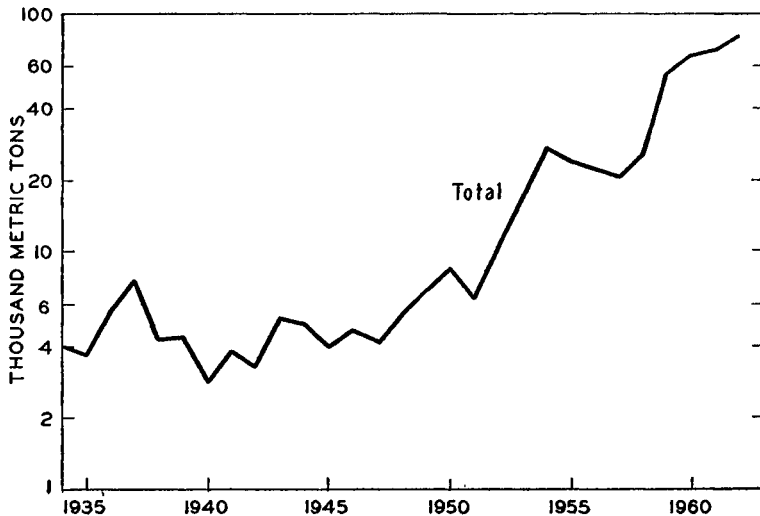
While due appreciation is expressed for the generous financial aid granted by the four foundations and the cooperation of agencies of the Colombian government, they are in no way responsible for the contents of this study. The author alone bears that responsibility.

of the century, the textile industry, born of the protectionist policy of President Rafael Reyes, developed substantially despite extremely difficult internal transport. After the world crisis of the thirties, the government encouraged the production of American-Egyptian cotton. The textile mills were for a time required to absorb the national production. New areas of the lowlands, until then mainly under grazing, were planted to cotton in large mechanized farm units. Insects soon multiplied, as did the consumption of insecticides. The market for insecticides, mainly provided by the cotton growers, expanded until a new protected insecticide industry could be supported. The development of successive monopolies—a buying cartel of the textile industry, an organized pressure group of cotton growers, state monopoly of ginneries, and dominance of the insecticide market by a limited number of firms—built serious weaknesses into the structure of the industry.

The biological aspect is vitally important, the increased attacks of insects having been the most serious and most preoccupying threat to the industry. Insect attacks have been one of the major reasons for frequent shifts in location of cotton growing, and they continue to be a menace to the results already achieved. Innovations in the cotton industry have been substantial in the last twenty years. Yet the massive importation of easily transferable procedures, of seeds selected elsewhere, and of machinery, have not overcome the difficulty of achieving a sustained adaptation of foreign technology in a tropical setting.

This paper describes the spectacular achievements of the Colombian cotton-growing industry in the last quarter century and successive developments in different regions, with particular emphasis upon the roles played by insects in production and by monopolies in marketing.

CHART 1.—PRODUCTION OF COTTON FIBER IN COLOMBIA, 1934-62*
(Metric tons)



* Data are from the sources cited as 4, 22, and 16.

TABLE 1.—COTTON FIBER YIELDS PER HECTARE IN COLOMBIA, 1934, 1937-38, and 1950-63*

Year	Kilograms per hectare	Year	Kilograms per hectare
1934	205	1955	294
		1956	329
1937-38	148	1957	327
		1958	332
1950	230	1959	429
1951	163	1960	451
1952	192	1961	466
1953	254	1962	452
1954	339	1963	476

* Data for 1934 from *Agricultura* (Colombia, Departamento de Agricultura, Ministerio de Agricultura y Comercio, Bogotá), IX, 8, May 1937, p. 150, regarding fiber as unginned cotton times .31; for 1937-38 from H. G. Porter, *The Cotton Industry of Colombia* (U.S. Department of Agriculture, FAS M-113, Washington, 1964), p. 6; for 1950 from T. J. Goering, *Cotton Production in Colombia* (Universidad Nacional de Colombia, Facultad de Agronomía, Palmira, 1962), mimeo., Table 3, p. 5; for 1951-62 from Instituto de Fomento Algodonero (IFA), *Colombia, algodón y oleaginosas 1961-1962* (Bogotá, 1963), Table 1, p. 9; and for 1963 direct from Instituto de Fomento Algodonero, regarding fiber as unginned cotton times .382.

COLOMBIAN COTTON PRODUCTION IN AN INTERNATIONAL SETTING

Colombians are proud of the achievements of their cotton growers. Has not the rate of growth of this activity exceeded that in most of the major producers in the Western Hemisphere in the last fifteen years? Did not national yields per hectare double, and total production increase tenfold in twelve years? Colombian production, increasing quite slowly until 1950, has indeed shown spectacular growth since then (Chart 1). In 1950, Colombian production represented only one-twelfth of the production of Argentina; in 1962, nearly two-thirds (Chart 2). Similarly, yields present a comforting aspect: after a long period of apparent stability until 1952, with highs and lows varying with weather, they rose very rapidly, exceeding 300 kilos of fiber per hectare in 1954, 400 in 1959, and 450 in the following years (Table 1).

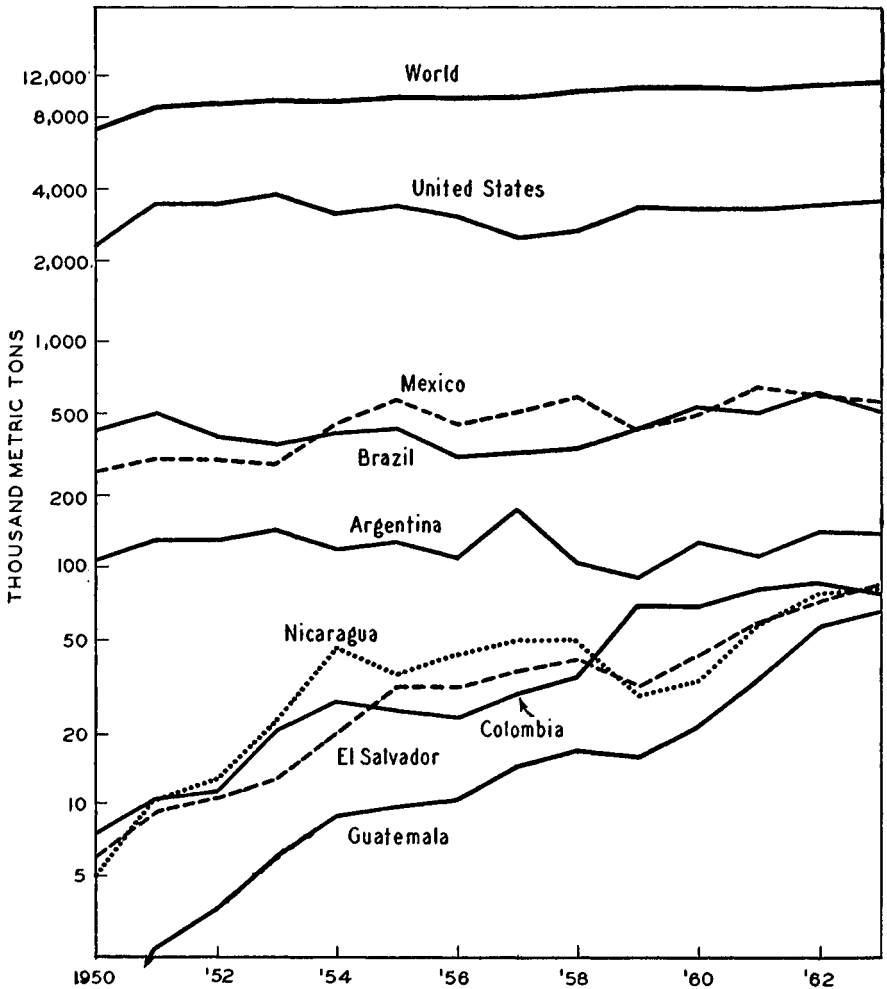
Twenty-four countries of the world produced 97 per cent of the cotton grown in 1960. Ranking of those countries by their progress in yields per hectare since 1950 puts Colombia in fourth place, and it ranked tenth in level of yield per hectare in 1960 (Table 2). Significantly, yields in Colombia are among the highest in the group of tropical countries growing cotton without or with very little irrigation, including Brazil, Uganda, Burma, India, and Paraguay. Only Central America presents more successful developments.¹ Yields in Colombia approach

¹ In Central America cotton is grown on rich alluvial or volcanic soils along the coasts. As in Colombia, insects are the major problem. There are no freezing temperatures to kill hibernating insects and, as in Colombia, heavy showers wash off insecticides, making frequent applications necessary. In El Salvador, for instance, total sprayings average 20 per season but may go as high as 35 to 40. In Nicaragua the application of insecticides represents about 45 per cent of the cost. The major differences between the Central American countries and Colombia originate in economic policy. In Colombia the markets for cotton and for insecticides alike are protected. In Central America insecticides and machinery are imported and cotton exported with an eye to world market conditions (50, pp. 8, 15; 38, pp. 306-09).

A more detailed analysis of the conditions that explain the development of the cotton industry of El Salvador, Nicaragua, and Guatemala would throw further light on the impact of divergent economic policies in a similar natural setting.

CHART 2.—COLOMBIAN PRODUCTION OF COTTON FIBER COMPARED WITH WORLD TOTAL, THE UNITED STATES, AND SELECTED COUNTRIES, 1950-62*

(Thousand metric tons)



* Data from U.S. Department of Agriculture, Economic Research Service, *Supplement for 1964 to Statistics on Cotton and Related Data, 1925-1962* (Statistical Bulletin 329, October 1964), Table 91.

those obtained in some countries where cotton is totally or principally irrigated, as in Mexico and Peru.

Of the 24 countries listed in Table 2, only four had increases in yields greater than those in the United States. All of these are Latin American—El Salvador, Guatemala, Nicaragua, and Colombia—and all have enjoyed the support of American technology. Mexican farmers did nearly as well growing cotton in the same ecological conditions as their Arizona and California neighbors, on irrigated desert land.

The Colombian industry is more interesting as a case of transfer of technology. Its success was achieved notwithstanding the climatic and ecological drawbacks

TABLE 2.—COTTON FIBER YIELDS FOR IMPORTANT COTTON-GROWING COUNTRIES IN 1950 AND 1960, IN ORDER OF INCREASE IN YIELD, WITH COMPARISONS*

Country	Yield (<i>kilograms per hectare</i>)			Yield rank in 1960	Production 1960 (<i>thousand metric tons</i>)
	1950	1960	Increase		
El Salvador	322	818	496	2	41.7
Guatemala	374	832	458	1	21.5
Nicaragua	287	542	255	6	33.1
Colombia	230	451	221	10	69.6 ^a
United States	315	522	207	8	3,236.9
Mexico	343	527	184	7	476.3
Spain	120	299	179	15	74.8
U.S.S.R.	541	704	163	3	1,542.2
Egypt	480	633	153	4	498.0
Bulgaria	129	273	144	18	21.5
Iran	225	319	94	12	103.4
Argentina	232	309	77	14	129.0
China, Mainland	205	278	73	17	1,474.2
Syria	473	545	72	5	115.9
Greece	343	395	52	11	65.3
Brazil	175	219	44	20	442.3
India	105	138	33	22	1,050.1
Congo, Leopoldville	135	156	21	21	28.4
Mozambique	105	120	15	23	37.2
Pakistan	228	242	14	19	317.1
Uganda	106	114	8	24	70.1
Turkey	276	283	7	16	175.8
Peru	554	503	-51	9	125.9
Sudan	460	313	-147	11	119.1
Total					
Listed countries ^b	254	339	85	...	10,269.4
World	248	327	79	...	10,589.2

* Data for Colombia from Table 1; all other data computed from U.S. Department of Agriculture, Economic Research Service, *Supplement for 1964 to Statistics on Cotton and Related Data, 1925-1962* (Statistical Bulletin 329, October 1964), Tables 90 and 91.

^a As reported by the U.S. Department of Agriculture; the source cited for Colombia gives 68.7.

^b Countries producing 20 thousand tons or more in 1960, except Nigeria and Tanganyika for which area data are lacking in 1960 and/or 1950.

of a tropical, semihumid climate. Since 1952 yields in the Colombian cotton fields have moved upward much like those in the United States (Table 3) though on a somewhat lower level. But Colombian production has not followed a smooth and safe highway of progress. The geographical pattern of cotton production in Colombia has been completely changed as a result of a succession of surges of cotton growing, first in one area, then in another.² Yields did not progress smoothly from low to high all over the country or in the same zones. Success came with shifts in areas, in types of cotton grown, and in entrepreneurship. It came from competition between old established perennial and "Lengupa"³ types

² Cotton was grown in Colombia before 1500, certainly in Santander-Boyacá (see Map 1B). Before 1870, it was grown in Atlántico Province. Spurts of cotton growing later came in northern Tolima (1934), southern Tolima (1936), the Sinú Valley of Córdoba (1948), the César Valley of Magdalena (1952), Valle Province (1958), and Meta Province (1961).

³ This is an annual that grows in a nine-month cycle, has about 40 per cent fiber and no linter on the seed. It has been named Lengupa after a place where it is grown in the Santander-Boyacá area.

TABLE 3.—COTTON FIBER YIELDS IN COLOMBIA COMPARED WITH OTHER AREAS,
SELECTED YEARS 1935-62*
(Kilograms per hectare)

Year	World	United States	Other countries	
			Total	Colombia
1935	194	217	182	...
1940	226	295	196	...
1945	220	297	185	...
1950	248	315	226	230
1952	261	327	233	192
1954	279	399	243	339
1956	286	478	241	329
1958	319	544	279	332
1960	327	522	281	451
1962	341	535	293	452

* Data for Colombia from Table 1 above; all other data computed from Table 29 of source cited for Table 2 above.

of cotton, fated to disappear, and the newer Upland cotton grown on modern farms; and from the use of machinery, insecticides, irrigation, and occasionally fertilizers.

Thus in 1942, the 7,000 cotton growers of the Atlántico Cooperative produced only about 1.2 thousand tons of cotton fiber accounting for one half of the national production, while in 1960, 450 growers throughout the country were selling 61 per cent of the total output (4, pp. 52, 53; 43, p. 1). In 1963, 600 farmers on 800 farms produced two-thirds of the national product (16, p. 59.)

The farmers of the traditionally important areas of the Atlantic Coast and Santander and Boyacá lost ground year after year; they were faced with the introduction of pests from the new farming fields and were unable to meet this new challenge. (Provinces, geographical features, the transport net, and major cotton producing areas are shown in Maps 1A and 1B.) Yields in Atlántico are not known, but in Santander and Boyacá, the estimated yields show a decreasing rather than an increasing trend (Chart 3). Similar trends were observed in the Dabeiba area in Antioquia north of Medellín. Progressively the old "colonial" sector of the cotton industry has been wiped out.

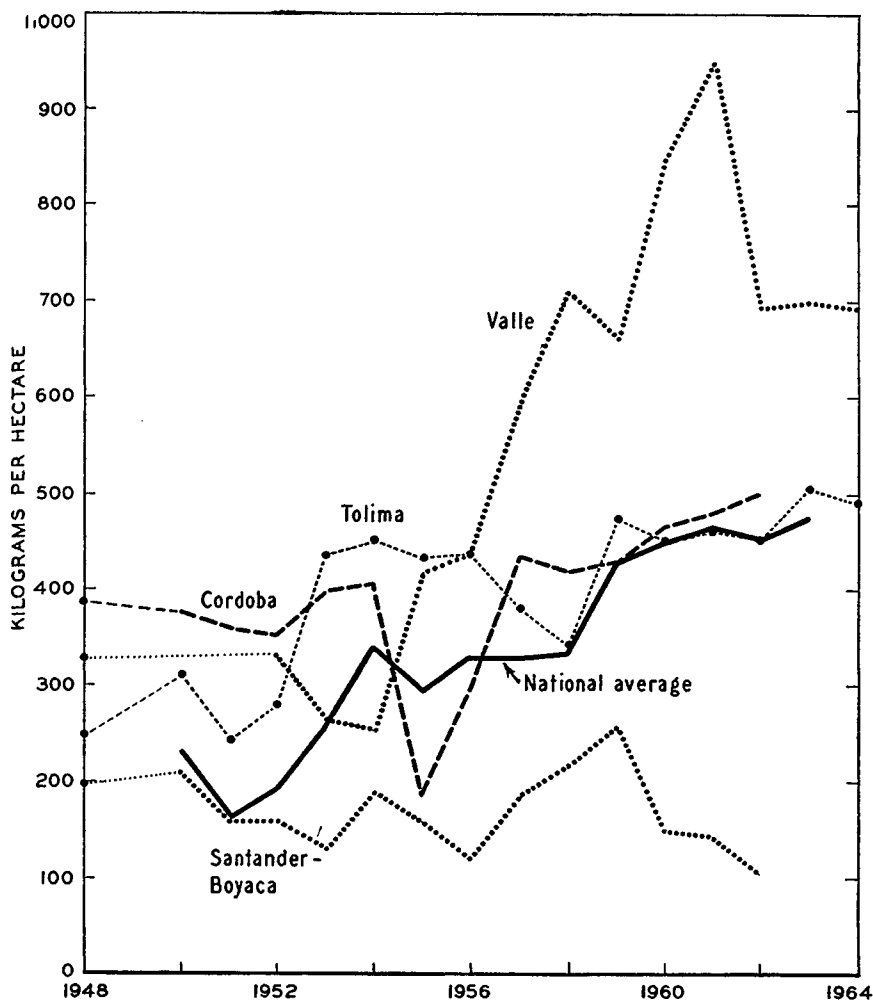
The modern farming community, on the other hand, has enjoyed not only governmental protection but also banking facilities, special credits from the Export-Import Bank for development of the use of tractors, concentration of mechanical equipment of the Colombian-American technical extension service in two of the most important areas,⁴ availability of American seeds—Deltapine 12, 15, and smoothleaf—that adapt easily to the local environment, and supported prices.

However, the growing cost of pest control is a weighty handicap to sustained growth of the industry. It is of major importance in explaining shifts of location

⁴ The functions of the Servicio Técnico de Agricultura Colombiana Americana (STACA), an organization no longer in existence, have been taken over by the Ministerio de Agricultura and Rockefeller interests. Concentration of mechanical equipment was in Espinal and Codazzi.

CHART 3.—COLOMBIA, COTTON YIELDS IN MAJOR AREAS AND NATIONAL AVERAGE, 1950-62*

(Kilograms per hectare)



* Data are from the sources cited as 16, and 43, and for 1962 and 1963 direct from Instituto de Fomento Algodonero (IFA).

of production, as appears from the following history of cotton growing in Colombia.

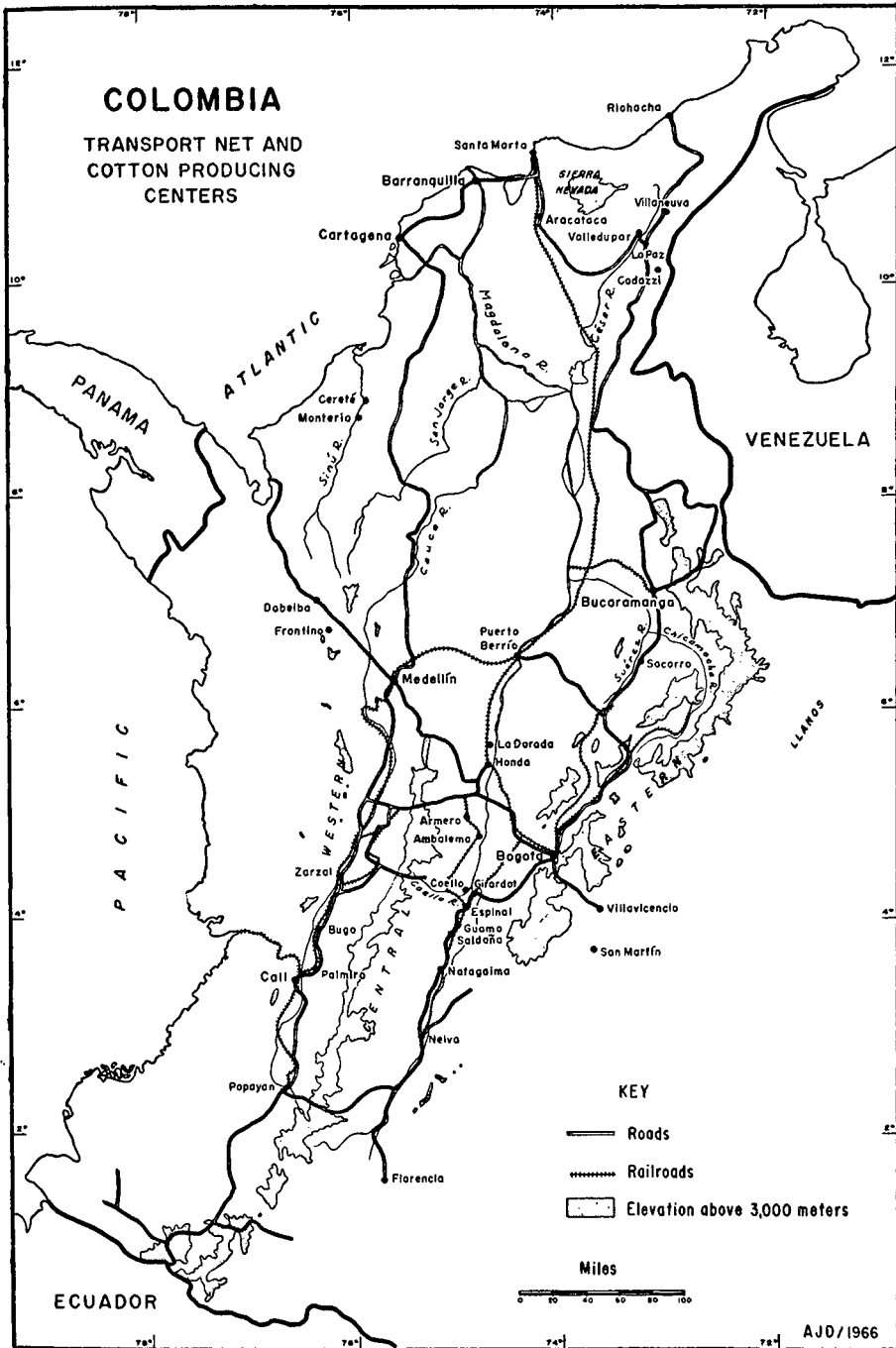
HISTORICAL DEVELOPMENTS

Production and Marketing of Traditional Types of Cotton

In 1932, just one year before the introduction of American Upland into Colombia⁵ the Colombian cotton was almost all of a perennial variety and was grown on

⁵ American Upland cotton was first planted in 1933 on experimental fields in Ambalema and Armero, in northern Tolima Province (33, p. 12). There had been an unsuccessful introduction of cotton in the Cauca Valley (Valle del Cauca) around 1926-28, but the results were disappointing and it had disappeared by 1929.

MAP 1B.—COLOMBIA: TRANSPORT NET AND COTTON-PRODUCING CENTERS



the north coast around Cartagena. A little annual cotton was produced in Santander, Boyacá, and in the Dabeiba area north of Medellín in Córdoba Province. Santander is apparently the oldest growing area of the country, dating back earlier than colonial times; in the north cotton was introduced less than a century ago (6, p. 4). The Dabeiba area was an outgrowth of the textile industry, created only in the twentieth century.

In the mountainous area bordering Santander and Boyacá, on the Meseta de Jeridas, cotton was harvested before the Spanish conquest. The gold-hunting Spaniards were attracted to the Bogotá Altiplano by tales of "El Dorado," a Chibcha chief who, it was believed, covered himself with honey and gold dust and ritually dived into a sacred lake every year. The gold mines were never found, for the Chibcha were getting their gold by trade, mainly by selling large cotton *mantas*, produced with native cotton. On the tableland between the Suárez and Chicamocha rivers in Santander and Boyacá a hybrid variety, the Lengupa cotton mentioned above, with a nine-month cycle, has been grown for centuries, interplanted with maize and beans. The labor-consuming production methods have changed little. In the traditional harvest system the mature cotton plants interplanted among other crops are uprooted and brought outside the field, and then the bolls are picked. Only 25 kilograms of raw cotton are picked per day (20, p. 90). However, the traditional system provides some control of insect attacks by eliminating the stalks where insects multiply and by avoiding massive plant concentration.

Land rentals in this area, which reflect population pressure and varying price levels for cotton, show considerable variation. The value of the rent has been estimated at one-fourth of the harvest plus the obligation of planting the field to sugarcane (the major cash crop for landowners) (20, p. 90), to 30 to 40 per cent of the gross harvest (48, p. 10), and in extreme cases, the rent has been equal to half of the cotton produced.⁶ An estimated four-fifths of the producers are sharecroppers, each growing a small parcel. In 1961-62, 2,026 "cotton farmers" delivered the product of 2,500 hectares to the Socorro ginnery, a total of only 1,028 tons of raw cotton (27, Tables 12 and 14). Yields per hectare of this type of cotton, if the estimates for an interplanted crop are reliable, must have fallen in the last twenty years (Chart 3). In 1949, the Santander area produced about 7.5 per cent of the national fiber production (51, p. 38), but in 1962, production was only 0.2 per cent of the national total. The end of this ancient system of production was officially marked as 1963, when production figures ceased to be recorded.

More recently, but more important, in the first half of the twentieth century, production of perennial cotton on the north coast met a similar fate. But the north coast has continued for decades to be the major growing center of perennial cotton. Cotton was exported from Cartagena and Barranquilla to New Orleans as early as the 1870's, and the industry along the neighboring coast developed under the stimulus of world markets. In 1918 approximately 10,000 hectares were planted under the incentive of high prices prevailing after World War I (32, p. 483). Atlántico Province alone produced half of the national output as late as 1942 (4, p. 52). A substantial amount was produced near Cartagena in Bolívar

⁶ In 1952, there were some cases where the landowner's part was valued at a price nearly equal to the current capital value of the land (9, No. 2, pp. 37-45; No. 3, p. 44).

Province and on the shores of the Magdalena in communities facing Atlántico.

Cotton growing developed near the sea harbors under the stimulus of world market conditions. In years of high world prices, as after World War I and in 1926-27, exports increased (26, Table 3). Large farms growing the perennial type were on the eastern shore of the Magdalena (52, pp. 7-17), and in years of low prices production stopped completely on the modern farms. It continued to be grown only by the mass of shifting cultivators, who accounted for the bulk of the harvest.

This cotton was a native hybrid, an interbreeding of four major cotton types.⁷ It grows well in sandy soils, under harsh conditions, withstanding insect attacks and long droughts well enough to produce some harvest no matter how badly mismanaged—a set of conditions ideal for shifting farmers. To grow this hybrid on a modern farm is generally uneconomic.⁸

Cotton was not the major crop for small growers, but was second to manioc. (In 1946 manioc paid 150 pesos per hectare, cotton only 80 pesos.) Mixed cultivation of several crops has advantages also for good protection against deterioration (52, pp. 7-17).

In general small growers were not landowners. More than 90 per cent of the coastal cotton farmers in 1952 were following a system whereby they entered into agreement with cattle farmers anxious to clear pastures invaded by brush. Each grower got from one-half to five hectares to till, with the obligation of returning the parcel planted with grass, usually Guinea grass, after two or three years. These *roceros*, as they were called, first gathered together with friends for food and drink (4, p. 8), and then cut the shrubs and trees, piled the branches, and burned them to make charcoal.⁹

Harvesting methods have not changed substantially since the beginning of the industry, and are as primitive as planting. Perennial cotton grows for three or four years, giving one crop per year, or two crops if the rainfall is propitious. Some plants have branches up to 20 feet long that are partially cut down before picking time, only a small piece of bark remaining to connect the branches with the trunk. Bolls that have not opened at the time of cutting the branches very soon burst open owing to the lack of sap, and a large quantity of soft unripe fiber thus produced is collected along with the ripe and overripe fibers. In many fields picking is so long delayed that much cotton falls to the ground to be left there or to be gathered up mingled with dirt (39, p. 95).

In the opinion of Manchester experts, in 1926, cotton picking in Colombia was considered the worst on earth, worse even than in India. Careless picking was the major reason for the many black and brown spots all over Colombian cloth. About one-fifth of the harvest was lost for lack of proper attention. The methods of picking were also wasteful of time; whenever a picker gathered one handful of cotton, he walked back to his sack, repeating this hundreds of times (39, p. 95).

⁷ *Gossypium peruvianum*, *Gossypium barbadense*, *Gossypium purpurascens*, and *Gossypium hirsutum* (48, p. 13).

⁸ In 1926 the pickers were harvesting only 25 pounds per working day, one-third to one-fourth of the average picked at the time by Texas cotton pickers under warmer temperatures (39, p. 113), and the wages in Atlántico were higher than in Texas (39, p. 94).

⁹ Such a system is common in pre-industrial societies in Africa, as it was in Peasant Europe in the 18th century.

The fields were infested with pests and diseases, a major problem for future development. Smallholders, in debt, were in the grasp of petty traders. Unscrupulous practices were common: stones were placed in the bags, cotton was moistened to increase weight, still a practice among cotton pickers in the Cauca Valley in 1964, unfortunately, and the supply of the Medellín mills was cornered time and again.

Shrub cotton might have been profitable had it been correctly managed. For example, in 1926, a year of good cotton prices, a farmer in an area of southern Huila still free from pests and isolated from the high wage levels prevailing in the banana belt in northern Colombia, managed his fields correctly with the necessary number of pickings. On a block of 300 hectares he harvested an average of 750 kilos of cotton per hectare, or 300 kilos of fiber. His selling price was three times the variable cost of production and his yield three times the average yield obtained on the coast in the period 1930-50 (49, pp. 148-51).

In the early thirties wages on the coast ceased to rise. And at the same time the government did its best to support the cotton growers. A research station devoted to the study of perennial cotton was established in the suburbs of Barranquilla in 1935.¹⁰ With the creation of a successful growers' cooperative in Barranquilla in 1936, the production of the Atlantic Coast developed substantially. This cooperative established a cotton gin, and more important, provided needed credit facilities and a safe market for the output of small peasants. Credits were progressively expanded, at first from the resources of the cooperative itself, and after 1938, from the larger resources of the State Agrarian Bank (Table 4). Under this incentive the production of cotton increased, or at least the picking became more thorough. Indeed, to tap a new financing facility, large cattle farmers began to harvest the third and fourth crops growing on the cotton trees left in the Guinea pastures by the *roceros*. By 1947 the cooperative had a membership of two-thirds of the cotton growers on the coast, had 62 agencies operating all over the cotton belt, and was providing credit, buying cotton, selling bags, and in fact regulating the market (14, pp. 45-48).

Marketing has improved substantially since the creation of the Cooperative of Cotton Growers, but the insect problem has never been solved. The *roceros* left the fields planted in Guinea grass but failed to cut the cotton shrubs. The cattle farmers picked some of the regrowth when prices were good, but left the parasite-infected trees standing. As cattlemen, they had no interest in eradicating the dead shrubs (4). Production in the third, fourth, and fifth years was generally lost, and parasites living on growing cotton spread throughout the area. This became a major problem in annual cotton. It also explains the disappearance of tree cotton after 1952.

The third major cotton-growing area of the thirties, the cotton belt north of Medellín, developed under conditions similar to those in Santander. The proximity of the market of Medellín accounts for the planting of annual cotton in Dabeiba and Frontino. On the mountainsides a nine-month cotton¹¹ was inter-

¹⁰ In 1948 the Barranquilla Research Station had selected varieties of perennial cotton producing 875 kilos to 1,000 kilos of raw cotton per hectare or 350 to 400 kilos of fiber, which was double the current yield in northern Tolima at that time. However, the research station was closed in 1948 and the results of years of selection were lost (6, p. 4).

¹¹ A mixture of *Gossypium barbadense* and *Gossypium hirsutum*.

TABLE 4.—ATLÁNTICO COOPERATIVE: NUMBER OF MEMBERS AND CREDITS, 1936-52*
(Thousand current pesos, except as otherwise indicated)

Year	Number of members (thousands)	Credits provided by			Total credits at 1952 prices	Price index, 1952 = 100	
		Cooperatives	Agrarian Bank ^a	Total			
1936	.6	28	—	28	—	120	23.4 ^b
1937	4.4	357	—	357	—	1,389	25.7
1938	5.2	366	419	785	53.4	2,716	28.9
1939	6.1	301	449	749	59.9	2,480	30.2
1940	6.1	236	414	650	63.7	2,226	29.2
1941	6.4	268	224	492	45.5	1,708	28.8
1942	7.0	465	331	796	41.6	2,543	31.3
1943	7.5	964	812	1,777	45.7	4,895	36.3
1944	8.3	1,008	1,120	2,128	52.6	4,870	43.7
1945	9.6	1,175	2,515	3,690	68.2	7,593	48.6
1946	10.4	1,133	2,257	3,389	66.6	6,382	53.1
1947	11.1	1,360	2,748	4,108	66.9	6,541	62.8
1948	12.0	1,263	2,554	3,818	66.9	5,223	73.1
1949	12.3	2,011	4,217	6,228	67.7	7,985	78.0
1950	12.9	2,522	4,605	7,127	64.6	7,518	94.8
1951	13.4	1,781	2,948	4,729	62.3	4,618	102.4
1952	14.0	2,528	3,710	6,239	59.5	6,239	100.0

* Data on the Atlántico Cooperative from Gabriel Apreza Ruiz and Carlos Cabrera Forero, *Campaña de transformación algodонера en el Departamento del Atlántico* (Universidad Nacional de Colombia, Facultad de Agronomía, Medellín, 1952), thesis. Our conversions to 1952 pesos using the cost-of-living index for workers in Bogotá from *Revista del Banco de la República*, various issues.

^a Credits provided to the cooperators by the Agrarian Bank under the terms of a special agreement.

^b Approximation based on the Lopez index which showed an increase of 10 per cent from 1936 to 1937.

planted with maize and beans, the staple foods in Antioquia Province. The cotton was grown under the same terms as in the north: small settlers received the use of small patches for a few years. They cut the brush, grew cotton and foodstuff, planted grass, and delivered the fields under grass to the landowner at the end of two or three years. The cotton was ginned locally, but the seed was lost. The use of selected seeds and of supervised credit was introduced in groups called "agricultural cells"; some seed selection was begun (30, p. 63; 18, p. 25).

There were prompt results. By 1948, 320 hectares of blocks of cotton, planted with disinfected seed in clean fields under the supervision of a regional agronomist, produced a substantial increase in income to formerly shifting farmers (2, p. 27). As late as 1952 the area was free of pests and yields averaged 500 kilos of raw cotton per hectare, or 200 kilos of fiber (20, pp. 89-90). Civil war later affected the area, bringing disease and insects. Production decreased 80 per cent in a couple of years, improved communications eliminated locational advantage, and finally cotton disappeared in the zone.

The Introduction of American Upland Cotton and the Birth of a Modern Industry, 1926-1948

High international price levels in the twenties encouraged Colombian growers to produce cotton and to export it notwithstanding increased demands by the

national industry. More than 100 tons were exported in 1917, 1922, 1927, and 1928 (26, p. 10). All of this cotton was of the perennial or of the Lengupa type.

Conscious of the backwardness of national methods of production, the Colombian government invited a Mission of English experts to visit Colombia in 1926. This team proposed a shift from perennial interplanted cotton to annual cotton, the creation of cotton farms, and a more modern approach to production. They recommended the Cauca Valley as one of the most promising areas if correct cultural practices were followed. Farmers in the Cauca Valley had introduced all kinds of varieties: Peruvian Tanguy, long- and short-fiber cottons, and Egyptian and Sea Island types. Interbreeding and degeneration occurred. A pink bollworm (37, p. 300),¹² much larger than the usual Indian species, appeared and checked production, which was still at an experimental stage. The Mission suggested planting a "bread and butter" short-fiber cotton of one kind only, and systematic eradication of stalks. They recommended that cotton be grown only once a year and that cultivation be mechanized. All these changes designed to make the Cauca Valley a large producer of cotton (39, p. 96), were actually applied in 1954 when the crop was reintroduced.

Because of the new interest in cotton resulting from the Mission's optimistic considerations, the Colombian government gave special facilities for importing cotton machinery tax free, for transporting it at cheap rates on government railroads, and for financing its purchase by the official agricultural bank. An experimental farm for cotton research was inaugurated in Palmira at the end of 1928, and about 250 hectares of an Upland cotton were planted in the Cauca Valley in 1929. It was, however, a complete failure because stalks were not properly eradicated and insects destroyed the harvest. In 1929 the Palmira cotton farm experimented with better systems of mechanization, improved pest control, selection of varieties, and ginning methods. But in 1930 a Puerto Rican Mission, visiting the Cauca Valley, pointed out that conditions were excellent for sugar growing there¹³ and the Palmira cotton farm shifted interest to sugarcane and other crops. Cotton disappeared entirely (31, p. 49).

Carlos E. Chardon, head of the Puerto Rican Mission, recommended the appointment of an entomologist to the Colombian government as a preliminary condition to any cotton development in Colombia, thus pinpointing the fundamental weakness of the Colombian cotton industry (37, p. 13). But cotton growing was not to become important in the Cauca Valley before 1954.

In Tolima Province, however, the first essays at cotton production were made in 1933 in Armero and Ambalena (34, p. 12). In 1934 the Ministry of Agriculture began a national campaign for cotton growing and established the Armero Research Station. This station was dedicated to the study of cotton growing and planted the first experimental fields of the Vergara variety in March 1934. In 1935 the Experimental Farm of Atlántico, in Barranquilla, was founded to investigate possible ways to improve the lagging production of perennial cotton. At the experimental level both stations showed substantial accomplishment. From

¹² *Pectinophora gossypiella* (Saund.), a moth larva that feeds inside green cotton bolls and especially inside the developing seeds. It occurs in the United States in Texas, Arkansas, New Mexico, and Arizona. It was found for the first time in California (Imperial County) in 1965.

¹³ This Mission imported mosaic resistant varieties, including the famous P O J 2878, still the staple of the sugar industry.

1935 to 1948 Atlántico farm developed high-yielding varieties of perennial cotton, which, unfortunately, were never adopted by the shifting cultivators in the north. The Armero station introduced better varieties of annual cotton and organized the distribution of certified seeds after 1946.¹⁴

Cotton growing in Tolima was highly mechanized from the outset and responded smoothly to economic incentives. Cotton introduced to the farmers in 1935 was planted on about 4,000 hectares three years later. In 1937, to encourage production in the area around Armero, the Colombian government increased import duties on fiber from 0.10 to 0.14 pesos per kilo (41, p. 4, Ley 94, 1936). International cotton prices rose and the textile mills became highly interested in Armero cotton. But in 1938 international prices dropped and the cotton mills declared national cotton to be unfit for their requirements (8, p. 395).

In 1937 the Junta del Algodón was created to advise the Ministry on policy. Conflicts of interest soon appeared between the cartel of textile buyers and the syndicate of Armero growers. In 1938, at a time when growers were asking .65 pesos per kilo, the mills refused to pay more than the equivalent of imported fiber plus duty, or .60 pesos. A conference ended in deadlock. In 1938, to demonstrate their new power, the cotton growers marched in the streets of Armero with their mechanical equipment, swore that they would not grow cotton at such a price, and stored their product. From 1938 to 1939 production in the Armero zone (Table 5) fell from 815 to 240 tons (41, p. 5).

In 1941 the Colombian government organized a system of minimum prices and the first system of commercial grading of cotton. The industry, under obligation to absorb the total national production, established a purchasing agency to take charge of the distribution of cotton among mills. International prices soon rose, due to war conditions, and production in Tolima had a new stimulus. But yields per hectare, initially 250 to 280 kilograms of fiber per hectare, had fallen to 150 and less (3, p. 27). Pests attacked the fields from the beginning, causing loss of production in the Espinal area as early as the first half of 1936, the second growing season of cotton in southern Tolima (33, p. 13). By 1948-49 yields had fallen so far that it became necessary to stop growing every other season. Production had ceased to rise in this district when in the late 1940's upland cotton was about to be introduced in new areas.

YEARS OF GROWTH, 1948-1962

In 1948 official policy gave the industry a substantial lift. The industrial census of 1945 had shown that Colombian industry was utilizing about 484 million pesos of imported food and fibers, which could easily be produced in the country. The Ministry of Agriculture, which had been abolished in 1934, was reestablished in 1947, and in April of the following year the Minister of Agriculture decided upon a policy to promote cotton growing by every means of government support, including protectionism. The textile industry raised objections. They contended that with an average yield per hectare of about 125 kilos of fiber, more than 200,000 hectares of cotton would have to be grown to produce the 25,000 tons

¹⁴ Vergara variety was introduced in 1934 and the Expresso do Brasil in September 1940. The Deltapine 12, first used in March 1941, was propagated and used exclusively after the second season in 1942 (34, pp. 2-4).

TABLE 5.—COTTON FIBER PRODUCTION IN TOLIMA, 1934-64,
AND COTTON PRICES TO 1943*

Years	Production (<i>metric tons</i>)			Price (<i>pesos per</i> <i>100 kgs.</i>)
	Armero Zone	Espinal Zone	Total	
1934	... ^a	—	... ^a	—
1935	6	—	6	.6
1936	119	12	131	.67
1937	756	45	801	.73
1938	815	120	935	.615
1939	240	36	276	.595
1940	171	40	211	.63
1941	226	142	368	.63
1942	677	248	925	.64
1943	448	434	882	.82
1944	627	713	1,340	
1945	595	837	1,432	
1946	738	673	1,411	
1947	1,060	1,340	2,400	
1948				
1949				
1950				
1951	...	...	2,465	
1952	...	...	5,589	
1953	...	...	11,281	
1954	...	...	18,853	
1955	...	...	17,028	
1956	...	...	18,056	
1957	...	...	14,296	
1958	...	...	14,874	
1959	...	...	29,048	
1960	13,089	16,016	29,105	
1961	11,910	18,436	30,346	
1962	10,810	16,923	27,733	
1963	6,660	7,377	14,037	
1964	6,550	7,360	13,910	

* From 1951 to date includes minor production in parts of these zones, actually in Caldas, Cundinamarca and Huila. Production data for 1934-47 from Mario Londoño Beltrán, "Producción de algodón en el Departamento de Tolima," *Agricultura Tropical*, IV, 6, May 1948, p. 17; for 1951-59 from Lauchlin Currie, assisted by Julio Bejarano M., *El algodón en Colombia, problemas y oportunidades*, study contracted by the Fundación para el Progreso de Colombia for the Federación Nacional de Algodoneros (Bogotá, 1963), mimeo; for 1960 from IFA, *Colombia, algodón y oleaginosas, economía y estadísticas 1960* (Bogotá, 1961), p. 34; for 1961 computed from *Colombia, algodón y oleaginosas, 1961-1962* (complete reference, Table 1), Table 21, converting fiber at 36.3 per cent; for cotton year 1962-63, computed from data on raw cotton obtained from IFA and converted to fiber at 36.3 per cent; for 1964 from *Boletín Mensual de Información* (IFA), No. 5, May 1964, Table 1. Prices 1934-43 from Carvalajino Jacome, "La agricultura en 1944," in *Colombia en cifras* (Bogotá, 1944), p. 55.

^a Less than 500 tons.

required by the mills. In their view this was an impossible task and the result would be increased costs for the industry with little benefit to Columbian agriculture. But the growers insisted that yields would be substantial and that they could meet the challenge. Faced with the determination of the Ministry to protect the growers, the industrialists decided to promote a cotton growing institute,

which would at least give them some control of the quality and the uniformity of the product.

This new cotton agency, the Instituto de Fomento Algodonero, was interested in the promotion of annual cotton. In 1948 the IFA took charge of the research station on perennial cotton in the suburbs of Barranquilla, but closed it immediately notwithstanding its substantial achievements in propagating perennial cotton. All the cotton growers, not excepting the small growers in the cooperative, had to pay a levy per kilo sold to finance the building of cotton gins, research, and the marketing of cotton by the IFA. Naturally this was a serious blow to the cooperative since the growers of perennial cotton were now compelled to pay a second tax to develop annual cotton which competed with their product (6, pp. 4, 13).

At about this time welcome news came from the northwest in the Sinú River valley area (Córdoba Province). Cotton grown experimentally there gave yields of 1,250 kilos per hectare, 35 per cent more than in Tolima, and there was plenty of land available in this plague-free area (7).

In Tolima in 1948 an above-average yield of 1,000 kilos of seed and fiber per hectare doubled the invested capital in six months (35, p. 14). In the Sinú, with a yield 35 per cent higher and low land rentals, incomes were tremendous. The major assets of cotton farmers there were in their mechanical equipment, worth at least four times as much in Colombia as in the United States.¹⁵ Modern cotton farmers so equipped can quite easily shift their activities from one area to another.

While Tolima production was at a standstill from 1947 until 1951, a new surge of cotton growing occurred in Córdoba Province. This began with the planting of 20 hectares in the Sinú Valley in 1947 and 280 in 1948, and in the following year 2,900 hectares were planted (41, p. 43). The new area was supplied with the most modern types of equipment; one of the three cotton harvesters known to be in use in South America was in the Sinú (11, p. 49). Rentals there, as well as land values, immediately adjusted to the new conditions. Rents per hectare in 1952 were estimated at 185 pesos in the Sinú, 130 pesos in Tolima, so that rentals in the Sinú reflected proportionally higher average productivity (44, p. 9).

Yields in 1949 were very high in the Sinú, the newly opened area being free of insects and pests, and the season had been perfect. The area planted rose to about 15,000 hectares in 1950. But setbacks followed. Floods in 1950 destroyed all the plantations situated at lower levels; drainage of such soils appeared impossible to individual farmers. Some fixed investments in land were lost and machinery was damaged. Only 8,000 hectares were harvested. The farmers used these misfortunes to obtain an increase in the price of cotton as an emergency measure; at the end of 1950 a 40 per cent price increase was asked by the farmers but the government conceded only 15 per cent. On the other hand, import duties were substantially increased, from 0.14 pesos per kilo to 0.25 plus 10 per cent ad valorem. Yet the troubles of the Sinú farmers were not at an end. Plagues

¹⁵ An American Agricultural Mission, preparing a report on credits for the increased mechanization of Colombian agriculture, estimated in 1948 that a medium-sized tractor with all its implements, worth about \$3,000 in the United States, sold on the Colombian market for \$12,000. A similar price difference was mentioned in 1964 in the Magdalena. (Interview, May 1964, with the Director of the Zona Agropecuaria in Santa Marta.)

were introduced to that isolated area by the farmers themselves. In the "cotton rush" of 1949 in Bolívar Province, fields expanded around the city of Cartagena. Ignoring official regulations, farmers imported new breeds of cotton on their own initiative, for instance, cotton of the Strain varieties were introduced from the United States. In 1949 the harbor section of vegetal sanitary control was abandoned, and in that same year *Anthonomus grandis*, the common cotton boll weevil, which is notorious for the enormous damage it did to the cotton economy of the Old South in the United States, was brought in along with seeds of Strain that were imported.¹⁶ Pests were indeed increasingly diffused throughout the country. An estimated 30 per cent of the value of the production was lost due to insect attacks in 1952 (9, No. 2, p. 43). To fight insects, cotton growing was prohibited during one semester each year, proving relatively effective in the areas that grew annual cotton. But it was not an effective method of fighting *Anthonomus* in perennial cotton areas. To protect the development of annual cotton production under the technical conditions of the early 1950's, total eradication of perennial cotton, which then accounted for 30 per cent of the agricultural income of Atlántico Province, became imperative.

Credit facilities had substantially contributed to the development of perennial cotton, and certainly credit might help to eradicate it. A technical conference meeting in Barranquilla in May 1952 decided upon suspension of credit, systematic promotion of the development of annual cotton through zoning, suspension of the distribution of perennial cotton seeds, and eradication of perennial cotton in areas fit for annual cotton. Credit would be granted to adversely affected farmers only to help them plant other crops (4, pp. 23-24). Other substantial efforts would be made to promote annual cotton. Twenty agronomists and twelve assistants would be assigned to the North Coast. IFA would experiment with cotton all over the area and 62 sets of cotton-growing equipment would be rented cheaply. (A five million dollar credit for agricultural machinery granted by the Export-Import Bank was strategic here.) Two hundred tons of selected seed would be made available, and the building of ginneries and the buying of raw cotton at official prices would be guaranteed (10, p. 21).

One of the major difficulties of developing cotton production in new areas was the cost of tree eradication. Special credit facilities would be granted for this purpose, 300 pesos per hectare for lands to be cleared, 200 for lands cleared and cultivated mechanically, 150 for lands cultivated by hand (4, p. 37).

Perennial cotton was slowly strangled. The few large farmers left the Atlántico area for the new frontier and planted annual cotton. Smallholders who obstinately continued to plant perennial cotton got a final blow in 1963 when the cotton cooperative was dissolved. Annual cotton, on the other hand, continued to expand more and more rapidly.

Actually, the explosive increase in cotton production progressed by leaps, from

¹⁶ In January 1951 *Anthonomus grandis*, a quarter-inch long greyish weevil which infests the cotton plant, leaving larvae that feed on the interior substance of the buds and bolls, was detected 10 kilometers from the harbor. By mid-year it had spread along the highways east and south of Cartagena. Sanitation barriers were established but not respected. Transportation of raw cotton from the affected areas was prohibited. It was ordered that all cotton produced in the infested area be moved to a Barranquilla ginnery where a special disinfectant room was available; but some producers paid no attention and infected cotton went to the Cereté ginnery in the middle of the Sinú area, spreading *Anthonomus* all around the ginnery (5, pp. 17-22).

one area to another. From 1947 to 1950, as already noted, the Sinú Valley was invaded by cotton planters. After 1950, the César Valley, between the mountain ranges of the Sierra Nevada and the eastern Cordillera, awoke to modern commercial agriculture. In 1958, the Cauca Valley followed suit and in 1961, cotton growing expanded to the eastern Llanos. Simultaneously cotton production increased in the Tolima area and its surroundings. Shifts in land use in the same area were most notable in 1959, after a substantial change in lines of credit and in price support and import policies. In one year, cotton production doubled; this was largely at the expense of other commodities, as for example rice in the Coello and Saldaña irrigation districts, as appears from Table 6. However, in one area after another, increased insect attacks raised a major threat to the viability of the industry. Thus the surge in the great Eastern Plains which began after 1960 was checked by insect attacks as early as 1963.

Following the Sinú Valley, the César Valley, in Magdalena Province, became the new frontier of cotton growing. This valley, in the geological past the flood plain of the Magdalena River, covers more than a million hectares of irrigable soil. This land, granted to Don Bartolomé Aníbal Paleólogo in 1590, produced 3,000 head of cattle for the city of Cartagena in the earlier half of the 16th century. For four centuries cattle raising continued to be the basic activity of the region. In 1948 it would have been difficult to locate a single tractor in this isolated, sparsely settled valley (1, pp. 22-25). In 1959, 1,303 tractors, 10 per cent of the Colombian total, were at work in the Magdalena (13, p. 16). The industrial revolution swept into this sleepy country like a gusty wind. In 1950, farmer entrepreneurs shifted from the flooded area of the Sinú, where the rents for flood-free land had jumped to excessively high levels, to the open plains of the Mag-

TABLE 6.—AREA OF RICE AND OTHER IRRIGATED CROPS IN THE COELLO AND SALDAÑA IRRIGATION DISTRICTS, 1956-59*
(Hectares)

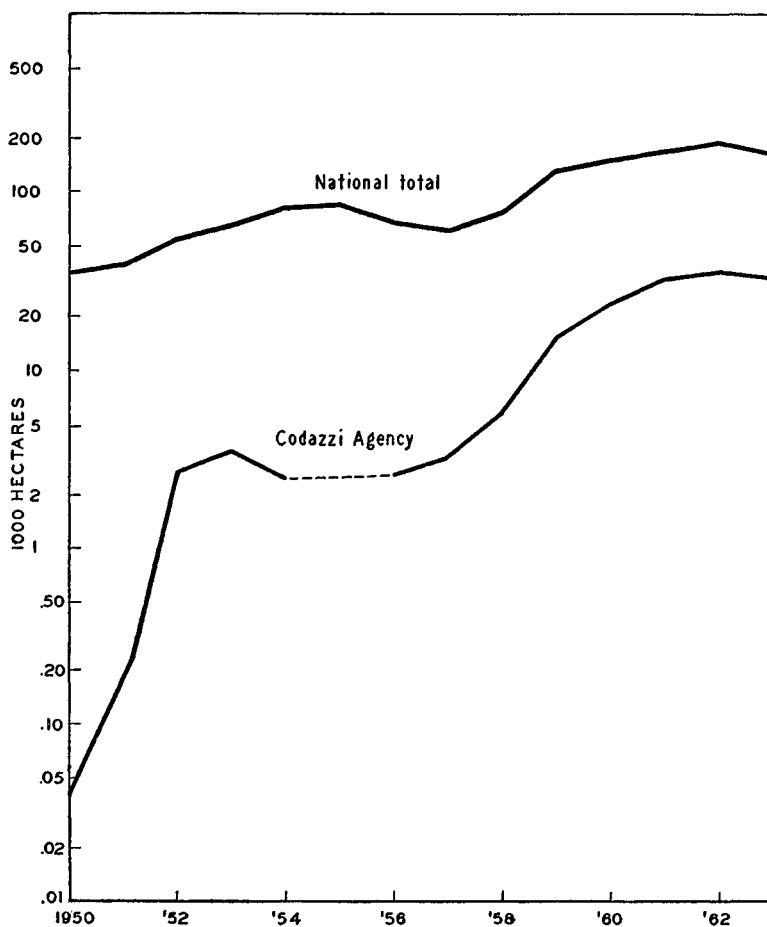
Year	Semester	Coello				Saldaña			
		Total	Rice	Cotton	Other	Total	Rice	Cotton	Other
IRRIGATED									
1956	1	3,178	3,178	—	—	4,119	4,119	—	—
1956	2	4,766	4,766	—	—	4,346	4,346	—	—
1957	1	5,911	5,839	—	72	3,830	3,830	—	—
1957	2	6,886	6,875	—	11	4,936	4,926	—	10
1958	1	7,273	7,193	—	80	3,515	3,086	—	429
1958	2	6,884	6,658	—	226	4,049	4,049	—	—
1959	1	8,100	5,000	2,400	700	4,700	3,000	1,700	—
1959	2	6,900	6,650	—	250	4,000	4,000	—	—
TOTAL									
1959	1	14,000	5,000	4,000	5,000	9,700	3,000	2,500	4,200
1959	2	10,650	6,650	—	4,000	4,300	4,000	—	300

* By law cotton can be grown only in the first semester in Tolima. Data from Caja de Crédito Agrario, Departamento de Investigaciones Económicas, *Informe financiero, económico y social sobre el estado actual de los distritos de irrigación de Coello y Saldaña en el Tolima* (Bogotá, January 30, 1960), pp. 26-27, 47, 49-50.

dalena, where farms were sold or rented cheaply. Rents in Valledupar in 1952 were only one-fourth the rents in Cereté, in the Sinú Valley (44).

At the same time local farmers shifted to cotton. In 1949 a large market for beef cattle was close at hand in the petroleum belt of Venezuela. The next year the Colombian government, seeking to reduce the cost of living in Bogotá, decided to prohibit exports of cattle. This adversely affected the Valledupar area but was without advantage to Bogotá. Farmers experimented with cotton; and although the yields did not reach the high levels of the Sinú, they were satisfactory. The municipio of Codazzi is an example of the spectacular development brought by the introduction of a new crop (Chart 4). In 1950, the place was a dusty hamlet, visited only occasionally by cattle and wood traders; natural pastures were dotted with clumps of bush; cattle roamed about, half wild. Some 40 hectares of cotton were grown that year with a yield of 750 kilos per hectare of raw cotton—a good yield considering that the weather was unfavorable. In 1951

CHART 4.—CODAZZI AGENCY, COTTON ACREAGE, 1950-63*
(Hectares)



* Data from Table 7.

TABLE 7.—AREA PLANTED TO COTTON IN THE CODAZZI AGENCY COMPARED WITH THE TOTAL FOR COLOMBIA, 1950-63*
(Hectares, except as otherwise indicated)

Year	Colombia	Codazzi Agency	Codazzi Agency as per cent of Colombia
1950	36,825	40	.1
1951	39,700	240	.6
1952	55,163	2,500-3,000	5.0
1953	67,080	3,583	5.3
1954	82,280	2,571	3.1
1955	84,050	...	...
1956	68,578	2,648	3.9
1957	63,000	3,330	5.3
1958	77,000	5,872	7.6
1959	131,371	15,484	11.6
1960	150,074	23,427	15.6
1961	165,952	32,616	19.7
1962	184,891	36,546	19.8
1963	161,203	33,013	20.5

* Data for Colombia: 1950-59 from T. J. Goering, *Cotton Production in Colombia* (for complete reference see 22), p. 3; 1960-63 direct from Departamento Administrativo Nacional de Estadística (DANE).

Data for Codazzi Agency: 1950-52 from Hernando Plata García, *Contribución al estudio agro-económico del Valle Medio del César o Provincia de Valledupar* (Universidad Nacional de Colombia, Facultad de Agronomía, Medellín, 1952), thesis; for 1953-58 from IFA Departamento Técnico, *Información Estadística*, May 1954, p. 18, February 1955, p. 21, February 1957, p. 22, February 1958, p. 27, and February 1959, p. 38 (data 1956-59 for Codazzi combined with municipio Robles); for 1959, unpublished data from *Censo Agropecuario 1959* (DANE) for Robles and for Codazzi; and for 1960-63 direct from IFA Departamento Técnico. For 1962 and 1963, figures for the new Becerril Agency, formerly part of the Codazzi Agency, have been added.

refugees from the flooded Sinú area arrived in the César Valley with their machinery and planted cotton in Valledupar, Aracataca, La Paz, and Codazzi. The cotton area expanded in Codazzi from 500 hectares in 1951 to nearly 3,000 in 1952. In that year 60 complete sets of equipment and 20 tree uprooters had been brought in and the Cotton Development Institute began to construct a gin (42, pp. 1-2).

Since then production of cotton in the Magdalena has expanded rapidly with systematic help from government credit organizations and from extension and provision of facilities for the financing of seed, pesticides, etc. From the beginning large farmers had an advantage in this development.¹⁷

Cotton production expanded in waves. After an initial burst of success, the familiar insect pests appeared. In 1954, 519 growers were producing cotton in the Codazzi area (Tables 7, 8). That year, attacks of *Secadodes pyralis* in the middle Magdalena Valley were relatively mild; but 1955, a dry year was disastrous. Through lack of care, most of the stalks had been left in the fields, providing breeding ground for *Secadodes*, which affected 90 per cent of the fields in Valledupar, Villanueva, and Codazzi. Sometimes the attack was so severe that

¹⁷ For instance, the cost of tree eradication in the wooded pastures of the César Valley was estimated, in 1952, at 400 pesos with hand tools, customary among small farmers, but as 175 pesos with rented machinery, and only 100 pesos at the fee farmers were charged by the government pool of agricultural machinery (40, p. 18). Small farmers rarely had access to this mechanical equipment available on contract.

TABLE 8.—CODAZZI AGENCY: NUMBER OF COTTON GROWERS AND AREA PER GROWER, SPECIFIED YEARS 1951-60*

Year	Number of growers	Hectares per grower
1951	1	40.0
1954	519	5.0
1957	53	62.8
1958	80	73.4
1959	134	115.6
1960	212	110.5

* Data for the number of growers in 1960 from IFA, *Colombia, algodón y oleaginosas 1961-1962* (for complete reference see 27), p. 31. Otherwise from and computed from the sources cited for Table 7.

the fields could only be plowed up (53, p. 297). The number of cotton growers fell abruptly, only 53 surviving in 1957. The average acreage per farm rose from five hectares in 1954 to 60 in 1957 and to more than 100 in 1959. After 1958 production steadily increased until 1962 (Chart 4). In January 1959, banks were forced by law to assign 15 per cent of their credit to agriculture; bankers flew immediately from Bogotá to Valledupar and Codazzi to choose the more successful cotton farmers. With credits pouring in and with high guaranteed prices, production increased ninefold from 1956 to 1960, and 40 per cent more from 1960 to 1962.¹⁸ Since 1961 Codazzi production has amounted to around a fifth of the total production of the country. Today the former dusty village of the Colombian "Far East," where only cowboys and wood traders gathered ten years ago, has a population of about 5,000 plus some 20,000 cotton pickers during the harvest months of December, January, and February (45, pp. 241-42). The paved highway carries advertisements of tractors and supply parts, and leads to insecticide stores and farm machinery shops. Four-wheel-drive jeeps are more common than horses, bank branches have been opened, the long haul to the Medellín textile mills, formerly by the Barranquilla road, has been shortened by the new Atlantic Railway. Extensive areas of land have been cleared and more is available. Economic life has been brought to a new province of Colombia, even though it is currently menaced by the counterattack of plant pests and diseases. This has been accomplished under the leadership of a few technically skilled entrepreneurs, including the first postwar Minister of Agriculture, the author of the cotton expansion program.

In the Cauca Valley a new spurt of cotton growing developed after 1958. For many years farmers there had thought of growing cotton, but the prevalence of insects made it impossible until the introduction of modern insecticides. After 1954, although it had been proved that cotton was potentially profitable in the conditions prevailing in the Cauca Valley, expansion of output was delayed by lack of ginning facilities. Local processors refused to buy cotton at the official prices and the Development Institute had to build a ginners and experimental

¹⁸ The increase in production from 1959-62 in the area of the Codazzi Agency approximately equalled the whole of national production in 1951.

station in Buga. Once more there was a surge of cotton growing. The price of sugarcane was low at the time, and rice and maize were displaced by cotton. The drought of 1959 caused losses to some farmers, prompting the introduction of irrigation, including sprinklers, so as to sustain yields. Some areas produced as much as 2,907 kilograms of raw cotton per hectare in 1960. In 1961 the average yield for the Cauca Valley was 2,216 kilograms of raw cotton or 846 kilograms of cotton fiber per hectare in consequence of the increasing use of irrigation facilities. The spread of irrigation had been accelerated by high land rentals, 15 to 18 per cent of the harvest in 1963.¹⁹

However, concentration of cotton growing in an area of high-density farming and permanent exploitation fosters insects. While a rest period had been imposed from the beginning, according to the advice given by the English Mission as early as 1926, other crops in the Cauca Valley—soybeans, maize, and sesame—alternate with cotton or grow in neighboring fields. One important cotton parasite, *Heliothis*, attacks some of these crops, notably maize, during the season without cotton. The cost of control rose and the price of sugarcane went up at the same time. After a peak in 1962, acreage and production in the Cauca Valley declined (Table 9).

In the Meta, in the vast areas of lowland east of the Cordillera and southeast of Bogotá, refugees from the Civil War in Huila and Tolima across the mountain range were the principal occupiers of new land. Although the Meta has a short dry season which increases the difficulties of mechanized cultivation, and especially of cotton planting during the humid period, development of cotton attracted the interest of several important organizations.²⁰ Hence credit was provided, seed distributed, gins built. The small settlers on patches of twenty hectares or less responded to such incentives as quickly as the large farmers of other areas. Cotton expanded to the edge of the frontier; cotton production, nonexistent in 1960, increased to 139 tons in 1961, 1,534 tons in 1962, 11,956 tons in 1963.

Unfortunately, in early 1963 in the northern part of the province, one of the most destructive insect pests of cotton, *Secadodes pyralis*,²¹ was found in small patches bordering the province of Boyacá at the limit of the wilderness. A systematic campaign of destruction, and introduction of methods of biological control were decided upon. But the pest quickly appeared in settled areas; for the year 1963 in Villavicencio and San Martín, losses due to insect attacks were estimated at 30 per cent (19, p. VII). The campaign to destroy stalks proved to be extraordinarily difficult and slow, as a result of the inexperience of most of the growers, the spread of the plantations and difficulty of visiting them, partly due to the bad state of roads and to floods (15, p. 1). Consequently attacks of insect pests increased and the 1964–65 harvest was a failure. Nature had again checked the expansion of cotton growing.

¹⁹ Personal data, based on IFA files.

²⁰ For the government it was an opportunity to provide the refugees with a cash crop; for the textile industry, the possibility of obtaining cotton of a superior type, less harmed by insecticides. Any expansion would naturally increase the influence of the Cotton Federation and the Development Institute.

²¹ This is a moth larva which feeds inside green cotton bolls. It is not known to occur in the United States. Its English name is South American Bollworm or Trinidad Bollworm.

TABLE 9.—CAUCA VALLEY: COTTON AREA, PRODUCTION, AND YIELD, AND NUMBER OF GROWERS, SPECIFIED YEARS 1929-64*

Year	Area (hectares)	Production (tons fiber)	Yield per hectare (kg. fiber)	Number of growers
1929 ^a	266	...	...	...
1948 ^a	40	...	...	...
1952	33	10	297	...
1953	200	47	235	...
1954	310	70	226	19
1955	343	132	385	...
1956	434	170	392	26
1957	911	485	532	51
1958	4,370	2,759	631	136
1959	21,158	12,480	590	...
1960	19,128	14,479	757	444
1961	21,098	17,858	846	...
1962	35,919	22,190	618	...
1963 ^b	30,092	18,317	609	901
1964 ^b	15,174	9,158 ^c	604	...

* Data for 1929 from Ciro Jaramillo P., "El algodón en el Valle del Cauca," *Agricultura Tropical*, VIII, 1, January 1952, pp. 49-52; and for 1948 from Raúl Varela Martínez, *Economía agrícola de Colombia* (Colombia, Ministerio de Agricultura y Ganadería, División de Economía Rural, Bogotá, 1949), p. 33.

For 1952 and later years figures are IFA data as reported in the following sources: Area—1952-57, Tomás Orosco O., "Algunos aspectos del cultivo del algodón en el Valle," *Agricultura Tropical*, XIII, 11, November 1957, p. 690; 1957-59, Servicio Nacional de Aprendizaje, *Estudio socio-económico-area del Valle del Cauca* (SENA, Dirección Nacional, División Mano de Obra, November 1962), p. 17; 1960-64, direct from IFA, Departamento de Investigaciones Económicas; Production—1952-62 from Lauchlin Currie, *El algodón en Colombia, problemas y oportunidades* (for complete reference see 16), p. 14; 1963-64 direct from IFA, Departamento de Estudios Económicos. Number of growers from IFA *Información Estadística*, February 1955, p. 21, February 1957, p. 25, February 1958, p. 29, February 1959, p. 40, *Colombia algodón y oleaginosas 1961-1962* (complete reference, Table 1), Table 11, and IFA unpublished data supplied to author.

^a Approximate.

^b Including northern Cauca and Pereira, Caldas.

^c Our conversion of raw cotton to fiber at the rate shown for 1963 (37.3 per cent).

Map 2 shows the distribution of cotton in 1963 with heavy concentrations of acreage in Magdalena in the north and in the Cauca Valley and Tolima in the south.

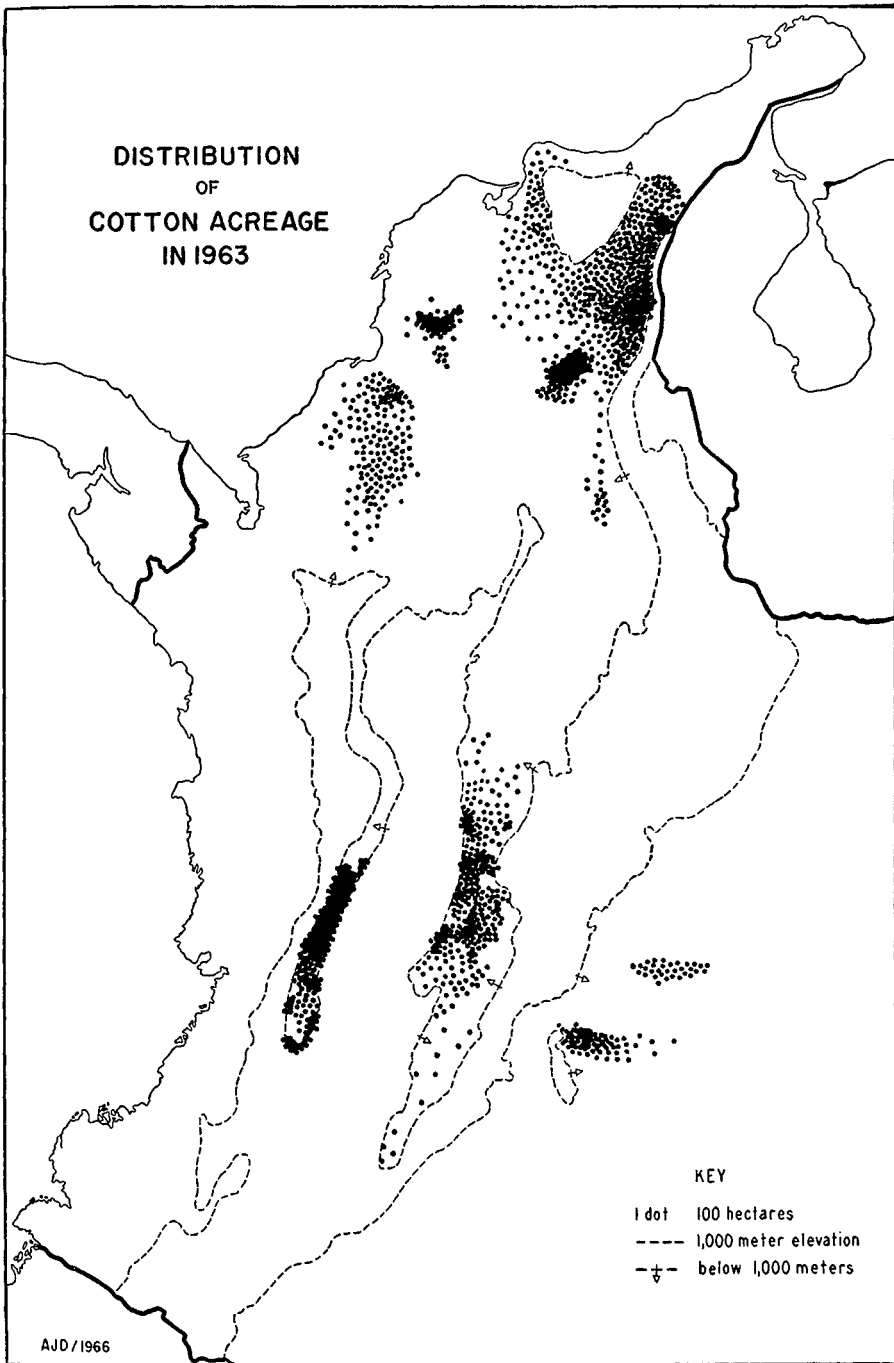
THE ROLE AND IMPACT OF THE MAJOR DETERMINANTS OF CHANGE

Technical Improvement and Drawbacks

This contest with nature could supposedly be won with the help of modern technology transferred from the cotton belts of more advanced areas, such as the United States or Peru. Such a transfer has occurred at an accelerated tempo, but in the longer run has proved to be relatively difficult. In some farm operations, where implements and tools are plentiful, it is relative costs that matter. Teams of hand pickers, generally from the Tolima cotton belt, are used rather than the more costly mechanical harvesters.²² They move from one harvesting area to

²² Cotton pickers were cheaper and harvested a cleaner cotton than mechanical harvesters. In 1960 only 100 hectares of cotton were picked mechanically (22, p. 21).

MAP 2.—DISTRIBUTION OF COTTON ACREAGE IN 1963*



* Data from Instituto de Fomento Algodonero, Departamento de Investigaciones Económicas, *Años Algodoneros Internacionales: Periodo 1960-64* (Bogotá).

another and are made available to the farmers through the Federation of Cotton Growers.

Seeds from the United States—successively Deltapine 12, Deltapine 15, Early-staple, Coker 124, and Deltapine Smoothleaf—have been imported and distributed to cotton growers.

The use of fertilizers is still in its early stages; in 1961 only 5 per cent of the cotton acreage was fertilized (22, p. 17). Of 97 farms, sampled by the IFA that year, only six used chemical fertilizers, three in Espinal, two in the Cauca Valley and one in Cereté in the Sinú Valley. Among the large farmers of this sample, expenditures for fertilizers represented only 2 per cent of the cost of production, 10 per cent of the expenditure for insecticides (16, p. 44).

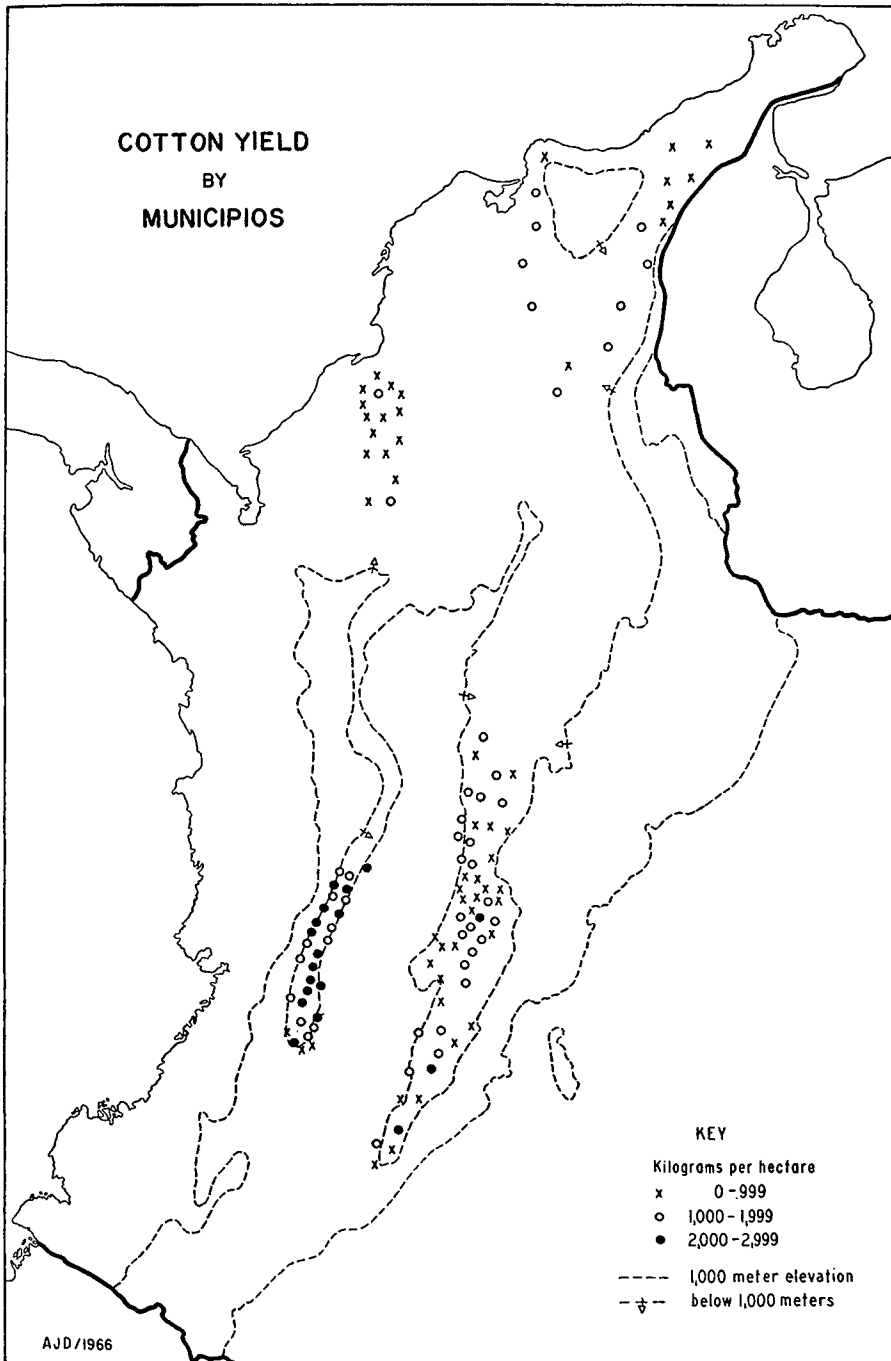
The two major natural risks to cotton production in Colombia are erratic rainfall and insect attacks. To face the disasters in dry years, such as 1955 in the north, farmers adopted irrigation in some major areas, mainly the Tolima districts and the Cauca Valley. As soon as the rice growers of Coello and Saldaña in Tolima discovered the profitability of cotton under irrigation, a large development of cotton production took place, at the expense of rice. Differences in levels of yield are substantial (Table 10 and Map 3); in large part the lower yields result from drought. For example, a good field in northern Tolima, growing cotton once a year, produced 2.5 tons per hectare with a good rainfall distribution in 1957 and only a tenth of a ton in the dry year of 1958. In central Tolima, in Espinal, 225 kilos were produced without irrigation, but 1,800 kilos with it (12, p. 28). In the Cauca Valley, a good agricultural area where land rentals are currently among the highest in the country, serious losses were incurred by farmers who did not have irrigation facilities, as in 1959 and 1964. Consequently irrigation became increasingly important to the central and southern parts of the

TABLE 10.—NUMBER OF MUNICIPIOS WITH SPECIFIED YIELDS PER HECTARE OF RAW COTTON IN 1960*

Kilograms per hectare	Cauca Valley	Others	Total	Kilograms per hectare	Cauca Valley	Others	Total
0-99	—	1	1	1500-1599	1	4	5
100-199	—	2	2	1600-1699	2	—	2
200-299	—	3	3	1700-1799	2	1	3
300-399	—	5	5	1800-1899	3	—	3
400-499	—	4	4	1900-1999	4	—	4
500-599	—	10	10	2000-2099	2	—	2
600-699	2	9	11	2100-2199	4	1	5
700-799	1	9	10	2200-2299	4	1	5
800-899	—	7	7	2300-2399	1	—	1
900-999	—	10	10	2400-2499	1	—	1
1000-1099	1	7	8	2500-2599	1	—	1
1100-1199	—	11	11	2600-2699	—	—	—
1200-1299	—	5	5	2700-2799	—	—	—
1300-1399	—	4	4	2900-2999	1	—	1
1400-1499	—	7	7	0-2999	30	101	131

* Data from IFA, *Colombia, algodón y oleaginosas 1960*, Table 28, p. 53 (for complete reference see 26).

MAP 3.—COTTON YIELD BY MUNICIPIOS*



* Data from Instituto de Fomento Algodonero, Departamento de Investigaciones Económicas, *Colombia, algodón y oleaginosas 1960, economía y estadísticas 1960* (Bogotá, 1961), p. 53.

Cauca Valley. In 1960 an estimated 2,000 hectares of cotton were grown under irrigation in the north of Columbia and 10,000 in the central part with 7,000 of this in the Tolima irrigation belt and a significant part of the remaining 3,000 in the Cauca Valley (22, p. 16).

In 1963, 2,117 hectares, or 19 per cent of the 11,100 hectares of cotton grown by tenant farmers in Cauca Valley, were grown under gravity flow irrigation; 3,177 hectares or 28.6 per cent under sprinkler irrigation (Table 11). Sprinklers were used by the larger farmers whose average cotton area was 79 hectares. The average cotton area of farmers utilizing flow irrigation was 39.2 hectares, and of farmers not utilizing irrigation at all, 44.0 hectares.²³ If similar figures are accepted for owner farmers, the irrigated cotton acreage would have multiplied at least fourfold from 1960 to 1963.

Use of farm machinery paralleled the expansion of cotton. Uprooters, powerful tractors, and plows have been bought under easy terms by cotton farmers, substantially helped by American aid.

But in insect control, the expansion in use of modern technology on Colombian farms was unfortunately more difficult and less rapid. This is the major problem for cotton growers all over the tropics. To transfer machinery to new areas under favorable economic incentives is easy, as well as to introduce fertilizers, sprinklers, and chemical products. The use of airplanes for spraying is a spectacular example, yet it by no means ends the ever-recurring fight against insects. In early years this was not a major problem; for in 1948 only *Alabama argillacea* (Hübner)²⁴ was causing substantial damage in Tolima. Since then the list of pests has expanded, very often by the actions of producers themselves, and today all the major parasites known in the world feed on Colombian cotton.²⁵ Three are particularly damaging: *Anthonomus grandis* (boll weevil) in the northern area; and almost everywhere *Heliothis zea* (corn earworm), and *Secadodes pyralis*.²⁶

Insecticides had to be used from the onset to control these parasites. In 1948, only about 50 kilos of arsenic were required to control *Alabama* in northern Tolima. Since then both the cost of application and the percentage of losses have increased. In the Sinú Valley, in 1948, the cost of insecticides and their application were only 5 per cent of the estimated cost of production (7). But by 1958 insecticides were being applied to about 20 per cent of the total area planted to cotton (29, p. 29). In 1961 a sample of twenty farms growing from 48 to 230 hectares of cotton per farm, showed the cost of insecticides and their application as 452.89 pesos per hectare (16, p. 44); and if one applies that figure to the total

²³ The percentage of flow and sprinkler irrigation depends naturally on local conditions. In Ginebra, Guacarí, Río Frío and Yumbo more than half of the fields were grown with the aid of sprinklers.

²⁴ This is the cotton leafworm, the larva of a moth which skeletonizes the leaves of cotton plants. It is not known to occur in California, but is found in many states from Arizona to the Atlantic coast. It is not known to overwinter in the U.S. Adults fly in each spring or summer from Central or South America.

²⁵ *Aphis gossypii* (cotton aphid or melon aphid), *Prodenia ornithogalli* (yellow-striped armyworm), *Pectinophora gossypiella* (pink bollworm), *Anthonomus grandis* (cotton boll weevil), *Heliothis zea* (corn earworm, cotton bollworm, tomato fruitworm, depending on the crop attacked), and *Secadodes pyralis* (South American bollworm or Trinidad bollworm).

²⁶ One remembers how *Anthonomus* was introduced to Colombia by growers of annual cotton, diffused by careless farmers who ignored official prohibitions and sanitary barriers, and how this finally eliminated the traditional growing of tree cotton by small farmers around Barranquilla; perennial cotton is indeed an ideal nesting ground for *Anthonomus*.

acreage under cotton in the same year, the cost of insect control would have been 75 million pesos (approximately 10 million U.S. dollars), amounting to one fifth of the total value of the harvest.

The number of applications of insecticides to a crop has increased year after year. There was an average of ten fumigations per farm in the IFA sample, and some farmers made seventeen (28, p. 38). Systematic efforts to reduce the number of applications in 1964 have generally failed. In the Cauca Valley, for instance, notwithstanding constant technical care and a reduction of applications to the minimum, ten applications were required in the fields supervised (25).

The losses due to insects, in terms of quantity produced or in terms of quality,

TABLE 11.—METHOD OF IRRIGATION USED BY TENANT FARMERS IN THE CAUCA VALLEY, BY AGENCY AND LOCATION, 1963*

Agency and location	Area (hectares)				Users (number)			
	Flow	Sprinkler	None	Total	Flow	Sprinkler	None	Total
Zarzal								
Cartago	—	369	627	996	—	4	12	16
La Union	—	115	292	407	—	1	12	13
La Victoria	—	—	977	977	—	—	32	32
Obando	—	—	1,332	1,332	—	—	21	21
Pereira	—	—	115	115	—	—	2	2
Baldarillo	—	—	429	429	—	—	7	7
Zarzal	—	214	626	840	—	2	18	20
Total	—	698	4,398	5,096	—	7	104	111
Buga								
Andaluscia	192	310	80	582	2	4	5	11
Buga	255	261	65	581	8	6	3	17
Bugalagrande	237	168	513	918	7	3	8	18
Cerrito	271	192	—	463	7	2	1	10
Ginebra	39	70	—	109	3	1	—	4
Guacari	141	554	4	699	10	7	1	18
Riofrío	18	42	13	73	1	1	1	3
San Pedro	22	77	208	307	4	1	3	8
Tulua	822	403	211	1,436	10	4	1	15
Trujillo	—	—	19	19	—	—	2	2
Yotoco	86	179	90	355	—	—	—	—
Total	2,083	2,256	1,203	5,542	52	29	25	106
Palmira								
Candalaria	—	51	—	51	—	1	—	1
Palmira	—	145	205	350	—	2	3	5
Florida	17	—	—	17	1	—	—	1
Yumbo	17	27	—	44	1	1	—	2
Total	34	223	205	462	2	4	3	9
Grand total	2,117	3,177	5,806	11,100	54	40	132	226
PER CENT OF TOTAL								
Zarzal	.0	13.7	86.3	100.0	—	6.3	93.7	100.0
Buga	37.6	40.7	21.7	100.0	49.0	27.4	23.6	100.0
Palmira	7.3	48.3	44.4	100.0	22.2	44.5	33.3	100.0
Grand total	19.1	28.6	52.3	100.0	23.9	17.7	58.4	100.0

* Compiled by the author in Bogotá from IFA records for individual growers. Data may be incomplete.

reached 30 per cent of the value of the harvest in 1952 when a large amount of perennial cotton was still grown (9, No. 2, p. 43). The same percentage loss for annual cotton prevailed in the 1960's as a result of attacks of *Secadodes pyralis* alone (22, p. 20). As already mentioned, there was a loss of 30 per cent in the Meta in 1963. As an example, the application of insecticides in one field in Aracataca, Magdalena, in 1955, was so poorly done that 90 per cent of the field received no insecticide whatever while the remaining 10 per cent suffered defoliation from excessive application. One of the most elementary duties of management would be to inspect the field every five days and to apply the insecticides at the moment when the development of a specific pest requires it. Insecticides were generally spread by airplane at regular intervals without any consideration for the condition of the fields (53). In 1961 farmers were still following the same procedure notwithstanding its defects (28, p. 37). Excessive use of virulent insecticides was common even to control relatively innocuous insects like *Aphis*, in addition to suppressing the predators *Secadodes* and *Heliothis*, which have developed an immunity to insecticides currently in use (36, p. 162). Difficulties have also arisen because of the adulteration of some insecticides so that they did not contain the specific content stated in their advertisements; some had been diluted for years but the law prohibiting such adulteration had not been enforced (46, p. 411).

It has been notably difficult to force farmers to destroy stalks. The Cotton Growers' Federation finally retained part of the value of the crop until eradication was completed. But as evidenced in the Meta, understaffed control teams can hardly verify compliance with this rule in sparsely settled areas.

Biological control of pests has been tried in Colombia, following the example of Peru where the use of bees to kill bollworms in the oases of the Peruvian coastal desert proved successful. Unfortunately the first attempt failed.

The ecological conditions of Colombia make biological control very difficult. Different fields in areas of regular cropping are at different stages of growth at any one time if only because of the irregularity of rainfall, so that their germination is not simultaneous. Insecticides used at a specific time to avoid the destruction of pest predators in one field overlap a neighboring field where the stage of growth is different. A season without cotton is useless for control of insects that breed on other plants, as does *Heliothis* on maize. The use of insecticides with residual effects is of no value, for the torrential rains wash the insecticides from the leaves. When cotton is grown in isolated valleys, as in northern Huila, the brush around the cotton fields provides magnificent breeding ground for pests. For reasonable success, a heavily staffed control service, constantly extending its activities to all crops cultivated in the cotton-growing belts and collaborating with all the farmers, is required.

In the first attempts at supervised control the farmers, though handpicked for their willingness to collaborate, failed to follow correctly the instructions of the entomologists. They changed the timing of applications and type of product without advising the supervisor. There is great need for substantial improvement in the collaboration between farmers, as well as an enlarged staff of entomologists, to assure the future of the Colombian cotton-growing industry.

Thus a contrast is evident in the efforts to foster technical progress. Innova-

tions adopted by individual producers which do not require continuous and substantial technical support have rapidly been introduced to the Colombian growing industry under the expectation of high rates of return. American varieties of cotton, American tractors and machinery, sprinklers, air spraying, and, in a few cases, fertilizers, have been adopted. But when sustained effort at the community level is necessary to avoid the spread of destructive insects, to respect the rule of stalk eradication, and to avoid the useless spreading of pesticides that destroy a useful insect fauna, the results achieved are meager. This is a matter of increasing concern to those responsible for the cotton industry.

Monopoly and Monopsony

The increasing importance of cotton growing in Colombia resulted directly from government stimulus and from the changing balance of influence within a group of powerful institutions: the cotton-buying organization of the textile industry, a monopsony; the Cotton Growers' Institute which monopolized ginning until recently; and the oligopoly formed by the incipient Insecticide Industry in recent years. The uneasy relationships among these different groups have been analyzed at length by Currie and Goering (16, 22).

A few words will suffice to sketch the economic atmosphere of the textile industry. Its attitude, itself dictated by the general policy of the government, has played a dominant role in the formulation of decisions concerning cotton growing. The textile mills had only 22,000 spindles in 1926, no more than in one average mill in Manchester (39, p. 96). Good-quality cotton cloth was imported and major consuming groups, such as the coffee growers, were opposed to any substantial increase in protection. After reinstatement of the customs tariff in 1931 and a more than proportional decrease in the value of the peso, the mills made a profit by purchasing national cotton. They showed a substantial but short-lived interest in buying the national product. Around 1936 the import duties were increased from 0.10 to 0.14 pesos per kilo of fiber. Under the incentive of good prices the farmers around Armero, in northern Tolima, produced increasing quantities of cotton. Samples sent from Tolima to Medellín were found interesting, but when the price of imported fiber declined, the industry refused to buy (8, p. 395), and farmers unanimously shifted to other lines of production in 1938.

In 1941 the mills were obliged by the government to buy all the available national cotton on the market at a government established price under a quota system, to which they complied not without resistance. But the prices did not yield substantial profits to the farming community, and expansion of annual cotton ceased.²⁷

With wartime, the industry once more became interested in buying national cotton. Credits were extended to the cotton growers' cooperative of the Atlantic Coast under an agreement between the textile industry, the Agrarian Bank, and the cooperative (47, pp. 3-5). The industry paid prices higher than the floor prices named by the government. But in 1945 conditions changed; the seas were

²⁷ A typical anecdote of the time is that in the early forties a farmer who inquired if he was obliged to plant cotton was advised instead to purchase textile stocks with his money; he did so and in three years made more money than in 40 years as a cotton planter (21, p. 221).

free again, the policy of protection of the industry was in full swing, the duties were only 0.14 per kilo of fiber as against 0.70 and 0.90 pesos per kilo for the roughest textiles. The textile mills once more became interested in importing. The industrialists refused to purchase 5,000 tons of raw cotton in Tolima, arguing that the specific type failed to meet their requirements and was unfit for their machinery—the argument that had been used in the price controversy of 1938. The cotton was then bought by a newly formed price stabilization institute, the Instituto Nacional de Abastecimientos (INA), created in 1944 (23, p. 34).

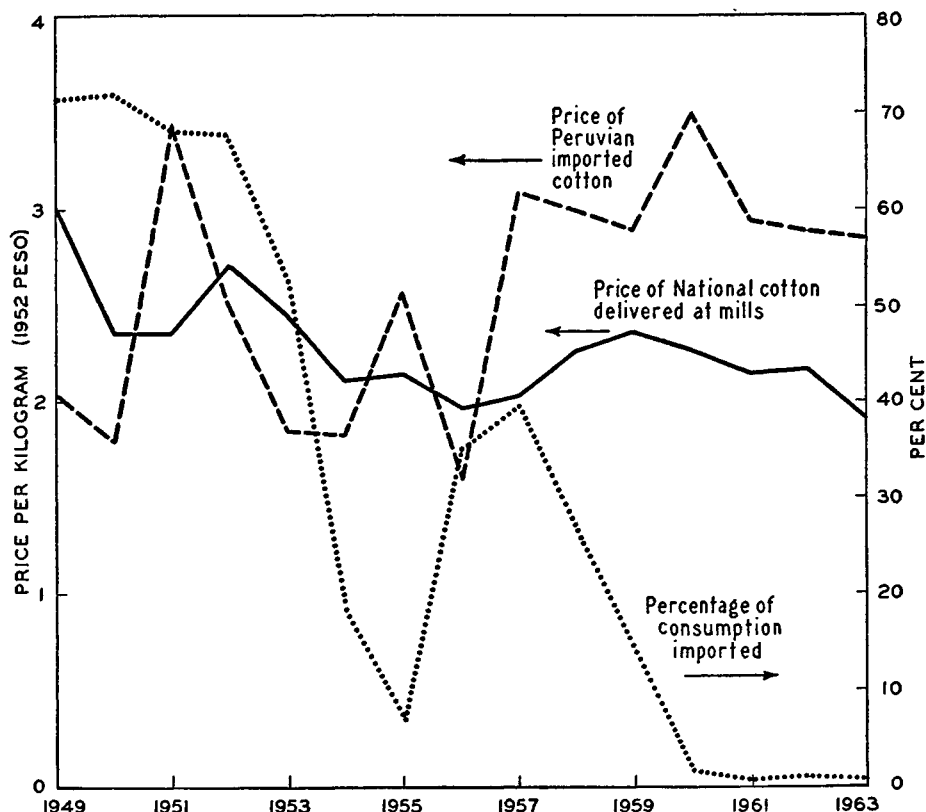
The Minister of Agriculture, backed by the agronomists and farm interests, decided to push Colombian agriculture. National production of fiber was sheltered by increased protection (24, p. 44). Then, in 1947 the three major textile mills created the Cotton Development Institute (IFA). The Institute became official in 1948 and played a decisive role in subsequent cotton developments. The IFA was made responsible for monopolizing ginning for a decade, for research and extension work, for management of farm machinery pools in the early years of the decade, for diffusion of new seeds, and for financing insecticides under liberal credit terms. In the meantime, up to 1957, the industry complied strictly with its obligations. But because the nationally produced cotton became increasingly poor and unattractive, the mills did not actively participate in the promotion of national cotton.

From 1953 to 1957 the cotton grown in the country was paid for at 4 pesos per kilo, while imported cotton could have been obtained for approximately 2.51 pesos per kilo. But the quality of the national cotton was worsening because of heavier use of pesticides and of deterioration in ginning. The ginning margins paid to IFA remained unchanged from 1951 to 1963. Meanwhile the price level nearly trebled. The IFA had to cut its operating costs by using unskilled labor and by lowering the average quality of ginning.

Following devaluation in 1957, import prices of cotton fibers rose sharply (Chart 5) and interest on the part of the textile mills changed abruptly. When credits were extended to agriculture in 1959 in order to increase production, the textile interests gave their support. The farmers responded too well to the incentives. Cotton production doubled from 1959 to 1960, most of the increase coming on larger farms. From 1958 to 1962 the production of fiber increased from 25,000 to 80,000 tons. More than two-thirds of the total increase of 55,000 tons had been planted by the 600 largest growers. When production became larger than current consumption, which also was rising, the textile industry had trouble. Absorption of all the nationally produced cotton proved to be difficult. The qualities that the mills require do not necessarily coincide with the qualities offered by the farmers. Criteria of classification were rough, and thus spelled overproduction of some fibers not meeting requirements. The cotton industry complained about the sluggish demand for fabrics and refused to accept the increases in price asked by farmers. So now, by its encouragement of national production, the textile industry had directly contributed to building up a strong adversary, the Federation of Cotton Growers, a pressure group whose strength had increased with concentration of cotton growing on a limited number of large farms. (See Chart 6.)

The increased concentration of cotton growing was accompanied by notable

CHART 5.—PRICES OF NATIONAL AND PERUVIAN IMPORTED COTTON (1952 PESOS), AND PER CENT OF COTTON CONSUMPTION IMPORTED, 1949–63*
(Prices in 1952 pesos per kilogram)

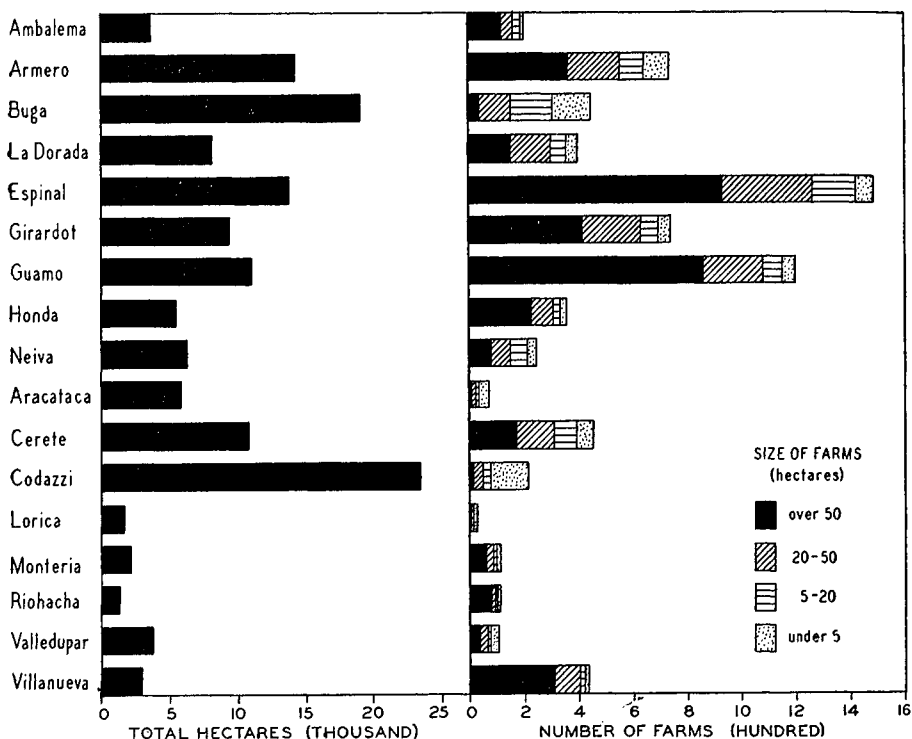


* Prices for 1949–52 from Palacio del Valle, *Desarrollo agrícola de Colombia*; for 1953–63 from Lauchlin Currie, *El algodón en Colombia, problemas y oportunidades* (Bogotá, 1963), mimeo., p. 22, deflated by wholesale prices for 15 foodstuffs from *Revista del Banco de la Republica*, various issues. Imports as per cent of total consumption for 1949–51 based on Mario Londoño Beltrán, "Cultivo del algodón en Colombia," *Agricultura Tropical*, XII, 7, July 1956; and for 1952–62 based on p. 4 of the source cited above for 1953–63 prices.

changes in production techniques. Mechanized equipment had to be used to make a profit in cotton—not only tractors, but also trucks to move the harvest, and root extractors, sold in Colombia at four times the American price. In the cheap land area, as the César Valley, newly settled communities and other facilities had to be built, and very often roads as well. Large capital infrastructure investments, normally supplied by the State, were the responsibility of cotton farmers. And, with only one harvest a year, someone had to provide for subsistence on the farms where no other cash crop had been developed.

In other areas, the middle of the Cauca Valley for example, the success of farming depended on irrigation, so that sprinklers constituted an important new capital expenditure. Everywhere the risk of the cultivator is high in the cotton areas where one year of ample rainfall is followed by another of drought. In general, economies of scale are substantial. For reasons of insect control cotton

CHART 6.—DISTRIBUTION OF CULTIVATED ACREAGE AND NUMBER OF FARMS BY ZONES AND AGENCIES, 1960/61*



* Data from Instituto de Fomento Algodonero, Departamento de Investigaciones Económicas, *Colombia su desarrollo agrícola, algodón y oleaginosas, 1961-62* (Bogotá, 1963).

growing is prohibited in the first semester in the littoral and Meta, in the second semester in the Cauca Valley and the middle Magdalena Valley, and as a consequence big entrepreneurs fly from one farm to another and transfer part of their machinery from one growing area to the other, thus reducing the capital cost of their operations. On large farms insects are controlled by aerial spraying, teams of cotton pickers are brought in from specialized areas (as mentioned in relation to Codazzi) and have to be fed and sheltered. All such operations are beyond the powers of the small grower.

The risks of cotton farming ought to be spread in as many different areas as possible. Large-scale growers can spread the ecological risk by growing cotton in association with other growers in different areas.²⁸ Considerable bank credit is necessary and a knowledge of modern methods is of great help.²⁹ Consequently large farms had an advantage in new areas of cheaper land; in old settled areas the advantage was smaller but nevertheless existed. (See Chart 6.)

²⁸ In 1963 one very large grower planted 2,500 hectares of his own and another 1,000 in partnership to divide the risks; another planted 200 hectares of his farm and 800 in partnership (16, p. 61).

²⁹ As an example, between 1948 and 1952 one agronomist, who had been badly paid during three years in the Ministry of Agriculture, made use of his firsthand knowledge of bank connections and State credit available and thorough knowledge of farm management to successfully develop two large farms in Sinú and eastern Magdalena, the first as tenant, the second as owner, and this without any personal capital (44).

The concentration of production in a few hands naturally added to the power of the Cotton Growers' Federation.³⁰ However, the classical limits of monopoly power were soon reached. In the short run the mills had to pay the price, but in the longer run the creation of new synthetic fiber plants became a serious threat to the cotton growers.

Monopoly-monopsony relationships are also visible in other parts of the cotton industry. In 1963 the Growers' Federation cornered the supply of cotton seed and doubled the price charged to oil producers who were suddenly short of supply (16, p. 125). The same procedure was followed at other times when dealers needed a substitute for soya and sesame.

Relations between cotton growers and suppliers of insecticides became increasingly unsatisfactory. As other groups had done in previous years, the cotton growers questioned why they should pay excessive prices for insecticides mixed in the country. They imported a stock of insecticides in the free port of Barranquilla and began a newspaper campaign to put pressure on the government to abolish the restriction on importing pesticides. But their efforts failed, as had the earlier efforts of the textile mills to import more fiber and the attempt made by coffee growers in 1931 to persuade the government to permit the importation of cheap textiles.

In the field of research and ginning the Cotton Development Institute, IFA, long enjoyed another monopoly. Although new gins were regularly built as the expansion of acreage warranted, the quality of ginning suffered from the freezing of ginning fees at a constant amount from 1951 to 1963 and the work had to be done over by the textile processing plants. In general, however, the interests of both the cotton growers and the cotton users were parallel in this technical organization, which had a good record of achievement until the sharpening of conflict between the two interested groups in the 1960's. Many responsibilities of the Development Institute were slowly taken over by the Growers' Federation: the management of exports, the financing of the harvest and inputs, and the building of its own ginneries. Recently, following the suggestion of Laughlin Currie (16, p. 155), the Cotton Development Institute abandoned its economic activities to concentrate its efforts on the technical aspects of seed selection and improvement in methods. The cotton industry thus developed a monopoly-monopsony relationship of a quasi-textbook type. In some aspects these developments were conducive to progress. The increased cost of domestic cotton possibly contributed to the degree of efficiency achieved by the textile mills, for increased efficiency of the Colombian textile industry in recent years has been notable. From 1954 to 1960 the official support price for cotton increased 92 per cent, the price of cotton cloth only 36 per cent, a result of the greater efficiency of the industry (54, p. 83). The power of the Growers' Federation forced producers and distributors of insecticides to grade their product in agreement with sanitation laws that had not been enforced earlier (46, pp. 411-13). Satisfactory rates of return resulting from high, supported prices contributed substantially to the opening of new areas. Nevertheless one can only conclude that the development of cotton growing had

³⁰ For instance, in January 1963 the cotton growers refused to deliver their cotton to the mills. When members of the purchasing organization were threatened with having their supply cut off, the managers of the textile-buying organizations flew hastily from Medellín to Bogotá to discuss prices. The ensuing discussion was so heated that an important official of the monopoly and a leader of the monopsony fought each other in the office of the President of the Republic (17).

depended in large part on monopoly profits achieved through governmental support.

CONCLUSIONS

Developing new lines of agricultural production presents major advantages during the first step of modernization of a pre-industrial society. It is often an economical means of tapping unexploited resources of land and labor and it does not suffer from some of the drawbacks of industries working for a protected market of small size. It is both a valuable and a difficult task.

Indeed the warm and wet equatorial climate permits very high yields, but also presents very serious difficulties in pest control, storage problems, plant diseases, and fungi.

Importing and adapting the available backlog of modern technology is consequently not altogether easy, but when successful is highly rewarding in agricultural production. Of interest in study of the Colombian cotton industry is the apparent success of this transfer under difficult climatic conditions. Colombia now stands among the countries with the highest cotton yields aside from the favored irrigated sections of arid or semiarid countries.

The change was due to the massive building up of a modern industry of American-Egyptian cotton with American seeds, machinery, and farming systems. The traditional sector, largely based not on annual but on perennial cotton, was systematically wiped out. A complex organization was built with weaknesses on the level both of technology and of organization.

Organizational difficulties can be corrected but to the battle against natural conditions there can be no end. The experience of the Colombian cotton industry suggests that in the conditions of moist tropical climates a more than proportionate effort must be spent on applied biology in order to attain rewards comparable with those in cooler climates; and a strict agricultural discipline of a kind more typical of developed than of underdeveloped countries must come to prevail.

CITATIONS

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