

TRENDS IN LAND USE IN SOUTHEAST PUERTO RICO

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To the G.I. Bill which provided higher education to veterans of World War II, and to the American Way of Life in which such a rare opportunity is taken as a matter of course.

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CHAPTER I

INTRODUCTION

The Greater and Lesser Antilles stretch in a long sinuous sweep from Florida to Venezuela, separating the Caribbean Sea from the Atlantic Ocean. The Greater Antilles lie closer to Florida and are composed of the four islands of Cuba, Jamaica, Hispaniola, and Puerto Rico.* Puerto Rico is the smallest of the four and the most easterly, lying between 17°52' and 18°37' North Latitude and 66°45' and 67°22' West Longitude.

The island is roughly rectangular in shape, approximately 100 miles long from east to west and 35 miles wide from north to south. This makes it about as long as Long Island, New York, but twice as wide. There most comparisons cease. The relief is rugged and the population is dense, over 2,000,000 persons living in an area of about 3,400 square miles. Sixty percent of the population is rural and forty percent urban. (222)

Puerto Rico has the highest standard of living of any of the islands of the Caribbean as is shown by its paved highways, an excellent health program, and a constantly

* The original Spanish spelling was Puerto Rico. The official American spelling from 1900 to 1933 was Porto Rico. Since 1933, the official spelling has been Puerto Rico. Some companies, the South Porto Rico Sugar Company, for example, still use the early American spelling.

improving educational system topped by a first rate university. Nevertheless, its living standard on the average is below that of the United States. Despite the small group of wealthy Puerto Ricans at the top of the social pyramid, the broad base contains some of the most wretched and poverty-stricken people imaginable.

Throughout its history, the island has supported itself by agriculture. Because it lacks minerals, particularly industrial minerals and fuels, it will probably continue to support itself by agriculture despite the 20th century development of hydroelectric power and the current plan for industrial development.

Since the United States took over in 1898, a ferment of progress has been bubbling through the island. One aspect of this progress has been an increased participation of the Puerto Ricans in their own government; another has been a continuous reexamination of their economic situation. A recent reexamination included the Rural Land Classification Program sponsored jointly by the Puerto Rican Planning Board, the Social Science Research Center of the University of Puerto Rico, and the Northwestern University of Evanston, Illinois. The program was administered by the Geography Department of Northwestern University and the Puerto Rican Department of Agriculture and Commerce.

The Rural Land Classification Program produced an inventory of the land use of the island during the years 1950 and 1951 and provides a scientific base for future planning.

The present study in historical geography grew out of the writer's participation in that program and is an attempt to explain how the present land use developed in one section of the island, in the hope that the story of the past may have some implications for the future.

Southeast Puerto Rico is the area surveyed personally by the author. The title is contrived and is not used on the island. It may even be misleading because Southeast Puerto Rico does not include the southeasternmost portion of Puerto Rico. (See Mapa de Municipios y Barrios de Puerto Rico.*)

Southeast Puerto Rico has never been either an administrative or a census area but is an arbitrary grouping of six of the seventy-seven municipios that make up the island. The main justification for creating the region is that historical data are available for the political units making up Southeast Puerto Rico. The six municipios of Coamo, Santa Isabel, Salinas, Guayama, Arroyo, and Patillas are the present day counterparts of the early Spanish administrative areas of Coamo and Guayama.

The "land use" in the title refers only to agricultural land use. Urban land use, industrial land use, and mining land use are excluded from the study. The chief urban centers

* The Spanish term municipio as used in Puerto Rico is most like the United States term "county". Municipios are composed of barrios, which are most like United States' "townships". The Spanish terms are used throughout the paper.



BARRIOS URBANOS DE RIO PIEDRAS

1. BARRIO PIEDRAS	11. BARRIO SAN JUAN
2. BARRIO DEL CANTON	12. BARRIO SAN ANTON
3. BARRIO DEL PUERTO	13. BARRIO SAN ANTON
4. BARRIO DEL SUR	14. BARRIO SAN ANTON
5. BARRIO DEL NOROCCIDENTE	15. BARRIO SAN ANTON
6. BARRIO DEL NOROCCIDENTE	16. BARRIO SAN ANTON

BARRIOS URBANOS DE PONCE

1. BARRIO URBANO	11. BARRIO URBANO
2. BARRIO URBANO	12. BARRIO URBANO
3. BARRIO URBANO	13. BARRIO URBANO
4. BARRIO URBANO	14. BARRIO URBANO
5. BARRIO URBANO	15. BARRIO URBANO
6. BARRIO URBANO	16. BARRIO URBANO

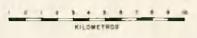
LEYENDA

- LIMITE MUNICIPAL
- - - LIMITE DE BARRIO
- LIMITE DE BARRIO URBANO
- CIUDADES Y PUEBLOS
- ZONA URBANA

GUBERNIO DE PUERTO RICO
 JUNTA DE PLANIFICACION DE PUERTO RICO
 SANTIURCE, PUERTO RICO

MAPA DE MUNICIPIOS Y BARRIOS DE PUERTO RICO

PREPARED BY: *[Signature]*
 DATE: JULIO DE 1958



of Southeast Puerto Rico are the capitals of the six municipios, of which Guayama, a city of 19,367 (224), is the largest. Industrial land use is largely limited to the five sugar mills, (locally called centrals, a term that will be used hereafter), and to a few small factories in the municipio capitals. Mining is unimportant; a combined gold, silver, and zinc mine in barrio Carmen of Guayama is no longer in operation. (126, p. 131) Salt is extracted by solar process along the shores of the Caribbean in barrio Aguirre of Salinas, and unexploited deposits of kaolin, the raw material for porcelain, exist in the municipios of Guayama and Arroyo. Otherwise no important minerals are known in Southeast Puerto Rico. Considerable limestone is quarried for road metal.

The paper begins with a brief description of the physical background on which the land use patterns developed. Four patterns are described and mapped; about 1500, in 1776, in 1897, and in 1951. The main influences on land use that are traced throughout are the changes in racial composition and numbers of the population, the introduction of new plants and animals, the development of transportation, the system of land holdings, and the changes in the administrative regulations that affected the land use in Spanish and American times.

Various trends in land use are discovered. Some have reached their conclusion; others may continue to modify the land use pattern.

CHAPTER II

THE PHYSICAL BACKGROUND

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CHAPTER II

THE PHYSICAL BACKGROUND

Land Forms

Origin. Southeast Puerto Rico, like the rest of the island of Puerto Rico, emerged and underwent complete reconstruction within the last tenth of geologic time. (126, p. 206) Since Cretaceous time of the Mesozoic, explosive and intrusive activity, together with marine and alluvial deposition have produced the types of rocks shown on the Geology map. Uplift and subsidence, including block-faulting and tilting, combined with alluvial and marine processes to create the land forms.

Two stages in the geologic past set the limits of the present land forms. The uplifted St John Peneplain (Miocene) holds the tops of the present mountains to under 2,500 feet, except for a few monadnocks that reach 250 to 500 feet higher; the Pleistocene marine transgression delimits the almost level coastal plain.

According to Berkey, all present relief forms are erosional or depositional. (20, p. 12) The destruction of the St John Peneplain began when a major uplift during the lower Pleistocene initiated the erosion cycle that established the present drainage pattern and removed most of the deposits laid down during the Tertiary. Only one hill, Cerro del Muerto, in barrio Boca Velazquez of Santa Isabel, is still topped with Tertiary limestone. (See no. 1 on map of Geographic Regions.)

Later in the Pleistocene, a subsidence allowed the sea to form great bays in the valleys of the rivers; one reached up the Rio Descalabrado as far as the present Ponce-Coamo highway, a second extended up the Rio Coamo almost to the Ponce-Coamo highway, a third up the Rio Salinas to the confluence of the Rios Lapa and Majada, a fourth up the Rio Guamaní just past the site of the present city of Guayama, and a fifth up the Rio Patillas to the site of the present city of Patillas. (See map of Topography.)

The sites of the cities of Patillas and Guayama were underwater and those of Salinas and Santa Isabel were between 50 and 60 fathoms deep. The isolated hills which now protrude from the coastal plain were then islands barely awash or reefs 25 or more feet above the sea bottom. (102, p. 201) These hills are numbered 1 to 9 on the map of Geographic Regions.

At this stage, the rivers emptied into the sea at the inner margin of the present coastal plain. Subsequent erosion and deposition helped give the landscape its present aspect. Some of the Quaternary deposits partially filled in the Pleistocene bays to form the alluvial plain. One unfilled bay is the present Bahía de Jobos which makes the harbor at Central Aguirre. (126, p. 178) Further Quaternary deposition took place in municipio Salinas adjacent to the coastal plain, and in barrios Los Llanos and San Ildefonso of Coamo behind a limestone ridge. (See map of Geology.)

More uplift, subsidence, and differential tilting seem

GEOLOGY

QUATERNARY

Unconsolidated littoral and alluvial sediments

TERTIARY

Relatively pure limestone

ANTILLEAN

Granitoid intrusives

UPPER CRETACEOUS

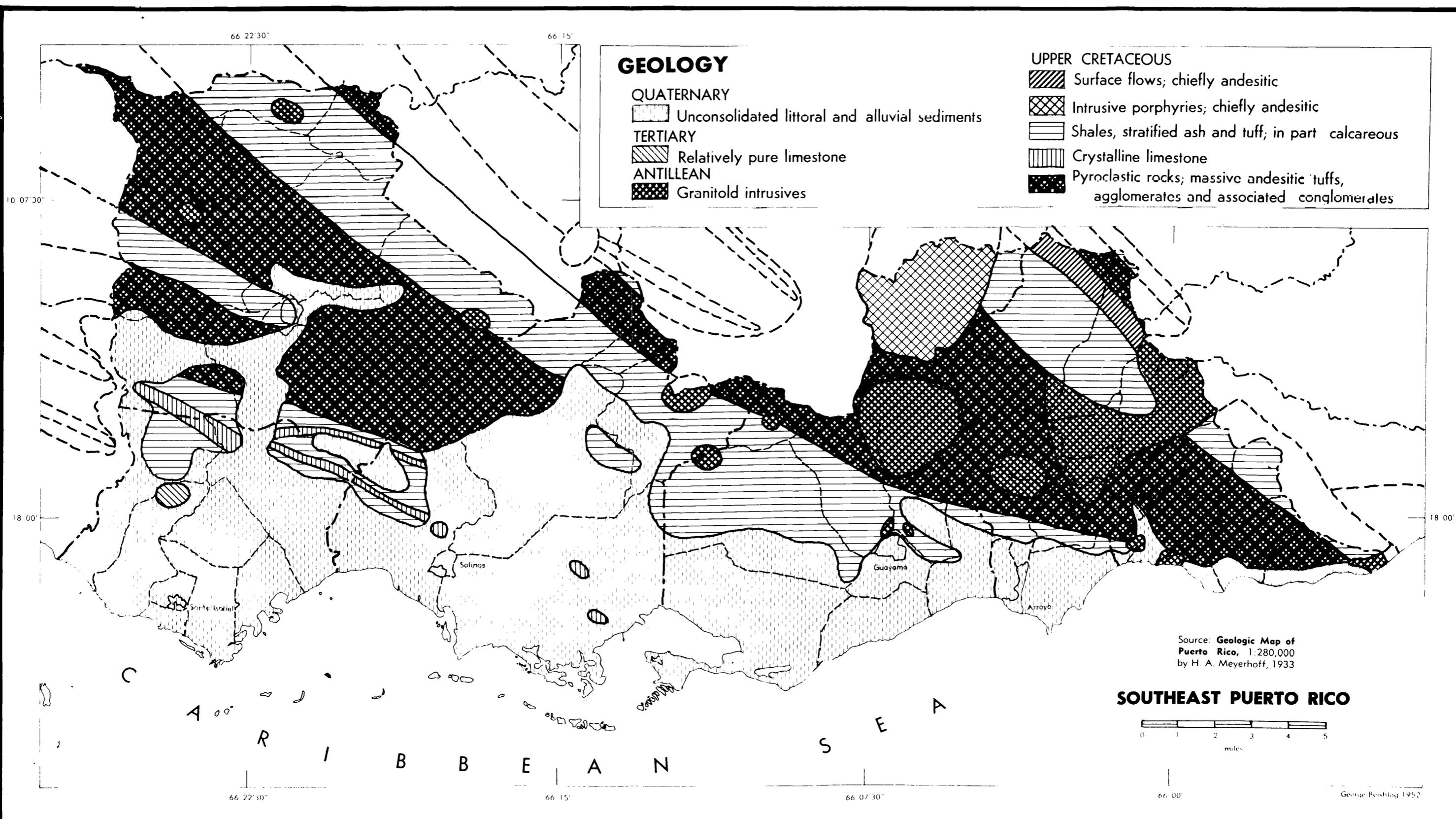
Surface flows; chiefly andesitic

Intrusive porphyries; chiefly andesitic

Shales, stratified ash and tuff; in part calcareous

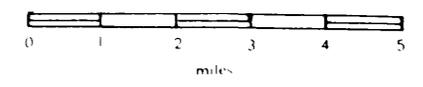
Crystalline limestone

Pyroclastic rocks; massive andesitic tuffs, agglomerates and associated conglomerates



Source: **Geologic Map of Puerto Rico**, 1:280,000 by H. A. Meyerhoff, 1933

SOUTHEAST PUERTO RICO



George Beishlag 1952

66° 22' 30"

66° 15'

TOPOGRAPHY



First Class Highway



Second Class Highway



Third Class Highway



Other Highway

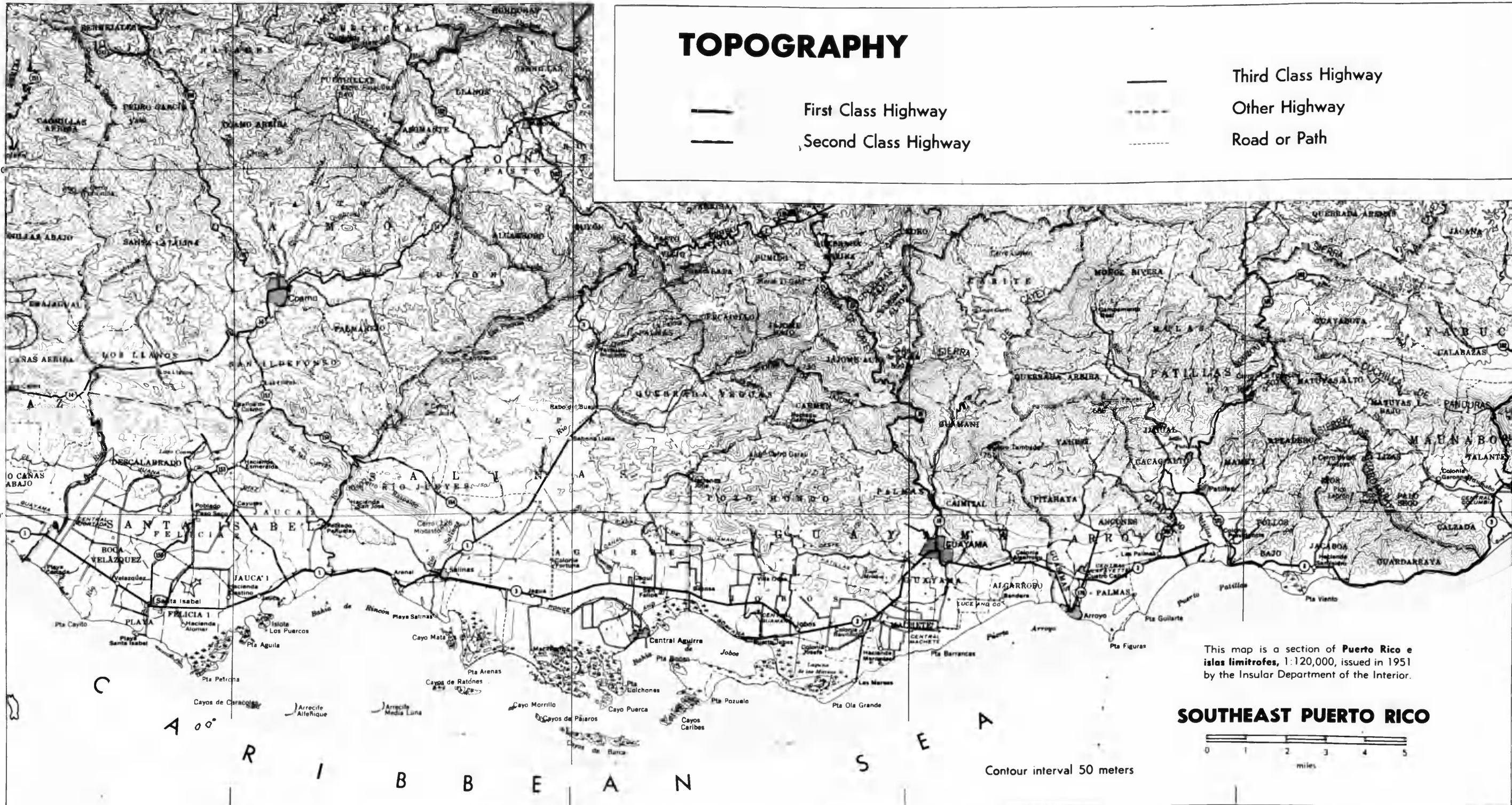


Road or Path

18° 07' 30"

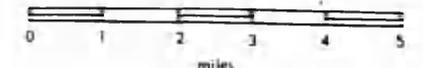
18° 00'

18° 00'



This map is a section of Puerto Rico e islas limitrofes, 1:120,000, issued in 1951 by the Insular Department of the Interior.

SOUTHEAST PUERTO RICO



Contour interval 50 meters

66° 22' 30"

66° 15'

66° 07' 30"

66° 00'

George Beishlag 1952

to have occurred, as well as eustatic changes in sea level, although no geologist has yet worked out exactly what happened. (126, p. 180) Still to be determined is whether the series of terraces, found on the coastal plain near the upper courses of all the main streams, are river terraces or sea cliffs. (111, p. 370)

The Caribbean shoreline, being little disturbed by the trade winds, is gradually moving south. Offshore sand bars are continually building up. Some remain offshore islands; others, like Punta Pozuelo in Guayama, became attached to the mainland and formed sandspits. One former sandspit, that is now a beach, runs from Punta Figuras to Punta Guilarte in Arroyo. (See map of Topography.) Associated with the sandspits are salty marshes that gradually dry out as shore building continues.

Types of Land Forms. In general, the relief is in a state of maturity; early maturity in the old lands to the north, and late maturity in the coastal lands to the south. (21, p. 4) Dissection by the rivers has been influenced by the rainfall regime, which causes many of the streams south of the divide to be intermittent and most of the stream beds to be full of sizable rocks which are moved only in times of flood. The types of land forms are given below, in order, from the insular divide south.

1. The Ridge of the Insular Divide. The line of the insular divide is shown on the map of Geographic Regions.

Elevations vary from a high of just under 3,000 feet at Cerro La Santa on the northern border of Patillas to a low of just over 1,600 feet on the border between barrios Carite and Guamaní of Guayama. Only two barrios, one in Coamo and one in Guayama, are north of the divide. From the south, the divide appears as a ragged escarpment with long irregular spurs trailing down between steep-walled and cirque-like valley heads. (111, p. 315) Slopes of 40 degrees are common and of 50 degrees frequent. (111, p. 317)

2. The Irregular Spurs Trailing from the Divide.

The spurs are similar in appearance to the ridge of the divide with sides no less steep. A typical one originates at a height of 1,900 feet on the northern border of barrio Palmas of Guayama and descends in five miles to an elevation of 800 feet on the outskirts of the city of Guayama. What is reputed to be the steepest slope on the island is found in northern barrio Lapa of Salinas where there is an almost sheer drop of nearly a thousand feet from the crest of a spur to the Salinas Valley. All of the paved roads crossing the divide climb spurs because the valley heads are too steep. (102, p. 148) Notable are the highways from Coamo north, from Coamo northeast, from Salinas northeast, from Guayama north, and from Patillas northeast. (See map of Topography.)

3. The Peaks and Occasional Flat-Topped Mountains.

These forms are related to the trailing spurs and the insular divide but have been separated from the main chain by fluvial action. Knife-edge crests are common and are ordinarily used

by the trails climbing the slopes. (102, p. 120) All of the peaks are below the level of the old St John Penepplain.

Examples are: Cerro Cariblanco (1,800 feet) in barrio Lapa of Salinas, Cerro Tumbado (2,400 feet) on the border between Guayama and Arroyo, and Cerro Yaurel (2,200 feet) on the border between Arroyo and Patillas. (See map of Topography.)

4. The Limestone Ridges. These are the only land forms that are directly oriented with the geologic structure. (102, p. 148) They run mainly south of the border between Coamo and Santa Isabel, but extend into Salinas and seem to be related to some of the outlying hills in the coastal plain. Their greatest height is just under a thousand feet (Cerro Raspaldo in barrio Rio Jueyes of Salinas) and ordinarily they rise less than 650 feet above the alluvial plain.

The three main rivers (Rio Descalabrado, Rio Coamo, and Rio Jueyes) that cut through the ridge, do so at a 90 degree angle to the strike and in narrowed channels. (102, p. 122) There are numerous small wind gaps, the most important being between Cerro Raspaldo and Cerro Modesto in barrio Rio Jueyes of Salinas. (102, p. 120) The wind gaps indicate that stream piracy has captured the streams that cut the gaps.

The limestone ridges provide a convenient source of road metal and could provide material for cement making. (102, p. 224)

5. The Subsequent Valleys. Most of the valleys are independent of the structure and the rocks, although two have cut into slightly softer intrusives. (126, p. 100)

The headwaters of the Rio Plata have cut a valley into a porphyritic intrusion in barrio Carite of Guayama, while the Rio Guamaní has cut into a granitic intrusion in barrio Guamaní of Guayama. (See maps of Geology and Topography.) Elsewhere in the area underlain with Cretaceous sediments, the drainage pattern shows little relation to the geologic structure. The limestones and shales seem to be more resistant than the pyroclastic rocks and the intrusives, but the valleys are not usually oriented to the strike of the formations. An exception is the main valley of the Rio Grande de Patillas, which follows a shale formation although the tributary valleys do not.

The largest of the subsequent valleys (three to five miles across in places) are the Coamo, in the municipio of Coamo, and the Salinas, in the municipio of Salinas; (102, p. 152) both are cut mainly into pyroclastic rocks.

6. The Isolated Hills in the Alluvial Plain. All of these are much lower than the peaks and mountains to the north. The highest, which is on the eastern outskirts of the city of Guayama (no. 8 on the map of Geographic Regions) rises less than 500 feet above the alluvial plain. (All are numbered on the map of Geographic Regions.) Some are remnants of old land projecting through the later sediments; 1. Cerro del Muerto, is a remnant of Oligocene limestone, while 3. Cerro Modesto, 5. Monte Sabater, and 6. Aguirre Hills, are remnants of Cretaceous limestone. Two groups of hills, 8. Unnamed hills near Guayama, and 9. Unnamed hills near Patillas,

are remnants of Cretaceous shales, but the hills numbered 2, 4, and 7 are probably older knobs covered with Quaternary sediments. Most of the hills serve little purpose, but some (7) help impound Lago Melanía, and others (6. Aguirre Hills) provide the site for the settlement of Central Aguirre.

7. The Alluvial Plain. According to Lobeck, (111, p. 239) the alluvial plain is formed of true alluvial fans which merged to form the plain. As evidence, he cites the type of sedimentation and the pronounced seaward slope of the plain which he measured at one to two degrees. (111, p. 352) The elevation varies from 250 feet to sea level and the plain at its widest extent (in Salinas) reaches more than ten miles inland.

Streams crossing the alluvial plain are modified. Some meander in incised flood plains, while others wither away and practically disappear in the porous alluvium. Rio Coamo is a good example of the former and Rio Salinas of the latter. (102, p. 123) The degree of incision of the streams seems to decrease eastward, a fact which may be related to the genesis of the controversial terraces. The streams which show the most prominent intrenchments also show the best developed terraces. (102, p. 123) The Rio Jueyes, which forms the border between Santa Isabel and Salinas, shows three distinct terraces although the lower two are much dissected. The lowest occurs very near the coast and is only a few feet high. The second terrace stands 35 feet high a mile from the coast. The highest terrace is 100 feet higher than the second terrace

two and a half miles from the coast -- at the side of Cerro Raspaldo. (102, p. 119) The flood plain of the Rio Jueyes is so counter sunk across most of the coastal plain that the coastal highway crosses at the sea's edge. (See map of Topography.) Such intrenching of streams favored the construction of three of the four reservoirs of the region on the inside edge of the coastal plain. The counter sunk flood plains show up well on the map of Irrigation System and Land in Sugar Cane 1951 because they are not planted to sugar cane. The terraces have proved useful to inhabitants of the area. Both the cities of Guayama (102, p. 119) and Coamo (111, p. 370) are built on terraces, and the highway from the city of Coamo to Baños de Coamo runs on top of a terrace. (111, p. 351)

The capacity of the underlying rocks to store ground water is of great importance to agriculture in the coastal plain. The pre-Quaternary rocks which underlie the upland do not store much water. Fortunately, the coastal plain is underlain by Quaternary deposits which retain water well. McGuinness, who made a ground water study of the island in 1946, found that the Quaternary sands and gravels of the south coast yielded about 200 million gallons a day to wells. (124, p. 563) There are no figures on the amount of water pumped in Southeast Puerto Rico. The number of pumps shown on the map of Irrigation System and Land in Sugar Cane 1951 gives an idea of the importance of pumping ground water to the area. All but one of the pumps (in northern Santa Isabel) draw water

from Quaternary deposits.

Two mineral springs occur in the Alluvial Plain; the more important is at Baños de Coamo (Coamo Springs) where a health resort has been built to take advantage of the warm waters, and the other is at Virella Spring in Arroyo. (See map of Geographic Regions.) Both seem related to fissures in older rock series underlying the coastal plain deposits. Neither is of any agricultural importance.

8. The Swampy Lands. The Alluvial Plain usually slopes gradually into the sea in a succession of salty and swampy lands and sandy beaches. The only cliff at the water's edge is in barrio Machete of Guayama where there is a 15 to 20 foot drop. The swampy lands can be seen plainly on the map of Topography. They are largest in Salinas and Guayama and smallest in Arroyo where the only mangrove swamp was drained and planted to sugar cane. The salty lands along the shore are useless to the agriculturalist without expensive draining. Wells nearby tend to suck in salt water from the sea if over-pumped.

9. The Sandy Beaches and Sand Bars. These have been discussed previously. The bars are built up by the sea and gradually attached to the mainland, usually through the action of mangroves. Some of the sand bars remain as offshore islands for long periods.

One sand spit, Punta Pozuelo in Guayama, has formed across the mouth of an unfilled Pleistocene bay to form the Bahía de Jobos. (See map of Topography.) Shallow water on shore limited it to small craft until a deepwater pier was

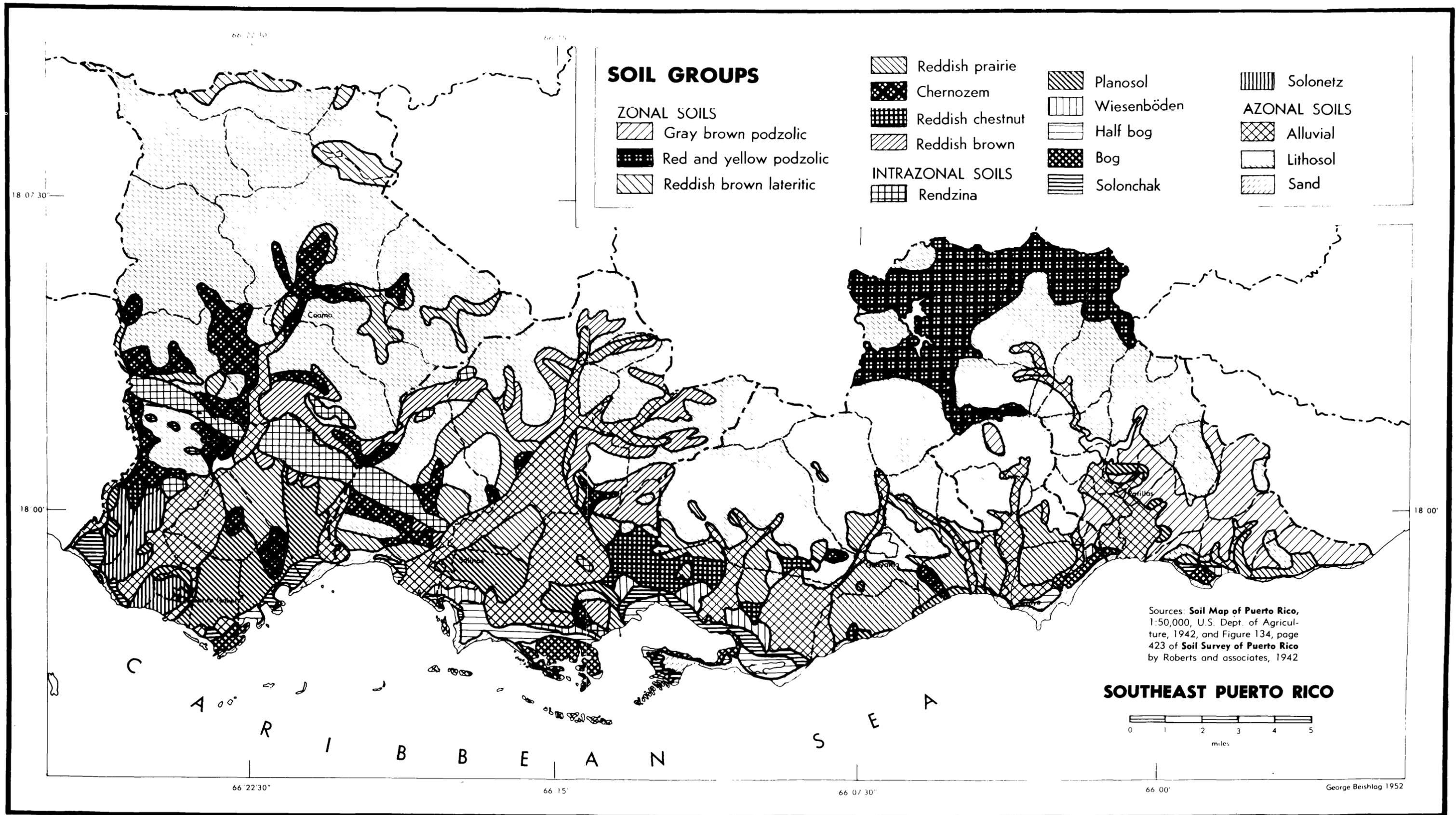
built at Central Aguirre. This is the only sheltered harbor in the area. All the others are open roadsteads.

Soils

For a small area, Southeast Puerto Rico has many types of soils. The attached soil map was simplified from a more complex map made jointly by the U.S. Department of Agriculture and the University of Puerto Rico Agricultural Experiment Station. The 17 groups shown are composed of 111 soil types and phases. (201, p. 421)

Soils are formed from parent rock by the active factors of soil genesis, climate and vegetation, and are of three orders: zonal, intrazonal, and azonal. (See map of Soil Groups.)

Zonal soils are formed from parent material that is not of extreme texture or chemical composition, and that has been in place long enough for the climate and vegetation to have produced a well developed soil. Seven groups of zonal soils are found in Southeast Puerto Rico. Two podzolic soils and one lateritic soil have developed in the upland parts of the area under moist conditions. A gray brown podzolic soil occurs in southern Patillas. A red and yellow podzolic soil covers most of barrio Carite of Guayama and the northern edge of Patillas. A reddish brown lateritic soil occurs in patches in northern Coamo. The remaining zonal soils lie mainly on the coastal plain and were developed under drier conditions. A reddish prairie occurs in patches from Coamo to Arroyo. A



SOIL GROUPS

ZONAL SOILS

-  Gray brown podzolic
-  Red and yellow podzolic
-  Reddish brown lateritic

-  Reddish prairie
-  Chernozem
-  Reddish chestnut
-  Reddish brown

INTRAZONAL SOILS

-  Rendzina

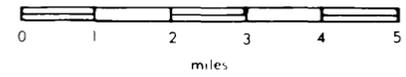
-  Planosol
-  Wiesenböden
-  Half bog
-  Bog
-  Solonchak

AZONAL SOILS

-  Solonetz
-  Alluvial
-  Lithosol
-  Sand

Sources: Soil Map of Puerto Rico, 1:50,000, U.S. Dept. of Agriculture, 1942, and Figure 134, page 423 of Soil Survey of Puerto Rico by Roberts and associates, 1942

SOUTHEAST PUERTO RICO



chernoziem likewise occurs in patches from Coamo to Guayama, although the concentrations are in Coamo, Santa Isabel and Salinas. A reddish chestnut is found mainly in Salinas while a reddish brown is commonest in inland Salinas. The drier zonal soils are among the most useful and productive of the island if water can be brought to them. Unfortunately, they occur not only in the easily irrigated lowland but also in northern patches that are out of reach of irrigation waters.

Intrazonal soils have more or less well developed soil characteristics that reflect the dominating influence of some local factor over the normal effect of climate and vegetation. Such soils are the rendzina formed on the limestone ridges that extend between Santa Isabel and Coamo into Salinas, the planosol which develops a hardpan on flat land under grass in parts of Santa Isabel and Salinas, the wiesenböden, half bog, and bog, which are too wet, and the solonchak and solonetz which are too salty for agriculture. The latter five groups lie along the coast and are influenced by the Caribbean Sea. The azonal soils are without well-developed soil characteristics because they are all too young. An alluvium laid down along the streams is found in all six municipios. Most is valuable soil, but some, like that deposited by the Rio Coamo in Santa Isabel, is gravelly and does not retain water. A lithosol is the commonest soil of the area, as it covers a considerable percentage of the upland in all the municipios except Santa Isabel. It is a sticky clay-like mass that forms on steep slopes and erodes before it can develop zonal char-

acteristics. It is sometimes cultivated on slopes of from 30 to 40 percent. (20, p. 13) A sand which is found along the coast was laid down as bars.

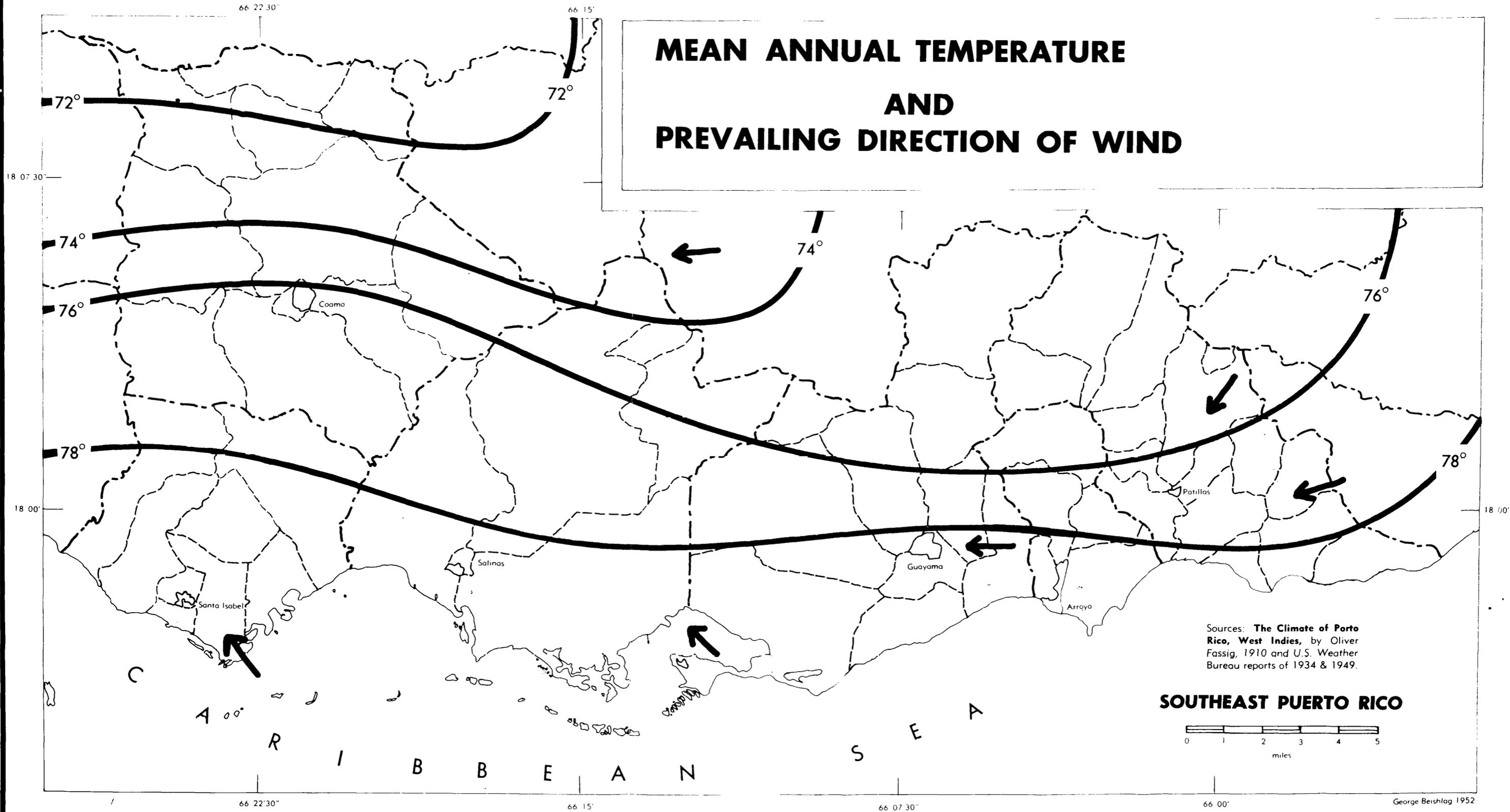
A comparison of the maps of Soil Groups, Geology, Topography, and Irrigation, shows that sugar cane is grown mainly on level land that can be irrigated, on porous soils that lie over rocks that store water well.

Some of the poorer soils have been improved by man. The hardpan layer of the planosol has yielded to deep plowing and some of the wet and salty intrazonal soils have been drained. The occurrence of non-irrigated cane in Patillas and Arroyo is related to the amount of rainfall rather than to the factors just mentioned. (See map of Mean Annual Rainfall.)

Climate

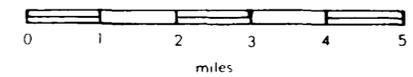
The climate of Puerto Rico is dominated by tropical weather -- by the generally easterly air flow out of the North Atlantic anticyclone, and by the tropical disturbances drifting in that air flow. It is permanently subject to the weather phenomenon of the frontal trough or temperate front that lies between the North Atlantic anticyclone and the upper American anticyclonic cell. (81, p. 105) This frontal trough stays permanently over the West Indies and acts as a potent source of frontal weather. The island is not reached by the cold waves that sometimes move from North America over Florida and Cuba during the winter. The main effects of the southward

MEAN ANNUAL TEMPERATURE AND PREVAILING DIRECTION OF WIND



Sources: **The Climate of Porto Rico, West Indies**, by Oliver Fassig, 1910 and U.S. Weather Bureau reports of 1934 & 1949.

SOUTHEAST PUERTO RICO



migration of the vertical position of the sun are a slightly cooler and a slightly drier winter season.

The small size of the island and the constant north-easterly winds prevent the development of a continental type climate. Air passes over water before reaching Puerto Rico and the moist winds modify the climate to a marine tropical type. The mountainous terrain of Puerto Rico causes orographic rainfall on the windward side of the divide and a rain shadow on the leeward side. This is especially important to Southeast Puerto Rico because most of the region is south of the insular divide.

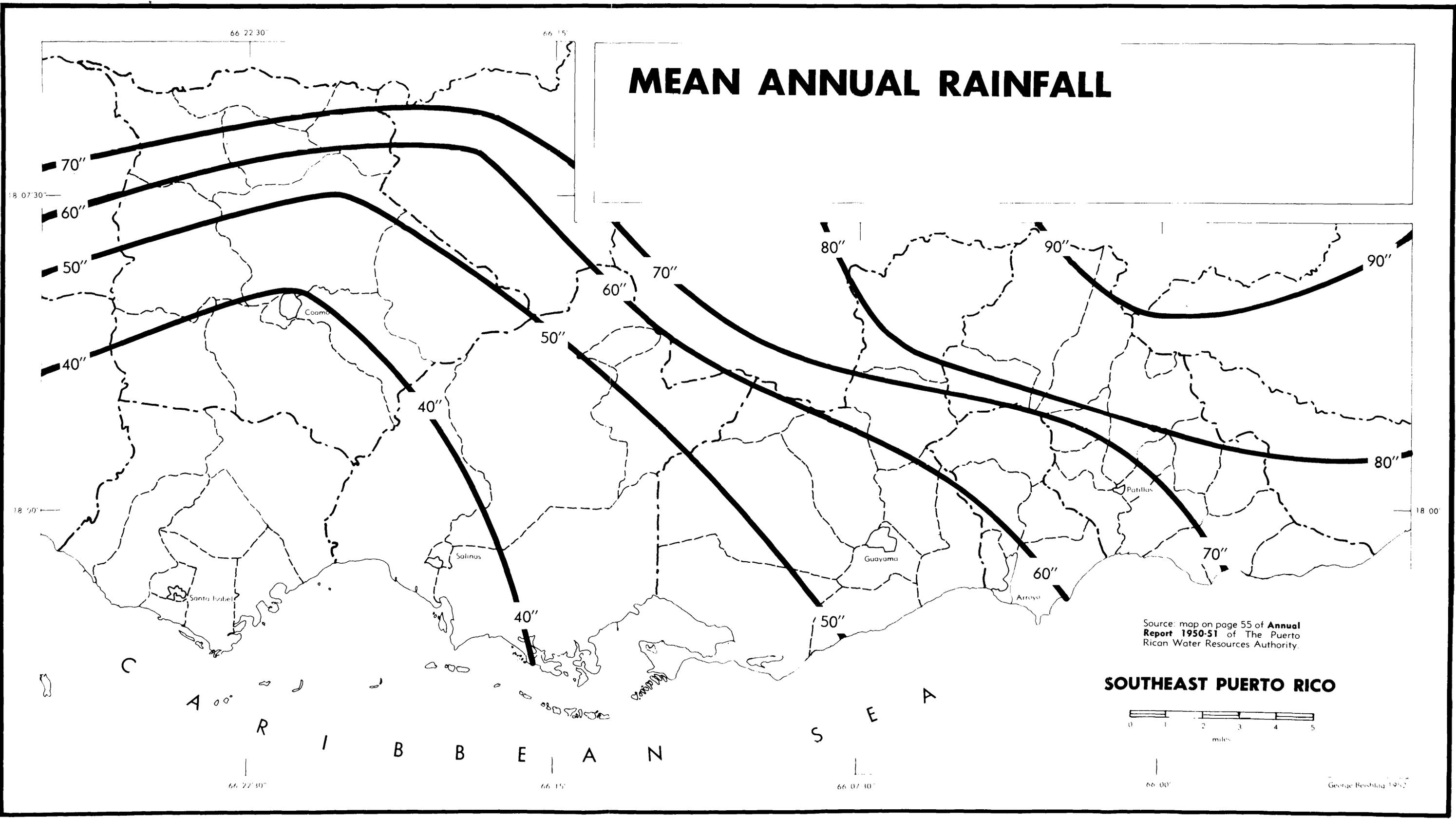
Southeast Puerto Rico, then, has a tropical marine climate with a large part semi-arid. Temperatures vary little throughout the year. Rainfall, on the other hand, varies considerably. The wet and less-wet season regime, common to the island, is so accentuated by the rain shadow that most of Southeast Puerto Rico is semi-arid.

Temperature

The accompanying map of mean annual temperatures shows that the warmest part is nearest the Caribbean with gradually decreasing temperatures going inland. This is undoubtedly due to the effect of elevation. Still cooler temperatures are experienced in the higher parts of the island.

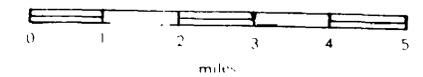
There seems to be a fairly constant difference throughout the year between the temperatures inland and on the coast. At the largest city, Guayama, the annual temperature averages

MEAN ANNUAL RAINFALL



Source: map on page 55 of **Annual Report 1950-51** of The Puerto Rican Water Resources Authority.

SOUTHEAST PUERTO RICO



George Beschlag 1952

79.6°F. During the last 50 years, the extremes recorded were 97°F one September day and 60°F one February night. The mean diurnal temperature range for August, the warmest month, is 13 degrees, with an average daily maximum of 88.3°F and an average daily minimum of 75.3°F. The mean diurnal temperature range for February, the coolest month, is 14.6 degrees, with an average daily maximum of 84.4°F and an average daily minimum of 69.8°F. The average daily range is much greater than the seasonal range, as is usual in tropical climates. (248, p. 13, 14)

The temperatures of Southeast Puerto Rico make a year-round growing season possible. Extremes of temperature are rare. There is never any frost or freezing weather; neither are there the excessively high temperatures common to many continental semi-arid regions.

Rainfall

Rainfall is the critical factor in the climate of Southeast Puerto Rico. The map of Mean Annual Rainfall shows the generalized picture but it must be remembered that average conditions rarely occur. The unpredictability of the rainfall is its most outstanding characteristic.

The critical isohyet is the 70 inch rainfall line; lands receiving 70 inches or more will support humid-type vegetation. Lands receiving less (and most of Southeast Puerto Rico receives much less) will support humid-type vegetation only along water courses or under irrigation. The humid parts are

in northern Coamo, northern Guayama, and most of Patillas. The driest section is Santa Isabel with adjacent parts of Coamo and Salinas.

Rainfall distribution is similar for most locations in Southeast Puerto Rico and can be shown by examining the record for one station. Guayama receives an annual average of 53.46 inches (249, p. 150) distributed as follows:

January	2.46	July	5.08
February	2.09	August	5.35
March	1.79	September	7.13
April	2.04	October	6.85
May	5.91	November	6.03
June	5.66	December	3.06

There is no season in which rain may not fall but there are seven months, May through November, which are rainier, and five months, December through April, which are less rainy. September is the wettest month and March the driest. The dry winter makes cane harvesting easier but also may limit the growing of non-irrigated crops to the summer and fall seasons, nullifying part of the all-year growing season.

The rains of Southeast Puerto Rico are usually heavy but of short duration. The average shower is probably not more than 10 to 12 minutes long, during which time from three to five tenths of an inch of rain may fall. (74, p. 13) Rains occur in Guayama on the average of 66 days a year. (74, p. 14) Days of continual rain are rare and are the result of a tropical hurricane passing close or of a temperate zone storm dipping south into the tropics. Ordinarily the storm comes up quickly, passes almost as quickly, and is

followed by bright sunshine. The character of the soil affects the usefulness of the rain received. Residual soils on Cretaceous rocks are impervious and shed the rain which quickly swells the streams and runs rapidly toward the sea. Soils developed on Quaternary rocks are usually porous and allow the rain to sink in and become ground water. Some such soils are so porous that they dry out too quickly and will support only xerophytic plants.

Storms are apt to be limited in area. The wide-spreading storm, common in temperate zones, is not usual in Southeast Puerto Rico. One spot may be drenched with all streams swollen and unfordable while another spot not so far away may be suffering from drought.*

Sometimes a heavy tropical storm will bring the entire month's supply of rain. If the storm is heavy enough, the rainfall for the month may be above normal. No matter how statistically satisfying such rainfall may be, the result for the farmer is a flood and a drought.

Extremes in rainfall occur with discouraging frequency. In 1897-98 for a period of 13 months not a drop of water fell in Guayama. The Rio Guamaní dried up to its source. (257, p. 229) In 1916 Guayama received a record 69.10 inches of rain; the very next year, 1917, Guayama received only 38.64

* While mapping in Patillas in the rainy season of 1951, the writer was caught three times in one day in tropical rain storms, none of which extended as far as Guayama. At the same time Salinas was suffering from months of continual drought.

inches. In a drier zone, Aguirre in 1900 received 64 inches and in 1907 only 20.60 inches. Perhaps the most surprising statistic on rainfall for all of Southeast Puerto Rico is the 8.10 inches in 24 hours that Coamo received on January 23, 1901. (248, p. 105, 107) January is normally a dry month in Southeast Puerto Rico and Coamo is in the driest zone of all.

The irregularity of the rainfall was a main reason for the construction of the irrigation system which was designed to bring water from the wetter interior regions to the drier coastal plain. An examination of the detailed records of the irrigation service shows that in a ten year period from 1931 through 1940 the rainfall was adequate enough to supply all the irrigation water needed only half the time. In three years irregular rainfall reduced the water in the reservoirs so that water service to planters had to be cut to about 80 percent of their needs while in two years the drought was so severe that service was only 50 percent adequate. (166)

The irrigation service expects a heavy drought about every ten years but the drought of 1939 and 1940 was an unusually heavy one. (166, 1939-40, p. 7, 8)

The effect of the distribution of rainfall is to create two different appearing landscapes during the year. Summer is green and lush with blooming trees; winter is dry and sere with many trees dropping all their leaves. To the winter visitor Southeast Puerto Rico appears like *summer* in southern California; to the summer visitor it looks like *summer* in

southern Florida.

Hurricanes

Hurricanes are a spectacular but relatively uncommon part of the climate of Southeast Puerto Rico. (See Appendix A.) They occur mainly in the months of July to October and move slowly through the Caribbean from east to west. Several occur each year but few hit Puerto Rico. Appendix A lists all the recorded hurricanes that have affected the island. The list is rather complete for the period since the 18th century and includes many hurricanes that did only a moderate amount of damage. Twentieth Century Southeast Puerto Rico suffered mainly from the hurricanes of 1899, 1928, and 1932. For the past twenty years the island has been free of them. This is not to say that one might not occur any year. Because winds of over 100 miles an hour are always found near the center of a hurricane, it is most dangerous to be directly in the path of the storm. Terrific downpours accompany the high winds. The town of Adjuntas (west of Southeast Puerto Rico) was in the center of the path of the 1899 hurricane and received 23 inches of rain in 24 hours. (74, p. 13) The winds and rain wreak havoc on all crops. No protection is possible. Different crops recover from hurricanes at different rates. Sugar cane and tobacco can recover in one year but coconuts and coffee must wait several years for new trees to come to bearing age.

Wind and Humidity

The normal winds of the island are the northeast trades which blow almost continually at about 11 miles an hour, increasing to 13 miles in July and dropping to 8 or 9 in October. (248, p. 17) Because of the relation of Southeast Puerto Rico to the insular divide, the winds are deflected from true northeast to become east or even southeast winds. They blow none-the-less steadily. The continuous breeze makes the constantly high humidity a bit more endurable for the inhabitants of Southeast Puerto Rico but joins with the large amount of insolation received in drying out the soil during times of low rainfall. The high humidity, on the other hand, frequently is condensed as heavy dew in the night and early morning and compensates somewhat for the lack of rain. The high humidity also acts as a blanket at night and prevents the large and rapid fall of temperature so typical in semi-arid regions in the temperate zones. (74, p. 15)

Sunshine

Cloudy and partly cloudy days are not common in Southeast Puerto Rico. As has been previously stated, rainstorms are sudden and transitory. Rainy days usually have a large percentage of sunshine. The intense tropical insolation received does its part toward making the region semi-arid.

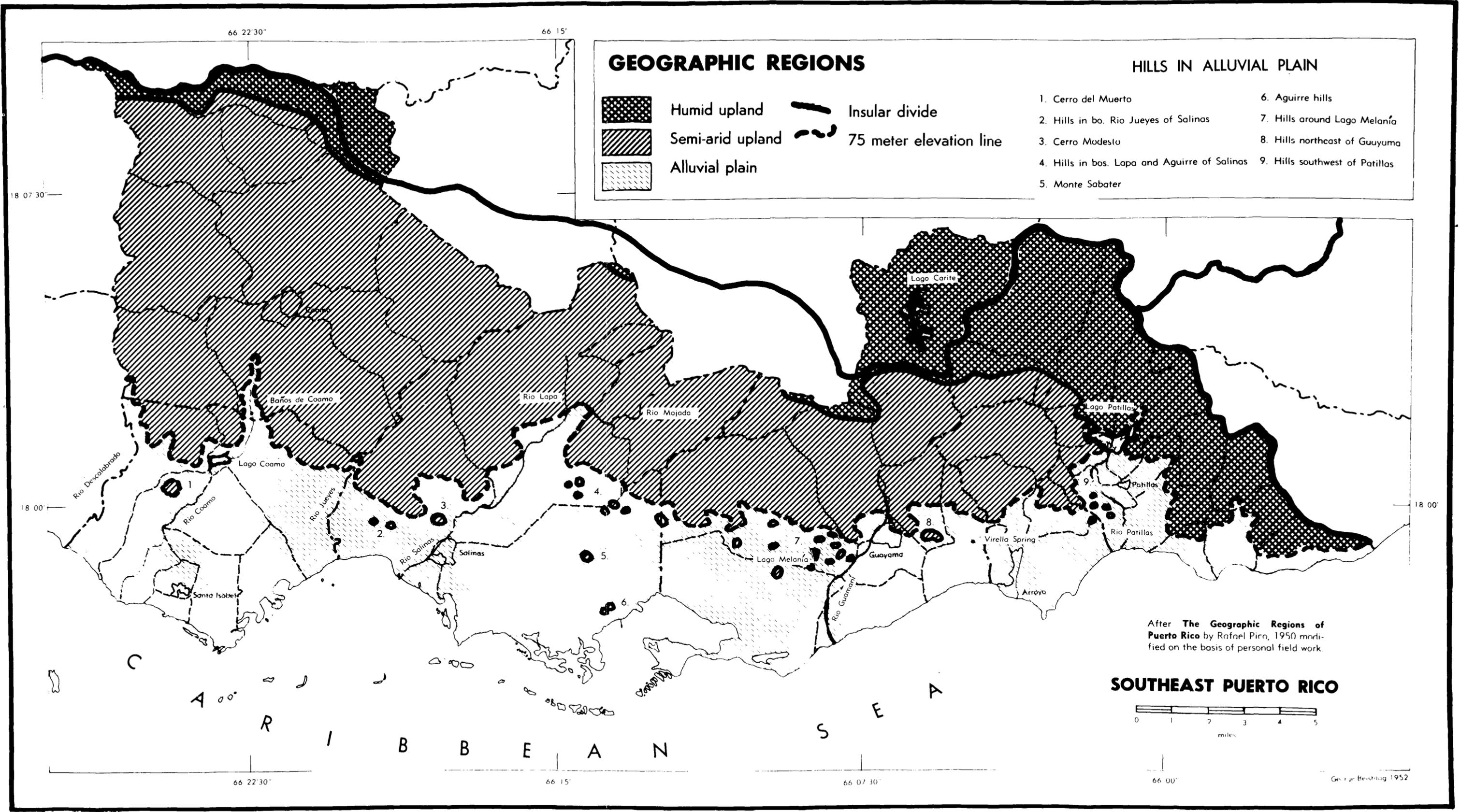
Geographic Regions

The Geographic Regions of Puerto Rico have been generally delimited by Picó. (150) The map of Geographic Regions is based on that previous work although the boundaries differ somewhat. The main reasons for the differences are the larger scale of the attached map over that of Picó's map (150, p. 2) and the more detailed information available because of the mapping done for the Rural Land Classification Survey.

Southeast Puerto Rico does not lie wholly in any one geographic region, nor does it entirely contain any geographic region. Parts of three geographic regions cross Southeast Puerto Rico roughly from west to east. These three regions are labeled by Picó; the Dry Southern Coastal Lowlands (The Ponce-Patillas Alluvial Plain Section), the Semi-Arid Southern Foothills, and the Humid East Central Mountains.

The Ponce-Patillas Alluvial Plain extends from the Caribbean Sea inland to about the 250 foot contour line, according to Picó. (150, p. 116) This delimitation was followed on the attached map with the slight change that the 75 meter contour line was substituted as being more convenient. The elevations are nearly the same.

The alluvial plain is economically the most important geographic region of Southeast Puerto Rico. It contains all of the irrigated sugar cane lands and three of the four artificial lakes that supply the irrigation water. It is normally the driest and the warmest of all the three regions.



GEOGRAPHIC REGIONS

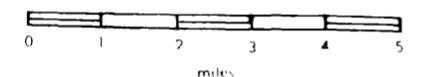
-  Humid upland
-  Semi-arid upland
-  Alluvial plain
-  Insular divide
-  75 meter elevation line

HILLS IN ALLUVIAL PLAIN

- 1. Cerro del Muerto
- 2. Hills in bo. Rio Jueyes of Salinas
- 3. Cerro Modesto
- 4. Hills in bos. Lapa and Aguirre of Salinas
- 5. Monte Sabater
- 6. Aguirre hills
- 7. Hills around Lago Melania
- 8. Hills northeast of Guayama
- 9. Hills southwest of Patillas

After **The Geographic Regions of Puerto Rico** by Rafael Pico, 1950 modified on the basis of personal field work

SOUTHEAST PUERTO RICO



(See rainfall and temperature maps.)

The second geographic region north of the Caribbean is the Semi-Arid Southern Foothills which extends north from the Ponce-Patillas Plain until it meets the more moist Humid East Central Mountains Region. The boundary between these two regions is set by Picó as a vegetation line rather than a topographic line. (150, p. 116) The beginning of a humid climate, as evidenced by luxuriant vegetation, marks the dividing line.

The Semi-Arid Southern Foothills are at present out of reach of irrigation waters. If the proposed irrigation project for the Coamo Valley is adopted, (See irrigation map) water may be brought to some of the excellent soils in southern Coamo.

The third geographic region is the Humid East Central Mountains, a large region of which only a small portion is in Southeast Puerto Rico. The southern border as delimited on the attached map differs considerably from Picó's more generalized version. Because the border is related to the insular divide, the line of the divide has been traced on the map. Part of barrio Pulguillas of Coamo and all of barrio Carite of Guayama lie north of the divide. A branch of the insular divide follows the border of Patillas to the sea.

The divide is not very high, varying from 1,600 to 3,000 feet. Because the moisture-laden winds come from the northeast, all land north of the divide receives sufficient rain-

fall to support humid mountain vegetation. Some of the moisture is carried a bit south of the divide extending the humid belt onto the down slope. Delimiting the southern edge is quite a task inasmuch as the forest vegetation which would provide a clue has been cut in most cases. Picó set the 70 inch rainfall line as the southern border. (150, p. 118) The line on the map was drawn on the basis of the occurrence of coffee since coffee needs at least 70 inches of rain annually. (196, p. 139) The southern border of the attached map coincides very well with Picó's line in Coamo but disagrees in Guayama, Arroyo, and Patillas, putting rather less land in the humid zone in Guayama, and Arroyo, and rather more in Patillas. The line, as currently drawn, roughly coincides with the 70 inch rainfall line on the Mean Annual Rainfall Map.

The humid lands of Coamo, Salinas, and Guayama produce coffee, oranges, bananas, and plantains. The humid part of Patillas is thickly settled with subsistence farmers who raise mainly food crops. Part of northern Patillas (as well as part of northern Guayama) has been taken over by the Insular Government as a forest preserve, although the project is more reforestation than preservation of forests. (See Map of Land Withdrawn from Private Ownership.)

CHAPTER III

LAND USE UNDER THE INDIANS ABOUT 1500

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CHAPTER III

LAND USE UNDER THE INDIANS ABOUT 1500

When white men first came to the island of Puerto Rico, they found Indians living there who practiced agriculture and knew how to make long journeys in seaworthy canoes. (33, Vol. III, p. 235) Fewkes believes that the Indians were not native to the island but had come from South America around 500 A.D., probably from the general region of Venezuela, bringing their cultivated crops with them (77, p. 217)

Although the island was first sighted by white men in 1493 on Columbus' second voyage, the first extensive description of the Puerto Rican Indians was not written until 1776 by Fray Inigo Abbad y Lasierra. (10) By that time, the Indians had practically disappeared. The two principal sources for Abbad's work, the writings of Las Casas between 1547 and 1566 (33) and of Oviedo y Valdes between 1535 and 1557 (146) were by men who had seen and known the Indians and Indian culture in various parts of the New World but who wrote little specifically about Puerto Rican Indians.

Early accounts of white men's settlements give little insight into Indian land use. Such accounts cover only the northeast and southwest parts of the island. The eastern and southern sections were not settled by whites until the 17th century but became places of refuge for Indians from other parts of the island who fled from Spanish slavery.

The Indian Population

The Borinquen* Indians, who occupied the entire island, were a peaceful group who welcomed the Spaniards although they were used to fighting off attacks of enemy Caribs from other islands. It is not known how many Indians were on the island in 1500. Neither Las Casas (33) nor Oviedo y Valdes (146) made estimates, and subsequent guesses vary from 18,000 to 600,000. Coll y Toste, a 20th century Puerto Rican historian, thought that 60,000 was a fair estimate. (46, p. 92). A considered guess would be that there were only a few hundred Indians in Southeast Puerto Rico in 1500.

Two shell heaps intermixed with bird bones give archaeological evidence of Indian settlements which may or may not have been extant in 1500. One is on the coast near the present-day town of Salinas and the other is inland on the left bank of the Coamo River not far from the Baños de Coamo. (77, p. 86) The latter was undoubtedly located so far inland because of the mineral spring there. Another Indian settlement may have been located at Virella Spring, a hot spring in the municipio of Arroyo. All three localities are shown on the Map of Land Use about 1500.

* Bo means "man" or "master"; Ri means "valor" or "force"; the prefix N means "of them"; the root Que signifies the "earth"; and N is the final sign of the plural. Borinquen with the stress on the i would mean "land of the valiant masters" or the "fatherland of powerful men". (77, p. 78)

Cultivated Plants
(See also Appendix B)

The food crops raised were mainly roots like manioc (yuca), from which they derived their bread, and taniel (yautía) which they boiled and ate, although corn (maíz), pineapple (piña), peanut (maní), and red pepper (ají picante) were also planted. The most important of the food crops were yuca and yautía. Minor food crops are listed in Appendix B.

Non-food crops were tobacco (tabaco), raised for religious use, and cotton (algodón), which was woven into clothes and hammocks.

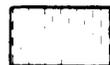
Growing crops was a woman's task, although the men cleared the temporary patches, usually by burning off the trees. The only farming tool was a sharpened stick or coa. There was neither a plow nor a domestic animal to pull one. It is doubtful whether any cultivation of the crops was done. The clearings were probably out of sight of enemy Indians who might be paddling by, but were located near the coast along streams, occasionally penetrating back into the higher land. The Indians were largely clustered near navigable water, which would locate most of the agricultural patches not far from the sea. None of the rivers of the area are navigable.

Wild Plants
(See Appendix B)

A number of plants, mostly trees, growing naturally on

LAND USE ABOUT 1500

CROPS

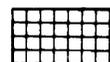


Area of shifting
agriculture

POTENTIAL PASTURE



Natural grassland



Salty scrub

FORESTS



Rain forest



Savanna forest



Mangrove forest

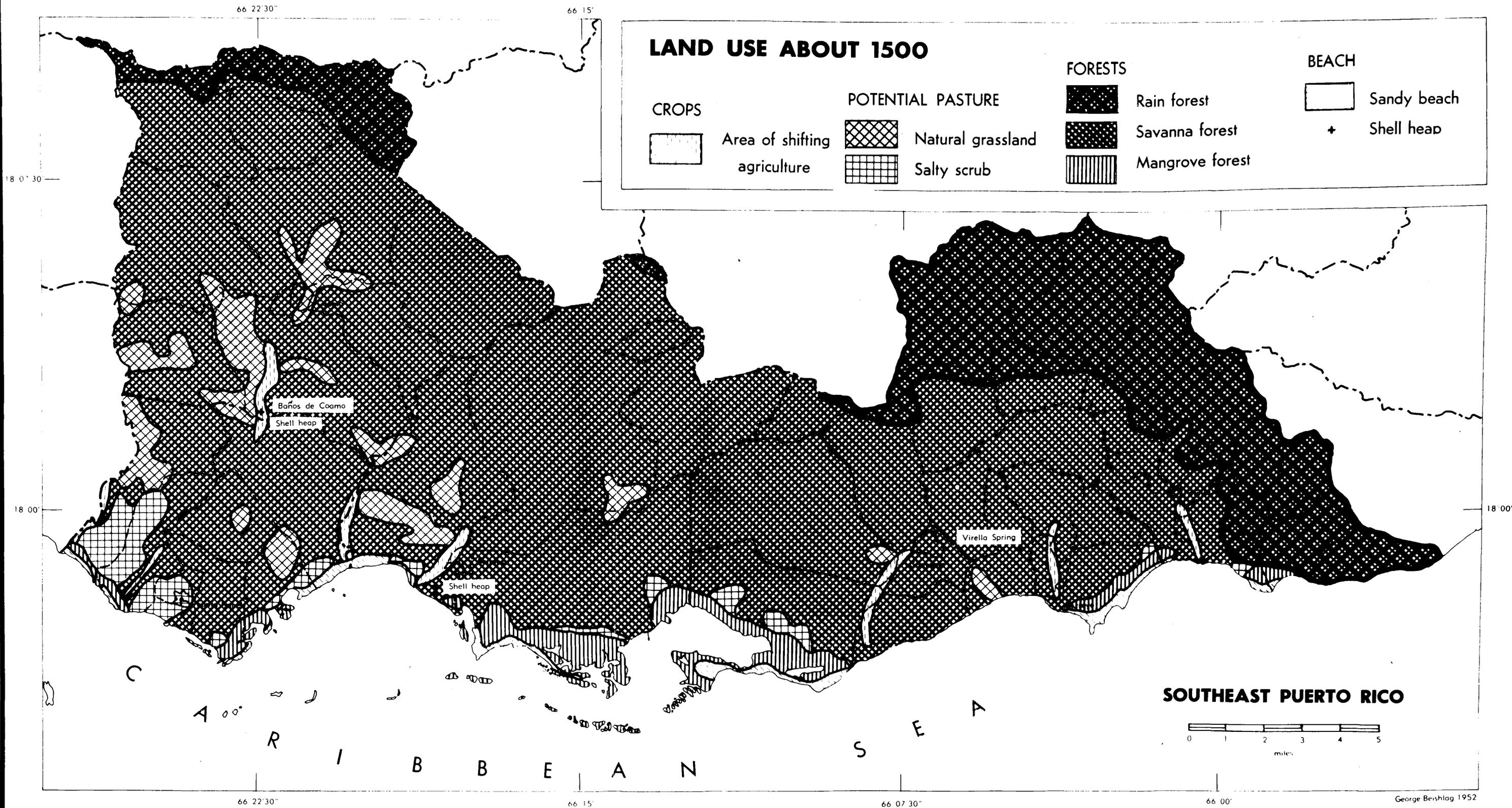
BEACH



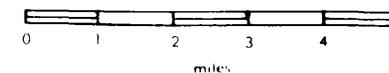
Sandy beach



Shell heap



SOUTHEAST PUERTO RICO



the island, provided fruits to supplement their diets, stains to paint their bodies, calabashes to use for utensils or water bottles, fibers for cordage, and materials for houses, canoes, and weapons. Fortunately, all these plants grew in the semi-arid lowlands or in the river valleys and were readily accessible to the Indians. To this day, such plants are extensively utilized. Most are still left to grow wild in the countryside, although two, annatto (achiote) and papaya (lechosa), are frequently planted in the dooryards of the country huts (bohíos).

Animals

No land at all was devoted to the raising of animals, even though the lowland savanna country was a natural grazing area. The only domesticated animal was the dog, which was described by Oviedo as similar to the dog of Spain except that it did not bark. (146, Vol. III, p. 61) There were no domestic fowls, although small birds were sometimes kept captive for their colorful plumage.

Several wild animals were hunted for food. The prize take was the manatee or sea cow (manatí) which browsed in the shallow waters along the Caribbean shore. It was shot by an arrow equipped with a long cord and a float, much as whales are harpooned. The favorite game was the hutia (hutia), a rodent weighing from 10 to 15 pounds. Other animals taken for food were the lizards, particularly the iguana, turtles, birds, and a variety of sea foods; crabs, lobsters, mollusks,

and many kinds of fish. Many of the animals were caught along the shore and it is probable that most of the fishing was done by casting nets in the surf, although some fishing may have been done with bow and arrow.

Transportation

Travel was mainly by canoe on the Caribbean, the Indians being able to paddle their canoes to nearby islands. Travel to the interior was by unimproved foot paths. There were no pack animal trails because there were no pack animals.

Land Use About 1500

A description of the land use during Indian times must be based on inference and conjecture. The following description is made of small bits of information from a variety of sources, interpreted in the light of knowledge gained from a first hand reconnaissance of the area. Southeast Puerto Rico under the Indians was largely in natural vegetation, although the types varied. (See Map of Land Use About 1500) Along the coast were discontinuous mangrove forests broken here and there by sandy beaches or small cliffs. Mangrove islands lay off shore. Natural salt drying pans were located along the coast of what is now municipio Salinas. Patches of salty scrub lay back of most of the mangrove forests. The level land to the north was covered with a savanna forest of widely spaced trees and occasional thorn or brush forests. A thicker gallery

forest grew along the streams. Some open treeless stretches, called sabanas by the Indians occurred here and there. The first hills and mountains were also covered with savanna forest. Bare rock occasionally showed through the shallow soil. Farther inland, the highest mountains were covered with a true rain forest, particularly in what is now the municipio of Patillas. This rain forest continued over the crest of the divide and joined the larger rain forest on the northern side.

The areas of shifting agriculture shown are along the lower courses of rivers. Probably no land was in permanent cultivation, crops being moved when the land became exhausted.

Summary

The pre-Columbian Indian population of Southeast Puerto Rico was sparse, and the land was largely in natural vegetation. The few crops raised were for subsistence or local use; small patches of land were cleared, cropped, and then allowed to revert to natural vegetation when the fertility became exhausted. Domestic animals, except the dog, were lacking. Travel was on foot on land and by canoe on the sea. The only outside influences were raids by Indians from nearby islands; local affairs were handled by the tribal chief.

CHAPTER IV

LAND USE UNDER THE SPANISH 1508 TO 1776

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CHAPTER IV

LAND USE UNDER THE SPANISH 1508 TO 1776

Historically the period of Spanish sovereignty extended from the early years of the 16th century until the last of the 19th century. For convenience, the Spanish period has been divided into two periods; 1508 to 1776, and 1777 to 1898. The time before 1776 lacks documentation. The first census of any kind was in 1765.

The Population

Southeast Puerto Rico was not one of the areas of early Spanish settlement. One of the first references to settlement there simply mentions that a French privateer made an attack on Guayama* in 1541. (252, p. 110)

The first Spanish village in Southeast Puerto Rico was in the municipio of Coamo† some distance from the coast. In

* Guayama as a place name refers both to the city and to the surrounding area. In the earliest days, the area of Guayama included the present-day municipios of Arroyo and Patillas. It is probable that the raid was made on the site of the present harbor of Arroyo, which was known as the harbor of Guayama in early days. In any case, the settlement raided was small. The present city of Guayama did not become a town (pueblo) until 1736. (9, p. 216)

† The village in the municipio of Coamo was undoubtedly on the site of the present city of Coamo. Settlement would logically be made there along the Coamo River.

1580 it was reported that there were 170 vecinos (heads of families) in the capital, San Juan, 40 vecinos in San Germán, the second city, which was located in the southwest, and 20 vecinos at Coamo, (47, p. 26) which would make Coamo the third settlement in size on the island in 1580.

Because the history of early Spanish rule in Southeast Puerto Rico cannot be separated from the history of the entire island, the story of the disappearance of the Indians, the introduction of Negroes, the increase in the white population, and the introduction of new species of plants and animals will be discussed for the island as a whole.

Disappearance of the Indians. When the Spaniards first came to the island, they had one idea in mind -- to get gold. Some of the early explorers had noticed the gold disk worn around the neck by caciques, (chiefs) and reasoned from that evidence that the island was rich in gold -- which proved not to be the case. Rather foolishly, some of the caciques showed the Spaniards where to search for gold in the various streams. (33, Vol. III, p. 236) This generous gesture probably led to the extinction of the Indian race because the Spaniards proceeded to enslave the Indians and make them mine gold. In 1509 the system of repartimientos was borrowed from the nearby island of Hispaniola. This consisted of distributing land and Indians among the officials and colonists. The first repartimiento assigned 1,160 Indians to nine individuals. A second repartimiento in 1511 assigned 4,040 Indians to sixty

individuals. (252, p. 45) The terms of the division required the Spaniards to pay the Indians for their labor and to teach them the Christian religion, but the Indians were soon treated as common slaves.

There were many reasons for the decline of the Indian population. Many who were mining gold died of poor working conditions. Others fell before the white men's diseases of measles and small pox. (252, p. 89) A number were killed in the unsuccessful Indian revolt of 1511. A hurricane in 1515 caused many deaths by sickness and starvation. Other Indians committed suicide or fled to nearby islands.

The Spanish soon began to worry about the reduction in numbers of Indians. In 1543 an Order in Council ordained that all Indians alive in Cuba, Hispaniola, and Puerto Rico were as free as the Spaniards themselves and that they should be permitted to loiter and be idle, "that they might increase and multiply". (252, p. 89) Bishop Rodrigo Bastidas, who was to carry out this order in Puerto Rico, found 80 Indians to liberate. Later, in 1582, Presbyter Ponce de Leon and Bachelor-at-Law Santa Clara in a communication to the authorities wrote, "...today there is not one left, excepting 12 or 15, who have been brought from the continent...the few remaining In the country are scattered here and there among the Spaniards on their little plantations. Some serve as soldiers. They do not speak their Indian language, because they are mostly born on the island, and they are good Christians." This is the last written communication about the

Borinquen Indians. (252, p. 90)

One factor in the extinction of the Borinquen Indians was the mixing of blood streams practiced by the Spaniards wherever they colonized. A different mixture, that of Indian and Negro, resulted from the importation of male African slaves. The Indians as a race may have disappeared in the late 1500's but there is still much evidence of their blood in the straight hair and Indian features of many of the country people. One Puerto Rican historical authority, Dr Cayetano Coll y Toste, believed that much Indian blood remained on the island in the 20th century. (45, p. 127)

The disappearance of the Indian race as a race did not mean the disappearance of all of the Indian culture. The Indian hut (bohío) remains the standard dwelling of the peasant (jíbaro), the hammock (hamáca) is the bed of the poor, and the cultivated crops of the Indians, especially tobacco (tabaco), corn (maíz), and tanier (yautía) are still raised.

The gold-hunting period which had started the destruction of the race came to a close in a little over twenty-five years. According to official statistics, the Spanish Crown received 2,700 pounds of Puerto Rican gold between 1509 and 1536. Most of the gold came from the northeastern part of the island but it is a matter of record that some gold grains or nuggets were found in Coamo, (240, p. 33) which may account for Coamo being the first urban settlement in Southeast Puerto Rico.

Growth of the Negro Population. Negroes from Africa were introduced into Puerto Rico two years after Spanish colonization. The first Negroes who came to the island were house slaves brought by Micer Gerón, an iron smelter from Brussels, under the provisions of the cédula real (royal letters patent) of 1510. The two Africans were brought directly to Caparra (now part of San Juan) from Spain where they had been purchased at a market in Sevilla (45, p. 138). Sr. Gerón was permitted to bring them in only after he swore that they were for his own personal service. Two years later, in 1512, a Sr. Sedeño brought in two more Negroes under similar circumstances. (252, p. 92)

The general introduction of African slaves into the Antilles was authorized in 1513, and by 1531 over 1,500 Negro slaves had been imported into Puerto Rico. To control the smuggling of Negroes, those imported legally were branded with a hot iron -- the carimbo. Any slave not so branded could be confiscated and sold at public auction. (240, p. 46) Branding was not abolished until 1784. (130, p. 48)

Still the island remained sparsely populated. In 1534 Governor Lando informed the Emperor that in the only two towns on the island at that time, San Juan and San Germán, there were "very few Spaniards and only 6 Negroes in each". (252, p. 93) Evidently most of the Negroes had been taken out into the country and put to work on plantations.

Two facts stand out regarding the Negroes in Puerto Rico. First, they have usually been docile workers, and second, the free

Negroes in the population soon outnumbered the slaves. The only record of any slave insurrection is a small uprising in 1527 which was quickly put down. (60, Vol. II, p. 318) At that time there were few Negroes on the island. The number of free Negroes increased because the Spanish slave system allowed more chance for the Negroes to obtain their freedom than did the English or French systems. The possibility of becoming free had much to do with the docility of the Negroes in Puerto Rico. By 1776 there were 44,446 free persons of color (pardos libres*, negros libres, and agregados) and 6,487 slaves on the island. (10, p. 286-7)

Most of the slaves were brought from Africa to the coastal lands of the island to work on the plantations that developed there. To this day, the incidence of blacks is higher on the coast than in the interior. This despite the fact that many Negroes, Indians, and poor whites fled to the mountains and there became the ancestors of the present-day jíbaros.†

* The word pardos in the term pardos libres means "dark" or "colored" and implies that the persons listed are not pure blooded Negroes. The pardo class soon became much larger than the Negro class.

* The word jíbaro is usually translated as "farmer" in English, but a better translation is "peasant". The usual Spanish word for "farmer" is campesino which does not carry the derogatory connotations of jíbaro.

Increase of the Whites. The early whites who came to the island were of two distinct types; adventurers seeking their fortunes, and pardoned criminals exiled from Spain. The early governors were more like military governors than civil ones. Spain was interested in colonies that would return a profit to the mother country. Puerto Rico, unfortunately, was the smallest of the Greater Antilles, and it was constantly overshadowed by Cuba and Hispaniola. Furthermore, Puerto Rico early developed the reputation of being a "poor" colony. For the first 300 years of its existence, the colony was used mainly as a place of banishment for malefactors from Spain. (79, p. 1)

Among the first whites who came to the island after Columbus stopped in 1493, was Vicente Yañez Pinzón, who visited the island in 1499 and returned in 1505 with Martín García de Zalazar but did nothing more than land a few goats and pigs at Aguada on the west coast. (41, p. 247) No attempts at settlement were made until 1508 when Juan Ponce got permission from the Governor of Hispaniola to search for gold. He first landed with 50 men on the southwest coast at the Bay of Guanica on August 12, 1508 but made his permanent settlement at San Juan which became and remains the most important center on the island.

The fortune-hunting whites contributed little to the island except their mixed blood descendants. The banished whites led agricultural lives, raising barely enough for their own needs. Several times there was danger of the island

becoming depopulated of its whites. At the time of the Indian rebellion in 1511, there were about 200 Spaniards; between 80 and 100 were killed by the Indians. By 1515 the white population had increased to around 400. (252, p. 64) On February 27, 1534, Governor Lando wrote to the emperor, "Two months ago there came a ship here from Peru to buy horses. The captain related such wonderful things that the people here San Juan and in San Germán became excited, and even the oldest settlers wanted to leave. If I had not instantly ordered him away the island would have been deserted. I have imposed the death penalty on whosoever shall attempt to leave the island". (252, p. 91)

It was 1765 before the first census of the island was made by General O'Reilly (144) who reported that there were only 44,883 persons on the entire island; 39,846 were free men, women and children of all colors, and 5,037 were slaves. There is no way of determining how many of the free people would be classified as white, but it was probably less than half.*

* In this connection it is well to remember that the color classifications for races in use in Puerto Rico differ from those in use in the United States. In the United States, a person is classified as a Negro if he has any provable Negro blood no matter how white he appears. In Puerto Rico a person may be called white who has obvious Negroid features or tint of skin, or even an Indian cast of countenance. Many times, the possession of straight hair is enough to classify a person as white.

The entire matter of mixed blood remains an interesting subject to anyone investigating Puerto Rico. Segregation has played no part in the social pattern of Puerto Rico. From the earliest times, whites and blacks have worked together in the fields. That is not to say that the early hidalgos* like Juan Ponce de Leon did any common labor. It was the white men of pardoned criminal stock, which had arrived as early as 1515, (252, p. 64) who worked in the fields alongside of the free Negroes. Official notice of this lack of racial feeling was taken in the report of General O'Reilly to the king in 1765 when he wrote, "...the whites show no reluctance at being mixed up with the colored population.....There is little distinction among the people". (252, p. 147)

Spanish society in Puerto Rico was based on a small propertied class and a large peon laboring class. The owning class was originally all white but became diluted with mixed bloods as half-breed descendants of whites inherited property. The peon class always had both pure and mixed bloods. Progression from one class to another could be made

* Hidalgo is literally hijo de algo or "son of something". (252, p. 5) An hidalgo was usually a land owner or a person of property. Some were originally adventurers and treasure seekers like Juan Ponce de Leon, the founder of Puerto Rico, a poor hidalgo and native of Santervas de Campo in the kingdom of Leon, who came to the island to seek his fortune after serving in the Moorish wars. (240, p. 37)

only as property was acquired. Social discrimination was more by class than by color, although the old Spaniard, who would openly keep a succession of colored mistresses and sire a number of mixed offspring, usually preferred his high society to be as pure white as possible.

The 1765 census gives the first available figures for the population of Southeast Puerto Rico. At that time the territory of the present six municipios was included in only two political divisions; Coamo and Guayama*.

The figures are as follows: (10, p. 298)

	Coamo	Guayama	SEPR	Island total
<u>blancos, pardos y</u> <u>morenos libres</u> (free whites, colored and browns)	1,789	1,957	3,746	39,846
<u>esclavos (slaves)</u>	<u>400</u>	<u>447</u>	<u>847</u>	<u>5,037</u>
total population	2,189	2,404	4,593	44,883

Although the figures of O'Reilly are not to be considered reliable, (there being too many chances for error in taking a census on an island devoid of roads, for one thing) they do indicate that Southeast Puerto Rico, like the rest of the island, was sparsely populated, but that the ratio of freemen to slaves was lower in the southeast, being approximately four free to one slave, while in the island as a whole, it was nearly eight free to one slave. The relatively larger number of slaves in the southeast was probably the result of the growing number of plantations in the area.

* In 1765 Coamo included the present municipios of Coamo, Santa Isabel, and Salinas. Guayama, in like manner, included the present municipios of Guayama, Arroyo, and Patillas.

The first detailed figures that give a population breakdown by color are those of Fray Inigo Abbad y Lasierra for the year 1776. (10, p. 286-7) According to him the population picture was as follows:

	Coamo	Guayama	SEPR	%	Island	%
<u>blancos</u> <u>(whites)</u>	1,282	1,064	2,346	24	29,263	37
<u>pardos libres</u> <u>(Free colored)</u>	2,894	3,170	6,064	61	33,808	43
<u>negros libres</u> <u>(Free Negroes)</u>	40	124	164	2	2,803	3
<u>agregados*</u>	<u>117</u>	<u>251</u>	<u>368</u>	<u>3</u>	<u>7,835</u>	<u>9</u>
total free	4,317#	4,589#	8,906#		70,260#	
<u>esclavos (slaves)</u>	<u>474</u>	<u>511</u>	<u>985</u>	<u>10</u>	<u>6,487</u>	<u>8</u>
total population	4,791#	5,100#	9,891#	100%	76,747#	100%

* An agregado (there is no English equivalent; the nearest is "squatter") is a sort of serf who lives on the master's land under certain obligations to the master. Technically, he is a free man. Most agregados are of mixed blood.

Puerto Rican census figures of this time gave two totals; one of hecho (de facto) and the other of derecho (de jure). Hecho figures (marked thus #) were of those actually present when counted. Derecho figures (unmarked) include those belonging but not present when counted. Using derecho figures for the breakdown and hecho figures for the totals means that the totals are in all cases less than those that would be obtained by adding the columns of figures.

Abbad's total population figure for Southeast Puerto Rico is double that of O'Reylly. It is probable that there was no such increase in only 11 years, but that Abbad's figures are a bit more accurate than O'Reylly's.

Several interesting comparisons can be made on the basis of the 1776 figures. As in 1765 there was a larger proportion of slaves to free population in Southeast Puerto Rico than was usual on the island. The free whites were vastly outnumbered by the free colored groups in Southeast Puerto Rico while they were only slightly outnumbered in the island as a whole. Perhaps the most telling comparison is in the number of agregados and slaves. Agregados outnumbered slaves in the island average but were outnumbered almost three to one in Southeast Puerto Rico. This probably implies that free labor as a whole was beginning to supplant slave labor throughout the island but that slave labor was still holding its own in competition with free in Southeast Puerto Rico at this time. This was because Southeast Puerto Rico was developing into a cane-growing region.

Introduction of New Plants (See also Appendix C.)

The flora of the tropics is similar throughout the world, although botanists say that many plants are not indigenous to the entire zone. A man from Thailand, seeing some colored pictures of Puerto Rico, remarked on how similar Puerto Rico appeared to his homeland and proceeded to name the plants in

the pictures that also grew in Thailand. Some of those plants were native to Asia, others to Africa.

The visitor to Puerto Rico in May and June will see the flame tree or royal poinciana, (flamboyan), *Delonix regia*, ablaze along the roadsides; he will notice the fan-shaped traveler's tree, (palma de abanico), *Ravanela Madagascariensis*, and the filmy-branched Australian pine, (pino australiano), *Casuarina equisetifolia*, decorating the dooryards and plazas. He cannot fail to see the bamboo, (bambú), *Bamos* spp., standing in thickets along the water courses. He may be surprised to find out that the first two are natives of Madagascar, the third of Australia, and the last of Asia. He will also recognize many garden flowers that are native to Europe or America. He may begin to wonder what, if anything, is indigenous.

Beginning in the 16th century, there seems to have been a concerted effort on the part of the European Empires to distribute useful plants throughout their New World tropical possessions. Food plants were introduced to help the new colonies to feed themselves, and commercial crops were introduced to produce export crops for the mother country. The new empty lands, which never knew ice and snow, were to be covered with plantations, producing crops all the year round. The hopes were not entirely realized. Many of the imported plants failed to grow well in the New World tropics; a few succeeded beyond all expectations.

The Spaniards were leaders in the introduction of food

crops. In the first quarter of the 16th century, King Ferdinand ordered the establishment of what may have been the world's first tropical horticultural station on the Plata River not more than 15 miles west of San Juan (18, p. 248) The farm, known as Los Reyes Catolicos, was for the acclimation of new plants. Although it pioneered in the introduction of new plants, it did not survive the death of the first superintendent. (41, p. 241)

Puerto Rico received its share of new species, some directly from Europe, Africa, Asia, or America. Others were brought via Hispaniola, Cuba, Trinidad, Martinique, or other parts of America, having previously been received from the Old World.

The scope of the present study precludes an investigation of all species introduced into the island. There are two large groups totally ignored; the decorative plants, and those escapes from civilization that are growing undisturbed and unused in the roadsides and waste lands of the island. The plants included are those that are useful to the populace in one way or another. Even this listing cannot be complete. It is obviously impossible to ascertain all the plants that were brought in and did not survive. Unless someone wrote down a record, there is no way of knowing whether such and such a plant ever reached the island from abroad.

Early Export Crops. (See also Appendix C.) In the 1500's four imported plants, purging cassia (cañafístola), tumeric (cúrcuma), ginger (jengibre), and indigo (añil), made up the

export crops of the island. The trade in them was always small, and ginger probably did not grow in Southeast Puerto Rico. Trade in all four fell off after 1620.

Sugar Cane. Sugar cane is undoubtedly the most important plant ever introduced into Puerto Rico. This status did not come about as soon as sugar was introduced into the island, but developed slowly. At one time sugar seemed to be as much of an economic failure as ginger. Because of the importance of the sugar industry to Puerto Rico in general and to Southeast Puerto Rico in particular, the early development of the crop will be discussed in detail. Strangely enough, most of the early developments in the sugar industry were not in Southeast Puerto Rico, even though Southeast Puerto Rico is today the richest sugar region of the entire island.

One of the treasured legends of the Puerto Rican sugar industry is that Columbus carried a few plants of cane with him from the Canary Islands to Hispaniola on his second journey, in 1493. (41, p. 209) This would mean that when he sailed along the southern coast of Puerto Rico he had on board the plant that would eventually bring prosperity to that same southern coast. An American agricultural expert on Puerto Rico, O. W. Barrett, contends (18, p. 248) that this was impossible. Sugar cane did not reach the Canary Islands from Madeira until 1503.

No matter who took the first cane to Hispaniola, it was not until 1515 that cane came from Hispaniola to Puerto Rico. (60, Vol. I, p. 123) This means that cane reached

the island some five years after the first Negro. Their two fortunes were destined to be entwined for centuries to come.

Many varieties of sugar cane were to be brought to Puerto Rico in later years, and some were to be developed on the island. The first type brought was called creole (criolla), an inferior, low-yielding cane which is no longer cultivated. The Arabs are said to have brought it to Spain before the year 1000. (41, p. 41) The methods of cultivation were equally archaic. Cane was allowed to ratoon, (come up from the roots) for as many as 16 or 17 years, (41, p. 54) a most uneconomical procedure. Extraction of the sugary juice was at first accomplished by mashing the stalks by hand in a wooden mortar and pestle.* Later the pestle idea was adapted to animal power. Cylinders of wood and later of iron were moved by horse or ox. Water and wind were also employed. Still later, the grinding objects were placed in a horizontal position and operated by animal or steam power. (41, p. 45) A sugar-grinding apparatus was called an ingenio, a word which later came to stand not only for the apparatus but also for the

* Subsequently the guarapo (cane juice) was boiled down in open kettles until sugar crystals formed. Two methods were used to separate the brown sugar crystals from the molasses. Allowing the syrup to drain off by gravity produced the more desirable moscabada sugar. A less perfect, but quicker, separation was achieved by percolating a mixture of clay and water through the batch. This produced pilon sugar. (41, p. 48) Neither sugar was as refined as present-day brown sugar. The molasses residue was sold for syrup or used as raw material for distilling spirits.

township that grew up around the mill. The señor of the ingenio was usually also the alcalde or mayor of the township. The sugar machine itself soon came to be known as a trapiche. An ingenio without a trapiche was called an hacienda.

The first ingenio of record was built, probably in 1523, by Blas de Villasanta, Treasurer of the island, and his wife Teodora de Castellon. It was located at San Juan de las Palmas on the southwest coast at the mouth of the Rio Añasco. Its operation does not seem to have been successful, as in 1527 the mill was put up for sale without finding a bidder. In 1529 the mill was ordered to continue operations as a stoppage would cause loss to the community. In 1543 the mill was destroyed by French pirates; rebuilt, it was again destroyed in 1569. Subsequently the sugar land seems to have been converted to cattle ranching. (60, Vol. I, p. 124)

Meanwhile, other trapiches were being built. The collapse of gold mining gave impetus to the sugar cane industry. First, however, the cost of the trapiches had to be met. The local lack of capital (a cry that still echoes on the island) led the potential sugar growers to seek assistance from the crown. In 1535 Juan de Castellanos, then Island Treasurer, pointed out that gold mining was the only source of revenue to the crown. It offered no security because gold miners had no stake in the island and frequently left with debts unpaid. He urged the crown to grant loans of 2,000 pesos to individuals to partially pay for the construction of ingenios and to make the loans repayable in ten years. In return, the

owner of the ingenio was to supply land and water to nearby planters and to grind the cane for half the produce. The crown generously offered loans of 4,000 pesos but niggardly made them repayable in two years. Finding no takers, the offer was raised to 6,000 pesos. It was not until 1541, after Castellanos pointed out that a flourishing sugar industry was a better protection than ungarrisoned fortresses, that the crown increased the time of repayment to four years. This offer found a response and in 1541 Gregorio de Santolaya began the construction of a horse-driven mill at Bayamón, and followed it with a water-driven mill at Aybacoa, which was designed by a Cape Verde priest, Don Diego Lorenzo. (60, Vol. I, p. 124)

In 1546, Alonzo Pérez Martel who had married Doña Leonora Troche y Ponce de Leon, granddaughter of the founder of the island, also accepted a loan to build an ingenio on the Rio Toa. By 1549, when he was making the wheel, he estimated the cost of the ingenio at 20,000 pesos, which was considerably more than the loan he had obtained. (60, Vol. I, p. 124)

Another ingenio was built about this time on the Canoban River, four miles from San Juan. Its profits during the first few years of its history were estimated at 6,000 pesos annually. During its history, it was twice attacked by Caribs. The mill stood on the site of the present Central Canovanas, where there has been an uninterrupted record of sugar production for over 400 years.

A gradual development of the sugar industry found 11 ingenios operating in 1582 (129, III, p. 1) with a total production of 15,000 arrobas a year.* (41, p. 49)

Sugar production then declined almost as rapidly as ginger had previously. By 1602 only 8 ingenios were still operating. Production had fallen to less than 3,000 arrobas, about 37 tons. (41, p. 49) The sugar industry seemed destined to follow purging cassia, tumeric, ginger, and indigo into oblivion.

By 1776 when Abbad visited the island, the condition of the sugar industry had slightly improved. He wrote, (10, p. 309) "The cultivation of cane is very common throughout the island. There are few plantation owners who do not have some part of their land in this crop, but few have cane for the main crop. The large number of slaves that it needs, the great expense of building the ingenio and the needed utensils, will prevent the increasing of acreage in this plant, which might be very important to the island and without doubt could conquer all obstacles in its way if the extraction of spirits* were permitted".

* An arroba is roughly 25 pounds. This would make the total output of sugar in 1582 come to 375,000 pounds or about 187 tons -- a trifling amount.

* The making, use, and sale of cane liquor was forbidden in 1749 by order of Governor Don José Colomo. (41, p. 68) Later, O'Reilly reported in 1765 that little liquor was made from cane because imported liquor was cheaper. (41, p. 69)

Production in 1776 was 10,947 arrobas (136 tons) of sugar, (10, p. 309) which was less than the total produced in 1564 (129, III, p. 1). Land devoted to cane was only 3,156 cuerdas* in the whole island. (10, p. 309)

There is no readily available record of the beginnings of cane raising or of the construction of the first ingenio in Southeast Puerto Rico. In 1776 there were only 194 cuerdas of cane in the area. Production in "ordinary years" was estimated at 150 arrobas, about a ton and a half. (10, p. 313)

All cane raised on the island was the original imported variety, criolla. A much superior type, called white cane (caña blanca) or Tahitian cane (caña de Otahití) had been discovered growing on the Society Islands of the Pacific in 1768 by the French. Almost half a century was to pass before the Otahití was to come to Puerto Rico. (41, p. 209)

Coffee. Coffee is another of the outstanding successes introduced by the Spanish, although it came to the island late in the period under discussion. Like sugar, it was a product for which a demand had to be built up before production could be increased. Coffee was known in Europe around 1650. (41, p. 65) The first plants in Puerto Rico were

* A cuerda is .9712 of an acre. For all practical purposes, the two are considered the same in Puerto Rico. Cuerda is usually translated as "acre" and cuerda figures are usually given as "acreage", even though the acre is not used as a land measure on the island.

brought from Santo Domingo in 1736. (41, p. 249) Cultivation on a large scale did not commence until a cédula real (royal letterspatent) of the 8th of June, 1768, relieved the growers of coffee from payment of any taxes for a period of five years. Later this exemption was extended to 1776. (41, p. 64) There was a good reason for this grace period. Coffee is a tree that takes several years to develop before it produces a crop. Few plantation owners could afford to pay taxes on a crop that was producing no revenue. After the 1780's, coffee growing was advanced by émigrés from Haiti who fled the black insurrections and who brought with them experience in coffee growing. (245, p. 125)

Coffee demands different growing conditions than cane. In Puerto Rico it does best at elevations over 750 feet and needs shade. The growing of coffee meant the pushing of population inland into the hill country, the clearing of forests, the breaking of trails. Fortunately, there already grew on the island a tree that made a good coffee shade tree, the guaba, (Inga Inga) (25, p. 347). Fortunately, too, coffee did not compete for room with sugar cane, but developed best at elevations and on soils that had previously grown only tobacco. Coffee could be grown on a large or small scale. It provided a source of income for the hill jíbaro as well as a lucrative crop for the plantation owner. The skill required in harvesting made it more economical to employ free than slave labor. Furthermore, coffee demanded little cultivation, grew well, and had a ready sale abroad because of its good

quality. (10, p. 310)

There are differing opinions as to varieties of coffee trees and quality of flavor. Some botanists say that there is only one species with numerous variations developed under a variety of soils, climates, and cultivation. The coffee of Puerto Rico is a short-growing tree with medium-sized beans, but of a flavor that was acclaimed superior in the markets of Europe. When Abbad visited the island in 1776, he found that the crop was sold uncleaned in casara (in English in "silver skin") because there were no machines on the island to remove the parchment skin covering each berry. The price was, consequently, low. In usual years, like 1775, the crop was 45,049 arrobas (563 tons). "This," said Abbad, "is their main crop." (10, p. 310)

Coffee early developed as an important crop in Southeast Puerto Rico. This may have been because of the physical setting. Coffee grew best at higher altitudes and here the insular divide was less than 10 miles from the Caribbean shore. The distance the green beans had to be carried on horse back was an important cost factor.

Possible Export Crop. Cacao (cacao), the source of chocolate, was grown off and on for many years. It never became an export crop. See Appendix C.

Local Crops. (See also Appendix C) Other imported plants supplied subsistence crops or products for local trade. The banana (guineo), the plantain (platano), and the coconut (coco), which had come with the Negroes from Africa, became favorite foods in Puerto Rico. Citrus fruit trees were imported; the most popular citrus fruits were the sweet orange (china) and the grapefruit (toronja). Many imported garden vegetables successfully adjusted to the tropical conditions. The chief vegetables are listed in Appendix C.

The only imported grain that would thrive on the island was rice (arroz). A number of imported plants naturalized on the island and supplied fruits, berries, and fibers that the poor could have for the gathering.

Plants that Failed to Acclimatize. The imported plants that were successfully established were mainly of tropical or sub-tropical origin. Most of those that succumbed were of temperate origin. They included the fiber plants of hemp (canamo) and flax (lino), practically all the temperate zone fruit trees from apple (manzana) to plum (ciruela), the olive tree (olivo), many vegetables, the temperate grains of oats (avena), barley (cebada), rye (centeno), and wheat (trigo), and the grape (uva). A fuller account of the plants that failed to acclimatize is given in Appendix C.

The Native Crops

The foregoing recital of the importation of new species

into Puerto Rico might lead one to believe that the plants used by the Borinquen Indians lost their importance. That was largely true of some of the food crops like the lesser roots, but yautía continued to be a subsistence crop, while corn, yuca, tobacco, and cotton increased in importance. According to Abbad, the annual corn crop of the island was about 62,024 arrobas (775 tons), (10, p. 311) but yuca in 1776 occupied more slave labor than any other crop. (10, p. 310) He reported that the flat bread made from yuca was preferred to that made from corn. Yuca culture was important in Southeast Puerto Rico because the plant grew best in dry or sandy land of which there was a plenty.

Tobacco, a crop raised by small farmers, had a difficult time at first. In 1608, those in Spain opposed to the use of the new weed had succeeded in having its cultivation forbidden. (41, p. 55) In 1614, a new royal order allowed tobacco raising under rigid rules that made tobacco manufacture and sale a government monopoly. (41, p. 57) Abbad reported in 1776 (10, p. 310) that some of the crop was of excellent quality but that the 28,070 arrobas (350 tons) grown were consumed on the island.

Cotton continued to be raised as raw material for clothes and for the hammocks which the newcomers adopted from the Indians. Almost every farm raised a few bushes, but there were no cotton farms. There were no machines to clean it and the market in Spain was not large. In 1776 only 4,475 arrobas (55 tons) were exported. (10, p. 309)

The wild fruits enjoyed by the Indians continued to be gathered and one of the oldest resources, wood from the trees, began to be exploited in earnest. Some of the lumber was wasted in the clearing of land for crops. Burning was the commonest method. Other wood was used for cooking or for fuel to power the early steam-driven trapiches. There is no usable coal on the island. Some of the trees produced seeds that entered into commerce like the bay tree, (malagueta), *Amomis caryophyllata*, whose seeds were used for seasoning long before its leaves were distilled to make the bay oil for bay rum. (10, p. 483) The English provided a market for the wood of two Puerto Rican trees; the fustic, (palo de mora), *Chlorophora tinctora*, from which a yellow dye was derived, and the lignum vitae, (guayacán), *Guaiacum officinale*, whose hard wood made excellent blocks for the block and tackle gear used on shipboard.

Introduction of New Animals

The lack of domestic animals on the island when Columbus discovered it, early led to their importation. In fact, if Vicente Yañez Pinzón and Martín García de Zalazar really did abandon some goats and pigs on the beach at Aguada in 1505, domestic animals antedated the first permanent white settlement by three years. Ponce de Leon, himself, brought the first horses and cows in 1510. All of the preceding animals came via Hispaniola. The barnyard fowl arrived mostly from Europe although the guinea fowl came from Africa and the domestic turkey from Central America. The turkey became

most numerous in Southeast Puerto Rico because the climate was slightly drier there than on the north side of the divide. The donkey soon joined the horse; subsequently, mules were obtained by crossing the donkey and the mare. Sheep were brought from Europe but never became numerous. The climate made the wool degenerate into a lank kind of hair and the animals did not thrive. The domestic dog and cat arrived early. It was about 200 years after the white settlement that honey bees of European origin were brought over from Cuba.

The horse and cow soon came to be the most important domesticated animals. In 1534, the agents of Pizarro bought horses in San Germán for the conquest of Peru. (41, p. 52) In 1535 Andalusian sires (descended from Arabian horses) were introduced to improve the stock. As years went on, the horses on the island decreased in size but developed a remarkable endurance for climbing up and down the narrow mountain trails. From time to time, new strains were introduced to provide riding horses for the rich farmers or to improve the degenerating stock already on the island.

The mules produced on the island were in great demand but never numerous. The donkey, needed as a sire, did not thrive in Puerto Rico.

Cattle were raised wild on the natural savannas, particularly on the south coast, on public ranges. A cattle ranch was called an hato. In the 1600's there were an estimated 100,000 cattle. Only the hides were taken for

export. The meat was left for the dogs or the hill people. (41, p. 52) At one time up to 10,000 hides a year were exported to Spain. (41, p. 54) This was at the time when ginger export was at its height.

Some cattle from hatos near the ports were shipped alive to the slaughter houses of Spain. The animals of the island were larger than those of the other Antilles, and docile. There was more meat per animal and not so many died on the journey.

Another use for cattle was the production of work oxen. The larger sized animals of the island made heavier and stronger oxen. The bulls were usually not altered until their fourth year so that they might be more developed for work. The ox and the sugar cane industry were to become inseparable. The ox pulled the plow to prepare the soil, and later, hauled the cut cane. (10, p. 309)

The pig provided the favorite feast dish, the lechón asado (barbecued suckling pig) but was never raised extensively. Each household usually kept a few.

The chicken was the favorite fowl, although it was left to scratch for itself. The fighting cock, raised with care, was destined for the gallera (the fighting ring), rather than for the cooking pot, although the vanquished wound up there.

Transportation

Transportation was little better than during Indian

times. Travel was still mainly by sea and only secondarily by land. Sailing boats had replaced canoes in water transportation; pack horses and oxen now carried burdens on land.

There were no improved roads in the area. Travel still followed the old Indian paths that ran along the rivers and climbed the hills. The lack of bridges made the river crossings impassable in flood times, and the clay soil that covered most of the interior made the paths impassable in prolonged rainy periods. At any time, land transportation was slow, expensive, and perilous.

The Land Holdings

Land was first distributed to the Conquistadores, and to certain favorites of the king, under a system of usufruct. (128, p. 187). The grantee, or usufructuary, as a vassal of the king, was allowed to enjoy all the fruits or profits of the estate, even though the title to the land remained with the crown.

Large blocks of land (along with the Indians living thereon) were thus distributed. As might be expected, some of the boundaries of these grants were indefinitely described. Woods and waters were not included in any grant, but were to remain public land. (252, p. 104)

In 1541 the king ordered that pastures, as well as woods and waters, should be public land. This action, taken, it appears, in response to a petition sent from the island by a single petitioner, (252, p. 104) amounted to confiscation

of the pasture lands granted in the original distributions. Since the strongest land holders at this time were the cattle ranchers, they successfully resisted the attempts of the landless to encroach on the ranges. (148, p. 38) Indeed, as the population increased, the ranchers gradually occupied more and more land at the expense of the poorer and less influential farmers. (80, p. 7)

In 1625, the proving of legal claim to land was further complicated when some raiding Dutch burned the archives at San Juan and destroyed the land records. (128, p. 188) A reregistration of land titles in 1744 found 200 parcels of land unregistered. (80, p. 31) The king ordered the 200 parcels broken up and distributed in small lots, feeling that farming was preferable to ranching. (128, p. 188) In 1746, the king ordered a new registration of titles by 1765, and further ordered that all titles granted before 1618 be null and void. This order was suspended on the death of the King (Philip V) but was renewed in 1758. (41, p. 61) Apparently, the registration was never carried out.

One of the factors behind the unrest over land ownership was the lack of markets for any export crops that might be produced. Royal decrees forbade trade of any kind between Puerto Rico and places other than Spain. Because there was no chance of disposing of crops, there was no incentive for the handful of aristocrats who had the necessary money to do anything to develop agriculture on the island, or to build roads to bring crops from the country to the city. Meanwhile,

a growing number of landless had no place to raise food for themselves except on isolated pieces of public land.

Finally, the landowners complained to the Crown over the lack of markets. In 1765, the Crown commissioned Don Alejandro O'Reilly to visit the island and make a military, social, and economic report on conditions. He reported, among other things, that ownership of land by absentee owners was draining the resources of the island. Regarding the confused system of land ownership, he recommended the confiscation of land held in usufruct which was not being used, and the distribution of such land (with full title) to new colonists in proportion to the number of their slaves and dependents. (144) Action on O'Reilly's recommendations was not taken by the Crown until 1815.

In 1774, Governor Miguel de Muecas of the island, proposed a solution to the unsettled problem of land ownership. He suggested that those holding land should pay the cost of maintenance of the insular militia in return for full title to the land. (128, p. 188)

By 1776, the question of land ownership was still unsettled. No one had full title, and, since the cancellation of all grants prior to 1618, few had even a legal claim to land. Those who were most powerful controlled the land, particularly those great families of aristocrats who had influence at court. In the hills, the squatters collected on the public lands, growing barely enough food to support themselves.

Other Influences on Land Use

Events in the history of the island between 1505 and 1776 have been mentioned incidently so far in the chapter. Although this is not primarily a historical study, some additional events that bear directly on the land use should be recounted.

Spanish political control was repressive and autocratic (as most rule was at that period of history). Immigration was limited to Spaniards; only one port, San Juan, was officially opened to trade and all trade had to be with Spain.

The charge might be made that Spain neglected its colony, Puerto Rico, and cared little for its future. In 1536 crown officers complained that no ship from Spain had come to Puerto Rico for two years. (252, p. 99) From 1662 for 11 years, no Spanish merchant vessel called at the island. In 1680 the soldiers had to be cared for by the islanders because of their destitute state. No pay came for them from the homeland. (41, p. 60)

The truth is that Spain was frequently so busy with domestic affairs that it had little time for any colonies. Some of Spain's foreign involvements reacted to Puerto Rico's disadvantage. When Spain was at war, ships of enemy countries would raid the West Indies.

Puerto Rico suffered from a series of raids during the period; not all of them made by official enemies of Spain. The Carib Indians from nearby islands raided outlying settlements, killing settlers and destroying buildings in the 1520's.

(252, p. 81) French privateers began as early as the 1530's to burn and pillage. In 1537 they burned San Germán, the second town of the island. (252, p. 109) Trouble with English raiders began in 1595 when Sir Francis Drake almost captured San Juan. In 1597 the English captured and held San Juan for three months, only evacuating when their forces were decimated by dysentery and yellow fever. (252, p. 120) The Hollanders took their turn in 1625. (252, p. 123) From 1625 until the end of the period the island was in constant danger from raiders of all nationalities who swarmed over the Caribbean. (252, p. 129) Spain couldn't have helped Puerto Rico if it wanted to.

In this desperate situation, Puerto Rico took what was almost the only way out. The smuggling of contraband became the accepted method of commerce in the ports of the west and south coast. Smuggling began in the early 1600's and continued until the end of the 18th century. (240, p. 48) Trade was with the foreigners from nearby islands. The Dutch from Curacao took tobacco. The English from the British West Indies took the wood from two trees, the palo de mora and the guayacán. The Danes from the Danish Islands took vegetables and coffee. All three took cattle and as many mules as they could get. (144)

Smuggling was officially encouraged by Governor Matías de Abadía between 1724 and 1731. (245, p. 384) Meanwhile, vain attempts were made to open the other ports of the island to commerce or even to have San Juan declared a free port.

Opening the port of San Juan to the commerce of all nations would not have helped the farmers outside of the immediate area. The distance of the west and south coast from San Juan, the poor roads, and the lack of bridges or boats to cross the rivers, usually doubled the price of the commodities. If coffee were selling for 12 reales an arroba in San Juan, the out-country coffee raiser couldn't break even on sending coffee there for sale. A peon got 4 reales a day, his horse 8. A horse could carry 4 arrobas (100 pounds) of coffee. If the San Juan price were 12 reales an arroba, a horse load would bring 48 reales. If it took two days to journey to San Juan, one day for selling, and two days for return, the cost of man and horse would be 60 reales (20 reales for the peon and 40 for his horse) which was more than the selling price of the coffee. (10, p. 336) The out-country farmer had to smuggle through the nearest port or stop raising crops for export.

The farmer had other troubles that could not be laid at Spain's door. The island never suffered from frost and had a year-round growing season, except where a dry season interfered, but it was subject to the ever-present dangers of insect plagues or hurricanes. Such attacks did not come at regular intervals. In 1641 grubs and ants attacked the yuca. In 1718 ants attacked the sugar cane and oranges. (41, p. 230) According to observers, the fields and trees were left as barren and waste as if a fire from heaven had descended on them. (252, p. 72)

Hurricanes are a constant threat between July and November, although years may go by without one hitting the island.

All hurricanes are not of equal severity. The amount of damage depends on whether the center of the storm passes directly over the island. A severe hurricane with winds over 100 miles an hour ruins everything in its path. All crops are destroyed, but the farmer who grows annual crops recovers sooner. The farmer with tree crops may have to wait several years before his new plantings come into bearing.

Hurricanes came at unfortunate intervals for the early settlers. (See Appendix A Hurricanes) One in 1515 destroyed the food crops. In 1530 three hurricanes in 37 days almost convinced the settlers to abandon the island. Governor Lando wrote to the Governor of Hispaniola, his superior, "The storms have destroyed all the plantations, drowned many cattle, and caused a great dearth of food. Half the houses in this city San Juan have been blown down; of the other half those that are the least damaged are without roofs. In the country and in the mines not a house is left standing. Everybody has been impoverished and thinking of going away." (252, p. 74)

Other hurricanes came along at irregular intervals. During the 18th century there were three years that had two hurricanes each (1738, 1740, 1780) and two years that had three hurricanes (1766, 1772). There was no way of obviating hurricane damage. Hurricanes came and nothing could be done about it.

Land Use in 1776

In 1776 Southeast Puerto Rico was not yet organized into firm political divisions. Years before, Governor Ponce had divided the island into two departments; a northern with Caparra (later part of San Juan) as the capital, and a southern with San Germán as the capital. The chain of interior mountains was the mutual boundary. By this division, Southeast Puerto Rico was a part of San Germán department. Two nuclei of population developed within Southeast Puerto Rico; one at the present city of Coamo and the other at the present city of Guayama. Coamo was the older and the larger. It was a ribera (settlement) in 1580 and was declared a pueblo (town) in 1616. (9, p. 218) Guayama was made a ribera in 1736. The people of the present municipios of Santa Isabel, Salinas, and Coamo were linked to the town of Coamo with parish and military ties. Similarly the people of Patillas, Arroyo, and Guayama were linked to the settlement of Guayama. In 1765 Coamo had three companies totalling 342 soldiers. Guayama had two companies totalling 211. The entire island had 66 companies and 5,611 men. (200, p. 513)

The population of Southeast Puerto Rico has already been discussed. It is sufficient to say here that there were just under 10,000 people in the area, almost a thousand of whom were slaves.

In 1776 the farms and ranches were as follows: (10, p. 313)

<u>Type of Enterprise</u>	<u>Coamo</u>	<u>Guayama</u>	<u>SE PR</u>	<u>Island</u>
estancias (farms)	158	209	367	5,581
hatos (ranches)	<u>13</u>	<u>9</u>	<u>22</u>	<u>234</u>
total enterprises	171	218	389	5,815

It can be seen at a glance that Coamo lead in animal raising and Guayama in crop raising. The agricultural development of both areas was behind that of the rest of the island.

The statistics on land in various crops are inadequate. The only ones given are for land in "staple crops": (10, p. 313)

<u>Cuerdas</u>	<u>Coamo</u>	<u>Guayama</u>	<u>SE PR</u>	<u>Island</u>
cane	94	100	194	3,156
bananas	500	474	974	8,315
coffee*	184	162	346	1,196
cotton*	20	0	20	103

Coamo was in first place in the island in coffee and cotton acreage. Guayama was in third place in coffee acreage, right behind Ponce. With the first three places in coffee acreage held by areas on the south coast (Ponce is to the west of Coamo), it seems safe to state that in 1776 the coffee industry was centered on the south coast.

* The figures given by Abbad for coffee and cotton are for palos or plants. Taking 1,000 plants to the cuerda, a procedure followed by Flinter (77, p. 159) in giving cuerda figures for 1828, the above cuerda figures are obtained.

The annual production in "ordinary years" from the same source (10, p. 313) shows:

<u>Product (in arrobas)</u>	<u>Coamo</u>	<u>Guayama</u>	<u>SE PR</u>	<u>Island</u>
sugar	100	50	150	10,949
molasses*	644	2,900	3,544	78,884
bananas (unreported)				
coffee	4,000	5,200	9,200	45,049
cotton	401	40	441	4,475
corn	2,100	1,000	3,100	62,024
rice	1,600	2,000	3,600	80,386
tobacco	100	3,000	3,100	28,070

Sugar cane was converted into crude sugar and molasses. A larger percentage of sugar was produced in Coamo than in Guayama. A comparison of the two preceding charts shows that Guayama produced more coffee on fewer trees than Coamo did. This may be because Guayama has more rainfall, on the average, than Coamo.

All production figures are so rounded as to be merely estimates. Rice is an important crop for the island as a whole but in Southeast Puerto Rico is only a little more important than the corn crop. This is probably because the best rice-growing region of Southeast Puerto Rico, Patillas, was hardly settled at the time.

The lack of figures for the citrus fruits and coconuts probably means that neither was important on the island at the time.

The map of land use in 1776 shows little change from that of 1500. Crop lands had developed around the settlement of Coamo in the erstwhile grasslands (sabanas) and around the settlement of Guayama in the savanna forest. In the valley of the Guamaní, north of Guayama, some mediocre farms were

* in bottles of unspecified size

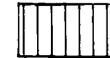
LAND USE 1776

CROPS

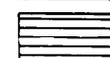
 Coffee



Bananas

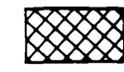


Sugar cane



Royal palms

PASTURE



Natural pasture

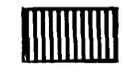
FORESTS



Rain forest

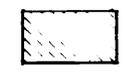


Savanna forest

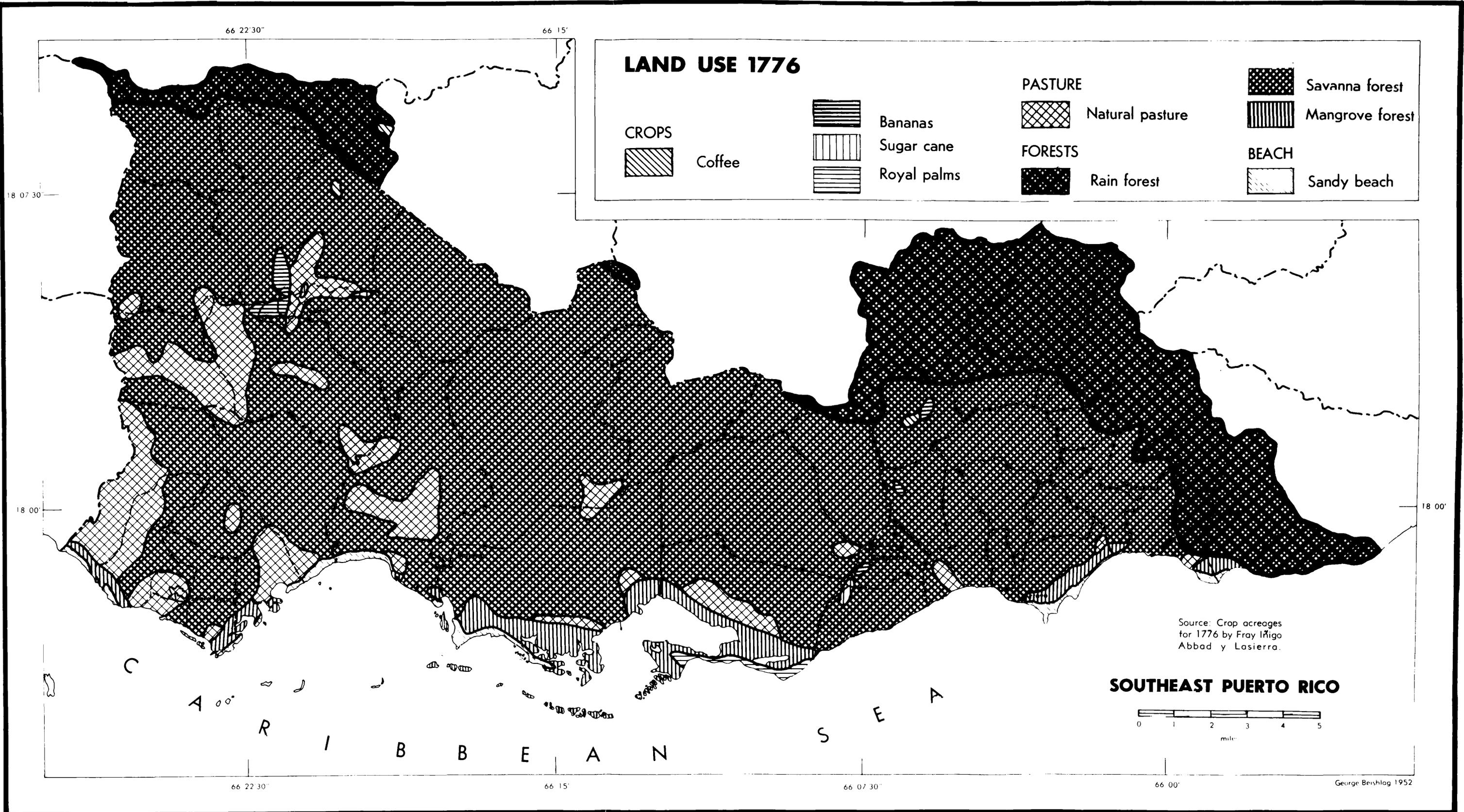


Mangrove forest

BEACH

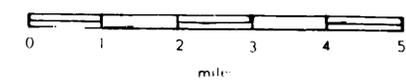


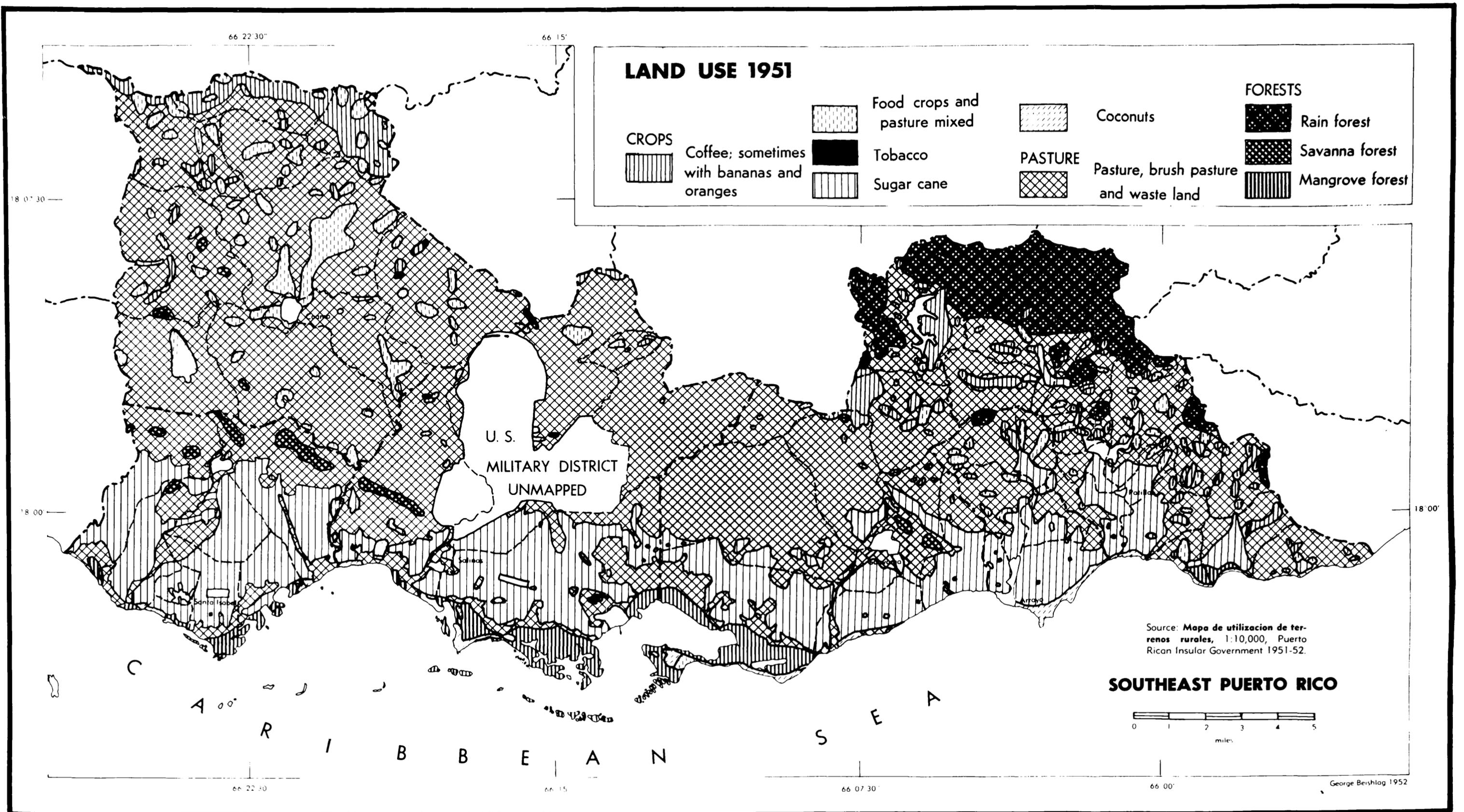
Sandy beach



Source: Crop acreages for 1776 by Fray Iñigo Abbad y Lasierra.

SOUTHEAST PUERTO RICO





LAND USE 1951

CROPS

 Coffee; sometimes with bananas and oranges
 Food crops and pasture mixed
 Tobacco
 Sugar cane

Food crops and pasture mixed

Tobacco

Sugar cane

Coconuts

PASTURE

 Pasture, brush pasture and waste land

FORESTS

 Rain forest
 Savanna forest
 Mangrove forest

Rain forest

Savanna forest

Mangrove forest

U. S.
MILITARY DISTRICT
UNMAPPED

Source: *Mapa de utilizacion de terrenos rurales*, 1:10,000, Puerto Rican Insular Government 1951-52.

SOUTHEAST PUERTO RICO



George Beislag 1952

clustered at the base of the mountains, growing coffee, bananas, tobacco, and corn. (9, p. 215) Coffee at this time was a main crop, but its importance to the area was to lessen as more-productive lands in the interior of the island were developed.

The forests were beginning to be tapped for their riches but had not yet begun to disappear. The rain forest in Patillas was practically intact.

On the coast below the present city of Guayama, was a grove of royal palms that stretched to Aguirre and provided enough palm fruits to feed many pigs. (9, p. 219)

Tobacco as a crop was dying out in Southeast Puerto Rico. It had never been prominent in Coamo and the quality of the Guayama product became substandard. The tobacco farmers were beginning to switch to cane. The slaves and agregados were allowed to raise their own food crops on special plots set aside for their use, but they did not always get a crop because of frequent droughts.

All foreign trade of the area was illegal. Foreigners stopped along the coast to pick up coffee, tobacco, corn and other foods, bay berries (malagueta) and wood from the forest, cattle, horses, pigs, sheep, and even some tortoise shells which the Puerto Ricans collected along the shore. Puerto Rico was an unimportant island and Southeast Puerto Rico was one of the least important parts of the island. Even in smuggling, its chief port, Guayama, was behind the ports of Mayaguez, Ponce, and Cabo Rojo.

Ranchers found ready-made pastures in Coamo in the natural grasslands. Animals could be raised almost equally well around Guayama in the savanna forest.

Records of the animal population were made in 1765 by O'Reilly and in 1776 by Abbad. There are serious disagreements between them that lead one to question their accuracy. According to O'Reilly, there were only 64 ox carts in the entire island, none of them in Southeast Puerto Rico. Other figures for 1765 were: (144, p. 540)

<u>Animal</u>	<u>Coamo</u>	<u>Guayama</u>	<u>SE PR</u>	<u>Island</u>
horses & mares	1,085	1,048	2,133	18,577
mules	138	158	296	1,371
donkeys	119	183	302	1,031
oxen & cows	4,081	3,292	7,373	44,633
sheep	432	237	669	5,735
goats	158	82	240	2,683
pigs	<u>3,990</u>	<u>5,102</u>	<u>9,092</u>	<u>47,005</u>
totals	10,003	10,102	20,105	121,935

In 1776 the animal population was reported as follows:

(10, p. 313)

<u>Animal</u>	<u>Coamo</u>	<u>Guayama</u>	<u>SE PR</u>	<u>Island</u>
horses	2,703	877	3,580	23,195
mules	189	238	427	1,524
donkeys (unreported)				
cattle	6,148	2,782	8,930	77,384
smaller stock (sheep, goats and pigs)	<u>126</u>	<u>4,230</u>	<u>4,356</u>	<u>49,050</u>
totals	9,166	8,127	17,293	151,153

It is difficult to understand why, if the totals are correct, the animal population in Southeast Puerto Rico decreased in the eleven years between censuses. It is more difficult to figure why the sheep, goats, and pigs dropped

from 4,580 to 126 in Coamo, if they did. The totals of the entire island show a gradual increase in all animals except cattle which almost doubled. Perhaps the answer is that one census is more reliable than the other, though which one it is impossible to say.

The annual production in "ordinary years" is even more baffling: (10, p. 313)

<u>Animal</u>	<u>Coamo</u>	<u>Guayama</u>	<u>SE PR</u>	<u>Island</u>
horses	189	50	239	4,334
mules	134	25	159	952
donkeys (unreported)				
cattle	708	200	908	13,614
smaller stock	<u>1,338</u>	<u>800</u>	<u>2,138</u>	<u>31,758</u>
totals	2,369	1,075	3,444	50,658

To take these figures seriously, one must believe that the 126 sheep, goats, and pigs in Coamo normally had 1,338 offspring a year, a feat even in fertile Puerto Rico. It is more logical to believe that the figure for thousands has been omitted from the smaller stock inventory for Coamo.

Not much care was wasted on the raising of animals. The horses ate whatever herbage they could find, as did the other animals. No fodder crops were raised. The sheep were described as poor and without wool, the goats were classified as ordinary. Only the goat hides were taken; the meat and milk were not used. (144, p. 540) By modern standards the cattle, horses, and pigs would be considered inferior but they were good quality for the time. Coamo held second place in horses and cattle and third place in mules. Guayama was in second place in smaller stock.

Summary

Whites, Negroes, and mixed bloods replaced the Indians, who disappeared as an ethnic group. A social system of two classes, the land-holding aristocrats and the landless workers, was instituted. Some of the landless, the Negro slaves and the *agregados*, were tied to the owner or to the land. Others of the landless squatted on out-of-the-way acreage that was not controlled by the aristocrats and achieved a kind of isolated independence on a subsistence level.

The introduction of plants set a pattern that has been continued. Two kinds of plants were brought in, export crops and subsistence crops. The export crops of sugar and coffee were later to prove the most important. The subsistence crops were largely those familiar to the immigrants in their homelands. More of the plants from Negro homelands adjusted to the climate than those from white homelands.

Many different kinds of animals were introduced, but the most important were cattle and horses. The cattle supplied hides, an early export. Horses made personal travel a bit easier, even though roads were lacking.

The rules of land tenure were feudal and subject to change but favored the aristocracy. Land was held in usufruct at the pleasure of the crown. Absentee ownership of land was common. Repressive rules on foreign trade and the consequent lack of a market for export crops led to smuggling. Control from Spain was tenuous, as the local government was frequently out of touch with the crown. Hurricanes, on occasion, hampered the development of the area.

CHAPTER V

LAND USE UNDER THE SPANISH 1777 TO 1898

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CHAPTER V

LAND USE UNDER THE SPANISH 1777 TO 1898

The Population

Changes in Population. Between 1776 and 1899* the population of Southeast Puerto Rico, as well as that of the entire island, increased enormously, as can be seen from the following charts which give the population figures and percentages by color.

SOUTHEAST PUERTO RICO (10 and 245)				
	1776		1899	
white	2,346	24%	24,256	44%
mixed	6,432	64%	26,054	48%
Negro	<u>1,149</u>	<u>12%</u>	<u>4,202</u>	<u>8%</u>
total	8,906#	100%	54,512	100%

* Spanish civil rule ceased in October 1898 when Spanish forces left the island. American civil rule did not begin until April 1900. During the interim, the American military governed the island. A rather detailed census taken by the Military Government in 1899 (245) is drawn on for this chapter because it shows conditions at the end of Spanish rule. Much information is also taken from special studies made for the U.S. President and Congress in 1899 (32 and 225), since they summarize conditions at the end of Spanish rule better than any Spanish sources.

Figures in this column include absentees. Totals do not.

TOTAL PUERTO RICO				
	1776		1899	
white	29,263	37%	589,426	62%
mixed	41,643	52%	304,352	32%
Negro	9,290	11%	59,390	6%
Chinese	_____	_____	_____75	_____0%
total	76,747#	100%	953,243	100%

In one hundred and twenty-three years the population of Southeast Puerto Rico increased almost 7 fold. This seems impressive, but it was below the general increase for the island; in the same period, the population of the entire island increased more than 12 fold. Southeast Puerto Rico, which lagged behind the rest of the island in early settlement, also lagged behind in increase of population.

In composition of population there was a general trend throughout the island toward an increase in the percentage of whites and a decrease in mixed peoples. The percentage of pure Negro also dropped. These trends progressed almost equally in Southeast Puerto Rico, although the population of that area in 1899 as in 1776 was darker than the average for the island.

There are several reasons for the increase of population. The natural increase of a fertile people would account for a good deal of it. The absence of wars and the cessation of raids on the island would remove checks on the natural increase. The increase in percentage of whites and the decrease in percentage

Figures in this column include absentees. Totals do not.

of pure Negroes are partially due to an increased immigration of whites to the island and a decreased immigration of blacks. Another reason for the decrease in the number of pure Negroes is the tendency for the people of the island to intermarry.

Southeast Puerto Rico has a varied terrain. Some parts are almost entirely flat lands; others are largely mountainous. It would be illuminating to compare population statistics for different years for the various types of land, but it is not possible.* It is possible to show the composition of population by municipio in 1899, which follows: (245)

	Coamo	S.Isabel	Salinas	Guayama	Arroyo	Patillas
whites						
native	7,216	1,606	2,087	6,339	1,286	5,334
foreign	67	32	59	138	59	33
mixed	7,300	2,673	2,782	5,257	2,765	5,277
Negro	<u>561</u>	<u>547</u>	<u>803</u>	<u>1,015</u>	<u>757</u>	<u>519</u>
totals	15,144	4,858	5,731	12,749	4,867	11,163

* The main drawback is that Southeast Puerto Rico has never been an enumeration district. In 1776 there were two towns, Coamo and Guayama, in the area. The island was divided into two districts and all of Southeast Puerto Rico was in the district of San Germán. By 1899 there were six towns; Coamo, Santa Isabel, Salinas, Guayama, Arroyo, and Patillas. Each town was the head of a municipio (equivalent to an American county). The island had been divided into seven districts, and, unfortunately, the six municipios of Southeast Puerto Rico were assigned to three different districts: Coamo and Santa Isabel to the district of Ponce; Salinas, Guayama, and Arroyo to the district of Guayama; and Patillas to the district of Humacao. Most of the valuable census data are recorded by districts. Only occasionally are the data broken down by municipio.

The foregoing does not permit the drawing of conclusions as to what happened in specific areas of Southeast Puerto Rico between 1776 and 1899 but it does show the picture as of 1899. The two municipios with the largest percentage of flat land are Santa Isabel and Arroyo. Both are darker in population than any of the other four municipios. Coamo and Patillas have the largest percentage of hill and mountain. They are the two whitest municipios. Whites and colored are nearly evenly balanced there. Slaves proved most useful in the lowland cane plantations. They were not as economical as free labor in the upland coffee plantations.

There are no data at hand on immigration into Southeast Puerto Rico for the 123 year period under discussion. Prior to 1778, immigration to Puerto Rico was limited to those white Spaniards who chose to go there and those exiled white Spaniards and captive black Africans who had no choice in the matter. After 1778, foreigners who were Roman Catholic and who knew how to manufacture sugar were permitted to settle on the island. (60, Vol. I, p. 125) Under such conditions few enterprising whites chose to go to Puerto Rico when Cuba, Santo Domingo, Mexico, and Peru offered better chances for wealth. As early as 1765 when the King sent O'Reilly to investigate the Puerto Rican situation, there was a growing interest, both in Puerto Rico and in Spain, in changing the rules.

The royal decree of 1815 (Real Cédula de Gracia de 1815) was probably due, in part, to O'Reilly's report. (144) In 33 articles, the decree, subtitled, "Regulations for Promoting

the Population, Commerce, Industry, and Agriculture of Puerto Rico", held out flattering prospects to industrious foreigners, who no longer had to be Catholic, though they should be wealthy. The rights and privileges of Spaniards were offered to them and to their children, taxes were lightened or forgiven for from 5 to 15 years, and land was given gratis, the amount depending on the number of slaves brought in by the new settler. (252, p. 155)

In 1825 another important step in attracting immigrants was made. The King appointed Teniente-General Miguel de la Torre, Conde de Torrepando, Governor of the island and invested him with vice-regal powers. The new governor put an end to the corruption in the conduct of government which had become the accepted state of affairs and instituted an honest administration. (252, p. 158)

The era of prosperity that resulted from the actions of 1815 and 1825 attracted some of the best and wealthiest citizens from the nearby Danish Virgin Islands and later drew refugees from Haiti, Santo Domingo, and Venezuela who left their old homes to escape incessant revolution and persecution. Puerto Rico never experienced the stirrings of revolt that swept the English colonies in 1776 and later upset the monarchy of France in the French Revolution. It was equally undisturbed by the revolutions that swept the Spanish colonies on the American mainland from 1810 on. The island, under its liberalized laws, became a refuge for those Spaniards living in the Spanish mainland colonies who wished to preserve their old way of life. In this respect Puerto Rico was in a similar

position to Canada which received many Loyalist Englishmen of property from the English colonies at the time of the American Revolution.

There were other acts of the Spanish Government that attracted immigrants with ability. The trade with strangers, which had formerly been carried on through smuggling, became legal and in 1816 consuls of friendly nations were allowed on the island. (41, p. 93) These consuls were not limited to the capital city of San Juan. An American consular station was located in Guayama, the only port of first class* in Southeast Puerto Rico, from 1828 till 1850 when it was closed and combined with the consulate at Ponce.

It should not be thought that any great numbers of white immigrants poured in even though they did take over leadership in export agriculture. Immigration of loyal Spaniards from the revolting Spanish colonies did not exceed 7,000 and by 1830 there were only 2,833 naturalized foreigners on the island. (252, p. 215) What was more important than the numbers of the white immigrants was the quality of them. They provided a much-needed leaven of modernity by bringing with them capital,

* The port section of Guayama became the independent town of Arroyo in 1855. It was the only first class port in Southeast Puerto Rico. A first class port could deal in foreign import and export trade and local cabotage. Salinas, a second class port, could deal in foreign export and local cabotage. Three third class ports, Santa Isabel, Jobos (in Guayama municipio), and Patillas could deal in cabotage only. (158, p. 57)

industry, and a knowledge of the cultivation of sugar and coffee. (245, p. 17) Many of these foreign-born whites or their descendants later left the island when the Americans took over in 1898. The census of 1899 showed only 388 remaining in Southeast Puerto Rico. (245) A better picture of the importance of the foreign-born white is given by the census of 1897 which showed:

Foreign-born reported in the Census of 1897. (47, p. 63-318)

	Coamo	S.Isabel	Salinas	Guayama	Arroyo	Patillas	total
SPANISH							
Iberian	38	16	34	276	48	21	433
Mallorcan	8	3	2	34	12	2	61
Canary Is.		3	2	5	6		16
Cuban	6			5		1	12
Venezuelan	1	1		4	1	1	8
Mexican	4						4
Dominican				1			1
Filipino						1	1
OTHER WHITE							
French	39	2	19	95	11	15	181
Danish		5	5	20	6		36
English		2	1	18	13		34
Italian		14	1	19			34
Dutch				3			3
Swedish					1		1
American				1			1
OTHER RACES							
African		6	3	14	17	12	52
Asiatic	—	—	—	<u>12</u>	—	—	<u>12</u>
	96	52	67	507	115	53	890

This shows a total of 890 foreign-born in Southeast Puerto Rico, 536 of whom were from Spain or Spanish possessions. The next most important group were listed as French, even though most of them were from the island of Corsica and were called corsos in Puerto Rico. In addition to being business people,

which would bring many of them to Guayama, the chief port, the corsos excelled in coffee and cattle raising, which would account for so many going to Coamo and Patillas, municipios that otherwise had only Spanish foreign-born. The other whites tended to congregate around the ports, mainly Guayama.

It would be expected that the Danish and English would be prominent in the figures since many of those nationalities could move easily from near-by islands. What is a bit surprising is that there was only one American in all Southeast Puerto Rico. Evidently the large amount of trade that was going to the United States at this time was being handled by local business men. It can safely be stated that no American agriculturalist was operating in Southeast Puerto Rico during Spanish times.

The reduction percentage-wise in the number of pure-blooded Negroes began when the slave trade ended. The mixing of blood streams, begun in the 1500's, continued to dilute the Negro blood and to move the descendants into the mixed-blood group. It has previously been mentioned that Puerto Rico never had a large percentage of slave workers. This was because the island had a reservoir of labor made up of the freed white criminals and the freed blacks. The price of labor was so low for so long a time that planters could not afford to pay \$300 a head for African slaves, a price that slave traders were always sure of getting in Cuba. (214, p. 557) Furthermore, free labor was more efficient than slave. Don Darío de Ormachea writing a Memoria on agriculture, commerce, and public rents,

stated flatly, in 1847, that the labor of the free farmer was preferable to that of the Negro slave because of its "better quality, ease, and quickness." (quoted in 41, p. 112) Soon after the introduction of coffee, it was found to be cheaper to raise coffee with free labor. By the time slavery ended, it was cheaper to raise cane with free labor.

The slave trade in the Caribbean was supposed to stop in 1820 but it continued past that date although few slaves entered Puerto Rico from Africa. Most that came after 1820 accompanied their masters from other colonies. In the census of 1897 there were only 52 African-born Negroes in Southeast Puerto Rico. Thirty-one of these were in Arroyo and Guayama, near the one first-class port in the area. (47, p. 63-318)

A decree in July 13, 1870 prepared the way for eventual freeing of all slaves. Anyone born after that date was to be free. Others freed at the same time were those over 60 and anyone who had served the Spanish flag. A census of 1872 showed that slaves were only 5.1% of the total population. In Cuba they were 27.8%. (245, p. 18)

It can easily be seen that freeing the slaves would not cause any great economic dislocation. Slavery was abolished as of March 22, 1873. (47, p. 28) On that day 29,229 slaves were freed (41, p. 113) at a cost to the government of 200 pesos each, plus interest on the bonds that were issued. (252, p. 211)

The Agricultural Labor Force in 1899. Agriculture was the leading occupation in Southeast Puerto Rico as it was in

the rest of the island, even though the percentage of labor engaged in agriculture was less in Southeast Puerto Rico than for the island as a whole. The following chart shows how Southeast Puerto Rico compared to the rest of the island in 1899: (245, p. 294-305)

	SE Puerto Rico		Total Puerto Rico	
Total labor force	17,540	100%	316,365	100%
Agricultural labor force*	10,506	60%	198,761	62%
whites				
native	4,704	27%	122,771	39%
foreign	49	0%	1,589	0%
colored (all classes)	5,753	33%	74,401	23%

The following chart shows agricultural workers by color by municipio: (245, p. 294-305)

	Coamo	S. Isabel	Salinas	Guayama	Arroyo	Patillas
whites						
native	1,464	316	521	1,085	207	1,111
foreign	13	4	8	11	7	6
colored (all classes)	1,350	685	882	1,051	579	1,206
total	2,827	1,005	1,411	2,147	793	2,323

In most cases the percentage of each color engaged in agriculture corresponds closely to the percentage of color in the entire population. Arroyo, which is an exception in having a larger percentage of colored in agriculture, is the site of the only first class port in Southeast Puerto Rico. Many of the whites there would be engaged in trade rather than in agriculture.

* The census classification is "Agriculture, Fishing and Mining" (245, p. 294-305) There were few fishermen and practically no miners in Southeast Puerto Rico.

The relatively few foreign whites shown, (there were only 49 in agriculture in 1899) is not an indication of the total number who entered the area after 1810. The first wave of those who came had died off by 1899 and their descendants were listed as native whites. The 49 shown were part of a later wave of immigrants.

Introduction of New Plants

Sugar Cane. Previous to 1820, the only kind of cane raised was creole (criolla), a low yielding variety. The Tahitian cane (caña de Otahití), or as it was commonly called, white cane (caña blanca), was found by the French on the Society Islands in 1768, introduced into Cuba in 1793, and passed to Puerto Rico sometime in the 1820's. The Cheribon canes, Light Cheribon (crystalina), Striped Cheribon (rayada), and Black Cheribon (morada), which arrived as strays in shipments of white cane, began replacing the white cane in the 1870's. From 1878 on, many cane varieties were introduced. By 1895, twenty-two varieties in addition to creole and white cane were on the island. (178, p. 24) Most did not become important. At the end of Spanish rule, Tahitian cane and the Cheribons were the dominant varieties.

The story of the development of sugar cane growing and manufacturing is included here in general outline because of the subsequent importance of sugar to the island and to Southeast Puerto Rico. By the end of the Spanish period, sugar was the second crop to coffee throughout the island but it was

already the first crop in Southeast Puerto Rico.

Although the sugar industry began early in the 16th century, it was not until 1827 that production exceeded consumption. (60, Vol. I, p. 125) In that year the exports were 5,559 tons, the surplus of 275 plantations. The largest export during the Spanish regime was 112,000 tons in 1853. By 1898 production was less than half that much. The reasons for the decline will be discussed later.

Cultivation was by primitive methods. Labor was paid very little in 1899, about 50 cents a day (silver, worth 30 cents gold), but was not very productive. One of the most thorough planters of the island used 420 oxen to cultivate and harvest his cane crop -- on a plantation of a little over 800 cuerdas. It required six yoke of oxen and three men to plow three-fourths of an acre a day. The oxen, which were fed only grass, could plow half a day at a time, consequently three yoke were used in the forenoon and three in the afternoon. (225, p. 14) At that, the plowing was not very effective; the plows did not penetrate very deep into the ground.

Cane must be harvested at a critical moment of maturity. As long as the cane is growing, the sugar content is mostly in the form of glucose. When the cane blooms, or when it ceases to grow, most of the glucose is transformed into sucrose, the only form that is extracted by the sugar mills. Cane can be harvested profitably when it is naturally mature or when its growth has been stopped by a dry period. If mature cane is let stand, other troubles develop. Rains on cane make it green again. Further growth reduces the sucrose. Ripe cane leans over until it touches the ground. Roots sprout from

the internodes and new shoots take the sucrose from the old stem. If none of these misfortunes occur, the overripe cane becomes hard and difficult to grind. (245, p. 139-140)

Since not every cane farmer owned grinding equipment, there developed many disputes between the cane raisers and the owners of the ingenios as to the time assigned for grinding a certain farmer's crop. Cut cane lost sucrose content rapidly, and each individual farmer naturally wanted his cane ground at the time when the sucrose content was highest. Such disagreements have no solution. They still continue and seemingly always will.

A tendency toward growing cane on larger farms commenced in Spanish times. In 1899 it was reported that 61,000 of the 73,000 cuerdas in cane were in farms of 31 cuerdas or more. (41, p. 214) The tendency toward grinding the cane in larger mills had not progressed very far by the end of Spanish rule. The large-scale factory system (called the central system in Spanish) originated in the British West Indies and spread into the other Caribbean Islands in the 1870's but did not come to Puerto Rico until the American occupation*. (129, III, p. 31.) Santiago MacCormick in 1880 made an earnest plea for the introduction of the central system into Puerto Rico (119) at which time there was not a single central on the island. The next year Don Enrique Delgado published a detailed project for building a central. (61) In 1899 there were a

* The first of the modern centrals was built at Guanica in Southwest Puerto Rico in 1903. (88, p. 134)

reported 249 ingenios and 22 factorias centrales. (41, p. 214) None of the centrals would be considered modern sugar mills. Nearly half the ingenios were worked by ox-power.

The reduction in sugar production previously mentioned was due to a combination of causes. The Spanish government levied taxes in a most eccentric manner. The cane grower never knew what to expect. Old-fashioned methods made sugar production costs high and, when the world price of sugar went down, Puerto Rican sugar was priced out of the market. Two other things plagued the sugar producers; white sugar produced by sugar beet growers in the temperate zone took some of the quality market away from the brown moscavado sugar and in 1872 a blight attacked the Tahitian cane, reducing the yields. (41, p. 120) The blight baffled the cane-growers who did not know whether it was due to the ravages of insects (215, p. 112) or to a true cane disease. (178, p. 24) Government investigators surveying the damage, which was first noticed in the southwest part of the island, noted that the disease did not injure the Cheribon varieties of cane as much as it did the pure Tahitian.

The Cheribon canes, the Light Cheribon (crystalina), the Striped Cheribon (rayada), and the Black Cheribon (morada), had arrived on the island as an admixture with the Tahitian cane, and had been growing unnoticed in the mixed fields that were then common. (72, p. 31) The disease spread into the northwest and southwest parts of the island, and so alarmed the authorities that various commissions were appointed to

study it. Neither the cause nor remedy were ever found; the danger was eliminated by planting the Cheribons instead of the Tahitian cane. (72, p. 32) The change-over was slow and sugar growing was in the doldrums at the time of the American occupation.

In saving the industry, a pattern was set that continues to the present. Cane diseases are conquered by discarding the diseased variety and growing a resistant variety. The emphasis is not on treating the disease but on finding a new cane. This leads to the importation of many varieties and to the development of others.

This attitude of Puerto Rican crop growers toward plant diseases and pests is probably due to the fact that no pests winter-kill on the island and there is little the farmer can do to control plant diseases -- especially if he is poor and illiterate.

There were other pests that the cane farmer had endured before the 1872 disease came along; the changa (mole cricket), the gusano blanco (white grub), the taladro (sugar cane moth stalk borer), and the ever-present hormigas (ants) that could damage the crop at any time. (41, p. 228-232)

Coffee. Coffee had its ups and downs from the time it was introduced into the island in the late 1700's. It has already been suggested that coffee growing moved to the interior in the 1800's. Raising coffee with slaves proved uneconomical and, in the 1830's, many slave-operated plantations were abandoned in Puerto Rico and in the British and

French islands as well. (79, p. 186) Still coffee-growing continued to spread. It used the upland area where no other crop competed and it had the advantage of growing three crops at the same time. Bananas and oranges were commonly grown for shade. Bananas were the commonest starchy food of the island and always saleable. The main problem of the coffee grower was transportation. Coffee beans were not perishable and could be carried in sacks on the backs of horses and mules, but such transportation was expensive if the distance was great.

Up to 1876 coffee growing was not especially profitable, even though the life of a coffee plantation owner was pleasant. The limited markets were the ports of the Mediterranean, with Italian ports first. In 1876 the United States opened its markets to free coffee and the price jumped from \$12 to \$19 to \$29.30 a cwt. Puerto Ricans began to consider coffee-growing the most important industry. New plantations were started and new varieties were imported. Because it takes about ten years for a new planting to come into full production, the industry was at its height at the time the Americans took over the island.

Puerto Rican coffee did not stay in the US market. Unfortunately, no attention was paid to quality, a failing that more than once has kept Puerto Rican products out of lucrative markets. Brazil, a larger producer of mediocre coffee, captured the US market. Subsequently, more care was taken in the sorting and preparing of the beans and the better grades of Puerto

Rican coffee brought the highest prices and held the best markets of Europe. Oddly enough, Spain and Cuba consumed the poorest quality of Puerto Rican coffee. (245, p. 125) At the time the United States took over the island, coffee was the leading export crop. Figures for 1896 show the markets:

EXPORT OF COFFEE (in pounds) FOR THE YEAR 1896 (225, p. 16)

Spain	16,405,900
Cuba	15,577,710
France	11,306,689
Germany	8,120,409
Italy	4,388,819
Austria-Hungary	2,280,221
UNITED STATES	322,591
United Kingdom	304,119
Santo Domingo	22,501
Danish possessions	19,595
British possessions	452
total	58,780,006 pounds

Possible Export Crops. Coffee and sugar remained the most important export crops even though such plants as Manila hemp (abacá), ramey (ramio), cacao (cacao), Sea Island cotton (algodón sea island), cinnamon (canela), black pepper (pimienta del comercio), and vanilla (vainilla) were introduced and became established. A discussion of the reasons for such lack of development will be found in Appendix D.

Local Crops. New food crops like the Philippine coconut (coco macapunó), better avocados (aguacates), and breadfruit (panapén) improved the local food situation; new forage crops like Para grass (malojillo) and Guinea grass (yerba guinea) improved the pastures for the cattle industry. Details are in Appendix D.

Plants that Failed to Acclimatize. The coca (coca) tree, the source of cocaine, did not survive. Neither did some temperate zone nut trees and the tropical nutmeg (nuez moscada). It was a source of great disappointment to the cattle industry that alfalfa (alfalfa) and red clover (trebol) failed to establish themselves. See Appendix D.

Introduction of New Animals

The chief animal importations were Senegalese, Short-horn, and Jersey cattle to breed with the cattle already on the island. Of minor importance was the bringing in of the silk worm (gusano de seda), the mongoose (mangosta), and the rabbit (conejo). The silk worm was allowed to die out; the mongoose became one of the commonest wild animals on the island; and the rabbit became a minor source of meat.

Transportation

Poor transportation was one of the greatest handicaps to agricultural development throughout the Spanish period. Water transportation was of value only to lands in the immediate port area. Trails covered the island but could be traversed only by mule, horse, or ox, and then only in favorable weather. In bad weather, the torrential rains washed out the trails or made the deep clay soil of the interior so treacherous that even horses and mules would be stuck. Bridges were lacking and numerous stream crossings were not fordable when swollen by sudden rains.

The building of roads was at first nobody's responsibility. Later it was left to the local governments. Finally the insular government began to assume responsibility for some through routes. At the end of the Spanish period there were about 150 miles of all-weather roads in the entire island. The longest stretch was a cobble-stone surfaced road running from San Juan to Ponce, passing through the municipio of Coamo from east to west. (225, p. 10) According to the recollection of old men in the vicinity, the road, called the military highway, was completed in 1874 with labor supplied by prisoners. (314 and 317) A branch road that connected at Cayey with the military highway, was constructed from the city of Guayama northward and opened in 1865. (317) Both roads were supplied with masonry bridges and were well engineered, though narrow by present day standards. By these two connected roads, overland transportation by carriage was opened between Coamo and Guayama, the two largest towns of Southeast Puerto Rico, and between the two important cities of Ponce, the chief port on the south coast, and San Juan, the capital on the north coast.

These roads by no means solved the problems of the inland coffee raiser who was not directly on the highway. He had to depend on pack trains and occasionally, where the trails were wider, ox carts. At the end of the Spanish period one person reported that he paid \$12.80 for one ox-load to go 21 miles, which was several days' journey. (225, p. 11) This was in the time when a laborer received 50 cents (silver) a day.

The opening of the roads in Southeast Puerto Rico brought one major advantage. It provided a way for the food crops raised in the wetter mountain regions to reach the town markets of Coamo and Guayama in all weathers. This was especially important when the disturbed conditions of the Spanish American War period made it difficult to import food.

The Land Holdings

The confused situation as to the status of land ownership began to clear somewhat in 1778 when the king issued a special law which gave the landholders clear titles to their lands in exchange for an annual payment of 1 1/4 reales per cuerda for farm land and 3/4 of a real per cuerda for pasture land. The fees were to go toward supplying and outfitting the militia of the island. (128, p. 189)

Because Spain was at war and communications were cut off, enforcement of the new law did not begin until 1785 when the king named Julian Diaz de Saravia, crown solicitor of Santo Domingo, to reregister all lands beginning in 1786. War with England and the invasion of Spain by France interfered with the carrying out of Diaz de Saravia's task. Delimitation of the public lands was never completed. Most public lands were occupied by squatters who gradually acquired possession through a provision of the Law of the Indies that gave title to land after 40 years of peaceful occupancy. (128, p. 190) By the end of Spanish rule, much of the land in the interior was held under such titles. Such plots were usually small and on

inferior soil. The best lands were still held in large sections by the landed aristocracy, many of whom lived abroad.

By 1898, most of the flat lands along the coast, in Southeast Puerto Rico, were held in large tracts, sometimes by absentee owners. A few of the cane growers, who owned land along the rivers, had been granted water rights in perpetuity, and were permitted to divert water for irrigation. In the semi-arid hills were some large tracts of grazing land, and in the humid upland were some large coffee farms. Elsewhere, scattered throughout, were small and medium sized farms that grew mainly subsistence crops.

Possible Industries that Never Developed

During the period there were some experiments that might have led to new industries. Because there were so many fruits on the island that could not be marketed for one reason or another, efforts were made to distill some to produce fermented drinks. Experiments were conducted on the following:

<u>Spanish</u>	<u>English</u>	<u>Genus and Species</u>
*tamarindo	tamarind	Tamarindus indica
*caimito	star apple	Chrysophyllum Cainito
*níspero	naseberry	Sapota Achras
*guíneo "guarano"	banana	Musa sapientum
*guanábana	sour sop	Annona muricata
*china	sweet orange	Citrus sinensis
*mamey	--	Mammea americana
pomarosa	rose apple	Jambos Jambos
piña carrasqueña	pineapple	Ananas Ananas
*mango "rosa"	rose mango	Mangifera indica

Experiments were also conducted on fermenting the guarapo de caña de azúcar or the juice of the sugar cane as it comes from the crusher. Rum is ordinarily made from the residue after the sugar is removed. (41, p. 221)

Nothing came of all the experiments, though anyone who climbs over the fermenting mangoes in the mountain trails of Southeast Puerto Rico at the height of the mango season must wonder if it might not still be possible to develop a mango liqueur. Certainly there are enough mangoes going to waste.

Other Influences on Land Use

Political awareness came late to the island and only made itself felt just before the Americans took over. When the surge of revolt let loose by the American and French revolutions swept over most of the Spanish colonies in the new world, Puerto Rico was not affected. The upper class were mostly pro-Spanish and most of the lower class were too poor, too ignorant, or too illiterate to be concerned with the outside world.

Invitations of the insurgents of Colombia and Venezuela to join in their fight for liberty were looked on with suspicion. When Colombian insurgents appeared off Patillas in November 1829 and captured some small craft that were in the harbor, the Puerto Ricans thought of the "liberators" as just another sort of freebooter who had come to rob, and met them with guns on the beach when they landed. After eight Colombians were killed, the rest sailed back home, ending the attempt to free

the Puerto Ricans in spite of themselves. (252, p. 144-5)
 Patillas thus lost its chance to become the cradle of Puerto Rican liberty.

Development of Agricultural Societies and Fairs. Organized interest in agriculture began in 1811 when the Spanish Cortes ordered the establishment of La Real Sociedad Economica de Amigos del Pais (The Royal Economic Society of Friends of the Fatherland). The society was organized in Puerto Rico in 1813 with four commissions; 1. Population, 2. Public Instruction, 3. Industries, 4. Agriculture. The Agricultural Commission was to introduce seeds and instruments, to publish information and to give prizes for new developments. The society existed until 1898 and lived up to its aims, introducing new food crops (not always successfully, as in the case of wheat), founding a publication, and in general being helpful to agriculture. One of its recommendations is interesting in the light of subsequent developments. It proposed that the Puerto Rican farmer concentrate on interior commerce first, and exterior commerce second, because imported food was always expensive. (41, p. 88 and p. 244)

A royal order of November 27, 1853 required periodic public expositions under the patronage of the Junta de Comercio y Fomento (Board of Commerce and Development). Fairs that included the exhibit of agricultural products were held under Junta sponsorship in 1854, 1855, and 1860. (139, 140, 84)
 The Real Sociedad de Amigos del Pais sponsored two in 1865 and 1871. (90, 253) Later, by royal order, fairs were held

in 1892 in San Juan (107) and in 1896 in Ponce. (108)

The first local agricultural society was formed in Ponce in 1875. Others followed in Mayaguez and Guayama, the latter being the only local society in Southeast Puerto Rico. (41, p. 110) All three agricultural associations were interested in promoting agricultural fairs. The island-wide Asociación de Agricultores was founded in 1892, and what was even more important, the Banco Territorial y Agrícola in 1894. (41, p. 232-3)

The Agricultural Experiment Stations. Previous to this time, petitions from Ponce in 1876 led to the creation of two agricultural stations by royal law of 1888. One was located at Mayaguez and the other was supposed to be in Bayamón, but was finally located near Rio Piedras on part of a farm in Hato Rey known as Las Monjas. Two Puerto Rican agronomists who had been trained abroad were put in charge. Quintanilla at Mayaguez and Lopez Tuero at Rio Piedras. Because of a delay in receiving equipment from Europe, neither station went into operation until 1890. Both ceased functioning in 1897 for lack of funds. Both stations did good work on informing Puerto Rican farmers of fertilizers, rotation of crops, plant pests, and diseases. Controlled experiments were conducted with most work being done on the export crops of cane, coffee, and tobacco, although the stations did warn the crop growers of the inadaptability of temperate zone crops like clover, alfalfa, and cereals. (41, p. 124)

The rotation of crops never became a widespread practice in growing large-scale crops like cane and coffee, but it did

become a common practice in growing small-scale crops like tobacco, corn, and other food crops. Fertilizers recommended were manure, phosphates from the island of Mona, (southwest of Puerto Rico), bat guano, and various combinations. (41, p. 159) The use of fertilizers never became wide-spread in the Spanish period. The growers of cane were the ones who used the most of the fertilizers and many of them didn't think it worth the bother. Quintanilla at Mayaguez started experimental work on fertilizers -- mainly cane fertilizers -- but Lopez Tuero at Rio Piedras also realized their importance. In 1893 he wrote, "It is deplorable.....the little that the farmers do with fertilizers. They waste the manure, the garbage, and even the waste products of the slaughter-house which would be useful for fertilizer. The rains just wash the good away." (113, p. 102)

Destruction of Timber Trees. At the end of the Spanish period Puerto Rico was deforested from a lumberman's point of view. (244, p. 18) There were about 18 square miles of virgin forest remaining; 8 on the summit of El Yunque in the Sierra Luquillo in the northeast part of the island and another 10 in scattered patches in the Cordillera Central between Aibonito and Adjuntas, to the west and north of Southeast Puerto Rico. (101, p. 20-24) None of these bits of virgin forest were in Southeast Puerto Rico.

The destruction of the lumber trees did not mean that the remaining forests were of no value. Tropical forests rarely contain pure stands but are made up of a variety of species, some of which may never supply usable lumber. A mediocre second-

growth forest in Southeast Puerto Rico can supply fruits and other foods to feed the hill dweller, gourds for his eating utensils, material for his house, cordage for his ropes and bridles, and even saleable materials like bark and seeds for trading in town, and still be worthless as far as supplying saw lumber.

In 1898, Southeast Puerto Rico seemed to possess a considerable amount of forest. There were many large trees to be seen along the road sides and whole mountains appeared to be covered with woods. Many of those mountain sides were covered with coffee plantations, which are actually artificial forests.

The logging off of valuable timber trees proceeded from the shore line inland as population increased and transportation improved. Southeast Puerto Rico was originally covered by three types of forest; 1. mangrove forest on the coast, 2. savanna forest on the playas and foothills, and 3. rain forest rather generally in Patillas but only near the insular divide in other municipios.

The mangroves were used mainly for firewood and the land in mangroves was not thought usable for crops. Those forests persevered although they were much cut for firewood. The mangroves replenished themselves in short order and could be cut for fuel every five years.

The savanna forest was an open type that allowed easy access to valuable individual trees such as dyewoods and ebonies which were in demand for trade, and other hardwoods that were especially valuable for ox-cart construction. There are several reasons why this forest was the first one denuded.

It was mainly on level ground where logging was easy, the markets and ports were close, and the land was in demand for crop raising and grazing. The settlements located in the region made more and more demands for firewood as the population increased. Both Coamo and Guayama, the two largest towns, were located in savanna forest.

The rain forest, on the higher reaches, survived longer. Its inaccessibility kept the lumberman out. As late as 1832 Patillas had good saw wood. (53, v. II, p. 280) Eventually much of the valuable timber fell a victim to the coffee grower rather than the lumberman. The large trees planted for coffee shade were not good lumber trees, being useful only for firewood. Indeed, most coffee growers did a subsidiary business in firewood, selling the trimmings from their shade trees. Some of the valuable trees that survived the coffee growers fell before the wandering charcoal makers who burned charcoal in the hills and freighted it into town on mule back. Other good groves were destroyed by the conuco system of clearing and cropping. By 1878 most of the good timber was gone. A rather detailed study of the island at that time makes no mention of lumbering in any of the six municipios of Southeast Puerto Rico. (215, p. 230-272)

Wood for the construction of country houses was available even after the saw logs were exhausted. The jíbaro hut is built of poles and thatch, both of which can be procured from second-growth trees. Construction of larger city houses, on the other hand, had to depend on imported woods like temperate-zone pine and spruce which did not last long in the tropics. The termites

prefer a diet of imported soft woods to one of native hard woods.

The demand for wood and charcoal for cooking fuel became greater as the population increased. Wood was even used to power the early steam-driven cane-milling machinery. Between the farmer, the cattle-rancher, and the wood-chopper, the natural log woods had no chance to replenish themselves naturally. The only reforestation done, if it can be called that, was the planting of shade trees along roadsides.

(101, p. 46)

There is an opinion held widely throughout Southeast Puerto Rico and expressed independently by old settlers in Coamo (314) and Patillas (320) that clearing the forests from the mountains of Southeast Puerto Rico has made the land to the south much drier than formerly. Because weather data are lacking for the period when the forests existed, no scientific evaluation of this opinion can be made. Certainly the belief has been held for a long time. Flinter, who visited the island in the 1830's wrote that if the island became deforested,

"...water will become scarce; the rivers will dry up; the fields will become scorched savannahs for want of moisture; the cattle will find neither food nor shade from the noon-day sun; and this beautiful and fertile island will at once be deprived of its enchanting verdure, its fertility, and its riches. I am aware that this cannot happen in less than a century." (79, p. 199-200)

It is quite possible that Flinter's idea has gained wide circulation by word of mouth on the island and that he is just as wrong in his assumption as he was in his time estimate.

The entire island became equally deforested without causing the lands to the north of the divide to become dry and sere. The southern lands which were always in the lee of the trade winds seemingly were always dry. How much the degree of dryness was intensified by removal of the forest from many of the high mountains to the north remains to be proven.

Land Use at the End of Spanish Rule

By the end of Spanish rule, Southeast Puerto Rico was divided into six municipios, a division that persists to the present time. In 1889, there were 54,512 people in the area, a five-fold increase over 1776. (245, p. 159-162)

Detailed figures for agricultural land use are available only for the year 1897, which was just before the end of Spanish control. A comparison of the number of farms in 1897 with those in 1776 shows:

<u>Date</u>	<u>SE Puerto Rico</u>	<u>Total Island</u>
1776	389*	5,815**
1897	3,147	60,953

The ten-fold increase in the number of farms in Southeast Puerto Rico is a bit behind the almost twelve-fold increase for the entire island. The number of farms by municipio were:

<u>Date</u>	<u>Coamo</u>	<u>S. Isabel</u>	<u>Salinas</u>	<u>Guayama</u>	<u>Arroyo</u>	<u>Patillas</u>
1897	789	141	227	642	319	1,029

The outstanding feature is the large number of farms in Patillas. Patillas is the eastermost municipio in Southeast

* Actually, 367 farms and 22 ranches.

** Actually, 5,581 farms and 234 ranches.

Puerto Rico and the one receiving the most moisture. It early developed into a locality of small subsistence farms because it had little level land suitable for cane.

Farm ownership figures are not at hand, but it is known that most farms were owner-operated. In 1899 the U. S. War Department Census showed that, for the island as a whole, 91% of the cultivated land was owned by the occupants. (245, p. 18)

Land Use by Cuerdas. A comparison of the types of land use by cuerdas for Southeast Puerto Rico and for the entire island for the years 1776 and 1897 shows:

	Southeast Puerto Rico 1776 cuerdas	1897 cuerdas %	Entire Island 1776 cuerdas	1897 cuerdas %
sugar cane	194	6,179 3	3,156	61,556 3
coffee	346	4,376 2	1,196	122,358 6
tobacco		97 0		4,267 0
frutos menores		4,199 2		93,508 4
bananas	974		8,315	
other crops		1,633 1		17,176 1
cotton	20		103	
pasture		90,217 46		1,127,086 54
woods & waste land		<u>91,776 46</u>		<u>664,270 32</u>
totals		198,477 100%		2,090,221 100%

No totals are given for the 1776 figures because they do not give a complete picture of the acreage. It can be seen at a glance that all the crop land reported for 1776 did not amount to more than one per-cent of the total land of either Southeast Puerto Rico or the entire island.

In 1897 Southeast Puerto Rico had 8% of its land in cultivation as compared to 14% for the entire island. As previously, Southeast Puerto Rico lagged behind the rest of the

island in development of crop land.

Southeast Puerto Rico also had a smaller percentage of land in pasture, and a larger percentage in woods and waste-land (montes y malezas) than the average for the island. The fact that the insular divide practically borders the northern edge of the area and that there are many cuerdas in mangrove swamps on the south coast may account for the large amount of woods and waste land.

It is not possible to trace the increase of acreage by crops except for two crops. Figures for 1776 exist for cane, bananas, coffee, and cotton, but only cane and coffee can be compared. Separate figures for bananas and cotton are not given in 1897. Bananas are included in the figures for frutos menores and cotton figures are included in the figures for "other crops".

In Southeast Puerto Rico cane acreage increased almost 40 times over the 1776 figures, while acreage for the entire island increased 20 times over the 1776 acreage. This means that cane acreage increased in Southeast Puerto Rico at twice the rate it did in the rest of the island.

Coffee acreage increased 12 times over 1776 figures in Southeast Puerto Rico and 101 times for the island as a whole in the same period. Coffee acreage thus increased throughout the island ten times as fast as it did in Southeast Puerto Rico.

Crops.

1. Sugar Cane. Sugar cane, the leading crop, took 3% of the land -- the average for the island. Canelands at

the time were largely limited to the flat playas or alluvial lowlands bordering the island. The municipio of Coamo has no land in playas and Patillas very little.

Southeast Puerto Rico had one natural advantage (that could also be a curse) in the growing of sugar cane. A dry season occurred in what is the northern winter and allowed the cane growers to plan on a harvesting season free from rain. This meant a longer and safer time of cane-cutting, and best of all, a time when the weather forced the cane to change its glucose into sucrose. There were some disadvantages to the dry season; the pastures for the oxen and horses dried up and the animals had to be fed the cane tops during the harvest and be driven into the mountains of the interior to green pastures at the conclusion of the harvest. Sometimes the drought continued for eight, ten and twelve months, in which case all crops were lost. Such droughts did not always cover all the six municipios of Southeast Puerto Rico but were most common in Coamo.

Guayama had three solid years of drought from 1794 through 1796. The Guamaní River which runs by the town of Guayama dried up to its source. The wells went dry. Farmers abandoned their land because they could not pay the tax to the government which had to be paid in meat. In 1841 and again in 1844 drought struck Guayama. Ingenios ground less than a fifth of their normal output. (254, p. 250) What the people of Guayama were slow to realize was that drought was the normal situation for the area and years of a sufficiency of rain were the exception.

All of the cane was grown under an inadequate kind of irrigation. (117, p. 32) The plantation owners had secured concessions from the Spanish crown, usually in perpetuity, and diverted small amounts of water to their cane fields, which were planted close to the rivers. The irrigation systems were small, sometimes composed of brick or masonry canals, some of them resembling miniature Roman aqueducts. The first concessions were granted in 1841. All of the systems used a simple gravity-flow diversion canal. (240, p. 30)

The irrigation water always failed when it was needed most. The short, intermittent streams had water in the rainy season but dried up entirely in dry periods. Even the deep wells, which could be pumped in the ordinary dry season, gave out during protracted dry spells. (117, p. 32)

By 1883 a study project was conducted by some English engineers to look into the possibilities of irrigating large areas on the south coast. Investigations were made in Santa Isabel and the municipio to the west, Juana Diaz, and the opinion was voiced that water could be diverted from two rivers north of the divide, the Matrullas and the Toro Negro, for irrigating those two municipios.

Bridge builders, sinking piles for a bridge over the Guamaní River near Guayama, struck water close to the surface and became convinced that underground water was equally close to the surface throughout the immediate vicinity. An ambitious scheme was devised of sinking up to 800 wells from Ponce to Guayama and laying tracks to allow a pump on wheels to run from one well to another and bring up subterranean water for irriga-

tion purposes. Perhaps the most grandiose scheme was to construct a canal completely around the island, tapping the lower courses of all the rivers and diverting water from where there was an excess to where there was a dearth. (41, p. 270-272) Nothing came of any of these schemes because of the lack of capital. No geologic or hydrologic studies were made to determine whether or not the projects were physically feasible.

One last fact should be added about the method of cane raising practiced on the south coast. In all other parts of the island cane fields were grown in association with pasture and food crops so that the oxen and slaves could be fed from sources near at hand. In the south, because of the drought, pasture and food crops were not grown in conjunction with the cane but the cane was grown in continuous fields. Flinter in 1834 remarked on the "cultivation of cane without any pasture land" on the south coast. (79, p. 178) Continuous fields of cane did not become common throughout the island until the Americans took over. With the coastal land of Southeast Puerto Rico devoted increasingly to cane, pasture had to be found for the cattle farther inland and food crops had to be brought from inland or from abroad through the port of Arroyo.

2. Coffee. Coffee-growing in Southeast Puerto Rico, in 1897 was less important than cane-growing, although for the island as a whole coffee was the most important crop. It will be remembered that in 1776 Southeast Puerto Rico, together with Ponce, led the island in coffee acreage. This was when the cultivation of coffee was beginning, and most of the trees

were planted on the hillsides nearest the coast. With the improvement of transportation, coffee culture migrated to the interior of the island and the main production area shifted to the north and west of Southeast Puerto Rico. Coffee-growing could not have expanded in Southeast Puerto Rico in any event. Only small areas in Coamo, Guayama, and Patillas receive sufficient rainfall. (313, 314, 323)

3. Tobacco. Tobacco became a minor crop as far as acreage is concerned. It is always difficult to estimate the cuerdas in tobacco because tobacco is commonly one of a series of crops grown on the same land during the year. The rotation usually goes from tobacco to frutos menores and then to pasture. Tobacco land may be growing corn when a census is taken. Tobacco took up .04 of 1% of the land of Southeast Puerto Rico as compared to .2 of 1% for the island as a whole.

During the period, the quality of the tobacco raised in Southeast Puerto Rico declined. After 1850, superior tobacco was raised in the Cayey valley to the north. Production in Southeast Puerto Rico became unimportant.

The three preceding crops were the main cash crops of the island. Producers of cash crops rarely raised their own food but depended on imported food inasmuch as the local producers of food did not raise enough to feed the island. It was estimated in 1895 that the average cash crop grower imported 50 cents worth of rice, flour, fish, etc., for subsistence to enable him to produce one dollar's worth of sugar, coffee, and tobacco for export. If there was any failure in the

dollar crop, or if it sold for less than 50 cents, money had to be borrowed to pay for the 50 cents worth of food. (225, p. 27)

4. Frutos Menores. Southeast Puerto Rico has never been a big producer of frutos menores. Coamo and Patillas led in acreage, an indication that such crops tended to be grown in the higher lands. Jose Antonio Vazquez, writing about Guayama in 1848 said that that locality, more than most others, depended on foreign food. (254, p. 250) J. T. O'Neil, writing in 1861, seems to have put his finger on the problem when he wrote of Puerto Rico: (143, p. 157)

"Notwithstanding the suitability of the soil for both maize and rice, the cultivation of them (especially the second) is quite inadequate to the consumption, and it seems to be a rule that wherever sugar, tobacco, coffee, or cotton are the staple products, that country, though capable of producing the necessaries of life will depend upon others for most of them."

There was less profit in raising frutos menores than in growing cash crops. Frutos menores were grown where cash crops would not grow or where transportation costs made coffee-raising uneconomical. Of course, some frutos menores were grown around every settlement and it was a common practice, which is still followed, to allow slaves or agregados to have a piece of land, called a conuco anual upon which to raise food for the family. (254, p. 250) Slaves and agregados were also allowed to own fowl, pigs, and even horses and cows. (79, p. 247)

From the evidence of old farmers still living in the area, it would seem that Southeast Puerto Rico, particularly Coamo and Patillas, was more nearly self-sufficient in food raising in Spanish times than it has been since. (320, 324)

There are no figures to prove it, mainly because most of the frutos menores were consumed locally and did not enter into trade, but the chief crops were plantain (plátano), banana (guineo), rice (arroz), corn (maíz), sweet potato (batata), tanager (yautía), taro (malanga), manioc (yuca), and yam (ñame). Plantain, the chief food crop, was grown in the coffee plantations for coffee shade. The orange, the chief fruit, was similarly grown.

Of all the leading frutos menores, corn, sweet potato, yautía, and yuca were the only ones grown by the Borinquen Indians. By the end of the Spanish period, the aboriginal food crops had almost gone the way of the aborigines.

5. Other Crops. The "other crops" in the 1897 statistics included such crops as cotton and malagueta, the bay tree from which bay oil is derived. Southeast Puerto Rico devoted the same percentage to "other crops" that the rest of the island did, exactly .8 of 1%.

Land Use by Municipios. The following figures are for 1897. (47)

	Coamo	S. Isabel	Salinas	Guayama	Arroyo	Patillas
sugar cane	56	1,328	906	2,261	38	1,590
coffee	1,580	2	232	1,286	244	1,032
tobacco	3	20	0	35	7	32
food crops	1,675	159	529	742	332	762
other crops	271	12	157	105	20	1,068
pasture	24,340	13,102	21,499	16,945	6,226	8,105
woods & waste land	<u>25,094</u>	<u>7,052</u>	<u>20,492</u>	<u>18,756</u>	<u>3,054</u>	<u>17,328</u>
cuerdas	53,019	21,675	43,815	40,130	9,921	29,917

Pasture and woods and waste land occupied a large majority of the land in all six municipios. Patillas, Guayama, and Coamo had a larger percentage of woods and waste than they did pasture. This is probably because all three municipios extend to the insular divide and have a good deal of land that is inaccessible. Land lumbered off would go into waste land (maleza), rather than be grazed in such cases. Salinas, which also has territory running back to the insular divide, had a more equal division of pasture and woods and waste land. This is probably because of the broad valley extending far inland into the municipio.

Two municipios, Santa Isabel and Arroyo, have a preponderance of pasture over woods and waste land. Both municipios have a good deal of lowland. Santa Isabel is almost entirely lowland. Neither municipio extends far inland, and land, once cleared, being largely lowland, would go into grazing land for two reasons; the dryness of the lowland over

the higher land and the nearness of the lowland to the markets.

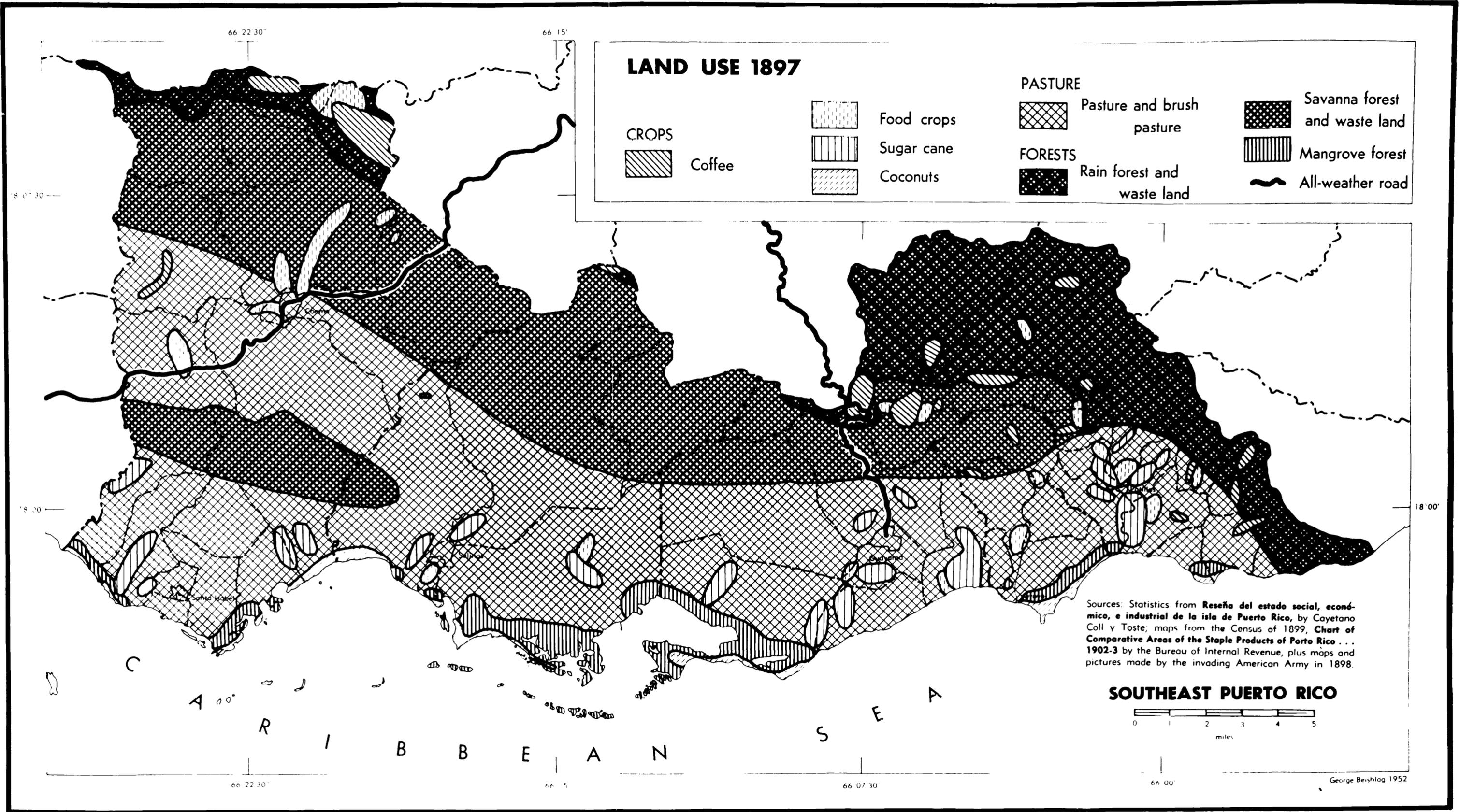
The cuerdas totals given for the municipios are, in every case, the figures given in the Spanish source. (47) Those figures were arrived at before the island was accurately surveyed and are a bit too large.*

The accompanying map of land use in 1897 is a mixture of accuracy and approximation. The mangrove forests are precisely located. The crop lands are only approximately located within each municipio and are shown concentrated, not fragmented among farms as they actually were. Least accurately located are the pastures and rain and savanna forests. They occupy the correct proportion of area in each municipio but are generalized for lack of locational data.

Inasmuch as the original forests were destroyed by 1897, the forest classifications are not strictly correct. Most of the forests were more properly waste land or maleza. Even the mangrove forests were largely cut off, although they replaced themselves with more mangrove forest, not with waste land.

An interesting change between 1776 and 1897 was the growing of palms on the formerly little-used sandy beaches.

* The estimated number of cuerdas in Southeast Puerto Rico in 1897 was 198,477. The US Census of 1950 estimated the number of cuerdas at 164,656 which was 33,821 cuerdas less than the 1897 figure.



LAND USE 1897

CROPS

 Coffee

 Food crops

 Sugar cane

 Coconuts

PASTURE

 Pasture and brush pasture

FORESTS

 Rain forest and waste land

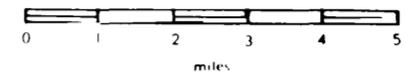
 Savanna forest and waste land

 Mangrove forest

 All-weather road

Sources: Statistics from *Reseña del estado social, económico, e industrial de la isla de Puerto Rico*, by Coyetano Coll y Toste; maps from the Census of 1899, *Chart of Comparative Areas of the Staple Products of Porto Rico . . . 1902-3* by the Bureau of Internal Revenue, plus maps and pictures made by the invading American Army in 1898.

SOUTHEAST PUERTO RICO



Animal Raising. A comparison of the growth of animal raising is shown in the following chart:

	Southeast Puerto Rico		Entire Island	
	1776	1897	1776	1897
horses	3,580	8,157	23,195	65,751
mules	427	652	1,524	4,467
donkeys	--	113	--	717
cattle	8,930	26,284	77,384	303,612
sheep	} 4,356	327	} 49,050	2,055
goats		983		5,779
pigs		989		13,411
total	17,293	37,505	151,153	395,792

Horses and cattle continued to be the dominant animals raised in Southeast Puerto Rico throughout the period, although the rate of increase was not as large for either animal in Southeast Puerto Rico as it was in the island as a whole. The number of horses doubled in Southeast Puerto Rico and nearly trebled in the island. Cattle increased three times in Southeast Puerto Rico and almost four times in the island as the cattle industry shifted from the production of hides for export to the production of meat animals and work oxen. Mules did not increase as fast in Southeast Puerto Rico as in the island. Sheep, goats, and pigs declined both in the area and in the island as a whole. Sheep and goats were never numerous. The great decline seems to have been in pigs which had been raised almost wild like cattle before 1776.

No comparable figures exist for domestic fowl, which were never raised in large flocks as in the United States. Each family had a few. All of them were in poor condition for

various reasons. Some degenerated in the tropics, others found new enemies to worry them; but all, except the fighting cock, suffered from general lack of care.

An animal that seems to have disappeared in this period is the perro cimarrón (the wild dog), which lived in bands in the mountains in the center of the island. They were descended from the dogs of the early settlers and had been useful as scavengers during the times of the early hatos, but had become quite a nuisance because of their habit of attacking smaller animals like sheep and goats. They were numerous in 1797 (110, p. 198) but seem to have dwindled numerically as the population increased. Perhaps the clearing of the forests in the coffee-growing fever of 1876 removed their last place of refuge. Because they domesticated easily when caught young, their descendants are doubtless still on the island.

The figures for animals by municipio in 1897 follow:

	Coamo	S.Isabel	Salinas	Guayama	Arroyo	Patillas
horses	1,897	919	2,102	1,478	644	1,117
mules	387	6	186	52	8	13
donkeys	31	15	39	21	3	4
cattle	4,766	3,816	7,039	5,279	2,242	3,142
sheep	2	94	134	96	1	0
goats	38	38	490	2	146	269
pigs	<u>37</u>	<u>46</u>	<u>324</u>	<u>56</u>	<u>201</u>	<u>325</u>
total	7,158	4,934	10,314	6,984	3,245	4,870

Salinas was the leading animal-raising municipio followed by Coamo and Guayama. Both Salinas and Coamo had much good pasture land; Salinas had a port through which the animals could be exported. Guayama had more land usable for sugar

cane than either of the two other leading animal producers and would naturally put as much land as feasible into the better-paying cane crop.

Summary

Between 1777 and 1898, the population grew and its composition changed. The two-class system of society continued. The propertied class remained dominantly white, although some colored acquired land. The freeing of the slaves brought an end to the importation of Negroes. The changing of immigration rules after 1815 allowed an influx of skilled and wealthy whites who took over leadership in export agriculture.

Additional plants and animals were introduced from abroad. It was discovered that a plant could adjust climatically and not be a success financially as an export crop. The most important plant introductions were the Cheribon sugar canes that were planted when the Tahitian cane became diseased. Coffee and sugar were the most important export crops.

The introduction of forage crops coincided with the clearing of land and aided the growth of the cattle industry which shifted from the production of hides for export to the production of meat animals and work oxen.

Many of the animal introductions were to strengthen the degenerating stocks on the island.

Transportation on land was still by animal. Pack horses and mules could travel the poorest trails, but oxen and carts could be used wherever roads were improved. There was one

all-weather, cobble-stone road in Southeast Puerto Rico.

The change in the system of land ownership from usufruct to full ownership enabled the large landowners (some of them absentee owners) to obtain title to the best lands. Failure to delimit the public lands allowed many small landowners to obtain legal title to small holdings in the hills. The first irrigation works were constructed on the alluvial plain.

Government policies liberalized immigration and opened the ports to trade. Trade to the outside was based on a few agricultural products. Development of agricultural societies and fairs led to the creation of two Agricultural Experiment Stations, which fostered scientific agriculture, but which operated only from 1890 to 1897.

Crop raising became differentiated into two types: the raising of crops for export, upon which most care was lavished, and the raising of crops for local consumption, which was left to the untender care of the ignorant.

The destruction of timber trees was in keeping with a tendency to destroy the natural vegetation of the area which had begun with the coming of the white man.

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CHAPTER VI

LAND USE UNDER THE AMERICANS 1898 TO 1951

The Population

Changes in Population. Between 1899 and 1950, the population of Southeast Puerto Rico, as well as that of the entire island, has slightly more than doubled. The following chart gives the population figures and the percentages by color.

SOUTHEAST PUERTO RICO (245, 223)

	1899		1950	
white	24,256	44%	84,063	66%
non-white	<u>30,256</u>	<u>56%</u>	<u>43,929</u>	<u>34%</u>
total	54,512	100%	127,992	100%

TOTAL PUERTO RICO

	1899		1950 (estimate)	
white	589,426	62%	1,776,000	80%
non-white	<u>363,817</u>	<u>38%</u>	<u>435,000</u>	<u>20%</u>
total	953,243	100%	2,211,000	100%

A comparison of this chart with the one in Chapter V showing the populations in 1776 and 1899 shows a continuing trend toward the increase of whites at the expense of non-whites. If the figures are to be believed, Southeast Puerto Rico had only 24% whites in 1776 and 66% in 1950. Similarly the island has changed from 37% white in 1776 to 80% in 1950.

An American visiting the island, carrying with him US

standards of race and racial mixtures, will immediately conclude that the figures are meaningless inasmuch as dark skin and kinky hair are possessed by many more than 20% of the island's population. When it is understood how the census is taken, the figures become meaningful. Under American administration the census taker asks the individual what his race is. The answer shows what race the individual considers himself to be. Since the prestige race is white, each person wants to be called white if it is at all possible. White ancestry is put forth as proof of membership in the white race. This being so, the large number of people who claim to be white is definite proof of the continuing mixing of races on the island. Negro immigration stopped long ago; fewer and fewer pure blood Negroes remain as more and more of the population can claim a white ancestor.

Another factor that would tend to throw more mixed-blood people into the white category is the population categories used in recent censuses. Race is not subdivided into white, mixed, and Negro but simply into white and non-white.

If immigration from the outside does not recommence, it is safe to assume that, given time, a rather uniform racial mixture will result on the island. Whether it should be called white is of little importance. At present there is a small group of definite whites who pride themselves on their lack of colored blood, a small group of definite Negroes who are black-skinned and kinky-haired, and a large group of mixed bloods who exhibit all shades of skin and variety of hair.

The small group of whites are mainly descended from immigrants of the 19th or 20th centuries. They and the mixed blood people make up the 80% white estimated for the island for 1950. Only the undeniably Negro will admit to being a part of the 20% non-whites.

Perhaps the most interesting fact to be gathered from the population statistics is that Southeast Puerto Rico has always been darker than the average for the island. By whatever criterion, the area under study has consistently been approximately 20% more Negro than the whole of Puerto Rico. This may indicate a relative stability of racial population which cannot be proved on the basis of present statistics. Information on intra-island migration between municipios was collected for the 1950 census but is not yet available for study.

The increase in population in the last 50 years may be largely due to the better health and sanitary conditions brought by the Americans. The decline in the death rate seems to have been more responsible for the increase in population than any increase in birth rate. (231, 1936, p. 6)

The following chart gives details of the population of Southeast Puerto Rico by municipios. A comparison with the similar chart in Chapter V makes it possible to see changes from 1899 to 1950. In 1899 only Guayama was dominantly white, and that by a narrow margin. Coamo and Patillas were nearest evenly divided. Santa Isabel, Salinas, and Arroyo were dominantly dark. By 1950, according to the statistics, the situation had changed. (223)

	Coamo	S. Isabel	Salinas	Guayama	Arroyo	Patillas
white	22,222	9,824	12,621	21,573	5,932	11,891
non-white	<u>4,263</u>	<u>3,654</u>	<u>10,814</u>	<u>11,234</u>	<u>7,004</u>	<u>6,960</u>
totals	26,485	13,478	23,435	32,807	12,936	18,851

Only Arroyo admitted to being dominantly dark. Salinas was the nearest evenly divided. The four other municipios were overwhelmingly white. The correctness of the Arroyo figures seems to be borne out by the fact that the municipio of Arroyo has a Negro alcalde (mayor) and that the municipio is known locally as the blackest one on the south coast.

The change in racial composition of the population of Southeast Puerto Rico is less startling than the change in total population of the municipios. From 1899 to 1950, while the population of the island more than doubled, two municipios, Coamo and Patillas, did not keep pace. On the other hand, Santa Isabel and Guayama more than doubled in population, Arroyo increased three times, and Salinas more than four times. The picture of the change by barrios is given on the map, Population: percentage of Change 1899 to 1950.

This map contradicts the idea that Puerto Rico is becoming evenly over-populated by showing that seven barrios in Southeast Puerto Rico have less population today than in Spanish times. Furthermore, of the 56 barrios in Southeast Puerto Rico, including urban barrios, only 24 increased 100% in population; 32 did not. On the other hand, the barrios that did increase sometimes made phenomenal gains. In Arroyo and Salinas some barrio populations increased three and four times. The great-

est increase was in barrio Aguirre of Salinas, over six times.

The uneven increases in population cannot be explained on the basis of natural increase but must have been due to migrations, either from abroad or within the island. Information given below proves that immigration from abroad was negligible, therefore intra-island shifts must have caused the new population pattern. The reason for the shift was the development of irrigated cane-growing on the coastal lowlands. The declines in the interior barrios are due to the lessening importance of coffee-growing and the abandonment of subsistence farms by farm labor that moved to the lucrative cane fields or to the municipio capitals.

Few immigrants came in after 1900. In the census of 1940 only 313 foreign-born were found in all Southeast Puerto Rico. Over 99% of the population was native-born. So unimportant is the factor of foreign birth in population problems that the 1950 census does not include it.

In 1897, as a chart in Chapter V shows, there were 890 foreign-born in Southeast Puerto Rico. Most were of Spanish descent and the majority were located in Guayama. Between 1899 and 1910 a spurt of immigration brought in Americans from the United States and possessions plus some immigrants from nearby islands. After 1910, immigration from abroad ceased to be important. (231, 1936, p. 6) The following chart of foreign-born in Southeast Puerto Rico in 1940 shows that Salinas has replaced Guayama as the leader in foreign-born and that the United States, as was to be expected, has replaced Spain as

the source of immigrants. Another fact that is not readily seen from the charts is that most of the immigrants were high type, those with money or with skills. Not a foreign-born Negro remained on the island in 1940, which proves that none had come in for some time previously.

It is not surprising that, under American domination, some of the chief commercial enterprises should be under American control. Americans also took over leadership in commercial agriculture much as the Spanish and French immigrants had done in previous centuries.

Foreign-born reported in the Census of 1940: (219, p. 47)

	Coamo	S.Isabel	Salinas	Guayama	Arroyo	Patillas	total
United States	5	2	77	41	14	2	141
US territories & possessions	4	2	18	4	4	5	37
Spain	2	3	15	25	6	4	55
W.Indies*	3		7	4	6		20
Cuba		1	4	9	1		15
France	1	1	2	8	1	2	15
GB & Ireland			8	2			10
Palestine & Syria			1	6		2	9
C&S America				2	2		4
Mexico	1	1		1			3
Italy				2			2
Germany					1		1
Canada	—	—	1	—	—	—	—
totals	16	10	133	104	35	15	313

The above chart shows that Salinas has more foreign-born than any other municipio although it is closely followed by Guayama. The rise of the Central Aguirre interests in the municipio of Salinas accounts for the large number of Americans,

* Excluding Cuba

who are mainly technicians and administrators. Guayama with its commercial and administrative functions would draw many Americans as well as some Spaniards. The decline in the purely port functions of Arroyo with the development of paved highways on the island would reduce the importance of Arroyo and lessen its interest for foreigners with money.

The Agricultural Labor Force in 1940. Agriculture remained the most important industry in Southeast Puerto Rico as it did in the rest of the island. The main change over the situation in 1899 was that less than half of the labor force was in agriculture. As can be seen from the following chart, 46% of the Southeast Puerto Rican labor force and 48% of the total island labor force was employed in agriculture in 1940: (219, p. 48-64)

	SE Puerto Rico		Total Puerto Rico	
Total labor force	37,004	100%	471,990	100%
Agricultural labor force	17,182	46%	228,811	48%
Sugar Farms	12,181	33%	123,886	26%
Tobacco Farms	638	1.6%	18,171	4%
Coffee Farms	568	1.4%	25,594	6%
Other Farms	3,795	10%	61,160	12%

The drop in the percentage employed in agriculture is not an indication that agriculture became less important, but rather that the higher standard of living now enjoyed by most of the people of the island requires more non-agricultural labor than the lower standard of 1899.

As compared to the rest of the island, Southeast Puerto

Rico employs more of its agricultural workers on cane plantations than on tobacco, coffee, or other farms. The other farms grow subsistence crops in Southeast Puerto Rico but also grow cotton, pineapple, and citrus fruits in other parts of the island.

The figures for municipios in Southeast Puerto Rico are even more enlightening. (219, p. 48-64)

	Coamo	S.Isabel	Salinas	Guayama	Arroyo	Patillas
Total labor force	7,861	3,783	6,063	10,440	3,482	5,375
Agricultural labor force	3,012	2,240	3,048	4,018	1,418	3,446
Sugar Farms	787	2,207	2,697	3,206	1,318	1,966
Tobacco Farms	439	4	57	67	0	71
Coffee Farms	372	0	25	22	36	113
Other Farms	1,414	29	269	723	64	1,296

The municipios having large stretches of coastal lowland, Santa Isabel, Salinas, Guayama, and Arroyo employ most of their agricultural workers in cane raising. Coamo and Patillas employ considerable farm labor on "other farms". Coamo has a surprising number of cane workers, 787, considering the fact that there was only one farm in Coamo that raised any cane at all in 1951. The answer is that cane workers live in Coamo and commute to work in the cane fields of Santa Isabel and Salinas over the paved highways. During the 20th century mobility has come even to the ordinary laborer.

Introduction of New Plants

Sugar Cane. Sugar cane was the most important crop in Southeast Puerto Rico in 1898 but the industry was in a sorry

condition. In 1872 a root disease had attacked the Tahitian cane, the chief kind grown, and caused it to be replaced by the various Cheribon canes from Java; crystalina, rayada, and morada. Cultivation continued to be haphazard and fertilizers were rarely employed. The Cheribons did not mill as easily as the soft Tahitian cane and the juices were harder to handle under the open-kettle methods in use at the time. (72, p. 8) Judged by present-day canes, the Cheribons were low yielders. To make a poor situation worse, the small cane mills then in operation extracted no more than 60% of the sugar that could now be obtained. (130, p. 124) The central system of milling was already operating in some of the nearby British islands, enabling those operators to extract more sugar from their cane. Puerto Rican sugar growers were going bankrupt from backward technology even before the price of sugar fell. For ten years prior to the American occupation, sugar sold for from 1.7 to 2 cents a pound. (225, p. 15) Many planters let their cane fields go back to pasture land and went out of the sugar business. To top it all, a hurricane reduced the 1899 export of sugar to only 35,000 tons for the whole island. Export had not been that low since 1843. In 1870, just before the root disease struck, export had been 105,000 tons. (60, Vol. I, p. 126)

The American occupation revived the sugar industry. When the island became an American possession, the sugar producers were immediately protected by the U.S. tariff wall and given direct access to the profitable American market. The reduced

1899 crop sold for $3\frac{1}{2}$ to 4 cents a pound and the sugar industry was in business again. (225, p. 15) A boom like the opening of the US west resulted. American investment capital flowed to the island, buying out many of the disgruntled Spanish land owners who were glad enough to sell out and return to Spain. Much of the American capital went into buying land, but more went into building modern centrals, or sugar mills, which reduced the cost of producing sugar and recovered more sugar from the cane.

There was one hindrance to the growth of the central system. A central must have a large and controlled supply of cane if it is to operate efficiently. The easiest way to ensure a continuous supply of cane during the grinding season is to own and operate large areas of cane land. However, the United States Congress, fearing the monopoly of land by the trusts, enacted Joint Resolution No. 23 on May 1, 1900 (170, p. 6) restricting the land holdings of corporations to no more than 500 acres. This rule made American capitalists reluctant to invest the money needed to build centrals and might have prevented the modernization of the industry if a way had not been found to circumvent the law. Puerto Rican authorities decided that they were under no obligation to enforce a Federal law; enforcement was the duty of the U.S. Attorney General. When the U.S. Attorney General took no action, capital flowed into the island and modernization of sugar milling got underway. The first large-scale central was Guánica of the South Porto Rico Sugar Company, erected in 1903 close to the

place where the U. S. troops made their first landing in 1898. (60 Vol. I, p. 126)

At the present time, there are five centrals in Southeast Puerto Rico. Three of the five are controlled by an American trust, the Central Aguirre Associates, (incorporated by Boston capitalists in 1905), which built Central Aguirre in Salinas municipio. In 1920 the company purchased a controlling interest in Central Machete in Guayama municipio and in 1924 obtained control of Central Cortada in Santa Isabel municipio. (130, p. 124-5) Present cane grinding capacities are: (89, p. 21)

Central Aguirre	4600 tons per 24 hours
Central Machete	1800
Central Cortada	<u>1200</u>
total	7600 tons per 24 hours

The two other centrals are under Puerto Rican control and management. Central Guamaní, one of the newest on the island, was built in 1930 by two wealthy Puerto Ricans, Genaro Cautiño Insúa and Juan González, and since their deaths has been administered by the successors. Central Lafayette, built earlier by the local Corsican family of Fantauzzi, has been operated since 1936 by a Puerto Rican cooperative called Asociación Azucarera Cooperativa Lafayette. Grinding capacities of the two centrals are:

Central Guamaní	1200 tons per 24 hours
Central Lafayette	<u>3000</u>
total	4200 tons per 24 hours

The five centrals grind all the cane produced in Southeast Puerto Rico. The largest percentage of the cane is grown by Luce and Company, an American colono firm that supplies the three American centrals. A colono is an independent land owner who grows cane and sells it, under contract, through a central which grinds the cane for a designated percentage and markets it for the best price procurable. The colono system sometimes works to the advantage of the central and to the disadvantage of the colono but it also allows the small farmer to market his cane. In Spanish days each cane grower almost had to have his own trapiche in order to get his crop ground.

There is little doubt that the setting up of two corporations, Luce and Company for cane growing and Central Aguirre for cane grinding, was an effort on the part of the American owners of Central Aguirre Associates to be ready for any possible future crack-down under the 500 acre law. Neither the Puerto Rican owners of the Central Guamaní nor the cooperative owners of Central Lafayette need fear the 500 acre law.

The most important advance for the sugar producers was the opening of the irrigation works and the development of pumping. Sugar cane does not yield well with less than 60 inches of rainfall annually. (182, p. 56) Luce and Company try to supplement the rainfall so that each field will receive the equivalent of 100 inches of rain. It is hard to measure the improvement in cane yields due to irrigation because the growing of better varieties of cane and the applying of fertilizer also increase yields. The head of the Irrigation Service, Antonio Lucchetti, estimated in 1930 that the average crop of sugar produced in the lands of the Irrigation District

during the seven years from 1909 to 1915, when the service began, was about 54,000 tons of sugar. From 1915 to 1930 the yearly average was 104,000 tons, an average increase of 50,000 tons of sugar in the crop produced each year under irrigation. The value of the 50,000 tons was estimated at not less than four million dollars. (117, p. 35) When it is remembered that the irrigation works cost only five million dollars, it is easy to see that the investment was well worth while. The increased production was not entirely due to increased yields on established fields. Many new fields that had never been in cane went into production with the availability of irrigation water. Most of the new cane land had previously been in pasture and had never been cultivated. Using virgin lands gave the growers of Southeast Puerto Rico an advantage over growers in other parts of the island. The new cane lands had developed under semi-arid conditions and contained valuable plant nutrients. The old lands in other parts of the island had been cropped for hundreds of years and had lost their plant nutrients either to the action of the rain or to the years of continuous cropping.

The advantage of rich soil has been maintained by most of the cane growers in the south because fertilization became a practice before the soils were exhausted. Without a doubt, the highest yields per acre on the island both of cane and of sucrose content are obtained by Luce and Company. Where cane on hill land in wetter parts of the island may yield as little as 15 tons of cane to the acre, gran cultura cane on the best lands in Southeast Puerto Rico has yielded up to 100 tons to the acre.

On occasion, the cane industry of Southeast Puerto Rico had its perilous moments. A mysterious disease, which proved to be a virus infection, attacked the cane in the western part of the island in 1915. The leaves developed yellow spots and the yields went down. Named the Mosaic disease (el matizado or mosaico) from the appearance of the plant, the virus spread to the northwest and southwest and threatened to destroy the industry. By 1921 the disease was at its height, although it, fortunately, never became dangerous in Southeast Puerto Rico. As before, when the root disease attacked the Tahitian cane in Spanish times, a search was made for an immune cane. Uba, a hitherto-worthless slender cane from India which had come to Puerto Rico via Argentina, was found to be immune. Planting Uba in infected fields gradually eliminated the worst of the disease, although some infection lingers to the present time.

Southeast Puerto Rico, luckily, was not greatly affected by Mosaic and continued to grow the susceptible crystalina because it yielded better under irrigation than Uba. Meanwhile, cane breeding, which had commenced in various parts of the world about 1905, began to produce promising new hybrids. Some were found to be immune, or nearly immune, to the Mosaic. Among the new hybrids were two-thick-stemmed canes, BH 10(12) and SC 12(4), which proved to be so superior in tonnage and sugar yield to crystalina that most of the growers on the irrigated soils changed over between 1925 and 1929. This varietal revolution on the south coast was caused by the Mosaic even if the disease did not infest the area.

In other parts of the island, Mosaic continued to be such a threat that BH 10(12) and SC 12(4), which proved to be susceptible, could not be planted. Immune varieties like the Javanese hybrids POJ 2725 and POJ 2878 became the main canes. All of the POJ canes are slender and less productive than the thick-stemmed canes.

At the present time, the most popular cane on the island is the Mosaic-proof POJ 2878. BH 10(12) dominates the irrigated lands of Southeast Puerto Rico and will probably continue to do so unless the Mosaic becomes more of a threat or a more productive variety shows up. The non-irrigated cane fields of Southeast Puerto Rico (See Map of Irrigation System and Land in Sugar Cane 1951) grow the island favorite POJ 2878. Many other varieties of hybrid cane are under test in hopes that a cane as Mosaic-resistant as POJ 2878 and as productive as BH 10(12) may be found. (For more information on cane varieties, see Appendix E.)

The following chart shows the 1949 crop acreage by variety for each of the six municipios of Southeast Puerto Rico.(205)

	Coamo	S.	Isabel	Salinas	Guayama	Arroyo	Patillas	total
BH 10(12)		7,179	4,098	5,564	2,233	982		20,056
POJ 2878	63	1,154	1,108	347	960	3,128		6,760
POJ 2961		90	24	345	17			476
M 275			22		257	50		329
PR 903		10	131	59	20			220
B 37161		193	13	1				207
M 336				93		19		112
PR 902		1		66				67
M 317				33				33
SC 12(4)						10		10
PR 905			3					3
Others		<u>249</u>	<u>207</u>	<u>207</u>	<u>41</u>	<u>8</u>		<u>712</u>
total	63	8,876	5,606	6,715	3,528	4,197		28,985

Cane grinding has become big business but it is well to remember that cane growing is not as completely in the hands of the few. The Puerto Rican land owner who still has his cane land, can reap profits from leasing it to one of the large colono firms or he can grow cane as a colono and market it on contract through a central.

Throughout the island, there was a 74% increase in cane acreage between 1939 and 1952. (192, p. 52) This was due largely to the attempts of the federal government to insure a stable sugar supply for the United States.

An Act of Congress in 1934 created a quota system under which the U.S.D.A. was to estimate the sugar needs each year and to designate how much sugar each producing

area could sell in the U.S. market. The current act, passed in 1948, was extended, in 1951, to the end of 1956.

(68, p. 29)

Under present operating rules, the U.S.D.A. not only sets a quota for Puerto Rico but also pays a subsidy to Puerto Rican producers of sugar. Payments to cane growers vary from 80¢ per 100 pounds of raw sugar for the first 350 short tons of sugar produced on a farm, to a minimum of 30¢ per 100 pounds for raw sugar produced in excess of 30,000 short tons on a farm. (232, p. 40) To support the act, a special tax of 50¢ per 100 pounds of raw sugar is collected when the sugar is brought into the continental United States. (232, p. 5)

Payments are conditional on compliance with fair labor practices, fair payment practices for cane purchased by mill owners from colonos, and the marketing of the sugar within the quota assigned. (232, p. 5) Quotas are assigned to centrals, not to sugar farmers.

From the first, the sugar quota system has operated to increase acreage in cane throughout Puerto Rico. Subsidy payments were made to all cane growers, and the higher payments to small operators tempted small land owners to plant cane on land that was better suited to other uses. New plantings of non-irrigated cane were made recently in Patillas, and new cane lands that will be pump-irrigated were being broken in Salinas in 1951. Furthermore, subsidy payments were made on all cane grown, whether or not it could be marketed within the U.S. quota for Puerto Rico. The re-

restrictions of the act were applied to sugar marketing, not to cane growing.

Fortunately for Puerto Rico, the quota system proved very elastic for a while. The provisions were relaxed during World War II. From time to time, Puerto Rico was given a temporary increase in quota when another producing area failed to meet its quota.

Gradually, however, a sugar surplus was built up in the warehouses of the island. As economic pressure increased, attacks were made on the validity of the Sugar Act of 1948. In an attempt to destroy the act and the sugar quota system, two centrals and the insular government, itself, carried a test of the constitutionality of the law to the U.S. Supreme Court. Early in 1950, the Court affirmed the constitutionality of the law. (67, p. 29)

By December 1952, the sugar surplus was estimated at 286,000 tons. (195, p. 57) There was little incentive to dispose of the surplus in the open world market. In 1952, the world price was \$4.75 per 100 pounds f.o.b. Cuba. The New York price was \$5.95 per 100 pounds, duty paid. (191, p. 52) The central owners, who had the sugar to sell, had paid the growers for it, according to the U.S. sugar rules, on the basis of the New York price. (192, p. 5)

There are indications that the sugar surplus problem may be attacked by restricting the acreage for the 1953 crop of cane. The federal government required a new application for the 1953 sugar subsidy and contemplated assigning acreages to growers and reducing the sugar subsidy on

additional sugar grown. (191, p. 52) It is difficult to restrict production to definite limits by restricting acreage. Tonnages of cane vary according to moisture available and fertilizers applied, as well as according to variety of cane grown. Sucrose content of cane, which determines how much raw sugar is obtained, may vary considerably from year to year. The 1952 sucrose content was the lowest in the past 27 years, principally because of rain at harvest time. (192, p. 52)

Some of the sugar producers of Puerto Rico are beginning to realize that the surplus problem will not be solved by an incessant clamor for a higher sugar quota. Luce and Company, who supply cane to Central Aguirre Associates, are experimenting with growing long staple cotton on irrigated land. A trial plot of 200 acres was planted to Sea Island cotton in 1952. The most efficient cane producers in Southeast Puerto Rico are looking ahead to new possibilities if their cane acreage should be limited. (194, p. 57)

Irrigation. Southeast Puerto Rico is the richest cane growing region of the island largely because of irrigation. Planters had long dreamed of some way of bringing water to the parched but rich soils of the south coast. Fanciful plans had been developed under the Spanish but nothing came of them. Some planters obtained water rights in perpetuity from the Spanish crown and diverted water from the rivers through private irrigation works, but these works were useless when the streams went dry, as most of them did every year.

The present irrigation service was developed at the instigation of the cane growers, who guaranteed payment for water received so that the system would be solvent. Agitation began in 1907 and the system began operations in 1914. The Insular Government issued \$5,000,000 in bonds which were to be retired through payments for water. (240, p. 30) It was estimated that the amount of water necessary to supply the deficiency of rainfall was four acre-feet per acre per year, which is equivalent to an application of four inches of water per month to the land under irrigation. (117, p. 35) Each planter was to pay \$15 per acre per year water tax and the irrigation system was to attempt to provide the allotted water in 12 monthly installments. (117, p. 35) The system was to be owned and operated by the Insular Government.

The irrigation works are well laid out and consist of four collecting reservoirs (Patillas, Carite, Coamo, and Guayabal), one storage reservoir (Melania), and about 100 miles of main canals and distribution laterals. (See Map of Irrigation System and Land in Sugar Cane 1951) The five reservoirs are grouped into three separate systems which are fed from different sources. Only two of the systems are in any way connected. In order to overcome the winter drought which reduces the flow of all rivers south of the insular divide, water from north of the divide (in two instances) is conducted through the divide to the south. Electric power is developed from the waters as they fall almost 2,000 feet to the coastal lands. (240, p. 32)

IRRIGATION SYSTEM AND LAND IN SUGAR CANE 1951

RESERVOIRS

1. Patillas
2. Carite
3. Melanía
4. Coamo

IRRIGATION CANALS

- Patillas Canal
- East Guamaní Canal
- West Guamaní Canal
- Juana Diaz Canal



Irrigated cane field



Non-irrigated cane field



Pump



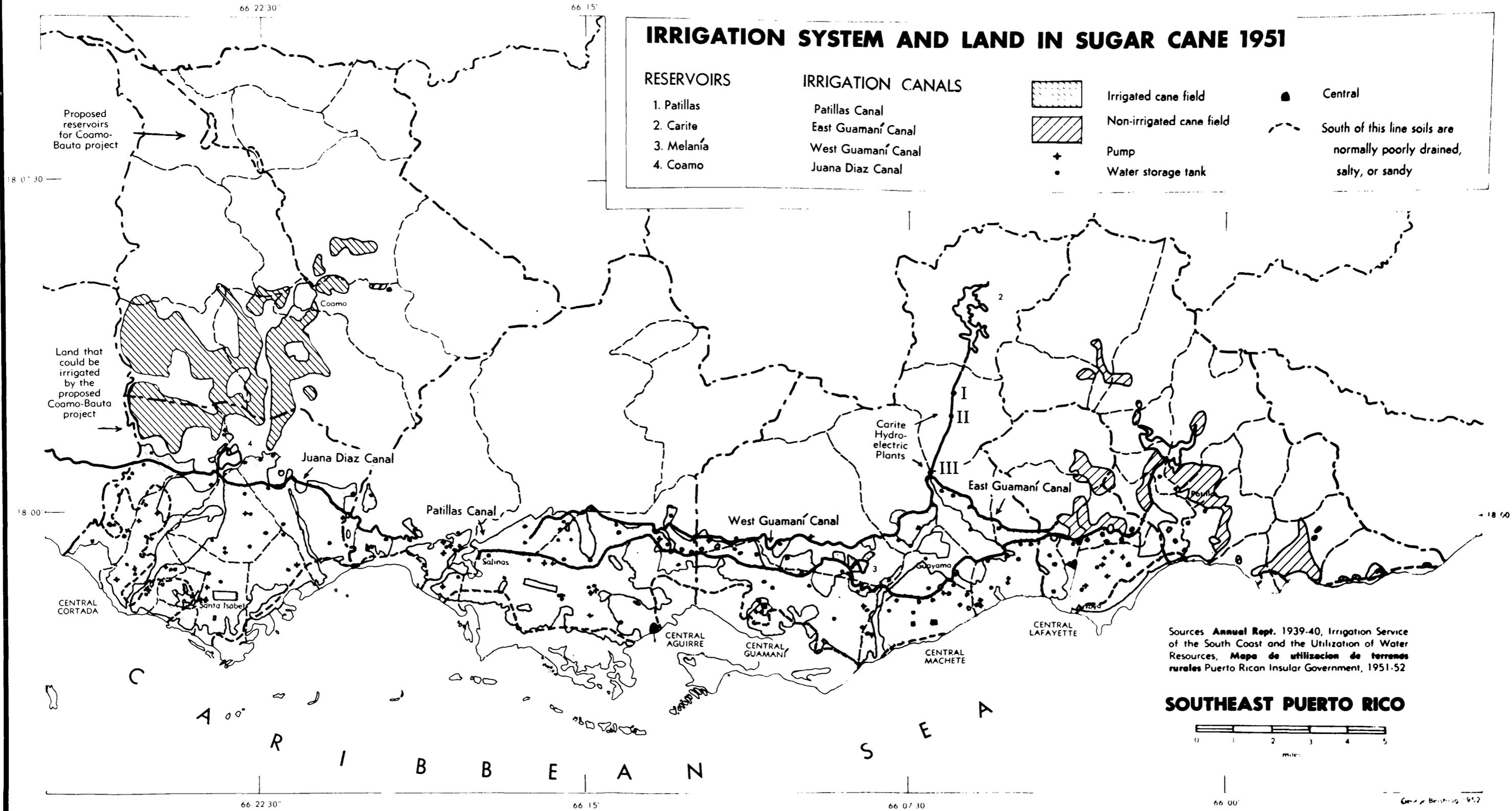
Water storage tank



Central



South of this line soils are normally poorly drained, salty, or sandy



SOUTHEAST PUERTO RICO



The Patillas Reservoir is located in municipio Patillas and is formed by a 132-foot earth and stone dam which impounds the waters of the Patillas and Maton Rivers. Maximum storage capacity is 14,531 acre-feet. Water from the reservoir is fed into the Patillas Canal which runs in a westerly direction to a point near the town of Salinas and irrigates land lying to the south, a total of 12,800 acres.

The Carite Reservoir is located in the north of municipio Guayama, north of the insular divide, and is formed by a 110 foot earth and stone dam which impounds the headwaters of the La Plata River. Maximum storage capacity is 9,339 acre feet. Water is delivered to the south side of the divide by means of a tunnel 3,060 feet long, built through the main range at an elevation of 1,738 feet above sea level. The fall of the water is used to develop hydroelectric power. Three power plants with a total turbine rating of 7,200 HP and a generating capacity of 5,800 KVA intercept the water before it is used for irrigation. (175, p. 32-33) Two irrigation canals conduct the water. The East Guamaní Canal runs in a southeasterly direction to a point in municipio Arroyo. It is not connected with the Patillas Canal. The West Guamaní Canal runs in a westerly direction to a point near the town of Salinas and has an overflow connection with the Patillas Canal through Melanía Reservoir near the city of Guayama. Both Guamaní canals are located at a higher level than the Patillas Canal and serve the higher lands situated between the Patillas Canal and the foothills to the north, irrigating a total of 4,950 acres.

The first two and a half miles of the West Guamaní Canal are built with a larger capacity so that some of the flood waters can be diverted through it and stored in Melanía Reservoir, a small reservoir with a capacity of only 300 acre-feet whose waters are used, from time to time, to reinforce the flow of the Patillas Canal, which runs nearby at a lower level.

Together, the Patillas and Carite systems make up what is known as the Eastern Irrigation District and service 17,750 acres.

The Western Irrigation District is only partly in South-east Puerto Rico, the main reservoir and some of the irrigated lands being outside the area. Waters of the Toro Negro, a north-flowing stream, are diverted through the insular divide at an elevation of 2,726 feet by the 2,770 foot-long Toro Negro Tunnel, and emptied into the south-flowing Jacaguas River. The Guayabal Reservoir is located downstream in the municipio of Juana Díaz, just west of Santa Isabel, and is formed by a reinforced concrete dam 115 feet high which impounds the waters of the augmented Jacaguas River. Maximum storage capacity is 9,524 acre-feet.* Water is fed into the Juana Díaz Canal which runs in an easterly direction to a point near the town of Salinas.

Water is added to the Juana Díaz Canal by the Coamo Reservoir, which is formed by a 65-foot reinforced concrete dam that impounds the waters of the Coamo River. Maximum storage

* None of the Western Irrigation District, just described, is shown on the accompanying map.

capacity is only 2,700 acre feet. The water is fed into the Juana Díaz Canal where it crosses the Coamo River, a short distance below the dam. A total of 15,250 acres is irrigated by the Juana Díaz Canal, not all of it in Southeast Puerto Rico. (117, p. 32)

The land that might be irrigated by a proposed irrigation system to be developed in Coamo and Santa Isabel is shown on the map, as are two of the proposed reservoirs. This project would also involve bringing water from north of the divide and would contain a hydroelectric system as well. There is no present indication as to the possibilities of the project ever being developed. Preliminary studies seem to indicate that it would be too expensive for the benefits derived.

The water problems of the cane growers were not entirely solved by the Insular Irrigation Service. The variations in rainfall that are notorious over the entire south coast affect both the fields and the reservoirs. Heavy droughts covering the whole region seem to occur at 10 to 12 year intervals, while extraordinarily heavy droughts occur at undetermined longer intervals. (166, 1939-40, p. 7-8) During such droughts the reservoir water dwindles, allotments to planters must be curtailed and sometimes even cut off entirely at a time when they are needed most. For 10 days in May 1938 there was no available water in the Patillas Reservoir. In normal years it is quite usual for the water supply to be low in one or another of the reservoirs for a short period. In such cases, water allotments curtailed one month are paid back the next. The pattern of rainfall is so varied throughout the south coast

that it is not unusual to have one reservoir at low ebb while another is wasting water over the spillway.

The planters had other water problems besides the varying quantity available from the Irrigation Service. Water is delivered in a continuous flow, day and night, until the monthly allotment is received. It proved wasteful to irrigate at night; much water was lost and sometimes cane was rotted out. Furthermore, many small irrigations are better than one large irrigation. On soils that are porous, four acre-feet was not enough. To solve their problems, the planters developed a system of small storage tanks to store the water received at night until it could be more advantageously distributed in the morning, and a way of pumping ground water to supplement the Irrigation Service water in porous soils and to replace it entirely during droughts. The water storage tanks and pumps are located on the accompanying map.

The widespread use of pumps, most of which run on hydroelectricity developed by the Irrigation Service, has changed the type of irrigation in Southeast Puerto Rico from a simple gravity system to a combined gravity and pumping system. The Insular Government has limited its activities to operating the gravity system and supplying at low rates the electric power required to operate the pumps, leaving to private initiative the exploration of the underground water supply and the investment of capital required for the installation of the pumps. The gravity system normally delivers 40% and the pumping installations 60% of the water used. (88, p. 84)

Irrigation solely by pumps has brought additional acres under cane which were not reached by the gravity system. In 1931, Antonio Lucchetti, the long-time director of the Irrigation System, reported that about 15,000 acres were irrigated only by pumps on the south coast in addition to the 33,000 acres served by the Irrigation Service. (117, p. 35) Another interesting fact was that of the 33,000 acres supplied with gravity water, only 24,000 acres paid the regular water tax. About 9,000 acres that were formerly irrigated under old Spanish concessions were exempted from the payment of the regular tax, although they were assessed a small yearly tax to cover their share of the cost of operation and maintenance. The disparity of payments should become less as time goes on. The sale of electricity to general consumers has been unexpectedly lucrative and profits from such sales go, by law, into retiring the bonds issued for constructing the system. By 1940 the water tax was reduced from \$15 to \$7 an acre. (226, p. 33) About half of the cost of constructing the system had been paid. (226, p. 118)

The combined gravity-pumping system makes good use of the physical setting. The irrigated lands are underlain with Quaternary sediments which store water well in the lower depths but which usually are so porous that they allow the irrigation water to percolate through rapidly. This makes for good drainage, a necessity for cane raising, and also provides a good supply of ground water for the pumps to bring up for further irrigating. Some of the soils near the sea are not porous but heavy and impervious. Tiling and ditching

help carry some of the excess water away, while pumping water from underneath aids further. Some pumps are used solely to get rid of excess water. A portable pump, which works full-time during the rainy season, keeps a former mangrove swamp in southern Arroyo drained enough so that cane is planted. In other localities booster pumps are used to raise water to the higher lands.

Care must always be taken to analyze the water for salt before making an irrigation pump installation. Some of the underground waters near the sea contain a high percentage of salt. Although the salt tolerance of cane has not been determined, it is known that lands irrigated for several years with pump water containing about 20 grains of chlorine per gallon become so alkaline that cane tonnages are reduced. (141, p. 39)

Most pumps are connected to a battery of wells of 6" to 10" perforated pipe driven about 100 feet into the earth. From 6 to 14 wells are coupled to a suction line with the pump in the center of the battery. During the dry season, costs of operation increase as the water table drops. Some deep wells from 16" to 26" in diameter are driven to depths of 750 feet. The pump is placed inside the casing at or below the pumping level of the water and is driven through a vertical shaft from the motor above ground. Pumping capacities vary from 500 to over 3,000 gallons a minute.

The water that originally falls as rain in the Carite Reservoir watershed is used at least five times. It creates

electricity as it goes through the three power plants, one after another, before it is spread over the cane fields by the gravity-flow irrigation system. Subsequent pumping may bring it to the surface several times before it is absorbed by the cane plants or evaporates. This takes no account of the numberless housewives who wash clothes in the irrigation ditches or the equally numberless animals and small children who drink and bathe in the flowing water.

The irrigation system has not only been phenomenally successful but it has had one unexpected result. It could be anticipated that the lower courses of three rivers, the Patillas, the Guamaní, and the Coamo would be eliminated because all of the water, except for occasional floods, was absorbed into the irrigation system. No one imagined that the sale of surplus electric power not needed by the pumps would put the Insular Government into an island-wide electric power business.

Coffee. Coffee became unimportant in Southeast Puerto Rico except in northeastern Coamo, even though there were many new varieties introduced and many experiments conducted. For the story of variety introductions, see Appendix E.

Tobacco. Tobacco became less and less important in Southeast Puerto Rico. For details of new introductions and the development of a new variety on the island, see Appendix E.

Possible Export Crops. Many different types of plants were successfully grown experimentally in an endeavor to find additional export crops. Chief among these were the drug

plants that produce quinine, strychnine, and senna; the rope fiber plants of sisal, Manila hemp, and hennequen; the cloth fiber plant, ramey (which had been imported previously in Spanish times); the Panama hat palm; plants that produced paint oils; plants like sunflower and peanut that produced edible oils; the castor-oil plant; various perfume oils and spice plants; plants like Paraguay tea and kola that were used in beverages; a plant that produced rotenone; a plant that produced chicle; plus improved varieties of species already on the island like grapefruit, pineapple, cacao, orange, coconut, vanilla, bamboo, and ginger. Details are given in Appendix E.

Most of the foregoing were never grown in Southeast Puerto Rico. Only the sunflower, the castor-oil plant, ilang-ilang, and lemon grass were seen growing in the area in 1951. None of them were growing on a commercial scale.

Local Crops. Better varieties of tree crops, like mango, avocado, and breadfruit, improved the quality of the local food supply. Tropical fruits, like mangosteen and durian, and tropical nuts, like pistachio and leechee, adapted to the climate but never became widely distributed.

The staple foods: banana, plantain, yam, yautía, yuca, taro, sweet potato, rice, squash, and corn, were subjected to intense experimentation by the Agricultural Experiment Stations. Improved varieties of most were imported -- a new taro (malanga) proved better than most root crops on the island -- and a new variety of sweet corn was developed at the Mayaguez Experiment Station.

Many forage crops were successfully introduced. Two, Guatemala grass and Elephant grass, supply most of the harvested forage for the dairy industry. Cover crops, mainly legumes, were imported to retard soil washing. Some cover crops, like tropical kudzu, are also good forage crops. A variety of grass, Manila grass, provides a good lawn grass for Puerto Rico; something that was previously lacking. See Appendix E for details.

Plants that Failed to Acclimatize. The plant failures included the drug plants that produce cocaine and camphor; the fiber plant, jute; several paint oil plants, the most important being tung oil; the spice trees that produce nutmeg and clove; three different rubber trees; the tea plant; and numerous temperate zone plants that had failed previously, fruit trees, berries, potatoes, grapes, and wheat. Several forage and cover crops also proved unadaptable to the climate. For a fuller account see Appendix E.

Introduction of New Animals

Few entirely new species were introduced; the pheasant, the frog, and the giant toad are probably the only ones. The toad is the most important in Southeast Puerto Rico where it helps to keep down the white grubs which are a pest in sugar cane.

Although improved varieties of honey bees, goats, pigs, rabbits, chickens, geese, sheep, pigeons, ducks, and turkeys were introduced, the most valuable importations were of horses and cattle.

The horses introduced were largely saddle horses. The one draft variety, the Belgian, was not a success. In many cases, stallions were brought in by the experiment stations and free service provided to local mares in an effort to improve the stock already on the island. Since the local horse was a small type, descended from Arabian stock, large stallions could not be used for such breeding. In a few cases, pure bred saddle horses were imported as mounts for the rich land owners, and efforts were made to maintain pure blood lines.

The failure of draft horses to adjust to the island was of little consequence. Oxen have traditionally been the draft animals. Pack horses or saddle horses are the preferred types. The introduction of large scale cultivation in the cane fields of the area increased the need for horses because more supervisors were needed and each supervisor rode horseback through the fields on inspection tours. An idea of the increase in use of saddle horses can be gotten from the figures for horses owned by Luce and Company. In 1941 there were 422 horses; in 1951 there were 467. (311)

Cattle are the most important animals raised in Southeast Puerto Rico. Those on the island in 1900 had been developed for their usefulness as beasts of burden, for their hides, and for their meat. The health program introduced by the Americans stressed the use of milk, which was scarce because the cows gave so little. Sires of milk-type were introduced and bred to the creole cattle (ganado del pais). Several milk-type scions were introduced; Ayshire, Guernsey, Holstein-

Friesian, Jersey, and Brown Swiss. The two Experiment Stations early agreed that one type, the Guernsey, was the best one to use in breeding to Puerto Rican cattle. The meat-type scions introduced were; Aberdeen-Angus, Hereford, Shorthorn, and Zebu. The Zebu was especially favored on the south coast in the days when the great development of irrigated sugar cane was taking place. Cross-bred oxen were larger, stronger, and faster than the native oxen. The pure Zebu bulls were also a lot wilder and harder to handle than the usually-docile Puerto Rican bulls. The problem of wildness was avoided by importing half-bred Zebu and Shorthorn bulls from Texas for breeding purposes.

The need for oxen in Southeast Puerto Rico had declined with the increased mechanization of plowing and hauling in cane culture. Luce and Company in 1932 had 4500 oxen, in 1941 had 2038 oxen, and in 1951 had only 139. (311) The decline in the use of oxen has coincided with the increase in keeping of herds for dairying.

The importation of superior breeding cattle was hampered by the ticks which infested the island and spread Texas fever. Keeping expensive imported bulls alive was a problem until it was discovered that the bulls could be protected by being kept penned in barns rather than being allowed to graze in the open where the ticks abounded. The problem of maintaining imported cattle was never really solved until the tick eradication program began in 1919. (112, p. 18) Whole areas of the south coast are now virtually free of the tick -- because of the compulsory cattle-dipping.

For fuller information on the minor animals introduced, see Appendix E.

Transportation

One of the main improvements since 1900 is the development of transportation. Coastal shipping has diminished in importance, the railroads in Southeast Puerto Rico have always served the cane mills rather than the general public, but the highways have been a major influence for public progress. (317, 320)

There are two railroads in the area, neither of which is shown on any of the accompanying maps. One private, narrow-gauge line runs from the Central Lafayette about a mile to the water front and transports sugar to the wharf. This line formerly operated in the cane fields to the east in the municipio Patillas but has been long abandoned even though many of the tracks are still in place.

The second line is the Ponce and Guayama Railroad Company whose entire capital stock is owned by the Aguirre interests. All of the trackage is narrow gauge and much of it is moved from place to place as the cane harvest progresses. About 40 miles of track delivers cane to Central Cortada, Central Aguirre, and Central Machete (65, p. 48) The line has connections with the narrow gauge line that runs through Ponce and freight could move the long way around the island to San Juan via the interconnection if there were any suitable freight to carry. It is doubtful if the railroad will ever

be used for freight other than cane. Imports from the outside can come by ship directly to the private pier at Central Aguirre, to the roadstead at Arroyo, or to San Juan or Ponce and be trucked the much shorter road distance to Southeast Puerto Rico. Sugar export, of course, goes directly from the pier at Central Aguirre or from the roadstead at Arroyo.

The highway pattern is depicted on the map of Highways and Land Withdrawn from Private Ownership. Only the asphalted "black-top" highways are drawn in although there are many gravelled roads that might be considered passable for autos in all weathers and many more roads that are passable for jeeps. Of the 56 barrios in Southeast Puerto Rico, only three, Coamo Arriba in Coamo, Carite in Guayama, and Apeadero in Patillas, cannot be penetrated somewhere by jeep. In places where wheeled vehicles cannot go, horses and mules climb the trails, which criss-cross in all directions to join all the scattered farm dwellings to the highway net.

The present paved-highway net is a recent development; when the Americans took over the island there were only two all-weather roads in Southeast Puerto Rico. The military highway from Ponce to San Juan ran through Coamo from southwest to northeast, and a branch of the military highway ran from Cayey south to the town of Guayama. Both roads were well engineered and all the water crossings were well bridged, but both were narrow by present standards and both were cobble-stone or gravel surfaced.

The present net started with the original Spanish highways. The present version of the military highway follows the old route but has been widened and rebridged. Many dead-end feeder roads have been added to enable the products to reach the main highway. In addition to the branch to Guayama, which is only now having wider bridges added, a new branch to Salinas has been built.

A coastal road has been constructed completely around the island, joining all the main towns on the route. The section in Southeast Puerto Rico runs east from Ponce through Santa Isabel, Salinas, Guayama, Arroyo, and Patillas before leaving the area for Maunabo and Yabucoa.

Two new north-south highways run from coast to coast. One starts at Santa Isabel and goes through Coamo to Orocovis and points north. The other north-south highway begins at Patillas, runs north to San Lorenzo, and continues to the coastal highway on the north coast. Practically all the highways have paved feeder roads, some of which are from three to six miles long.

It is scarcely possible to exaggerate the importance of transportation in the changing pattern of land use. The development of the central system of cane milling depended on getting a large supply of cane to the central on a regular schedule so that the mill could operate round the clock in season, using cane that had not had time to dry out after being cut. The Central Aguirre interests depend mainly on a private railroad for transportation although

independent colonos deliver their cane to the Aguirre mills by truck or ox cart. The Guamaní and Lafayette centrals depend on trucks.

The Lafayette Central pioneered in the island in moving cane by truck. Prior to the hurricane of 1928 there was a central, Columbia, in the municipio of Patillas grinding the ox-hauled cane of the immediate neighborhood. When Central Columbia was destroyed by the hurricane, the central was not rebuilt and the Fantauzzi interests bought the land of the central and hauled the cane by truck 10 kilometers to the Central Lafayette. This could not have been accomplished if the paved highway had not been completed.

Columbia's crop, usually about 80,000 tons, was hauled by a fleet of 15 trucks averaging 5 ton loads on a contract basis with outside owners of trucks. Beginning with the 1932 crop, the trucks were equipped with pneumatic tires to lessen the wear and tear on the highways. This was the first cane-hauling by truck in Puerto Rico, a practice which has since been extended to the rest of the island. (88, p. 148)

In many parts of the island where the rainfall is heavier than in Southeast Puerto Rico, the opening of a new paved highway has been a signal for the land owners to change from raising other crops to cane. This sort of development can occur in Southeast Puerto Rico only in the municipios of Patillas and northern Guayama because only there can non-irrigated cane be raised with any surety of getting a crop. In two places, Carite of Guayama and

Muñoz Rivera of Patillas, farmers insisted, in 1951, that the only thing preventing the raising of cane was the lack of a highway to carry out the crop. (310,325) It is possible that cane crops of average yield may be raised in both places but whether the centrals of Southeast Puerto Rico would be interested in grinding cane of lower quality than the high-yielding crop they now process from the irrigated fields remains to be seen. In most of Southeast Puerto Rico the two necessities for successful cane raising are availability of irrigation water and transportation. Both must be present for top production.

The paved highways also helped other crops. Coffee and food crops produced in Coamo can be trucked either to San Juan or Ponce, the two largest markets on the island. The new dairy industry can move its milk by highway to the town markets.

Another influence of the new highways was on the settlement pattern. When the government instituted a program of resettling agregados on government land, the road net, plus the new water facilities developed by the aqueduct service, made it possible to settle rural communities on land that had hitherto been only grazing land.

Personal travel on the island depends on the highways. Bus lines that run on schedule and "publicos", or government-licensed private cars that run at all hours, provide frequent and breath-taking service. Seeing the rapid transportation available now, it is hard to think back to a time when roads were mud holes negotiable only on horseback, bridges were

non-existent, and a sudden flood could make a ford uncrossable. Today such things are true only where there are no paved highways. The paved highways are always transitable, and bridges eliminate the dangerous fords.

The Land Holdings

When the American government took over Puerto Rico, all titles to land were honored. Even the water rights granted in perpetuity to certain cane farmers were continued.

There were, however, many transfers of title, accompanied by the concentration of the best lands in fewer hands, as American capital flowed into the island. Some of the Spanish absentee owners and many of the Spanish resident owners of large estates did not care to hold property under an American regime and quickly sold out to American capitalists and capitalist groups. In that way absentee ownership was continued even though the absentee owner became a corporation in Boston rather than a family in Europe.

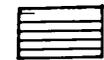
The Aguirre interests also bought up smaller farms and added them to the Aguirre land holdings.

A custom of Spanish times that continues to the present is of administering a deceased land owner's holdings as a sucesión or estate. Because Puerto Rican families are large, there are usually a large number of heirs, many of whom may have moved away. Each heir is interested principally in obtaining profits from the estate and very little in making improvements to either land or buildings. The sucesión

PARCELA COMMUNITIES and Land Holdings of Less Than 20 Cuerdas



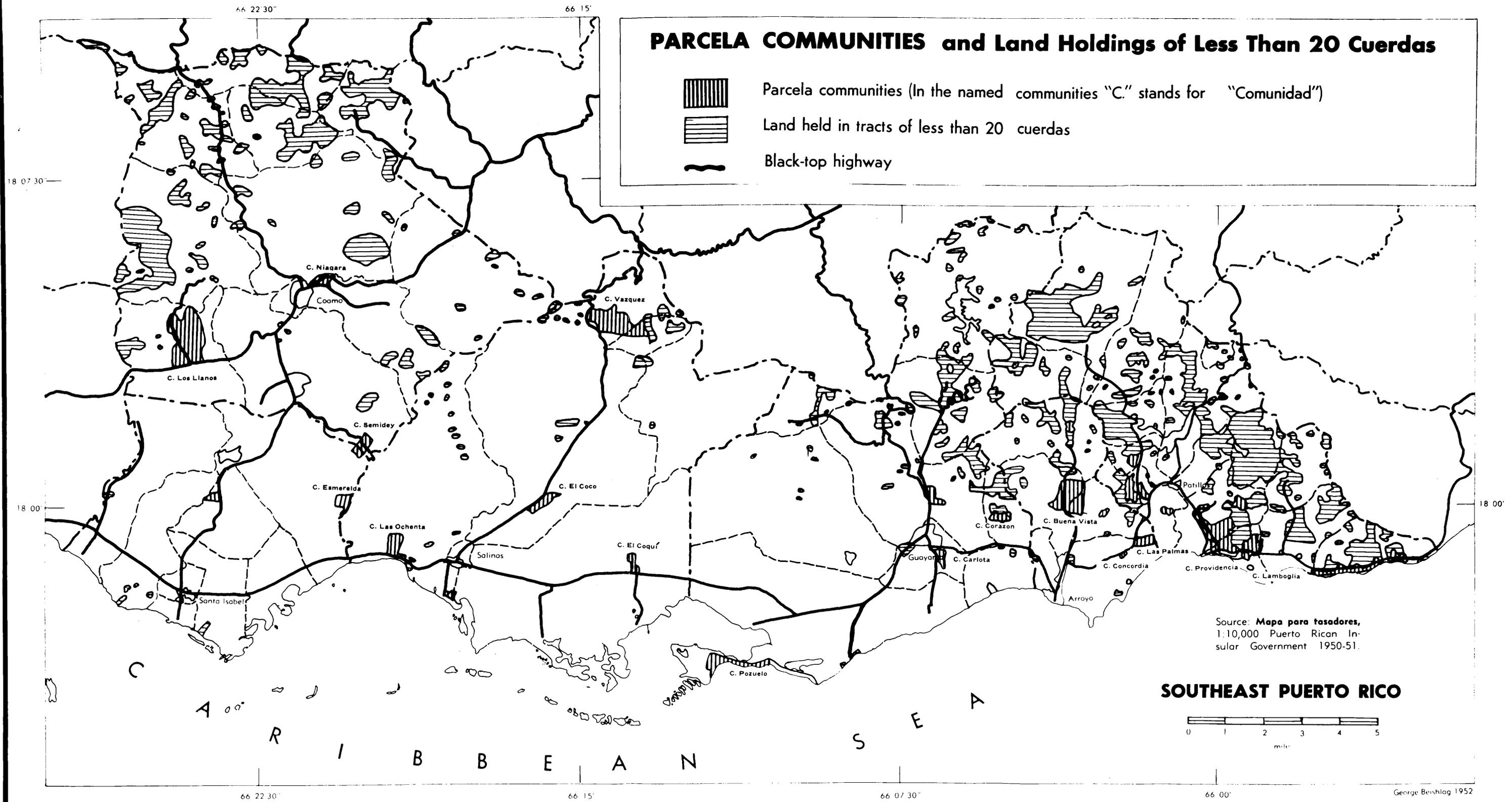
Parcela communities (In the named communities "C." stands for "Comunidad")



Land held in tracts of less than 20 cuerdas

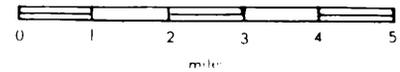


Black-top highway



Source: Mapa para tasadores,
1:10,000 Puerto Rican In-
sular Government 1950-51.

SOUTHEAST PUERTO RICO



custom keeps much land in a local kind of absentee ownership with the absentee owners usually living in town.

Sucesiones are found not only in the largest holdings (Central Guamani is operated as part of a sucesion) but even in the small farm holdings in the hills.

The 500 Acre Law. When military government gave way to civil government in the island, a famous law concerning land holdings was incorporated into the law of the land. Joint Resolution No. 23 passed by the United States Congress on May 1, 1900 (170, p. 2), which became a part of the Foraker Act, the first Organic Act of Puerto Rico, limited corporation holdings to 500 acres. This was an attempt by the US Congress to prevent the monopoly of land by a few corporations, and was an outward sign of the inner concern the new rulers of the island felt for the welfare of their new charges. The unexpected effect of the "500 acre law" was to prevent the investment of capital which would build modern centrals and modernize the industry. The Puerto Ricans soon advocated repeal of the law and attempted to eliminate the provision when a new Organic Act was passed in 1917. The US Congress insisted on including the proviso in the new Organic Act, the Jones Act, which, among other things, gave the Puerto Ricans American citizenship and an elective assembly.

Strangely enough, the 500 acre law was later used by the Insular authorities as the basis of a land reform program.

Federal Aid. In 1932, the San Ciprián hurricane

occasioned a rehabilitation and reconstruction program that resulted in a permanent program of land reform. At first, the financing and directing were in the hands of the Federal Government. Later, when the island obtained its own elected governor, the Insular Government took over the financing and directing, even though remnants of the federal program remain. Two problems were directly attacked: the problem of the landless workers (the agregados), and the problem of the sugar corporations, particularly the absentee-owned corporations.

The PRRA (Puerto Rican Reconstruction Administration) was a federal agency created May 28, 1935 by Executive Order No. 7057 of the President of the United States (57, p. 222) for relief purposes and also for permanent reconstruction of the island. Two activities, begun by that agency, have altered the land pattern of Southeast Puerto Rico. One activity was the resettlement of landless agregados on their own land and with their own modern houses. The concrete parcela houses seen throughout the area are a permanent record of this achievement. Each parcelero was given from 3 to 10 cuerdas of land -- not always good or useful land. One group of parcelas was settled in barrio Pasto of Coamo just below the crest of the insular divide, with a breath-taking view of the Caribbean 10 miles away, on land that yielded little because it was too dry.

A second activity was the purchase of Central Lafayette in Arroyo from the Sucesión Fantauzzi. Most of the heirs of

the Fantauzzi estate spent their time in France and the central, though modern and well kept up, was perhaps the prime example of an absentee-owned central on the island. Furthermore, the central was located on the irrigated south coast which had, and has, the most productive sugar land on the island.

The central was purchased in 1939, using U.S. Government funds, and the management was turned over to a group of cooperatives which controlled the land and operated the central. The AACL or the Asociación Azucarera Cooperativa Lafayette was the main cooperative which controlled the mill, the railroad, and the equipment of the central. The various cooperative members subscribed \$100 toward the purchase. The rest was a 100% loan from the PRRA. Under the arrangement, none of the cooperative members owns more than 500 cuerdas. A couple of large colonos who had formerly sold cane to the central did not join the cooperative but continued to sell to the cooperative central and continued to own over 500 cuerdas. (120, p. 4-5)

The central was the first cooperatively-operated one on the island and seems to have been a testing laboratory for developing all sorts of ideas. The first agricultural cooperative was organized on the principle of pooling of labor. It failed as all such cooperatives do and was dissolved in 1940. A central service cooperative that controlled all the oxen, carts, and implements proved economically unsound. It was placed on sale in 1939, but, when no takers

appeared, it was sold to the general cooperative and the equipment distributed. Another expensive experiment also failed. A butanol plant to extract alcohol from cane proved to have too high an operating cost to be economically sound. A modern hospital was built and operated on the central grounds. It was a great social benefit to the immediate region and is one of the two modern general hospitals in Southeast Puerto Rico, a private one at Central Aguirre being the other. The hospital, too, cost money.

Perhaps the greatest drawback to the entire cooperative effort was the fact that the individual members of the cooperatives had had no experience in cooperative undertakings. A succession of managers, five since 1939, did not provide a continuity of management. At present the project is financially sound in that it is not operating in the red. With the butanol plant closed and written off as a bad investment and with the service equipment distributed among the members, it looks as though the enterprise might be on a stable basis.

The cooperative experience since 1939 has not been very fruitful. The members of the cooperatives have not invested any more money in the enterprise than the original sum of incorporation. The Federal Government is still carrying the financial burden. It would seem that so long as the members do not have a financial stake in the central operation, so long will they be slow in learning the necessary lessons of cooperation. Some believe that the Puerto Rican is not naturally a cooperator. Even in big business, the central

owners of Puerto Rico do not cooperate as the big business men do in Hawaii for example*.

Had Central Lafayette remained in absentee ownership, there is no doubt that the management would have been more efficient and that the total cash profit produced would have been much greater. In simple dollars and cents reasoning, the turning of Central Lafayette into a cooperative has resulted in a cash loss. Some of the profits that would have been made simply were not made.

Another viewpoint is that the money that was not made is no loss to the island because the profits would have been drained out to France anyway. This viewpoint also sees the social benefits to the people of the area as more important than the cash profits.

In an unexpected way, the operation of Central Lafayette as a cooperative has worked in opposition to the PRRA program of resettling the landless on their own land where they can raise their own food. Some of the parcelas just southWest of Patillas Reservoir have now been turned to raising non-irrigated cane for sale instead of raising food

* Another disappointing experience in cooperatives in Southeast Puerto Rico was the Cooperativa Pozuelo which was proposed by Father Henry Goetten, a Redemptorist priest in Guayama city and financed by the Farm Security Administration. The cooperative members were poor farm laborers who proposed moving their homes from Puerto Jobos, in barrio Jobos of Guayama, to the sand spit of Punta Pozuelo where they contracted to buy 150 acres. The members were to continue working as cane field laborers but were to operate a fishing cooperative in their spare time. The women were to develop handieraft industries. This was in 1942. (28, p. 52-3) In 1951 the fishing cooperative had been sold to a private owner and the cooperative settlement had become the Comunidad Pozuelo operated by the Insular Land Authority.

for the parceleros. (See Map of Irrigation System and Land in Sugar Cane 1951) The small producer can always market his cane through the cooperative central. A larger central might consider the small grower's business not worth the bother.

The Insular Land Law. The attack on the problems of the landless and the corporate ownership of land was taken over by the Insular authorities with the passage by the Insular Legislature of the Land Law of Puerto Rico, Act 26, approved April 12, 1941, and subsequently amended. The new law created the Land Authority (Autoridad de Tierras), gave the Insular Government more control over the sugar industry than ever before and aided the relocation of hundreds of landless families in homes they can call their own.*

The cornerstone of the law is the heretofore unenforced "500 acre law". One section reads, (170, p. 5)

It is a fundamental purpose of this Act to put an end to corporate latifundia and to every large concentration of land in the hands of entities legally organized in such wise as to tend to perpetuate themselves and to prevent for all time the division of the great landed estates; and it is likewise the purpose to prevent the reappearance of such latifundia in the future. To win these objectives it is absolutely necessary as a fundamental agrarian policy of the people of Puerto Rico, to

* This does not mean that the power has passed from the American government into the hands of the small ruling clique that controlled Puerto Rico in Spanish time -- and, to a large extent, in early American times. The elected officials are, it is true, mainly from the old best families, but the political party in power is based on the jíbaro, not on the old best families.

extend the limitation of land holdings, set at 500 acres, to every organization or partnership of a corporate character, to the end of preventing that through other juridical instrumentalities the purpose sought by this legislation be frustrated.

It is worth pointing out that the law is aimed at "corporate latifundia" not at personal ownership of more than 500 acres. The Land Authority was the instrument created to carry out the provisions of the law. This is not to say that the Land Authority absorbed the old PRRA. The PRRA continues to administer the properties controlled by it since it is a federal not an insular agency. The PRRA does not, however, indulge in any new adventures. In time, it will be liquidated and will disappear.

As will be seen, the Land Authority profited by the experience of the PRRA and adjusted its programs, both in regard to the landless and to the latifundia, more closely to Puerto Rican realities.

Under the law the Land Authority is empowered to create three types of land holdings. Title IV farms (named for the title number of the Land Law) are large farms that can not be operated profitably when subdivided into smaller holdings. Such farms are called proportional profit farms and are maintained as large units under a hired manager with the profits divided among the agricultural laborers on the farm according to a set plan. Such farms do not show on the Map of Parcela Communities. Most such farms are not in Southeast Puerto Rico.

Under Title IV powers, the Insular Government took over

two centrals on the north coast, Cambalache in Arecibo, and Plazuela in Barceloneta. The plan of operation is not the same as that of Central Lafayette. The Autoridad de Tierras has taken advantage of the costly experience learned by the PRRA in Central Lafayette and maintains more control in the operations. In May 1951, it was reported that the Insular Government intended to dispose of the two centrals to private owners. (185, p. 35)

Title V holdings are not farms but small plots of land of not less than one-fourth of a cuerda nor more than three cuerdas. The plots are located in clusters of not less than 25 parcelas nor more than 500 parcelas. Each parcela community is located on or near a highway, or near an already existing population center. Almost thirty of these settlements are located in Southeast Puerto Rico. Together they occupy an appreciable amount of land. The purpose of the small parcelas is to allow the agregado to live in his own home on land that is the property of the government. The parcelero continues to work for an agricultural wage, usually in the cane fields, and may or may not raise some crops or livestock on his parcela. This settlement of the landless on land of their own was begun by the PRRA. The re-settlement being done recently by the Autoridad de Tierras differs somewhat from the PRRA type. Where PRRA gave title to the land, the Autoridad de Tierras maintains title with the government and gives land in usufruct to prevent difficulties on the death of the owner. The size of the

parcelas has been diminished. Where the PRRA tried to give at least three cuerdas, the Autoridad de Tierras since 1948 has been giving mostly .40 of a cuerda. Most of the parcelas created in 1950 and 1951 have been the minimum allowable size, .25 of a cuerda. There are several reasons for the change. Suitable land is becoming increasingly scarce. Parceleros have been more and more desirous of the facilities of urban life; electricity, water, health centers, etc. These facilities can be more easily provided when the parcelas are small and the settlement compact.

Other government agencies have aided the Autoridad de Tierras in locating parcelas. The Junta de Planificación (Planning Board) was created in 1942 to work on urbanization and zoning problems. The Autoridad de Acueductos y Alcantarillados (Aqueduct and Sewer Service) in 1945 took over all water and sewage on the island. The Planning Board could advise on locating the parcela communities while the Aqueduct Service could supply the necessary drinking water without which no new community could be started on the semi-arid south coast. A comparison of the Parcela Communities map with the Irrigation System and Land in Sugar Cane in 1951 map shows that most of the parcela communities in Southeast Puerto Rico are located within a short distance of the cane fields which provide the chief employment to the farm workers of the area.

Title VI farms are subsistence farms of larger size than the Title V plots. They are usually on poor land which

requires more than three cuerdas to support a family. Most are between three and twenty cuerdas in size. The map of Parcela Communities locates all the land held in tracts of less than 20 cuerdas. Most Title VI farms in Southeast Puerto Rico are located within such tracts, although it must be remembered when looking at the map that many small farms of less than 20 cuerdas have not been bought and divided by the Autoridad de Tierras but have been land holdings of that size for generations.

Land Withdrawn from Private Ownership. At the same time that various forces were affecting the agricultural land use, other forces were withdrawing land from cultivation. Since 1900 several sizable tracts of land have been purchased or otherwise set aside by the Insular and Federal Governments for purposes other than agriculture. The irrigation system created reservoirs in three of the six municipios and permanently flooded quite an acreage. (See map of Land Withdrawn from Private Ownership) Some mangrove swamps, which had never been used for agriculture, were set aside as insular reserves in municipios Santa Isabel, Salinas, and Guayama. Puerto Rico makes good use of mangroves. Under Insular management, the swamps are harvested for fuel under a plan that permits regrowth and maintains a continuous stand. In 1932 the land in mangroves was yielding a net income of \$5 per cuerda per year. (87, p. 23)

Other tracts of largely deforested lands in northern Guayama and Patillas were set aside as Insular Forests in

LAND WITHDRAWN FROM PRIVATE OWNERSHIP 1951



Insular forest; rain forest

Insular forest; mangrove forest

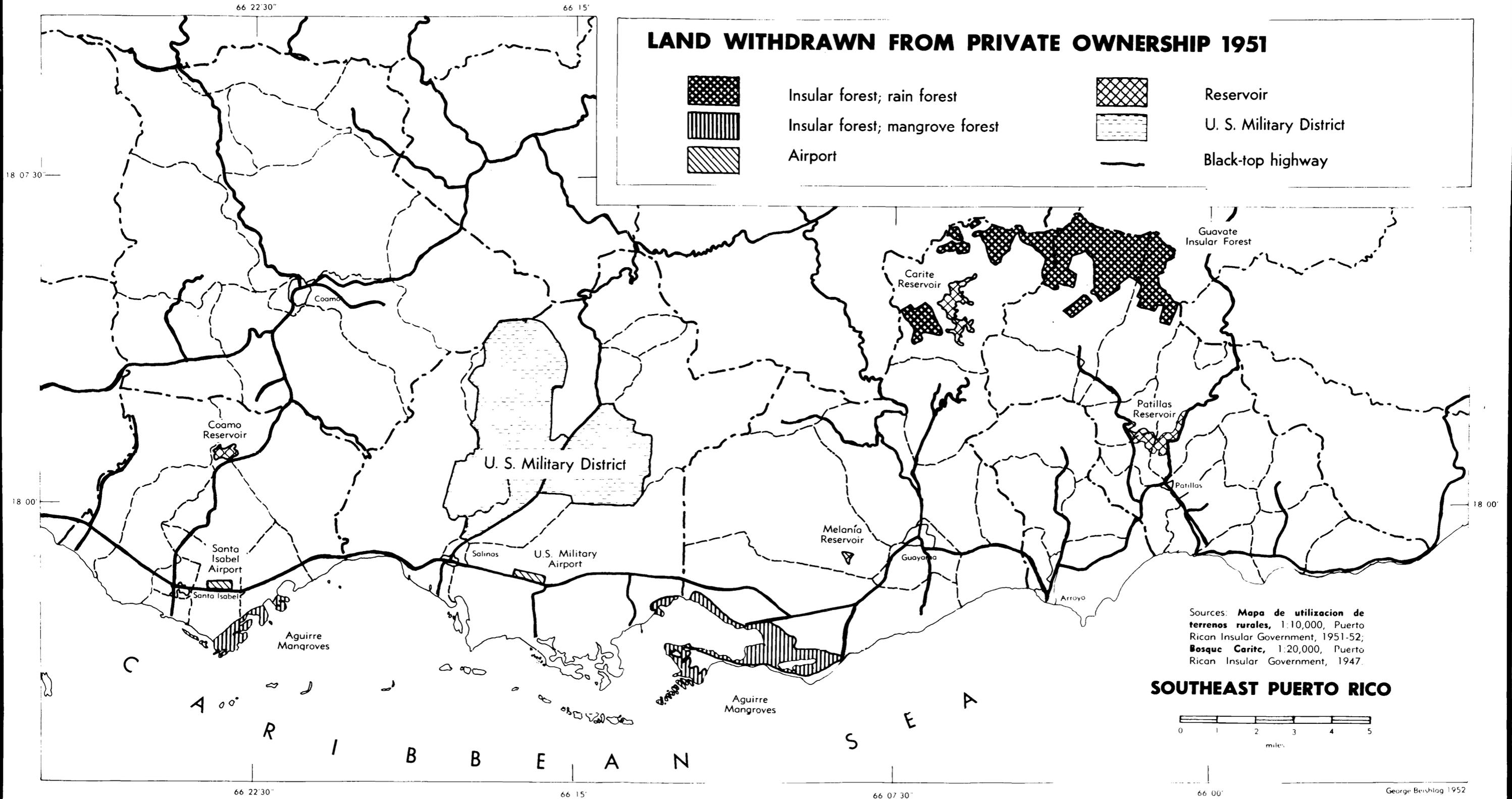
Airport



Reservoir

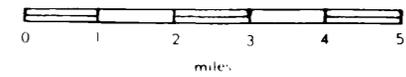
U. S. Military District

Black-top highway



Sources: *Mapa de utilizacion de terrenos rurales*, 1:10,000, Puerto Rican Insular Government, 1951-52; *Bosque Carite*, 1:20,000, Puerto Rican Insular Government, 1947.

SOUTHEAST PUERTO RICO



accordance with a plan to provide watershed protection, a future timber supply, and recreation areas. The tracts formerly were covered with rain forest. A plan was developed in the late 1930's to reforest the land by allowing laborers who worked in the forest to build a house and crop several acres of reforested land while the trees were small and needed care. (168, 1940-41, p. 13) In 1951 most of the upland Insular Forests remained in need of reforestation.

The previously-mentioned lands were largely non-agricultural. The tract sold to the United States Government for use as a military training district in the municipio of Salinas contained both crop and pasture land. By the sale, a tract as large as many barrios in Southeast Puerto Rico became totally useless for agriculture even though cattle were seen grazing on parts of it (probably illegally) in 1951. There were indications in that same year that the Federal Government might buy additional land in barrio Cuyon of Coamo immediately to the north of the military district. Mortar shells fired in practice within the district had a disturbing way of landing outside in some farmer's field. Duds became a problem. Buying additional land would keep the mortars within the federal land. It would also subtract more crop land from Southeast Puerto Rico.

The two most recent tracts withdrawn from private ownership are the most valuable agricultural land of all the areas withdrawn. The municipal airport at Santa Isabel and the US Military Airport in Salinas were taken from the

heart of profitable irrigated cane land as can be seen by referring to the map of Irrigation System and Land in Sugar Cane in 1951. Since flat land is needed for an airport and flat land is irrigated land in Southeast Puerto Rico, it is impossible to build an airport without using valuable cane land. The Santa Isabel Airport was occasionally used for non-scheduled flights (particularly since the Ponce Airport was out of operation) but the US Military Airport was totally unused and uncared for in 1951. The concrete runways prevent the easy reconversion to cane growing even if the land should be returned to private ownership.

Other Influences on Land Use

Attitude of the U.S. Government. Perhaps the most important change accompanying the shift in sovereignty was in the attitude of the governing power. Spain always considered the island as a possession, as an asset that should be profitable to the mother country. The United States felt a moral responsibility for the well being of the inhabitants of the island and spent much time and money bettering health conditions, education, and transportation. All three had an effect on land use.

The U. S. Tariff Wall. The most immediate effect of the new sovereignty was a reorientation of markets for Puerto Rican products. Henceforth, the island was within the American trade system with all its advantages and disadvantages.

All trade with the United States must be carried in American bottoms -- the most expensive in the world (240, p. 56) -- which made the cost of imported goods higher to the Puerto Rican consumer. An advantage was the free entry of Puerto Rican products into the protected American market. Nearby islands, like Cuba, had to pay a tariff if they wanted to sell competing products in the U.S. market.

The new trade situation was unfavorable for coffee but favorable for sugar. Coffee, which had been the leading product, had been so profitable in late Spanish times that planters had borrowed heavily to extend their plantings. In 1899, while the island was still under military rule, the San Ciriaco hurricane destroyed most of the coffee plantations, doing the greatest damage on the south coast. (225, p. 29) In the same year, the American dollar was made legal tender on the basis of 60 American cents to the peso. (240, p. 55) This was to the disadvantage of the coffee planters who had to repay their previous borrowings with more expensive money. The final blow for the coffee growers was the inclusion of the island within the United States' tariff wall. The main market for Puerto Rican coffee had been Europe. Puerto Rican coffee had been unable to compete in the American market with Brazilian. Coffee went into an inevitable decline. The coffee growers were so deeply in debt that they could obtain no more credit either to rebuild their plantations or to search for new markets.

The chief product to benefit from the favored trade position in the American market was and is sugar. Previously sugar had never been better than in second place among exports. It had been in decline at the end of the Spanish period. The tariff, which acted as an indirect subsidy to sugar growers, was of considerable cash value. Under the tariff of 1909, it was equivalent to 33 dollars a ton. (130, p. 126) The story of the rise of sugar growing in the 20th century has already been recounted. The industry shifted from the family type hacienda to the corporate land and factory combine under two influences; the favored position in the U.S. market and the availability of American capital. The impact of American capital was felt more strongly in the sugar industry on the south coast than in any other region of comparable size on the island. (129, Vol. I, p. 18)

Inclusion within the American trade system had another effect. The United States as a food producing country could ship food to the island sometimes cheaper than it could be produced locally. The agriculture of the island, and of Southeast Puerto Rico in particular, became more commercial agriculture for export and less and less subsistence agriculture for local consumption. Practically all the best lands grew export crops; only the poorer lands grew food crops for the island.

The Agricultural Experiment Stations. The United States Government in 1901 appropriated funds to establish an agricultural experiment station under the US Department of Agriculture. The station was first located in the northeast at Rio Piedras but soon moved to Mayaguez on the west coast where it remains today. (130, p. 157) The Sugar Producers Association of Porto Rico in 1910 founded a private institution at Rio Piedras named Estación Experimental para Caña de Azúcar (Sugar Cane Experiment Station). In 1914 the Sugar Producers Association ceded their station to the Insular Government on condition that the station would continue to introduce, test, and distribute not less than 300 tons of selected sugar cane varieties annually to the sugar cane planters of the island. (112, p. 15)

The two experiment stations have harmoniously attacked the problems of Puerto Rican agriculture. Because the Mayaguez station had ties with the Federal Government and participated in a program of world-wide exchange of plants, it has introduced more varieties of new plants. The Rio Piedras station was committed to supplying cane seed (cuttings), a task that occupied a good deal of space and time.

The stations operated with mixed motives. Their efforts at one time were centered on saving the sugar cane industry, the chief support of the island, when it was threatened with disaster. At other times, attention was directed toward increasing the yields and improving the salesability of

coffee and tobacco, the two other leading crops. Much time and effort were put into finding new export crops which might add to the income of the island. A chief source of concern was the fact that the island did not raise enough food to feed itself. New food crops and improved forms of familiar food crops were introduced, not always successfully. A new food crop may thrive on the island and yet not be accepted by the proposed consumers.

As in any scientific endeavor, failures often outnumbered successes. Diseases and pests destroyed plants that might have been able to survive the climate. Plants that had been failures in the Spanish period again proved to be failures in the American period. Other plants that adjusted to the climate proved to be expensive to produce. Imported products could be bought cheaper.

Federal Guidance in Agriculture. The Federal Government exerts a considerable influence on the land use through the Federal Agricultural Experiment Station at Mayaguez and the U. S. Agricultural Extension Service, both of which supply advice and booklets to farmers. The U. S. Soil Conservation Service has encouraged the planting of forage crops by paying a subsidy for the raising of Guinea grass in the non-irrigated sections of Southeast Puerto Rico. The U. S. quota system for sugar has, since 1934, (57, p. 101) limited the American market for Puerto Rican sugar, while the U. S. crop subsidy program has increased the raising of cane in Southeast Puerto Rico.

Natural Disasters. Natural disasters further helped to shape the land use pattern. In 1928 the San Felipe hurricane, one of the most destructive on record, hit the island just at the time a bumper coffee crop was ready for harvesting. This put the finishing touches on the ruin of the coffee industry. It also destroyed the coconuts, the bananas, the citrus fruits, and seriously curtailed the cane crops. (228, p. 4-11) Tobacco alone escaped; the tobacco crop had not yet been planted. The United States Government made a survey of the damage (228) and aided in rehabilitating the island.

In Southeast Puerto Rico, the San Felipe hurricane caused the abandonment of most of the remaining coffee farms. Many of the coffee trees found growing in the area in 1951 were the uncared-for survivors of the hurricane. The central system was also affected by the hurricane; Central Columbia in the municipio of Patillas was destroyed. The owners of Central Lafayette bought the fields, and the builders of Central Guamaní, which was erected later, salvaged some of the materials to use in constructing Central Guamaní.

Another hurricane, San Ciprián in 1932, was not as damaging but was much more far-reaching in its consequences. The disaster focused the attention of the U. S. authorities on the island and brought forth a permanent program of rehabilitation and reconstruction which continues today.

Land Use in 1950 and 1951

Between 1897 and 1951 there has been no change in the minor civil divisions of Southeast Puerto Rico, although during the same period the population has a little more than doubled. The most detailed recent data for the agricultural land use are for 1950, the year of the last census.

One of the changes that occurred in the American period was in the number of farms. There was a tendency toward the consolidation of small holdings into larger holdings, particularly in cane-growing regions. The following table shows not only the number of farms larger than three cuerdas but also the number of productive parcelas, land holdings smaller than three cuerdas that sold plant or animal products. A parcela for census purposes is a plot from one-quarter of a cuerda to less than three cuerdas, whether it is a government-sponsored parcela or a privately-owned piece of land.

Number of Farms and Productive Parcelas (sources 47, 220, 221)

No. of farms	SE Puerto Rico	Entire Island
1897	3,147	60,953
1950	2,473	53,515
No. of productive parcelas		
1950	3,538	51,157

The figures show that there was a general reduction in the number of farms throughout the island and a somewhat larger reduction in Southeast Puerto Rico. This is probably due to the concentration of land ownership that accompanied the modernization of the sugar cane industry.

The entire island has fewer parcelas than farms. South-east Puerto Rico has proportionally more than the average for the island, almost half again as many as the number of farms for the area. This is probably because of the sugar cane industry on the south coast. Most farm laborers work in the cane fields because of the high wages. It would be logical for the Insular Government to locate the greatest number of parcelas near the greatest concentration of agricultural workers.

The preceding figures are broken down by municipio as follows:

Number of Farms & Productive Parcelas by Municipio (47,220,221)

No. of farms	Coamo	S. Isabel	Salinas	Guayama	Arroyo	Patillas
1897	789	141	227	642	319	1,029
1950	763	26	139	347	206	992
No. of productive parcelas						
1950	587	215	790	509	669	768

Here the effect of the modernization of the sugar industry shows very plainly. Coamo and Patillas, which grow little sugar, have had only a slight decrease in the number of farms. Arroyo, which has good non-cane lands, is less affected by the concentration of land ownership than are Guayama, Salinas and Santa Isabel. In addition, Arroyo gained some farms in the break-up of the Fantauzzi estate when Central Lafayette was taken over by the cooperatives. Santa Isabel has long been pointed out as the municipio where the effect of the modern central system has been most strongly felt. It has a larger

percentage of irrigated cane land than any other municipio in Southeast Puerto Rico.

Productive parcelas outnumber farms in the municipios of Santa Isabel, Salinas, Guayama, and Arroyo where cane-growing dominates, but are outnumbered by farms in Coamo and Patillas where cane-growing is less important. At the same time, productive parcelas are most numerous in the central and eastern parts of Southeast Puerto Rico. This is probably because the western part is drier. Many of the parcelas observed there serve only as dwelling places. Such unproductive parcelas are not included in the above count but can be seen in the map of Parcels Communities.

Land Use by Cuerdas. It has been possible to compare land use by cuerdas for periods from 1776 on, but because the groupings used by the census takers have changed many times, it is not possible to make a continuous comparison of the same factors. The chart that follows gives land use by type of land rather than by crop as was done in Chapters IV and V.

	1897		1950		1950	
	cuerdas	%	cuerdas	%	cuerdas	%
crop land	16,484	8	50,572	31		
irrigated land					24,864	15
non-irrigated land					25,708	16
pasture	90,217	46	94,927	58		
suitable for crops					70,748	43
unsuited for crops					24,179	15
woods and waste land,	91,776	46	19,157	11		
hills and mountains,					12,394	7
bldgs, roads, waste					6,763	4
totals	198,477	100%	164,656	100%	164,656	100%

The first thing that must be recognized is that the percentage figures are more comparable than the cuerda figures. The number of cuerdas in Southeast Puerto Rico was overestimated in 1897 by some 33,821 cuerdas, according to the more accurate 1950 census.

The main changes in land use during the American period have been a trebling of the crop land acreage, an increase in pasture land, and a reduction of woods and waste land to only one-quarter of its previous acreage. The crop land picture is the most interesting one. In 1897 only 8% of the land was in crops. Now 15% is in irrigated crops and 16% in non-irrigated crops. Since sugar is the only irrigated crop raised in the area, sugar now takes up twice as much land as all crops combined in 1897. That is not to say that sugar has crowded out other crops. Non-irrigated crops, most of them not sugar, have increased to where they occupy 16% of the area acreage, 1% more than the total acreage occupied by irrigated cane. This seems to answer the common charge that sugar has crowded out food crops. In Southeast Puerto Rico at least, that is not so.

The increase in pasture land from 46% to 58% is a bit surprising, especially when one recalls that the increase in sugar acreage was largely at the expense of pasture land. The answer seems to be that pasture has expanded onto land formerly left in woods and waste. The fact that the 58% of land in pasture is divided into 43% suitable for crops and 15% unsuited for crops does not mean that the food raising capacity of the area could be suddenly raised by an intensive

farming of the 43% of land at present in pasture. The 43% of land in pasture but cultivable must be considered in relation to the 16% of land in non-irrigated crops. The system of cropping for one year and letting the land lie fallow for a year or two to recover its fertility is practiced in the un-irrigated lands where the soils are thin and where serious erosional problems occur when land is continuously cropped. The percentage of cultivable pasture to non-irrigated crop land is roughly two to one, which may indicate that the land is being overcropped rather than undercropped. If the land were allowed to lie fallow for two years, the percentage would be nearer three to one.

The percentage of land in pasture that cannot be cultivated is 15%, which seems rather low to the observer. Adding this 15% to the 7% in hills and mountains, and the 4% in buildings, roads, and waste land makes a total of 26% or more than one-fourth of the land of Southeast Puerto Rico, which cannot profitably grow cultivated crops.

In summary, it can be said that 15% of the land is excellent sugar land, the source of the wealth of the area, 59% of the land can be alternately cultivated and grazed, though the crops raised are not as lucrative as sugar, 15% of the land is good only for grazing, and 11% of the land is non-agricultural. This statistical picture corresponds roughly with the map of land use in 1951 which was developed through field mapping in the year following the census.

Land Use by Municipios. A more detailed picture of the land use for 1950 is given in the following table which shows

land use by cuerdas by municipios.

Land Use in Cuerdas by Municipios (221)

	Coamo	S. Isabel	Salinas	Guayama	Arroyo	Patillas
crop land	8,823	9,957	7,294	10,398	4,652	9,448
irrigated land	0	8,854	5,915	8,107	1,487	501
non-irrigated land	8,823	1,103	1,379	2,291	3,165	8,947
pasture	31,523	6,967	22,180	18,795	3,132	12,330
suitable for crops	25,646	6,511	12,335	13,637	2,332	10,287
unsuited for crops	5,877	456	9,845	5,158	800	2,043
woods & waste land	4,451	929	4,781	5,195	811	2,990
hill & mountains	2,379	141	3,535	4,033	338	1,968
bldgs, roads, waste	<u>2,072</u>	<u>788</u>	<u>1,246</u>	<u>1,162</u>	<u>473</u>	<u>1,022</u>
total cuerdas	44,797	17,853	34,255	34,388	8,595	24,768

Coamo and Patillas lead in non-irrigated crop land. Both are known as "poor" municipios. Santa Isabel is the leading municipio in irrigated land, having half its acreage irrigated. Most of the crop land of Salinas and Guayama is irrigated, while Arroyo has more non-irrigated than irrigated land.

Coamo has more acreage suitable for crops than any of the other five municipios; its relative poverty is explained by its total lack of irrigated land, a situation that would be remedied if the proposed Coamo-Bauta irrigation project were constructed.

Judging by the amount of pasture land that is unsuited for crops, Salinas, Coamo, and Guayama should be the leading grazing municipios. Statistics for animal industries, given later

in the chapter, prove this to be the case.

The above descriptions do not correspond in all cases with the picture presented by the Map of Land Use in 1951 because the map was made for a different year using slightly different criteria.

Figures are not available for the amount of land in individual crops or in forests and the picture must be seen on the Map of Land Use in 1951. Land in cane is mainly flat or gently sloping irrigated land, although Arroyo and Patillas grow some non-irrigated cane on steeper land. (See map of Irrigation System and Land in Sugar Cane 1951.) Coconut groves and mangrove forests are limited to the sandy beaches and the swampy lands along the coast. A wide sweep of pasture land extends from the cane lands inland until it meets the coffee uplands in Coamo and Salinas, and until it meets the coffee uplands and rain forest in Guayama and Patillas. In the wide pasture belt are many scattered plots of coffee and food crops, and occasional patches of tobacco. In Coamo and Salinas these are always along stream courses. In Guayama, Arroyo, and Patillas the plots tend to broaden out and take in more territory although they are usually on valley slopes. The outstanding characteristic of the scattered stands of coffee is that many of them are the untended remnants of former coffee fincas. The crop is collected, if any develops, but little care is given to the trees. This is in contrast to the care given to the coffee estates in northern Coamo.

A few patches of second-growth savanna forest are found,

mostly on the limestone ridges of Santa Isabel and Salinas and on the hills near Central Aguirre and the city of Guayama. Patches of second growth rain-forest are found in northern Guayama, Arroyo, and Patillas, as well as in scattered places in eastern Patillas.

Animal Raising. A comparison of the change in animal raising from 1897 to 1950 in Southeast Puerto Rico is shown in the following chart. A comparison for the entire island cannot be made because census figures are not yet available for 1950.

Animal Raising in Southeast Puerto Rico (47 and 221)

	1897	1950
horses	8,157	4,102
mules & donkeys	765	1,073
cattle	26,284	25,629
sheep	327	525
goats	983	3,750
pigs	<u>989</u>	<u>5,607</u>
totals	37,505	40,596
oxen		2,089
chickens		81,270

The most important animal industry in the area continues to be the cattle industry, there being only a few less cattle in 1950 than in 1897. A change that does not show in the statistics is in the use of the cattle. In 1897 many of the cattle were work oxen; in 1950 only one in twelve was a work ox. The growth of dairying on the south coast coincided with

the decline in the use of oxen so that the over-all figures for the number of cattle remain about the same. At present, the number of cattle seems to be increasing rather than decreasing.

The number of horses declined, but not so much as might be expected considering that the development of the highway net enabled the automobile to carry a good deal of the produce that formerly went by horseback. Mules and donkeys have increased because the remaining produce that moves on animal back is in the higher and rougher terrain where the mule and donkey are more sure-footed than the horse. The pack animals now travel shorter journeys than formerly, carrying their loads only to the nearest town, or sometimes only to the nearest highway, for transfer to a truck. Horses and mules will probably continue to be important in the future because roads (even roads that will pass a jeep) will never be built to all the inaccessible farms in the area.

The slight increase in sheep is surprising but unimportant. The scraggly sheep seen in the area in 1951 were useful only for meat.

Both goats and pigs increased in number many times over the 1897 figures. This is related to the growth in human population and to the development of the government parcels program. Most goats and pigs are not kept in large groups but are raised by twos and threes by farmers or parceleros to provide occasional meat for feast days. Meat is scarce on the island. A goat or a pig takes up little room and can be

raised with little trouble. Most are tethered out to graze on the nearest wasteland. Roadside herbiage is all some of them get. The goat also provides milk, a popular beverage among those exposed to the Insular health department program.

There is no way to compare the number of chickens in 1950 with the number in previous years because early data are lacking. Chickens are kept in small numbers by most farmers and parceleros. Many are of poor quality and lay few eggs. The eggs are not eaten by the poor but are sold or traded at the nearest store. This source of ready cash is important to a cane worker who has employment only six months a year.

No figures are available for the domestic dogs and cats, nor for the wild rats and mongooses. The domestic animals are rarely fed but are left to forage for themselves. The rats and mongooses continue to be nuisances. In 1951 a rabid mongoose bit a horse, causing a rabies scare and frightening the Insular Health Department into a mongoose-trapping campaign. It is hard to imagine the complete elimination of the mongoose from Puerto Rico. The animal is too wily and much too fast to be easily caught. Furthermore, the cane fields provide excellent cover.

The animal figures by municipio for 1950 are given in the following chart.

Animal Raising by Municipio, 1950 (221)

	Coamo	S. Isabel	Salinas	Guayama	Arroyo	Patillas
horses	1,268	234	892	668	239	711
mules & donkeys	286	102	217	313	49	106
cattle	9,056	961	6,579	4,352	1,388	3,293
sheep	231	0	122	130	11	31
goats	715	284	707	762	298	984
pigs	<u>1,530</u>	<u>471</u>	<u>783</u>	<u>963</u>	<u>271</u>	<u>1,589</u>
totals	13,086	2,052	9,300	7,188	2,256	6,714
oxen	391	177	405	206	377	533
chickens	29,072	4,336	7,596	13,749	3,980	22,537

A comparison of this chart with the similar one in Chapter V shows that the total number of animals in Southeast Puerto Rico has slightly increased although the increase was not uniform throughout the six municipios. Three municipios, Santa Isabel, Salinas, and Arroyo, have fewer animals than in 1897, with Santa Isabel experiencing the greatest decline. It now has less than half as many as in 1897. Animals have been displaced by irrigated cane. Coamo, Guayama, and Patillas all have more animals than in 1897. Coamo, which shows the greatest increase, is the only one of the six municipios with no irrigated land.

Horses declined throughout Southeast Puerto Rico; the decline was least in Coamo and greatest in Santa Isabel. The slight increase in mules and donkeys in some of the cane-growing municipios may be due to the use of mules in plowing or in powering some of the cranes that load cane.

Although cattle show a slight decline in over-all figures, two municipios experienced increases; Patillas had a slight increase, while Coamo almost doubled its cattle population. This is due to the rise of the dairy industry in Coamo.

Sheep increased principally in Coamo, the driest land available to them. Goats increased throughout the area but increased most in Guayama. Pigs also were more numerous, especially in Patillas and Coamo. The distribution of oxen would seem to indicate that more are being used in raising food crops than in cultivating cane. The cane lands tributary to the Central Lafayette seem to use more oxen than those tributary to the other centrals in Southeast Puerto Rico. Chickens are commoner in Patillas and Coamo than in the other municipios.

Summary 1500 to 1951

Population. The population increased from a few hundred Indians in the 16th century to a mixed population of 127,992 in 1950. Sixty-six percent claimed to be white. Racially the blending of Indian, Negro, and white strains is interesting because segregation did not develop. More important to agriculture was the growth of two distinct classes in the agricultural population; a group of large landowners who grow export crops on the best lands, and a group of small landowners who grow subsistence crops on the poorer lands. The large landowners, located mainly in the lowlands, have always taken the lead in new agricultural developments. The small

land owners, located mainly in the hills, have remained out of the current of progress.

The large landowning class has benefited from several infusions of new ideas and new blood. It might be said that the progress of agriculture is the story of the taking over of leadership by a succession of newcomers. In early Spanish times, the wealthy Spaniard came in with his slaves. After 1815 the French came from nearby islands with knowledge of sugar-growing, coffee-growing, and cattle-raising.* After 1900, the Americans came with capital, built the irrigation works, and developed the sugar industry to its present high standard as exemplified in Central Aguirre. The amazing thing about the immigrant in agricultural progress is that so few took over in so short a time.

One reason for the successive economic conquests of the area has been the paucity of natural resources. The riches are in agriculture and water power, but the riches can only be unlocked by those with either knowledge or capital. The small hill farmer had neither.

The long-time trend of immigrants taking over the leadership in agriculture has changed its nature recently. Since the initial influx of Americans, soon after 1900, there has been no

* Two of the leading coffee fincas in upper Coamo are owned by a Corsican, who came to Puerto Rico as a boy, and by the descendant of a Corsican.

sizable immigration of agriculturalists. Nowadays, there are two sources of new ideas: recent publications from outside the island, and knowledge imported by Puerto Ricans who study abroad. This importation and diffusion (mostly through the Agricultural Experiment Stations and the Insular and Federal Departments of Agriculture) will have to take the place of the importation of new leaders because a new wave of immigration is not expected.

New Plants. Imported plants dominate the agriculture of Southeast Puerto Rico. Three plants have lead in importance for more than a hundred years: sugar, coffee, and tobacco. Only tobacco was known to the Borinquen Indians and they never knew the improved varieties grown today.

Most of the important species of plants were introduced in the Spanish period. The American period has been dominantly a period of the introduction of improved varieties of species already on the island. From the beginning, two kinds of plants have been brought in: commercial crops for export and local crops for subsistence.

There has been a good deal of trial and error and some wasted effort in the introduction of new plants. Many plants that failed to acclimate came from temperate parts of Europe; plants that adapted themselves came mostly from tropical sections of Africa and Asia. Scientific procedures began in the American period when plants were exchanged on a world-wide basis through the U.S. Department of Agriculture.

Few plants provided first-class export crops. A constant

strengthening of the growing stock through the introduction of new varieties has been one reason for the success of commercial crop raising, particularly sugar cane, and has gone hand in hand with the continued introduction of improved farming methods.

Some plants took a long time to become important. Sugar cane, which has been on the island since 1515, did not become the principal crop in Southeast Puerto Rico until the end of the Spanish period. Since that time, however, sugar has remained the main crop.

Local food crops and food preferences have been influenced by the influx of people to the island. The Indian root crops and other foods like corn, pineapple, and peanuts, were adopted by the incoming races. The importation of slaves from Africa brought also African bananas, yams, and coconuts, which have become important in the present day diet of the island. The white men brought European plants. The European grains and fruit trees were not successfully established on the island, although many of the garden vegetables were. Repeated attempts were made to grow the grains, fruits, and nuts that the white man was used to in his homeland. Repeated failures did not cause the white man or his descendants to lose their taste for such foods, and they continue to be imported.

Some of the plants, especially the trees brought in by the early Spaniards, have escaped from cultivation to become naturalized. Some of these, like the quenepa, the tamarind, and the mango, provide valuable free supplements to the diet of the poor.

Citrus fruits are present in great variety on the island, but only limes and oranges are numerous in Southeast Puerto Rico. There are many varieties of citrus that are not widely known; most are specimens in the gardens of the experiment stations. At present, frozen orange and grapefruit juice are being produced in other parts of the island. There seems little probability of exporting citrus fruits to the United States as long as Florida, Texas, and California provide better quality fruit.

The introduction of forage crops made possible the development of the dairy industry. The most widely distributed forage crops are those brought in under Spanish rule; Guinea grass, for example, is the dominant forage plant in Southeast Puerto Rico. The most productive forage crops, elephant grass and Guatemala grass, were brought in under the Americans. Many of the new forage crops have not been wholeheartedly accepted by the farmers; an improvement in forage yield is possible through a wider distribution of plants already on the island. A trend is already apparent toward the wider use of silos for storing fodder for dairy cows during the dry season.

The introduction of cover crops in the American period coincided with the recognition by tropical agricultural specialists that clean cultivation is unwise in the tropics where pelting rain creates a serious erosion problem.

The temperate fruits, such as olives, small grains, grapes and nuts, have repeatedly failed to acclimatize. Even some tropical plants will not grow on the island because of the winds, nematodes, blights, pests, and diseases.

All plants that acclimatized were not financial successes; examples are the imported fiber plants that grow unused in the Southeast Puerto Rican countrysides. Experience with attempting to grow new plants for export should have taught the people of the island that an export crop cannot be profitably grown if another tropical locality is already producing that plant with labor that is more highly skilled or cheaper than Puerto Rican labor. The small size of the island and the high cost of land may also prevent Puerto Rico from competing on the world market.

There has been a noticeable tendency for the agricultural stations to concentrate on improving the established crops. This is understandable because the island depends on such crops for its existence and the export crop farmers are ready and willing to absorb new knowledge. Furthermore, the Rio Piedras station is obligated to produce cane seed (stem cuttings). Improving crops, and especially methods, for the jíbaro farmer, on the other hand, is thankless work. The jíbaro doesn't usually cooperate, and often has little understanding when he is willing.

It is possible that the agricultural experiment stations may have run ahead of the ability of the Puerto Rican farmer to absorb the new plants already acclimated to the island. If that is so, the answer is not to stop the importation or the experimentation, but to find ways of informing and persuading the farmers.

A development of the American period that could only take place under the experiment station set-up was the development

of new varieties of several plants. Sugar cane, sweet corn, and tobacco are the outstanding successes.

Animals. The introduction of new animals paralleled the introduction of new plants. Most of the species were brought in by the Spaniards, but the better varieties were brought in by the Americans.

The lack of animals on the island in Indian times was the cause of early importations of pigs, sheep, horses, cows, barnyard fowl, and domestic pets. Most came from Europe, but the guinea fowl came from Africa. Before the end of the Spanish period, improved breeds of cattle and horses were being imported. Bees, rabbits, and silkworms were brought in, though not in large numbers. Most animals were kept in captivity. The mongoose was imported and deliberately set free.

Few of the introduced animals failed to adjust. Sheep and goats became sickly in the damp parts of the island, but both survived on the semi-arid south coast. The ring-necked pheasant and the draft horse were the only failures.

During early times, many of the animals degenerated. The horses became dwarfed and the cattle produced little milk. Since the end of the 19th century, the two Agriculture Experiment Stations have attempted to improve the stocks by importing superior sires. The improvement has not been general throughout the area. Some of the most degenerate specimens of horses, sheep, cattle, and chickens can still be seen in isolated places.

The only example of an animal which was brought in for

one purpose and retained for another is the cow, which was imported to provide hides, work oxen and meat, and is now being developed to provide dairy products and meat. Many strains of cattle were imported. The Zebu was especially numerous on the south coast at one time. It helped produce good work oxen, but cross-bred cows gave little milk.

The most important recent influence on cattle raising was the decision of the Experiment Stations to develop a combined dairy and meat animal instead of trying to develop two different kinds of cattle. The relationship of forage crops to the raising of improved cattle has already been discussed.

A big step forward in the cattle industry was the dipping of animals to eradicate ticks. This program has been so successful that ticks have virtually disappeared from Southeast Puerto Rico.

Continued efforts are being made to improve the strains of cattle, horses, pigs, and chickens. Sheep and goats are no longer receiving attention.

Two smaller animals which have roamed wild without becoming pests are the giant toad, which controls a sugar cane pest that was doing serious damage to the crop, and the edible frog, which has not yet become widely distributed.

Some animals have no future in Southeast Puerto Rico. Silk worms were brought in twice, once in Spanish times and once in American times. No industry developed and the strains were permitted to die out.

Transportation. Transportation has had an important influence on land use in Southeast Puerto Rico. When the Spanish took over, inland transportation was difficult. Most travel was by water along the coast. Smuggling was almost inevitable as more products became available for trade. The authorities would not open the Southeast Puerto Rican ports to trade and the overland transportation to San Juan, the only open port, was so expensive that the local farmers couldn't compete with farmers closer to San Juan.

By the end of Spanish times, Southeast Puerto Rico was able to trade by sea with the outside, but had only one all-weather road to tie it to the rest of the island.

The American period brought not only the integrated system of paved highways but the automobile and truck, which made fast transportation possible, and changed the transportation orientation of Southeast Puerto Rico. Only sugar continues to flow out of the ports of the area. The sugar ships returning to Aguirre bring supplies for a store chain operated by an Aguirre affiliate, but other trade comes and goes via San Juan or Ponce and is trucked in.

For the farmer, the highway net has meant opportunity to grow more cane, the most lucrative crop, and the additional opportunity to truck perishable food products to the urban markets of the island. Crop land has inevitably expanded as paved roads were opened.

Railroads have never been important in the general transportation picture, but have been limited to carrying cane to some of the centrals and freighting raw sugar to the wharves.

Air transportation and air freight are of no importance in Southeast Puerto Rico at present, largely because there is no export product grown in the area that requires such fast handling.

The Land Holdings. The first lands distributed to white men were given under usufruct by the crown. From the beginning, large amounts of land were concentrated in few hands, sometimes absentee hands.

The change in the landholding system from usufruct to full ownership not only permitted the large landholders to obtain full control of their lands, but also allowed many poor squatters on the less desirable lands of the interior to become landowners under the terms of a Law of the Indies.

The introduction of the modern sugar central system, along with a change of sovereignty, led to a concentration of the sugar lands in fewer hands but did not alter the situation in non-sugar lands.

The 500-acre law, imposed by the U.S. Congress to prevent corporate ownership of large tracts of land, was not enforced for its original purpose, but was later used by the Insular Government as the basis for land reform. The most successful aspect of land reform in Southeast Puerto Rico is the resettlement of landless agricultural workers on parcels which they hold in usufruct from the Insular Government.

A recent development in landholding is the withdrawal of large tracts for irrigation reservoirs, Insular Forest, a U.S. Military District, and for airports.

Other Influences on Land Use. The early Spanish policy of treating Puerto Rico as a source of wealth for the mother country fostered the gold-mining period which ended when the small gold resources gave out. The policy of excluding all voluntary immigrants but Spaniards, which gave way to excluding all but Catholics, and finally was modified to excluding all but the rich, had a profound influence on the immigration of leaders to the island, and the development of the jibaro class.

When world events made it impossible for Spain to help the island, the people turned to feeding themselves and smuggling their surpluses. The relaxing of the rules of 1815 and 1825 made possible the agricultural development that allowed coffee to become the chief crop at the end of the Spanish period.

When the United States took over the island all the rules were changed. The reorientation of markets brought sugar into first place and completed the downfall of coffee which was suffering from other maladies. The attitude of the United States toward its possession was entirely different from that of Spain; the United States felt a moral responsibility for the development of the island and the enlightenment of its people.

Puerto Rico remained an unimportant small part of the United States, lost in the larger problems of the United States, until the hurricane of 1932 coincided with the New Deal in the United States and focused the attention of the Federal

Government on the problems of the island. The wave of rehabilitation and reform started then under United States' auspices has been taken over and continued under Insular auspices to create the present program of land reform.

Two important aspects of the land reform are the resettlement of the landless agricultural workers on small plots of government land in semi-urban settlements, and a greater control over the sugar industry by Insular Authorities.

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CHAPTER VII

CONCLUSIONS

General Trends in Land Use

1. There has been a continuing tendency to destroy the natural vegetation that was on the island when the white man took over. This long ago reached its logical conclusion except in the mangrove forests, which survive. The land that was once in forest does not immediately return to forest but usually goes into waste land.

2. There has been a growing tendency to put more and more land into cultivation and to leave less and less in grazing and forest. This trend parallels the growth of population and the development of transportation. Two barrios where this trend has been held up for lack of transportation are Coamo Arriba of Coamo and Carite of Guayama.

3. An early trend toward the raising of export crops instead of subsistence crops was frustrated by the lack of transportation (both within the island and to the outside) which forced the people of Southeast Puerto Rico to raise their own food crops. The coming of American sovereignty revived the earlier trend, which continues despite pressures to raise more food crops.

4. The growing of export crops is concentrated on the most productive land with level terrain, good soil, available

water, and good transportation. The growing of subsistence crops is relegated to the less productive lands; those with rougher terrain, poorer soil, less available water, and poorer transportation.

5. One product has usually dominated the exports. In early Spanish times it was hides, in late Spanish times it was coffee. In American times it has been sugar.

6. An early tendency toward raising export crops on a large scale began with the slave plantations under the Spanish but reached new heights after the central system was introduced into the sugar industry under the Americans. Concentration of sugar lands in fewer hands and corporate management resulted.

7. A tendency to grow cane in huge fields, which began on the south coast in Spanish times, has now reached almost the final stage. Under the Insular Government resettlement program, the agregados who formerly lived in barracks on cane lands are now being moved to parcela communities on the edge of the cane area, so that the uninterrupted fields now stretch for miles. The cane lands are becoming entirely depopulated. The fencing of the cane fields and the locking of the gates will soon make the cane lands inaccessible to the public -- and to the workers, too, in case of a strike.

8. Animal industries, except for the raising of cattle, have been small and localized. The cattle industry on the south coast formerly occupied much of the space now taken up

by irrigated cane. A revolution in cattle raising has changed the emphasis from the production of hides to the production of work oxen and meat animals, and, recently, to the raising of dairy and meat animals. The direction of the growing dairy industry is largely in the hands of wealthy cane growers who are investing their surplus funds in dairying. Under such progressive management, the dairy industry should develop rapidly.

9. A conservation trend is apparent in the creating of Insular Forests for the preservation of the mangrove forests and for the restoration of some of the rain forests. There is room for expansion of both kinds of Insular Forests. Additions to the rain forest preserves would make them easier to administer.

10. A trend toward turning agricultural land to non-agricultural uses and the employment of part of the labor force in non-agricultural pursuits developed simultaneously with the growth of population and the raising of the standard of living.

Changes in Land Use by Type of Original Land Use

Beaches. The sandy beaches along the Caribbean have had little development in the past and are only now being extensively used. Some of the beaches are little more than off-shore bars joined to the mainland. A few in Salinas still extend out into the sea, and are almost entirely surrounded by mangroves. In Indian times, it was dangerous to live there

because a beach-dweller was open to attack. At present, the beaches are sometimes places of refuge for displaced agregados. The living conditions are not very good, but a man can pick up a few extra pennies by fishing or crabbing.

Only two crops have been grown to any extent on the sandy beach soils. In early Spanish times the native royal palm was planted and the oily seeds fed to pigs. Later, coconut groves were planted. Outstanding groves are located in Salinas, Arroyo, and Patillas. The raising of coconuts is profitable and more might be planted on unused beaches in the area.

Recently, the Comunidad Pozuelo has been located on a sand spit that forms the eastern side of Jobos Harbor. This community, which started as a cooperative, is growing or attempting to grow, subsistence crops on the sandy soils. Sesame seed does well.

An interesting recent development is the Seaview Social Club in Salinas. A recreation center with cabins, dance hall, and recreation facilities has been built in the midst of a young, producing coconut grove. The owner gets income from renting facilities and from selling coconuts. Such dual use of the land should increase as the standard of living rises. There is an ideal spot for a similar development in Arroyo.

There are some small sandbar islands offshore either covered with or surrounded by mangroves. Some coconuts grow in the exposed sands but most of the islands are both uninhabited and unused and doubtless will continue in that state.

Swampy and Salty Lands. The swampy and salty lands have been the least changed of all the lands in Southeast Puerto Rico. The wettest of the lands are in mangrove swamps which are used as a source of firewood. Mangrove swamps can rarely be converted to any other use. There are only two such conversions in the area. In Salinas the natural salt beds have been enlarged by cutting off the nearby mangroves and extending the shallow evaporation basins. In Arroyo a former mangrove swamp has been drained and planted to cane. A pump is always at hand to keep the land drained, but even so, the cane seen growing there in 1951 was not of good quality. The rest of the mangrove swamps will probably remain as they are, especially since almost half of them are in Insular Forests.

The drier, salty lands which usually border the mangroves may be used for grazing but the areas are generally so small that they can be used only for agregados' animals. Some of the salty lands are cropped by agregados and some stunted food crops are raised. A few of the salty and heavy poyal lands that border the cane fields have been drained and washed of their salt before being planted to cane. Although this is the most profitable use made of salty lands, preparation and cultivation costs are high and the yields are not as good as on other irrigated land. The heaviness of the soils makes them difficult to handle without machinery. Rather extensive ditching in Santa Isabel and Salinas has helped drain the heavy poyal soils. Santa Isabel has the largest amount of poyal soil in cane.

There is probably not much hope for improving the rest of the poyal lands. Reclaiming them is expensive and the up-keep is equally expensive. Furthermore, there is frequently not enough acreage in such lands in one spot to make it worthwhile to reclaim them.

Savanna Forest Lands. The savanna forest lands, which once covered the largest area of Southeast Puerto Rico, have undergone the greatest change in land use of any lands in the area. The valuable woods of the savanna forest were early logged off for export, for oxcart construction, or for firewood. The savanna forest has never been replanted and may never be. This is the place of towns and cities and of the most valuable agricultural land in the area.

It was not always so. Early cropping was limited to the land along the streams. Large amounts of land that were deforested went into cattle grazing. The first coffee planting in the area was done at the time when the south coast led the island in coffee production. Cane, tobacco, and food crops were raised in small patches. With the increase in population, inadequate private irrigation systems watered the lands along the water courses when there was any water in the streams.

The construction of the modern irrigation system created the present wealth in sugar cane and divided the former savanna forest lands into two types of land use. Where irrigation water could reach, the land became valuable cane land; where irrigation water could not reach, the land remained semi-arid crop and grazing land which covers the largest underdeveloped

section of Southeast Puerto Rico and presents the greatest problem for development.

The irrigated lands are in sugar cane and probably will continue to be as long as sugar is the best-paying crop. Even if the price of sugar drops considerably, the irrigated lands can continue to produce sugar at a profit while marginal producers are being squeezed out. It is certain that the irrigated lands will continue to be cropped even if sugar stops being profitable or if quotas are set so low that some land must be diverted to other crops. High quality cotton is already being grown experimentally by Luce and Company.

There seems slight possibility of adding any considerable amount of land to the present irrigated fields. Some land might be drained to seaward, and some few more acres might be irrigated by pumps to landward, but the total possible amount is negligible. A whole new irrigated section in Coamo and Santa Isabel would be developed if the Coamo-Bauta project goes through. The newly irrigated lands would undoubtedly go into cane.

The non-irrigated savanna lands present an unanswered problem -- the problem of the tropical savanna -- which seems to be world-wide. L. Dudley Stamp, a world authority on underdeveloped areas, is of the opinion that of all the underdeveloped or undeveloped lands in the world, the tropical savannas most urgently need careful study (208, p. 69). It may be that Puerto Rico, with its excellent research facilities and its years of tropical agricultural experimentation behind it, may be in a position to point a way out. Progress should

be made if a blending is achieved of the centuries-old jíbaro methods of preventing soil erosion (digging-stick agriculture on steep slopes does prevent soil washing) and maintaining soil fertility (conuco agriculture does maintain soil fertility even if it does help destroy the forests) with the knowledge gained from almost 50 years of experimentation by the two Agriculture Experiment Stations on the island.

The non-irrigated savanna lands are dominantly hilly lands which are alternately cropped and grazed. Much of the area is in forage crops which feed many cattle but which dry out during the dry season. The remnant coffee lands will probably disappear in time. They are not worth the trouble needed to maintain them. Tobacco is also a dying crop because of the competition of the superior quality tobacco produced in the Cayey Valley to the north.

This land of dominantly jíbaro farming is being invaded by two forces: the Insular Government is settling most of its parcela communities in it, and some of the rich sugar growers from the south are investing their surplus capital in dairying which is being carried on in the savanna hill lands nearest to the irrigated cane. Such dairying is most prominent in Coamo, Salinas, and Guayama. Already the production of milk is important. Soon the production of cheese may follow. So far, the native Puerto Rican cheese, the queso blanco (white cheese), is the only one marketed, usually by small dairies. There is a noticeable tendency for the owners of herds to sell their milk to a pasteurizer who takes over the problem of distribution and sales.

Although grazing will probably remain the most important activity, the growing of corn, beans, and other food crops can be expected to continue. Much needs to be done to improve crop yields.

Rain Forest Lands. The rain forest areas are small in Coamo and Salinas, non-existent in Santa Isabel, and sizable in Guayama, Arroyo, and Patillas. The areas in Coamo, Salinas, and Guayama went into large coffee farms after the forest was cut, growing the coffee, banana, and orange combination which proved so profitable at the end of Spanish times. There has been little change in the crop pattern since the coffee complex was established. Of all the plants introduced by the Agricultural Experiment Stations which would grow under the same conditions as coffee, only vanilla was tried and that only in upper Coamo. Even today, when coffee farm profits are low and wages paid coffee laborers must be equally low, the complex survives.

Some years the coffee crop is so small or so low-priced as to hardly pay for picking it. Oranges have frequently been so cheap that they were left to rot on the trees. Usually the sales of firewood from the coffee shade trees and the sales of bananas (which bear the year round) have been the chief means of keeping the coffee growers solvent.

Coffee growing appears to be outmoded but no crop has yet replaced it. The Southeast Puerto Rico coffee areas are marginal as compared to more productive areas elsewhere on the island and should eventually go into some other type of land use. The Guayama section already shows signs of abandoning coffee.

In barrio Carite of Guayama, large tracts are incorporated into Insular Forest and more should be added to consolidate the disjointed holdings. Other, smaller tracts, have been put into Insular Government parcelas. The entire barrio is choked for lack of a road. Should a road be put in, some of the land might immediately go into non-irrigated cane.

In Arroyo and Patillas the rain forest land has gone into small-sized subsistence farms that raise food crops, and occasionally coffee, but not in such huge tracts as in Coamo and Salinas. This has been an area of little change in land use. A good deal of land in upper Patillas has recently been put into Insular Forest, as in Guayama, and more should be added to join the scattered holdings.

Two developments in Arroyo and Patillas are different than in the rest of the rain forest areas. Sizable parcela communities are located within the old rain forest land and non-irrigated cane is raised in the most favorable locations -- usually on the flatter lands. The parcela communities are well located for raising food crops but some grow cane instead. The non-irrigated cane is inferior in yield to the irrigated canes but is still the best paying crop that can be raised.

The old rain forest lands in Arroyo and Patillas, paradoxically, have always been "poor" areas. They receive more rainfall than the parched lowlands to the south and west, but were less important even before the irrigation works were constructed. The ample rainfall allowed them to go into small subsistence farms that barely supported the population. Other areas, much poorer in rainfall, developed into much richer agricultural areas.

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CHAPTER VIII

POSSIBILITIES IN THE FUTURE

The Population

No new immigration is anticipated although no laws prevent any American citizen from migrating to the island. The integrating of races will continue. Perhaps the most important influences on the population will be the increased diffusion of knowledge and the improved health conditions.

Introduction of New Plants

New species and varieties of plants will continue to be introduced but plant breeding and the improving of strains already on the island will probably be more important.

The past history of plant introductions would suggest that there is little chance of a new plant being brought in which might revolutionize export agriculture in a short time. Since 1900, many plants have been introduced, but none have displaced sugar. The plant exchange program of the U.S. Department of Agriculture has already surveyed most of the likely plants that might be introduced. There is more likelihood that if any plant does displace sugar it will be an improved variety of a plant already on the island. A new technology in growing or processing may make some minor plant already on the island take on an increased importance.

Plants that must be processed, like fibers, oil seeds, and perfume oil plants, may yet be made to pay if the plan of developing new industries on the island is extended to processing such crops. There well may develop a production of edible oils, like sunflower seed and peanut, for the island market which will reduce the dependence of the island on imported lard and olive oil. That is, if the consumers on the island can be persuaded that the unfamiliar oils are just as good as the fats and oils they now use.

Introduction of New Animals

Knowledge of how to improve the animal strains is already ahead of general practice. Improved breeding and importation of pure-bred stock can be expected to continue.

The raising of high-type dairy cattle may increase in Southeast Puerto Rico. Large tracts of land are suitable.

Saddle horses will continue to be used although their number will diminish as more roads are surfaced. Some sort of pack animal will be needed as long as crops are raised on farms that cannot be joined into a hard-surface road system. There are many such farms in Southeast Puerto Rico. The mule may become more important than the horse as a pack animal on such farms.

An increase in pig raising might free the area from the necessity of importing lard and enable the people to indulge in their favorite dish, lechón asado (barbecued suckling pig) with greater frequency. Some of the root crops might be raised

as feed for the pigs, (sweet potatoes, for example) and the animals raised on large tracts. Some places in Southeast Puerto Rico might be suitable for this.

Goats will continue to increase, but it is doubtful if sheep will ever become much more numerous.

The keeping of bees might be expanded; enough flowers are available for honey-making.

The introduction of animals to rove wild will probably not occur. Past experience with the mongoose will make the authorities hesitate to bring in similar animals.

Transportation

Transportation will continue to depend on the highways unless a new crop is developed that requires air freight. It is likely that present trunk roads will be widened and straightened before many new feeder roads are hard-surfaced. A road joining barrio Carite to the rest of the area is the most obvious immediate need.

There is a limit to the extension of roads. Many of the present trails can never be replaced by roads that will pass even a jeep. There will always be some isolated farms that will have to depend on animals to pack products to the nearest highway.

There is no reason to expect that railroads will ever be developed for general transportation. No standard gauge line exists anywhere in Puerto Rico.

If an export product that requires fast handling is de-

veloped, two small airports, one in Santa Isabel and one in Salinas, are available. Neither is large enough for extensive operations and enlarging either would require taking over some of the most expensive agricultural land in Southeast Puerto Rico. Seaplanes might land in the quiet waters of Jobos Bay.

Water transportation will continue to be used to ship raw sugar from Central Aguirre and Arroyo. No further development is probable.

The Land Holdings

Land ownership will be an increasing bone of contention as the population increases. More and more men will grow up without the possibility of acquiring land. The settling of agregados on Insular Government land under a system of usufruct will continue but will not solve the problem of land ownership. After most of the agregados receive government parcels in usufruct, they will probably press for full land ownership.

New cooperative ventures like Central Lafayette are not to be expected. The Federal Government, which carries the financial burden of the experiment, will eventually seek to liquidate the holding and the central operation will probably be sold into private hands.

Other Influences on Land Use

The Independence Question. The rights and wrongs of the

Independence question are no concern of the present study. The acquiring of dominion status was important to land use only because it preserved the status quo.

If Puerto Rico gains its political independence, drastic alterations in land use will ensue, the extent depending on what trade arrangements can be made with the United States.

Puerto Ricans advocating political independence for the island must recognize that the present land use depends on continuing within the U.S. tariff protection. Independence advocates on the island are few but vocal. They may obtain strong U.S. support from the same type of business man that pressured the U.S. Congress to free the Philippines. U.S. business men with large investments in Cuban sugar are very sympathetic toward the Puerto Rican desire for political freedom.

The Insular Industrialization Program. An increase in the number of people supported by non-agricultural pursuits can be expected as the Insular Government's program of development of industry continues.

The development of industry may clash with agriculture, not for manpower, which is plentiful enough, but for land and perhaps for water. The airports have already withdrawn excellent cane land. The water supply, which is in the form of underground water, is plentiful because of the Insular Irrigation System. Some underground water exists naturally, but the large amounts available now in the alluvial plain, where the towns and cities are, is due to irrigation. Old records tell of wells going dry where nowadays they do not. Locating

an industry that requires a good deal of water in one of the towns of Southeast Puerto Rico and bringing up a large amount of underground water may rob the cane growers of the water which they usually pump for irrigation. Those responsible for developing new industries would do well to take this into account.

Hurricanes. For over twenty years the island has been free of hurricanes -- an unusually long period judging by the hurricanes recorded for the 18th and 19th centuries. The odds are against a continued immunity. A disastrous hurricane may put Puerto Rican problems again in the lap of the U.S. Congress. Whether the island will again receive the generous treatment it did in early New Deal days is anybody's guess. The decision might be that Puerto Rico is no longer strategically important and is not worth rehabilitating.

Continuing Agricultural Problems

The opinions that follow were formed during the course of the study and concern only a few basic problems. Countless specific problems, that fall more properly within the competence of Insular and Federal agriculture specialists, are not included.

Export Agriculture. The continued importation of new agricultural ideas is important if Puerto Rico is to hold its place in crop export. The island has nothing unique in its agricultural situation. There are no unusual growing conditions which would enable the island to produce something

that would be unique in world trade. Everything Puerto Rico produces can be produced just as well elsewhere -- generally, more cheaply. Sugar growers jokingly, but truthfully, say that Cuba is too big. With such intense competition, Puerto Rico cannot afford to lag technologically as happened in the sugar industry in the late 19th century before the central system was introduced. Production must be kept modernized or the advantage given by the U.S. tariff will disappear. A problem that must be faced soon concerns the mechanized cane cutter that was developed and is in use in Hawaii. Will the abundance of labor in Puerto Rico and the pressures exerted in labor's behalf on the insular government prevent continued modernization of the industry and bring on the technological backwardness that led to decline of the industry at the end of the Spanish period? The problem involves the largest group of workers on the island -- the agricultural laborers.

With modernized technology, sugar cane will continue to occupy the irrigated lands of Southeast Puerto Rico unless either of two things happens. The sugar quota may be set so low that land is freed for other crops, or the development of a high-yielding cane may achieve the same result by allowing the quota to be grown on a fraction of the present cane lands. If either happens, a new export crop will be developed, probably from crops already on the island. Long staple cotton seems the likeliest candidate.

The freeing of present cane lands for new crops may permit the growing of irrigated forage grasses and stimulate the dairy industry.

Export Crops versus Food Crops. This long-time dissension never seems to die out but is revived in full fury whenever the importation of food is interfered with for one reason or another. Because the food-short days of World War II are still rather recent, propaganda for the raising of food crops at the expense of export crops is again heard, especially among food crop growers who dream of some sort of government subsidy. (It is amazing the number of farmers who think that lack of capital is the only evil they have to contend with!)

The raising of food crops is largely in the hands of the jíbaro farmers, most of whom have never faced the problem of raising crops competitively. They have yet to learn the first lesson -- that a quality product commands a higher price. In Spanish times, when shipping was scarce and food hard to get, the food raisers could sell locally whatever they produced. Nowadays, shipping is available and imported food is frequently better than the jíbaro can raise -- and there is a sophisticated urban market on the island that knows quality and intends to get it. Consumers demand and get the imported, processed white rice rather than take the unprocessed brown rice of the island. They buy imported dried beans, which are sometimes cheaper, but which are always more uniform in quality. They also buy canned pineapple imported from Hawaii, rather than that canned on the island, because it is of more dependable quality.

There is another aspect of the food crop versus export crop argument that is generally ignored. The island cannot grow all the kinds of food that the people of the island demand.

Enough rice and beans might be produced at an economic sacrifice, if the consumer would accept the quality, but no amount of trying can raise the wheat which the Puerto Rican insists on consuming. It is hard to imagine a Puerto Rican home without its tin of crackers or its long loaves of crusty bread. Imported olive oil and apples, almond candy and wine, are indispensable to the city dweller.

If the island cannot feed itself as it insists on eating, then the argument for raising food crops loses a good deal of its force and the question becomes one of degree. How much of its food should the island raise?

U.S. competition may provide the answer. It is possible that U.S. rice and beans may eventually drive local rice and beans from the urban markets through offering better quality at a lower price. The only local food products that are in no danger from outside competition are the bananas and the local roots and vegetables. It is probably only a matter of time before frozen foods from the United States, which have already appeared in select stores, will compete along with canned goods for the quality vegetable market of the island. Already, meats from the U.S. have captured the quality markets in the larger cities, even in the face of the lower cost of local meat.

On the average, the food crop grower is as far behind in technology as the ox-powered trapiche would be in comparison to the modern central. The trapiche has vanished from the island but the old-time food-crop raising is still being

practiced as it was in trapiche times. If quality standards are not raised, the time may come when the jíbaro food grower may find no market for his surplus food in the urban centers.

The great contrast between the methods used in export and subsistence farming can be seen by anyone who climbs a foothill in Southeast Puerto Rico. Below on the irrigated alluvial plain, modern tractors plow the cane fields which will be planted with selected seed and fertilized at just the right time with scientifically balanced fertilizers. On the un-irrigated hillsides, a jíbaro plants his unselected seed by old digging-stick methods. He is too poor to buy commercial fertilizer and too ignorant to use the manure from his own animals. The great gulf between the methods is the greatest agricultural problem facing the island. Can Puerto Rico afford to have so much of its land tilled by such inefficient methods as the jíbaro farmer uses?

Those in charge of agricultural progress have long been aware of the need of improving methods of growing food crops. A report by the Brookings Institute in 1930 stated that the chief problem was the jíbaro himself. (39, p. 501) Jíbaro agricultural methods are a part of his way of life which developed over centuries. It will take quite a while to change them. The agricultural authorities are wisely planning long-term remedies. The agricultural teaching in the secondary schools of Southeast Puerto Rico is an excellent step in the right direction. Progress will be slow, because the modern methods developed in the cane fields of the lowlands cannot be adapted to the hills. Much tedious experimentation must be done before an improved method of hill farming is

developed, especially in semi-arid Southeast Puerto Rico.

The Problem of Increasing Productivity. The only lands in Southeast Puerto Rico that are being used to the utmost are the flat irrigated lands that grow sugar cane.

The semi-arid non-irrigated lands might be better utilized. The problem of increasing efficiency in food crop raising has been mentioned above. Grazing land might be made more productive by planting a tree crop at wide enough intervals to permit the growing of forage grasses underneath. This would be reforestation of a sort, for it would be constructing a kind of savanna forest where such forests once existed. The bay tree (malagueta) was seen growing along with Guinea grass in parts of barrio Guamaní of Guayama. The tamarind tree grows similarly and provides welcome shade for cattle, even though no commercial use has been found for the tamarind fruits. There might be a possibility of growing chilte trees in the grazing lands and producing chewing gum and cattle on the same land.

The coffee, orange, and banana combination is not as profitable as it once was on the humid areas of Southeast Puerto Rico. Perhaps a search might be made for a new combination to replace the trio, keeping bananas in the combination.

The area might profit by finding a way to merchandize some of the products that at present either go to waste or are not fully utilized. Examples are the fiber plants, and fruits like mangos, tamarinds, and avocados.

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315. Forcelledo, Don Ramon, long-time employee of the Bureau of Tick Control. Interview. Mato Rey: September 12, 1951.
316. González Rios, P., head of plant breeding at the U. of P.R. Ag. Exp. Station. Letter concerning sugar cane varieties. Rio Piedras: May 6, 1952.
317. Huertos Cruz, Nicanor, parcelero. Interview. Bo. Marin of Patillas: July 3, 1951.
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319. Ortega, Sr., official, Puerto Rican Aqueduct and Sewer Authority. Interview. Santurce: September 13, 1951.
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July 20, 1951
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APPENDIX A

HURRICANES

16th Century

<u>Year</u>	<u>Month</u>	<u>Day</u>	<u>Name</u>
1508	August	16	San Roque
1515	July	4	San Laureano
1526	October	4	San Francisco
1530	July	26	Santa Ana
1530	August	22	San Hipólito
1530	August	31	San Ramón
1535	September	12	San Leoncio
1537	July	11	San Pío
1568	August	24	San Bartolomé
1575	September	21	San Mateo

17th Century

1615	September	12	San Leoncio
1626	September	15	Santa Catalina
1642	September	-	--
1657	August	-	--

18th Century

1718	September	7	Santa Regina
1722	August	28	San Agustín
1730	August	30	Santa Rosa
1738	August	30	Santa Rosa
1738	September	12	San Leoncio
1740	August	3	San Esteban
1740	September	11	San Vicente
1742	September	28	San Judas
1751	August	18	San Agapito
1766	September	19	San Genaro
1766	October	7	San Marcos
1766	October	8	San Adrián
1767	August	7	San Cayetano
1772	July	16	N. Sra. del Carmen
1772	August	28	San Agustín
1772	August	31	San Ramón
1775	August	1	San Pedro
1776	September	7	Santa Regina
1780	June	13	San Antonio

18th Century (Continued)

<u>Year</u>	<u>Month</u>	<u>Day</u>	<u>Name</u>
1780	October	10	San Paulino
1785	September	25	San Lope
1788	August	16	San Roque

19th Century

1804	September	4	Santa Rosalía
1804	September	21	San Mateo
1805	September	11	San Vicente
1806	September	11	San Vicente
1807	August	18	San Agapito
1809	September	2	San Esteban
1812	July	23	San Liborio
1812	August	21	Santa Juana
1813	July	23	San Liborio
1814	July	23	San Liborio
1816	January (?)	18,19,20	Santa Prisca
1819	September	21	San Mateo
1824	September	8	N. Sra. de la Monserrate
1825	July	26	Santa Ana
1827	August	17	San Jacinto
1837	August	2	Los Angeles
1846	September	11	San Vicente
1851	August	18	San Agapito
1852	September	22-26	San Mauricio
1853	October	26	San Evaristo
1867	October	29	San Narciso
1871	August	21	Santa Juana
1876	September	13	San Felipe
1888	September	5	San Lorenzo
1889	September	4	San Moisés
1891	August	19	San Magín
1893	July	16	N. Sra. del Carmen
1893	August	16	San Roque
1896	September	1	San Gil
1899	August	8	San Ciriaco

20th Century

1910	September	6	San Zacarías
1916	August	22	San Hipólito
1926	July	23	San Liborio
1928	September	13	San Felipe
1931	September	10	San Nicolás
1932	September	26	San Ciprián

APPENDIX B

PLANTS USED BY THE INDIANS PRIOR TO 1500

Cultivated Plants

<u>Spanish</u>	<u>English</u>	<u>Genus & species*</u>	<u>Use</u>
yuca	manioc cassava	Manihot Manihot	tapioca flour for bread; also a fermented drink
yautía	tanier	Xanthosoma spp.	starchy root; leaves of some varieties eaten
batata	sweet potato	Ipomoea Batatas	starchy root
lerén	--	Calathea Allouia	starchy root
imocoma, maraca	--	Canna edulis	starchy root
guáyaro, gunda	--	Rajania cordata	starchy root
maranta	arrowroot	Maranta arundinacea	starchy root

* The Genus and species names used throughout the dissertation are from three sources. Names for indigenous plants and for those introduced up to 1930 are from the Botany of Porto Rico and the Virgin Islands by N.L. Britton and Percy Wilson, 1923-1930 (25, 26). Names for plants introduced after 1930 are from the annual reports of the agricultural experiment stations at Mayaguez (231) and Rio Piedras (168).

Differing Genus and species names given in other reference books, particularly Colón (41) were found to be obsolete, misspelled, or incorrect for the plant being identified. Names for the plants used by the aborigines may not be correct in all cases. Many times the only reference available was the Spanish common name or an old Spanish transliteration of the Indian common name. Because Britton and Wilson frequently omit common names, it was necessary to search the floral families for a Genus and species known to be indigenous to the island in the hope of finding an equivalent scientific name.

Cultivated Plants (Continued)

<u>Spanish</u>	<u>English</u>	<u>Genus & species</u>	<u>Use</u>
apio, arracacha	--	Arracacia xanthorrhiza	vegetable root
maíz	corn	Zea Mays	edible seed; also a fermented drink
piña	pineapple	Ananas Ananas	fruit
chayote, chocho	--	Sechium edule	squash-like fruit
maní	peanut	Arachis hypogaea	nut
ají picante	red pepper	Capsicum frutescens	condiment
tabaco	tobacco	Nicotiana Tabacum	smoked for health or religious reasons
algodón	cotton	Gossypium spp.	clothing & hammocks

Wild Plants

<u>Spanish</u>	<u>English</u>	<u>Genus & species</u>	<u>Use</u>
mamey	--	Mammea americana	fruit
hobo, jobo	hog plum	Spondias Mombin	fruit
lechosa	papaya	Carica Papaya	fruit
guayaba	guava	Psidium Guajava	fruit
corazón	bullock's heart	Annona reticulata	fruit
guanábana	sour sop	Annona muricata	fruit
anón	sweet sop	Annona squamosa	fruit
caimito	star apple	Chrysophyllum Cainito	fruit, wood for bows
icaco	coco-plum	Chrysobalanus Icaco	fruit

Wild Plants (Continued)

<u>Spanish</u>	<u>English</u>	<u>Genus and species</u>	<u>Use</u>
cupey	pitch apple	Clusia rosea	fruit
tartago	physic nut	Curcas Curcas	fruit and medicinal seeds
parcha	--	Passiflora maliformis	fruit
tuna	prickly pear	Opuntia Ficus- indica	fruit
pitajaya	strawberry pear	Hylocereus trigonus	fruit
corozo	--	Acrocomia aculeata	palm seed; source of oil
aguacate	avocado	Persea Persea	oily fruit
higüero	calabash tree	Crescentia Cujete	utensils and water jugs.
achiote, achote	annatto	Bixa Orellana	orange stain for bodies
jagua	genipa	Genipa americana	brown-black stain for bodies
pita, maguey	--	Agave missionum	leaf fibers for cord
emajagua	--	Pariti tiliaceum	bark fibers for cord
palma de yaguas	royal palm	Roystonea boriquena	trunks for house sides, leaves for thatch and fiber
ceiba	silk-cot- ton tree	Ceiba pentandra	dugout canoes
guano, balsa	cork wood	Ochroma pyramidale	floats, rafts

APPENDIX C

PLANT AND ANIMAL INTRODUCTIONS 1505 TO 1776

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APPENDIX C

PLANT AND ANIMAL INTRODUCTIONS 1505 TO 1776

Introduction of New Plants

For convenience, the plants are arranged in groups. The first grouping is into plants that successfully grew on the island and those that did not. Each group is further subdivided into: export crops, local or subsistence crops, and naturalized plants. In most cases the common name is given in Spanish and English followed by the Genus and species, the use, the import date, and the origin. A word of warning should be given about the different classifications. In all cases the Spanish name is correct. The English name may sometimes be the one that is technically correct or one that is in use on an English Caribbean island but not on Puerto Rico. Examples are the Indian Almond, which is called just plain almond (almendra), and the Himalayan raspberry which is usually called by the Spanish name fresa which means strawberry. The Genus and species problem is complicated by the fact that various technical names have been assigned to the same species at different times. The import date is the first date of record. That date may or may not be important. The mango, for example, arrived on the island in 1742, but the really delicious varieties did not come until the 20th century. The place of origin is given only as Old or New World. The original home of many species is

still controversial among Botanists. Fortunately for the present study, it is immaterial, for example, whether the original home of sugar cane is Africa or Asia. What matters is that sugar cane was not native to Puerto Rico.

The plants seen growing in Southeast Puerto Rico during 1951 are marked with an asterisk. This does not mean that others not so marked may not have grown in Southeast Puerto Rico at some other time.

Plants that Acclimatized

Export Crops that were Financial Successes

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*cañafístola	purging cassia	Cassia Fistula	purgative pulp of fruit	early 1500's	Old World
curcuma, jengibrillo	tumeric	Curcuma longa	yellow dye from rootstock	middle 1500's	Old World
jengibre	ginger	Zingiber Zingiber	edible root	middle 1500's	Old World
añil	indigo	Indigofera 4 species	blue dye	?	2 Old World 2 indigenous
caña de azúcar criolla	creole sugar cane	Saccharum officinarum	sugar, rum & molasses	1515	Old World
*café	coffee	Coffea arabica	beverage from beans	1736	Old World

The first four crops were early successes as far as growing well on the island is concerned. They still grow well on the island although their commercial importance ceased soon after 1620.

Purging cassia was probably the first to be brought in, arriving via Hispaniola. Exports were listed as early as 1540 but the market soon vanished. (41, p. 50) Perhaps one should not expect to build a large trade on a product of such limited use. Today the tree is grown along road sides for its pretty yellow flowers. The native markets still stock the purgative pulp but there is little profit in selling a product that anyone can gather from wild trees.

Tumeric was first brought to Mexico and then to the Antilles. In 1580 exports from San Juan exceeded those from Hispaniola. (41, p. 50) Shortly after, the bottom dropped out of the market. Tumeric powder, made from the root, was used as a yellow dye, (a long-vanished use) and remains an ingredient of curry powder. This is another product of limited use. Curries are not popular in the diet of Puerto Rico.

Ginger early became so profitable a crop that all the Spanish islands raised it. As a result the small market for it soon became flooded. In 1602-3 the Spanish government forbade the planting of ginger in Puerto Rico, but so tenuous was the control from the homeland, and so slow the communications that the cultivation of ginger increased until 1624. In that year, lacking money, the colony sent to Felipe IV some 119 quintales, 45 libras of dry ginger (almost 6 tons) along with some 175 arrobas of sugar (over 2 tons) as a contribution toward the war with France. (41, p. 51) By 1644 there was no market left for ginger. Obispo Don Fray Damián López de Haro wrote in 1644 (41, p. 52), "All the trade of this island and all the crop is ginger which has so fallen

that no one buys it or wants to ship it to Spain." Although the crop is raised to this day in the high interior of the island where there is a plentitude of rain, it is doubtful if any was ever raised in Southeast Puerto Rico. The present-day market is an extremely limited one, entirely within the island.

Indigo was never important although there was a slight trade in the product. Two species of indigo are native to tropical America, *Indigofera suffruticosa*, and *Indigofera guatemalensis*; while two others, *Indigofera tinctoria* and *Indigofera sumatrana*, were brought from Asia. There is quite a bit of work involved in extracting the dye, which would limit the output in Puerto Rico. Indigo was a product on the world market just at the time that Puerto Rico was suffering from a labor shortage.

Sugar cane and coffee are discussed in Chapter IV of the text.

Export Crop that was a Financial Failure

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
cacao	cacao	Theobroma cacao	chocolate and cocoa	1636	New World

Cacao never caught on as an export crop. This may have been because other areas had cornered the market before Puerto Rico came into production or it may have been due to local growing conditions. The plant is native to America and grows in the same latitude as that of Puerto Rico, but it is rather limited in its growing conditions. Cacao needs shade, much

as coffee needs shade, but cannot tolerate a strong breeze at the time when the pods are ripening. The heavy pods are borne on such fragile stems that a wind will blow the pods off before they are ripe. There are some sheltered valleys where protection from the almost constant trade winds is available, but they are not numerous. Cacao reached Puerto Rico in 1636. (41, p. 249) Abbad reported in 1776 that the cultivation was almost abandoned on the island. (10, p. 474) Two barrios in Patillas, Cacao Alto and Cacao Bajo, got their names from this plant although no cacao trees were seen growing there in 1951.

Local Crops, either Subsistence or for Local Trade

Tree Crops

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*guineo	banana	Musa sapientum	fruit	1525	Old World
*plátano	plantain	Musa paradisiaca	starchy fruit	1525	Old World
*coco	coconut	Cocos nucifera	food & drink	early 1500's	Old World
*china, naranja dulce	orange	Citrus sinensis	fruit	middle 1500's	Old World
cidra	citron	Citrus Medica	fruit	early 1500's	Old World
lima	sweet lime	Citrus aurantifolia	fruit	later 1500's	Old World
*limón	lime	Citrus Limonia	fruit	later 1500's	Old World
naranja	bitter orange	Citrus Aurantium	fruit	early 1500's	Old World
toronja	grapefruit	Citrus maxima	fruit	early 1500's	Old World

The new tree crops that became the most important in the economy of the island were the bananas[#] and the coconuts. (51) The bananas, including the plantain, became the leading starch food, taking the place held by yuca during the Indian period. They grew easily, produced well, and were soon found to be an excellent plant to grow along with coffee because the large leaves provided shade for the coffee trees. By planting a succession of bananas, one could have fruit all the year round. Many varieties were found to adapt readily to the growing conditions of Puerto Rico. The coconuts were the yellow and green varieties. A better kind came later. Both bananas and coconuts came from Africa via the Canary Islands and Hispaniola, (146, vol. II, p. 274) reportedly on slave ships (41, p. 40, 249). The bananas grew anywhere on the island, while the coconuts grew on the sandy shorelines. Both were familiar foods to the blacks who came in increasing numbers.

Six kinds of citrus fruits came from Europe in the 16th century. There are no recorded dates, but the bitter orange and the citron are supposed to have arrived first, with the sweet orange coming about the middle of the 16th century, followed by the lime and the sweet lime. (18, p. 249) No date is given for the arrival of the grapefruit. The planting of all the citrus fruits were at first merely dooryard plantings around individual homes but the sweet orange became more important when it was discovered that oranges and bananas made good coffee shade. The fact that the orange was the best to eat

Technically bananas are not trees but they are frequently planted as shade trees.

out of hand soon made it the most popular of all citrus fruits. The triumvirate of coffee, bananas, and oranges became the commonest plant combination in the highland regions of the island.

At a later period some of the tree crops were to enter into export trade but up to 1776 all of them were only important locally. Most of the tree crops grew in Southeast Puerto Rico.

Garden Truck

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*ajonjolí	sesame	Sesamum orientale	oily seed	?	Old World
*berenjena	egg plant	Solanum Melongena	vegetable	early 1500's	Old World
*calabaza	squash	Pepo moschata	vegetable	?	Old World
cebolla	onion	Allium Cepa	vegetable	?	Old World
*col	cabbage	Brassica oleracea	vegetable	?	Old World
*frijol negro	black bean	Dolichos Lablab	vegetable	?	Old World
*gandul	pigeon pea	Cajan Cajan	vegetable	?	unknown
*guingambo	okra	Abelmoschus esculentus	vegetable	?	Old World
*haba	lima bean	Phaseolus lunatus	vegetable	?	New World
*habichuela, judia	kidney bean red bean	Phaseolus vulgaris	vegetable	?	New World
*lechuga	leaf lettuce	Lactuca sativa	vegetable	?	Old World
*malanga	taro, dasheen	Caladium Colocasia	starchy root	?	Old World

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*ñame	yam	Dioscorea rotundata	starchy root	1500's	Old World
*pepino	cucumber	Cucumis sativus	vegetable	early 1500's	Old World
*rábano	radish	Raphanus sativus	vegetable	?	Old World
*remolacha	beet	Beta vulgaris	vegetable	?	Old World
*sandía, patilla	melon, watermelon	Citrullus Citrullus	fruit	?	Old World
*tomate	tomato	Lycopersicon Lycopersicon	vegetable	?	New World
*zanahoria	carrot	Daucus Carota	vegetable	?	Old World

Garden plants adjusted themselves in astonishing number; even some that were used to the temperate conditions of Europe did well. Data are practically non-existent on the time of arrival of most of the garden plants, but all those listed were on the island by 1776. No one knows where one of the best of the garden plants came from. The gandul (one doesn't hear the English form "pigeon pea" on the island) is so widely distributed throughout the tropical lands of the world that its original home is unknown.

Lima beans, kidney beans, and tomatoes came from the American mainland. Dried beans are so prominent a part of the Puerto Rican diet that one wonders if the Borinquen Indians didn't have them before the white men came.

Black beans, okra, yams, and melons arrived from Africa, probably on slave ships. There were some inferior yams on the

island in Indian times (18, p. 244) which were not much used. The yam from Africa was the true yam, not the sweet potato which is sometimes called yam in the U. S. The melon, particularly the watermelon, is reported not to do so well in Puerto Rico, but it did give its name to Patillas, one of the six municipios of the Southeast Puerto Rico.

Only two garden plants came from Asia and the East Indies but both are much used. Sesame is used in a favorite candy, and taro root (always called malanga) grows like, looks like, and tastes like the indigenous yautía, albeit it grows to a much larger size.

From Europe came a selection of salad plants and vegetables; cabbage, onion, egg plant, leaf lettuce, cucumber, radish, beet, and carrot. All do not do equally well, but all will grow on the island. Cabbage, squash, and egg plant are produced in some quantity for the local market in Southeast Puerto Rico. The rest are normally dooryard crops.

Grain

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*arroz	rice	Oryza sativa	grain	Before 1523	Old World

Rice is the only one of the imported grains that did well. The kind grown is upland rice; paddy rice (grown standing in water) is not produced on the island. This grain has always been a favorite of Spanish peoples. Its introduction into Puerto Rico helped the islanders become more nearly self sufficient in food stuffs. Abbad reported in 1776 that rice gave

three and sometimes four crops a year. (10, p. 311) The farmers in Southeast Puerto Rico in 1951 were raising only one crop a year. Rice, here, has always been an upland crop. The flat lowlands were too dry.

Naturalized Plants

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*almendra	Indian almond	Terminalia Catappa	nut	?	Old World
*berros	water cress	Sisymbrium Nasturtium-aquaticum	salad green	?	Old World
*ciruela, jobillo	Spanish plum	Spondias purpurea	fruit	?	New World
*fresa	Himalayan raspberry	Rubus rosaeifolius	fruit	?	Old World
*granadilla	--	Passiflora quadrangularis	fruit	?	New World
*grosella	Otaheite gooseberry	Cicca disticha	fruit	?	Old World
*maguey	century plant	Agave americana	fiber in leaf	?	New World
mamey-sapote	--	Achras Zapota	fruit	?	New World
*mango	mango	Mangifera indica	fruit	1742	Old World
*nispero, sapodilla	naseberry	Sapota Achras	fruit, sap is source of chicle	?	New World
*pomarosa	rose-apple	Jambos Jambos	fruit	?	Old World
*quenepa, guenepa	guinep, Spanish lime	Melicocca bijuga	fruit	?	New World
*sansevieria	snake plant, bowstring hemp	Cordyline guineensis	fiber in leaf	?	Old World
*tamarindo	tamarind	Tamarindus indica	fruit	?	Old World

The fourteen plants listed are by no means all of the plants that have been brought in and naturalized on the island. They include only those that supply some product, other than firewood, to the people of Puerto Rico. Most of the fourteen supply some food product that the poor may have for the gathering. This free supplement to the diet is important in a land where so many have so little to spend.

Nine of the fourteen plants are trees supplying fruit. The mango is the most widely distributed and the most used, followed by the quenepa and the tamarind. The quenepa is chewed and the tamarind is used to make a refreshing soft drink. The níspero (sometimes called sapodilla in parts of Latin America and never called naseberry on the island) is a delicious sweet fruit which is not as common as the preceding three. Seemingly no one gathers the sap of the níspero tree which is the commercial chicle used in chewing gum. The almond, plum, and gooseberry are not the almond, plum, and gooseberry known to temperate zones, but tropical varieties with an acrid taste.

The mamey sapote is a favorite fruit while the rose-apple, which grows mainly on the north side of the island, is largely hog food.

Five of the nine fruit trees are native to Asia. The Indian almond probably reached Puerto Rico via the Philippine Islands. The tamarind and mango are thought to have come via Rio de Janeiro. There is no record at hand of how the Otaheite gooseberry and the rose-apple reached the island.

The four remaining fruit trees, the Spanish plum, the mamey sapote, the níspero, and the quenepa, came from nearby Central

America or possibly from nearby islands. Little is known of how or when they arrived. One of them, the mamey sapote, may have arrived in Indian times. (18, p. 251)

A vine, the granadilla, originally from Central America, is planted widely for its fruit, a kind of passion fruit.

Only one berry plant, the Himalayan raspberry, (universally called fresa) has been successfully naturalized. It grows in the higher parts of the mountains and bears all the year round. Some cash income is provided by the berry to the youngsters in Southeast Puerto Rico who live on the Cayey-Guayama highway. Any day in the year they can be heard shouting, "Fresa, fresa, fresa..." to the passing motorists as they offer boxes of the pretty, but not too tasty berries, which they have collected in the forest.

One salad plant, the watercress, grows in the streams. A native of Europe, it adapts itself where there is running water. It is found mostly in the upland streams in Southeast Puerto Rico. The lower courses of the rivers frequently dry up in the dry season.

Two non-edible plants are sources of fiber. The century plant came from Central America and the bowstring hemp from Africa. Both grow as escapes from cultivation in Southeast Puerto Rico. Each could be the raw material for a cordage industry. Perhaps neither plant has been so developed on the island because Puerto Rico is small and densely populated and hardly has room for the extensive plantations necessary. The two plants flourish in the semi-arid south and are handy for local use if needed.

Plants that Failed to Acclimitize

From the foregoing recital of plants that successfully adjusted to the growing conditions of Puerto Rico, it might be thought that the story of plant importation was a record of continuous triumph. Such was not the case. The white settlers of Puerto Rico came from Europe and brought with them most of the familiar plants from home. The King of Spain encouraged such planting by an order of 1523 specifying that each settler plant eight kinds of trees within two years after taking up land in Puerto Rico. (41, p. 40) All of the trees were temperate zone varieties and none naturalized.

The list of failures follows. It will be noticed that none of the failures came from the tropics. Most were temperate zone crops that either require a winter to force them to produce seed, or could not stand the continuous warmth of Puerto Rico.

The one failure from America was the potato, which would grow only in the highest and coolest part of the island, but which degenerated even there. (26) One plant from Africa was a failure for an unusual reason. The climate of Puerto Rico was not dry enough for the date palm to form fruit. (25) The fig, a Mediterranean tree, couldn't endure the nematodes in the soil. (18, p. 251)

The failure of the temperate fruit trees, particularly the apple, must have been a great blow to the Spaniards; the apple continues to be the most popular imported fruit. Several plants important to the diet of the people that would not grow, or grew poorly, are the olive, garlic, chick pea (garbanzo) and

wheat. Each forms a principal part of the preferred menu of the Spaniard.

The following lists are incomplete; they contain only the failures of record. Genus and species names are omitted because records are fragmentary and it is impossible to tell with certainty which species were imported. The use of each plant is not given because it is self-evident.

Intended Export Crops

<u>Spanish</u>	<u>English</u>	<u>Import Date</u>	<u>Origin</u>
cañamo	hemp	?	Old World
lino	flax	?	Old World

Intended Local Crops

Tree Crops

acerolo	hawthorne	?	Old World
albaricoque	apricot	?	Old World
alberchigo	kind of peach	early 1500's	Old World
camuesa	kind of apple	?	Old World
castaño (not the panapén for which the name is sometimes used)	chestnut	?	Old World
ciruela	true plum (not the same as ciruela -- Spanish plum)	?	Old World
datil	date palm	?	Old World
granada	pomgranate	?	Old World
guindo	cherry	early 1500's	Old World
higo	fig	early 1500's	Old World

<u>Spanish</u>	<u>English</u>	<u>Import Date</u>	<u>Origin</u>
manzana	apple	early 1500's	Old World
melocotón, durazno	peach	early 1500's	Old World
nogal	European walnut	?	Old World
olivo, aceituna	olive	early 1500's	Old World
pera	pear	early 1500's	Old World

Garden Truck

(some still grown in small amounts)

ajo	garlic	?	Old World
apio (not the same as native apio)	true celery	?	Old World
coliflor	cauliflower	?	Old World
espinaca	spinach	?	Old World
garbanzo	chick pea	?	Old World
guisante	true pea	?	Old World
nabo	turnip	early 1500's	Old World
papa, patata	potato, Irish potato	?	New World
salsifí	salsify, oyster plant	?	Old World

Grains

avena	oats	?	Old World
cebada	barley	?	Old World
centeno	rye	?	Old World
trigo	wheat	?	Old World

Vines

<u>Spanish</u>	<u>English</u>	<u>Import Date</u>	<u>Origin</u>
uva (not the same as uva de mar or sea grape)	European grape	?	Old World

Animals Successfully Introduced

*cabra	goat	1505	Old World
*cerdo	pig	1505	Old World
*caballo	horse	1510	Old World
*vaca	cow	1510	Old World
*burro	donkey	?	Old World
*mula	mule	?	Old World
*aves de corral	barnyard poultry		
*gallina de Guinea	guinea fowl	1549	Old World
*gallo de pelea	fighting cock	?	Old World
*ganso	goose	?	Old World
*paloma	pigeon	?	Old World
*pato	duck	?	Old World
*pavo	turkey	?	New World
*pollo	chicken	1500's	Old World
*gato	cat	?	Old World
*oveja	sheep	?	Old World
*perro	dog	?	Old World
*abeja	bee	1700's	Old World

APPENDIX D

PLANT AND ANIMAL INTRODUCTIONS 1777 TO 1898

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APPENDIX D

PLANT AND ANIMAL INTRODUCTIONS 1777 TO 1898

Introduction of New Plants

Plants that AcclimatizedExport Crops that were Financial Successes

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
caña de azúcar	sugar cane	Saccharum officinarum	sugar & rum		
Otahiti	Tahitian			ca.1820	Old World
crystalina	Light Cheribon			ca.1820	Old World
rayada	Striped Cheribon			ca.1820	Old World
morada	Black Cheribon			ca.1820	Old World
*café	coffee		beverage		
Moka	Moka	Coffea arabica		1879	Old World
Liberia	Liberian	Coffea liberica		1879	Old World

Both sugar cane and coffee had been introduced previously. The later varieties, brought in the 19th century, were better or more productive. The new canes supplanted the previous variety but the new coffee species were mostly grown experimentally. Other varieties of coffee in addition to the two named above were probably introduced. These are the only ones of record.

Export Crops that were Financial Failures

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
abaca	Manila hemp	Musa textilis	rope	1880	Old World
ramio	ramey or ramie	Boehmeria nivea	fiber	1882	Old World
cacao	cacao	Theobroma Cacao	chocolate & cocoa	?	New World

The two fiber plants, Manila hemp and ramey, both do well on the island but neither has become a successful export crop. Manila hemp was brought in several times from the Philippines. Ramey first reached the island from France when a medical doctor, Dr. Betances, sent several thousand plants from France to his native Puerto Rico in 1882. Two years later, he returned to the Caribbean area bringing two sets of machinery for the manufacture of fiber, one for Puerto Rico and the other for Santo Domingo where the plant was also cultivated. In 1886 the Governor General of Puerto Rico wrote to the consul of Spain in New Orleans about exhibiting some ramey at the exhibit which was to be held in that city in that year. (41, p. 268)

Neither fiber plant became a success. Probably neither was grown on a large enough scale. Puerto Rico is a small island and the land that can be devoted to any crop is limited. Certainly the large amount of labor required for successful production can be obtained more cheaply in the Orient than in Puerto Rico.

Cacao is a plant that was tried again and again on the island. Abbad wrote in 1776 that the cultivation had practically ceased and Flinter in 1834 reported that there was not a single cacao plantation on the island. (79, p. 192)

Programs of agricultural fairs in the 1850's (41, p. 97) tell of a hoped-for increase in cacao, and in 1897 one exhibitor at the San Juan fair was said to have had 18,000 trees. (41, p. 97)

Export Crops that were Never Developed

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*algodón sea island	sea is- land cotton	Gossypium sp.	long staple cotton	ca.1860	New World
canela	cinnamon tree	Cinnamo- mom zeylanicum	bark source of cinnamon	ca.1850	Old World
pimienta del comercio	black pepper	Piper nigrum	seeds source of pepper	1879	Old World
vainilla	vanilla	Vanilla Vanilla	Pods source of vanilla	prior to 1900	New World

The four foregoing plants might well have produced export crops but none was so developed in the period. Sea island cotton, according to one report, was the first kind brought by the Spanish. (41, p. 167) Other authorities suggest that sea island cotton was imported into the island at the time of the American Civil War so that Puerto Rico might capture some of the market that the American South could not supply during hostilities. (41, p. 168) Evidence to support the latter contention seems to be borne out by the listing of sea island cotton for the first time in the program of an agricultural fair in 1856. (90) Cotton was indigenous to the island but several varieties were brought in at various times. At no time was cotton ever an important export crop.

Cinnamon was brought to the island and raised as a curiosity in the municipio of Bayamón. Some of the bark was exhibited at a fair in 1860. (41, p. 189) No one seems to have taken up the raising of cinnamon seriously at any time.

Don Santiago McCormick brought seeds of the pepper vine from Trinidad in 1879 but the plant was never raised commercially. (41, p. 252)

The vanilla, an orchid native to Central America, produces the vanilla pod. The plant is a delicate vine which grows twining around a supporting tree and requires costly cultivation. It grew well on the island and undoubtedly arrived before 1900, although no attempt was made to produce it commercially until the 1930's. (18, p. 253)

It is not at all certain that any of the foregoing plants could have been developed into a successful export crop. It is certain that all of the plants grew well on the island. To speculate on the possibility of any or all of them changing the land use of Southeast Puerto Rico is valueless. Cotton is the only one of the five that was growing in the area in 1951.

Local Crops, either Subsistence or for Local Trade

Tree Crops

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*coco macapuno	Philippine coconut	Cocos nucifera	candy making	1895	Old World
*aguacate	W. Indian avocado	Persea Persea	oily fruit	ca.1890	New World

Both of these tree crops arrived late in the Spanish regime. The Philippine coconut is much superior to the African varieties that were already on the island. The African coconuts ran too much to water and too little to meat. (12, p. 408)

The Philippine coconut became the basis of a rather steady, though small, export crop that developed under the American regime. It is the coconut of candy and cake-making. (41, p. 253)

The West Indian avocados brought in were superior to those native to the island. The precise date that they arrived is not recorded. Avocados are valuable to the Puerto Rican diet because they supply a much needed fat to supplement the starch-heavy diet.

Forage Crops

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
cerrillo	Johnson grass	Holcus halepensis	forage moist lowlands	?	Old World
*grama	grama or Bermuda grass	Capriola Dactylon	forage dry lowlands	?	Unknown
*malojillo or yerba pará	Para grass	Panicum barbinode	forage wet meadows & marshes	early 1800's	New World
*yerba guinea	Guinea grass	Panicum maximum	forage drylands	early 1800's	Old World
sorgo	sorghum or Guinea corn	Holcus Sorghum	forage moist lowlands	1882	Old World
*mijo	hog millet	Panicum miliaceum	forage drylands	1890	Old World

The importation of forage grains and grasses took place after the island began to be more thickly populated. With the increase in population the forests were cut down and more and more land became available for pasture. In the early days the native grasses on the island were sufficient to support the animals. It was discovered that better grasses could be grown

with very little care once they were planted.

Johnson grass and Bermuda grass were introduced at an unknown date. It is possible that both came from Europe but Bermuda grass is so widely distributed that its homeland is unknown.

The two most successful grasses of the period were Para grass and Guinea grass, one from South America and the other from Africa. They supplemented each other, one growing where the other would not. How Para grass reached the island is not known, but Guinea grass, according to a local account, first came ashore at the port of Arroyo in Southeast Puerto Rico. Arroyo family documents seem to indicate that a slave ship standing in the roadstead off Arroyo threw overboard the straw that had bedded the slaves on their journey. It floated ashore and established the first growth of Guinea grass on Puerto Rico. (52, p. 211) Today Guinea grass is the most important forage crop in Southeast Puerto Rico.

Guinea corn and hog millet are usually planted as harvested forage. They are neither as widespread nor as important as the preceding.

The six forage crops listed are not the only ones imported into the island. They are the most important. Any or all of them might be treated as harvested forage. Most will seed themselves and come up from year to year.

Naturalized Plants

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*pan or panapén	breadfruit	Artocarpus communis	starchy fruit	early 1800's	Old World

The breadfruit tree was transplanted by the British from the Polynesian islands to Jamaica in the West Indies. It reached Puerto Rico early in the 19th century and became almost like a wild tree. Its habit of bearing the year round makes it a valuable food tree but the fruit has never become as popular an item of diet as the starchy roots or the bananas that were already on the island when breadfruit arrived. It is common throughout most of Southeast Puerto Rico and is especially numerous in the municipio of Patillas.

Incompletely Naturalized Plant

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
mangostán	mangosteen	Garcinia Mangostana	fruit	1879	Old World

The mangosteen is a fruit that has become very popular throughout the tropics of the world although it has never been widely grown in Puerto Rico. It was imported from Trinidad in 1879 and successfully grown on the island but its cultivation has never spread. Even if it became common on the island it would exert no influence on commercial agriculture, it being a fruit for the local market only.

Plants that Failed to Acclimatize

<u>Intended Export Crop</u>					
<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
coca	coca tree	Erythroxylon coca	leaves source of cocaine	1885	New World

Three small trees of coca arrived at Mayaguez from Paris in 1885. (41, p. 252) Nothing more is recorded.

Intended Local Crops

Tree Crops

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
almendra	true almond	Prunus amygdalus	nut	1890	Old World
avellana	hazel nut	Corylus avellana	nut	1890	Old World
nogal	European walnut	Juglans regia	nut	1890	Old World
nuez moscada	nutmeg tree	Myristica fragrans	nutmet spice	1879	Old World

Most of the foregoing were introduced at an earlier time but without success. The introductions in the 19th century were done experimentally, usually at a plant experiment station, and the success or failure of the plant was critically noted. The desire to grow the same fruit and nut trees that grew in Europe died slowly and only after repeated failures. The almond was the true almond, a relative of the peach (which also would not acclimate) and not the Indian almond (also called almendra), which is a relative of the mangrove tree and which grows well on the island. (41, p. 253)

The nutmeg tree, which might be expected to survive because it grows natively in a climate similar to that of Puerto Rico, could not stand either the hurricanes or the occasional dry periods. (52, p. 205) It came via Trinidad.

Forage Crops

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
alfalfa	alfalfa, lucerne	Medicago sativa	forage	1890	Old World
trebol	red clover	Trifolium praetense	forage	1890	Old World

The failure of both alfalfa and red clover to adapt themselves to the island was a great disappointment. In a time of importation of improved breeds of cattle, it was thought that the cattle would do best on the same feeds to which they were accustomed. Alfalfa and clover would grow for several years but invariably deteriorated. Both are native to Europe but both came to the island from the United States.

Animals Successfully Introduced

<u>Spanish</u>	<u>English</u>	<u>Import Date</u>	<u>Origin</u>
*ganado de casta senegalesa	Senegalese cattle	1850's	Old World
*ganado de casta shorthorn y jersey	Shorthorn & Jersey cattle	1890's	Old World
gusano de seda	silkworm	1850's	Old World
*mangosta or araña	mongoose	1877	Old World
*conejo	rabbit	1850's	Old World

Undoubtedly many small importations of cattle were made in the period. The three most important were one type from Africa

and two from America. The standard Spanish method was to bring in sires to improve the herds already there. Few pure-bred herds were kept. Nor was any differentiation made between meat and milk cattle.

The Senegalese cattle were introduced earlier. Coming from a tropical land, the African cattle could adjust easily to Puerto Rican conditions. Crosses of Senegalese and local cattle were larger and meatier but gave less milk than local cattle. (225, p. 24)

The Shorthorn cattle are one of the largest breeds of beef cattle; the Jersey are a smaller dairy breed. Both were mixed with the local cattle in the hope of producing bigger and stronger work oxen and cows that would give more milk.

One unusual introduction, which is not important enough to list above, was the importation of búfalos (bison) from Canada prior to 1890 to cross with local cows. The resultant cross was reported to produce large and strong work oxen. (114, p. 21) No further record is available. The introduction is mentioned not for its importance, which is nil, but to show that the experimental attitude toward agriculture was on the island in Spanish times.

The earliest record of silk worm growing comes from a fair held in San Juan in 1854. A Don Simón Boyer of Guayama exhibited some silk thread which he had produced in Guayama. No industry developed and after his death no more silk thread was produced. (41, p. 276) It is probable that Don Simón obtained his silk worms from the nearby island of Cuba where

silk was being produced. The silk industry rose and fell in Cuba and Mexico about this time.

The mongoose, mangosta or ardilla* in Spanish, was brought from the island of Jamaica by Don Guillermo Lamb in the hope that it would combat the rats that infested the island and were becoming an increasing nuisance as more and more of the land went into cane. (41, p. 261) The mongoose was never intended as a domestic animal but was released to rove wild. It did not eliminate the rats but rather lived with them, sharing the cane fields and thickets. Both rat and mongoose are a danger to domestic fowl. The mongoose in its native Asia attacks snakes but there are few snakes on the island for it to prey upon.

Rabbits were exhibited in the fair of 1860 and presumably were introduced from Europe. (84, p. 33) They were raised in the household and few of them found their way to market, most being eaten locally. (108, p. 133). Rabbits never became wild on the island.

* Ardilla (sometimes spelled ardia) is the Spanish word for "squirrel", an animal which does not exist on the Island. Though incorrect, the name is commonly used.

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APPENDIX E

PLANT AND ANIMAL INTRODUCTIONS 1898 TO 1951

Introduction of New Plants

The following charts list only the more important varieties that were introduced. Garden Truck, which were included in Appendix C, are omitted from this one. The Garden Truck list is long (43 vegetables and 21 herbs were introduced up to 1925 with only 5 failures) and adds little to the picture of changing land use. Many of the garden truck plants were improved varieties of ones introduced before 1776. No outstanding new species of vegetables were imported.

Plants that AcclimatizedExport Crops that were Financial Successes

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Introd. Date</u>	<u>Origin</u>
*caña de azúcar	sugar cane	Saccharum sp.	sugar & rum	1904	Old World
		Yellow Caledonia		1917	Old World
		Uba or Kavangire		1919	New World
		*BH 10(12)		1919	New World
		*SC 12(4)		1919	New World
		POJ 2725		1923	Old World
		*POJ 2878		1927	Old World
		*M 275		1934-6	Puerto Rico
		*M 317		1934-6	Puerto Rico
		*M 336		1934-6	Puerto Rico
		*PR 902		1936-9	Puerto Rico
		*PR 903		1936-9	Puerto Rico
		*PR 905		1936-9	Puerto Ricc
		*POJ 2961		1940	Old World
*B 37161		1946	New World		
*café	coffee	Coffea arabica		1909	Old World

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Introd. Date</u>	<u>Origin</u>
		Columnaris		1909	Old World
		Erecta		1909	Old World
		Maragogipe		1909	New World
		Mocha		1909	Old World
		Murta		1909	Old World
		San Ramon		1913	New World
		Bourbon		1915	Old World
		Pointed Bourbon		?	Old World
		Padang		?	Old World
		Guadeloupe		?	New World
		Jamaican Blue Mountain		?	New World
		Kamerun		?	Old World
		Kona		?	Old World
		Menado		?	Old World
		Philippine		?	Old World
		Preanger		?	Old World
		Surinam		?	New World
		<i>Coffea liberica</i>			
		Excelsa		1906	Old World
		Liberica		1910	Old World
		Dewevrei		1911	Old World
		Dybowski		1916	Old World
		Abeokutae		?	Old World
		<i>Coffea robusta</i>			
		Robusta		1914	Old World
		Canephora		1914	Old World
		Quillou		1914	Old World
		Congensis hybrids		?	Old World
		Laurentii		?	Old World
*tabaco	tobacco	Nicotiana Tabacum			
		Virginia tobacco		1926	New World
		two Colombian varieties		1929	New World
		"cenizo" variety		pre1933	Puerto Rico

The story of the introduction of new sugar cane varieties is long and complex, because the development of hybrid seedlings after 1905 multiplied the available kinds. Over 500 varieties were tested at the two experiment stations up to 1925. Most were tested and discarded; only a few were recommended for planting.

The varieties listed are those most important in the

development of the cane industry in Southeast Puerto Rico. Hybrid seedlings are not named but carry a letter and number to designate their origin. BH 10(12) means Barbados Hybrid produced in 1910, the 12th seedling of the year. SC 12(4) stands for St Croix, 1912, the 4th seedling. B 37161 is Barbados, 1937, the 161st seedling. Other seedlings are numbered consecutively, omitting the year. M is the letter for Mayaguez, POJ stands for the experiment station at Java (Proefstation Oost Java), and PR (Puerto Rico) is for the Rio Piedras Insular Experiment Station.

The Yellow Caledonia, Uba, and POJ 2725 were not grown in Southeast Puerto Rico in 1949; all the rest were. BH 10(12) and POJ 2878 covered the largest acreages and were by far the most important canes.

The coffee varieties listed as imported were usually grown only experimentally by the Mayaguez station. Because of the decadent state of coffee-growing in Southeast Puerto Rico, it is doubtful if any of the new varieties were planted in the area.

The chief coffee produced on the island is known in trade as Puerto Rican coffee and is a *Coffea arabica* descended from the plants brought in beginning in the 18th century. The variety is somewhat modified from growing under Puerto Rican conditions for generations. It was noted by the Mayaguez Experimental Station that other Arabian coffees tended to lose their distinctive flavor and take on the characteristics of Puerto Rican coffee when grown on the island. (122, p. 6 & 7)

Puerto Rican coffee grows on short trees (10 to 12 feet tall) and is superior in flavor although low in caffeine content.

The *Coffea liberica* varieties are tall trees that must be topped to keep them within bounds. The beans sell for less than Arabian coffee and are strong in flavor with high caffeine content. They were discovered in Africa.

The *Coffea robusta* varieties yield heavily and are at present the most popular varieties in the East Indies. Because their cup quality is inferior, they have never become popular in Puerto Rico. Most came to the island from Java.

Tobacco in Southeast Puerto Rico was in a slump from which it never recovered. Probably none of the newly imported varieties were planted in the area. The "cenizo" tobacco was a new variety developed on the island by plant breeding.

Export Crops that were Never Developed

Drug Plants

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
cinchona	cinchona	Cinchona sp. 17 species 1 species	quinine	1925 1935 1937	New World
--	strychnine tree	Strychnos nux-vomica	strychnine	1939	Old World
--	senna	Cassia angustifolia	senna leaves	1942	Old World

The cinchona tree produces the drug quinine. Java controls the world supply although the tree is a native of the mountains of South America. Early attempts at growing the tree in Puerto Rico were a failure but later attempts at an elevation of 2,600 feet were successful. Serious insect enemies attack the tree

on the island. The cheap labor and advanced research in Java exclude Puerto Rico from the world market although when Java was cut off from the US market during World War II the Puerto Rican potential seemed important. (231, 1938, p. 26)

Strychnine and senna were never planted on a large scale. Neither product can command a large export market. Senna is a relative of the purging cassia, an export crop that was important for a short while in the early history of Puerto Rico.

Fibers

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
sisal	sisal	Agave sisalana	rope	1902	New World
abaca	Manila hemp	Musa textilis	rope	1904	Old World
*henequén	hennequen	Agave fourcroydes	rope	1904	New World
*cadillo	--	Urena lobata	fiber	1905	Unknown
ramio	ramey or ramie	Boehmeria nivea	fiber for cloth	1905	Old World
palma	Panama hat palm	Carludovica palmata	fiber for Panama hats	1907	New World

Most of the fiber plants do well in Puerto Rico, climatically, although none so far has developed into an export crop. Sisal is handicapped by the slow growth of the plants and the high cost of processing machinery. The abacá needs good banana soil for growth and will not bring as high a price as bananas do. (231, 1907, p. 12) Hennequen grows on the dry lands of Southeast Puerto Rico but grows slowly. High land values and

the high cost of extracting machinery prevented the growth of a rope industry based on hennequen. The cadillo, a plant widely distributed throughout the tropics, produces strong fibers that do not separate readily by machinery. (231, 1905, p. 22) Ramey must be processed by expensive machinery. The Panama hat palm has been successfully introduced into the island but does not grow at present inside Southeast Puerto Rico.

Experimentation with fiber plants is long past. There was a flurry of interest during World War II but no industry eventuated. The possibility remains that, given another set of economic circumstances, fiber plants may still provide income for the island, particularly if the processing is done on the island and only the finished product marketed abroad.

Oil Seeds

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
--	--	Aleurites trisperma	oil for paint	1909	Old World
palma de aceite	Guinea oil palm	Eleaeis guineensis	edible or soap oil	1916	Old World
nuez de India	candle nut	Aleurites moluccana	lumbang oil for paint	1927	Old World
oiticica	oiticica	Licania rigida	oil for paint	1937	New World
--	oil nut tree	Aleurites cordata	oil for paint	1937	Old World
*girasol	sunflower	Helianthus annuus	oil seed	1939	New World
*higuerito	castor-oil plant	Ricinus communis 3 varieties	castor oil	1939	Old World
maní	peanut	Arachis hypogaea 6 varieties	peanut oil	1939	New World

Four of the above oil-producing plants give oil that is useful in paint making. All four grow well on the island, but, unfortunately, none of the four produces as valuable an oil as the original tung oil tree which did not adapt itself to the climate. So far as can be discovered, commercial plantings of the four trees have not been made anywhere on the island. They remain interesting possibilities.

The Guinea oil palm produces an oil much used in margarine and soap-making. It took seven years to grow from seed to fruit on the island but seems never to have been grown commercially. (231, v. 1925, p. 15)

Sunflower oil is much used as an edible oil in Russia and peanut oil is similarly used in China. It would be convenient if either or both oils could be substituted for the imported olive oil which the Puerto Ricans seem to prefer. Sunflower seeds can also be used to feed chickens.

Castor oil makes a fine lubricating oil which brings a fair price. The plants seen growing in Southeast Puerto Rico were largely ornamentals.

Perfume Oils

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
* --	ilang-ilang	Canangium odoratum	source of cananga oil	1936	Old World
--	lemon-scented gum tree	Eucalyptus citriodora	source of citronellal	1938	Old World
* --	lemon grass	Cymbopogon citratus	source of citral	1938	Unknown

Perfume Oils (cont'd)

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
--	musk mallow	Hibiscus Abelmoschus	source of ambrette	1938	Old World
--	tonka bean	Coumarouna odorata	source of coumarin	1938	New World
--	--	Pogostemon cablin	source of patchouli	1938	Old World
--	vetiver	Anatherum zizanoides	source of vetiver oil	1943	Old World

The production of perfume oils was investigated by the Mayaguez station beginning in 1938. None of the oils could be expected to supply a large export crop because of the limited market, but any of them might provide a lucrative subsidiary crop. The ilang-ilang did well on the south coast and lemon grass proved useful as a cover crop to prevent erosion on hill-sides. All of the oils can be used in blending perfumes. Whether any of the perfume oil plants will be developed commercially is problematical.

Spices

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
canela	cinnamon tree	Cinnamomum zeylanicum	cinnamon	1905	Old World
		C. cassia	cinnamon	1938	Old World
pimiento negro	black pepper	Piper nigrum	pepper	1924	Old World
--	Hungarian paprika	Capsicum annuum	paprika	1942	Old World
--	allspice	Pimenta officinalis	allspice	1946	Old World

Puerto Rico has never been a producer of spices although some spice trees have been on the island since Spanish times. Most spices are grown in parts of the world where land and labor are cheaper than in Puerto Rico. Those listed above grow on coffee land.

Miscellaneous

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
toronja	grapefruit	Citrus maxima 10 varieties	fruit	1902-24	Old World
piña	pineapple	Ananas Ananas 10 varieties	fruit	1902-25	New World
cola	kola	Cola vera	seed source of cola	1903	Old World
cacao	cacao	Theobroma Cacao 14 varieties	chocolate & cocoa	1903	New World
*china	sweet orange	Citrus sinensis 14 varieties	fruit	1904	Old World
*coco	coconut	Cocos nucifera 2 varieties 2 varieties Yellow Dwarf	edible nut	1904 1904 1933	Old World
vainilla	vanilla	Vanilla Vanilla several varieties 2 varieties 40 hybrids	flavoring	1909 1924 1947	New World
lino	flax	Linum usitatissimum	seed	1916	Old World
mate	Paraguay tea	Ilex paraguaiensis	beverage	1923	New World
*bambú	bamboo	40 species	construction	1925-50	Old World
derris	derris	Derris elliptica	root source of rotenone	1931	New World

Miscellaneous (cont'd)

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
jengibre	ginger	Zingiber Zingiber	ginger root	1938	Old World
chilte	chilte	Cnidioscolus 3 species	source of chicle	1945	New World

One of the first of the minor industries to develop during the American period was the growing of citrus fruits. The grapefruit was already on the island but improved varieties were imported and planted between 1908 and 1912. The eastern seaboard of the U. S. provided a market until the Florida and California growers introduced the grading of fruits and drove the mixed-quality Puerto Rican fruits from the market. Over and over again, Puerto Rico has lost out in the markets open to it because of lack of quality merchandise.

Sweet oranges were usually planted in coffee groves as part of the coffee shade. Pure groves of oranges were planted between 1904 and 1910 but some of them were later replaced by grapefruit. A recent development may lead to a revival of citrus-growing. Frozen orange and grapefruit juices are now processed on the island. Southeast Puerto Rico does not have any grapefruit groves but there are many orange trees grown as coffee shade. In recent years many of the oranges were not even harvested.

Pineapples are not grown in Southeast Puerto Rico, nor does there seem to be any possibility of a pineapple industry developing there.

The kola tree has been on the island since 1903, although no industry has developed. Certainly the cola drinks are prime favorites. The smallest country store on the most obscure trail has a supply. Probably commercial kola groves cannot compete with wild trees.

Cacao has been a crop of ups and downs for hundreds of years on the island. There are 12 known varieties of the tree, 3 of which are found in Puerto Rico. Hurricanes (or even strong winds) ruin the crop and there are only a few sheltered places available where crops may be grown in comparative safety. None of them are in Southeast Puerto Rico. After extensive experimentation, the Mayaguez station announced in 1925 that cacao when grown under ideal conditions yielded well but the product was not of the highest quality. (231, 1925, p. 5)

The coconut is an important tree in Southeast Puerto Rico. The Philippine coconut is reputed to have a larger percent of meat than other coconuts. The dwarf coconut grew well on the island, and flowered, but produced few fruits. It seems especially susceptible to attack by aphids. (168, 1938-39, p. 98)

Vanilla has been on the island since Spanish times but only became important when the Mayaguez station imported new varieties and experimented with vanilla culture. After 40 years of experimentation, the industry is a minor one in the economy of the island and the markets have been largely taken over by synthetic vanilla flavors. The plant is delicate, requiring much care in growing, and is subject to a severe root disease. (123) Vanilla was formerly grown in northern Coamo but no evidence of it was found in 1951.

Flax was raised on a 50 acre plot near Mayaguez between 1916 and 1919. The grower produced seed to be planted in the United States in the following summer. (231, 1919, p. 12)

Paraguay tea grew well at Mayaguez in 1923, but never developed as a commercial crop. It is probably expecting too much to have a tea catch the fancy of a coffee-drinking populace. There is little export market for the crop.

Bamboo was brought to the island by the Spanish padres and is common along the roads and watercourses of Southeast Puerto Rico. The original bamboos introduced were not well adapted to construction work because they were attacked by a borer. The Mayaguez station is continuing experimental work with various types of bamboo in an attempt to find out which can be used commercially. They may well develop a new industry for the island. Meanwhile the commercially-useless bamboos provide good windbreaks, preserve river banks, and generally retard erosion wherever they grow.

Derris root, which is the source of the insecticide, rotenone powder, was brought in by the Rio Piedras station. Experimentation proved that the cultivation required too much labor for the amount of money realized from the product.

Puerto Rican wages are low by U. S. Standards but still higher than those paid in localities where derris root culture is profitable. (132)

Ginger was a profitable crop in the early days of Spanish occupation. Roots left from Spanish days were found to be inferior to roots recently imported from China. In 1946, ginger

was grown and candied experimentally. The industry probably has little future because of the small demand for the product. Ginger will not grow in Southeast Puerto Rico.

Chilte is a chicle-producing tree which occurs in three species. Only one, *Cnidoscolus tepiquensis* or lowland chilte, grew well in experimental planting, but it grew with only 20 inches of rainfall. There is a possibility that chilte may be grown on land in Southeast Puerto Rico which at present supports only forage crops. (231, 1945, p. 34) Whether it would be economical to do so remains to be proven. The main source of chicle at present is the nispero tree (a rather scarce tree in Puerto Rico) which is grown for its fruit and, so far as is known, has never been tapped for chicle. The large supply of chicle that can be collected from the wild nispero trees in Guatemala and Mexico would tend to lower the price of chicle produced in Puerto Rico. The one ray of hope for chilte-growing on the island is that the trees were furnished to Puerto Rico by a chicle development company of Mexico. They, presumably, are willing to buy the chicle that might be produced. The experimental introduction was in 1945. No chilte was seen growing in Southeast Puerto Rico in 1951.

Local Crops either Subsistence or for Local TradeTree Crops Widely Distributed

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*mango	mango	Mangifera indica 59 varieties	fruit	1903-36	Old World
*aguacate	avocado	Persea Persea 42 varieties	oily fruit	1911-24	New World
*pan or panapén	breadfruit	Artocarpus communis yellow-fruited variety	starchy fruit	1942	Old World

All three of the tree crops listed have been on the island since Spanish times. The mango and avocado have been supplemented by dozens of varieties imported mainly by Mayaguez which now has one of the largest collections of mango and avocado species and varieties in the world. The new varieties of mango are planted in dooryard gardens throughout the island; the commonest varieties found growing in the fields and hillsides are the turpentine sorts imported long ago. There is little possibility that fresh mangos will ever be exported even if the temperate zone market develops a taste for them as the fruits prove too perishable to ship by sea and too low-priced to ship by air. They will continue to be one of the commonest fruits in season throughout the island. One commercial mango orchard was found in Southeast Puerto Rico in 1951.

The avocados now on the island are of four types: the Caracas with a long curving neck, the Guatemalan with a thick rind, the West Indian with a leathery, thin rind, and the Mexican with a very thin rind. The skin color varies from green to brown

and mottled. The Guatemalan and the named varieties were brought in by the Americans. (18, p. 250) One of the outstanding private avocado farms is in barrio Guamaní of Guayama. The avocado supplies a much needed oily food to supplement the dominantly starchy diet of the Puerto Ricans and may well become the basis of an export trade to the United States if some way can be devised to keep the fruit from spoiling soon after it is picked. At present, the best fruit will keep only about three days after being picked. Since some Puerto Rican avocados mature during the off-season for California fruit, it might be profitable to devise a way of getting some of the choicer Puerto Rican avocados to the quality markets of the Eastern seaboard. Some avocados weigh up to three pounds.

The panapén variety imported from the Orient by way of Barbados is a yellow-fruited type of better color and flavor than the white-fruited type which was previously on the island. The panapén grows almost wild in the eastern part of Southeast Puerto Rico and is a food of the poor, though not as highly favored as the bananas. Both panapén and bananas yield the year round.

Fruit Trees not widely Distributed

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
mangostán	mangosteen	Garcinia Mangostana	fruit	1903	Old World
--	akee	Blighia sapida	fruit	1904	Old World
carambola	carambold	Averrhoa Carambola	fruit	1904	Old World
--	citrus fruits	35 species of natural & hybrid citrus fruits		1904-24	Old World
durian	durian	Durio zibethinus	fruit	1920	Old World
lscucha	lakoocha	Artocarpus Lakoocha	starchy fruit	1921	Old World
lanzon	langsat	Lansium domesticum	fruit	1925	Old World
madroño	--	Rheedia madruno	fruit	1925	New World

The preceding list includes only the better of the foreign fruits introduced largely through the efforts of the Mayaguez station and the United States Department of Agriculture. Most are not grown outside the experiment station gardens. If all the second and third class fruits introduced were added, the list would be impossibly long. None of the citrus fruits introduced or hybridized on the island has caught on with the Puerto Ricans. No more have the mangosteen and the durian, widely acclaimed throughout the tropical world as the world's best fruits. Both trees grow on the island though neither is prolific. The mangosteen seedlings are not especially vigorous, (231, 1939, p. 93) and the one durian tree grown from seed planted in 1920 produced its first fruit in 1944. If a

taste can be developed on the island for the two unusual fruits, they may yet prove a welcome addition to the fruits already accepted by the Puerto Ricans. However, the slowness with which food habits change on the island does not hold much promise.

Nut Trees not widely Distributed

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
pistachio	pistachio	Pistacia chinensis	table nut	1903	Old World
--	monkeypot, sapucaia nut	Lecythis 3 species	table nut	1905-42	New World
litchi	leechee	Litchi Litchi	table nut	1921	Old World
palma	pejibaye palm	Guilielma utilis	table nut	1922	New World
nuez del paraiso	paradise nut	Lecythis Zabucajo	table nut	1924	New World

Most of the above nut trees remain as specimen trees in the Mayaguez station collection.

Staple Foods

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
*guineo	banana	Musa sp. 56 varieties	eating banana	1901-5	Old World
*plátano	plantain	Musa sp. varieties included in guineo varieties	cooking banana	1901-5	Old World
*ñame	yam	Dioscorea sp. 11 varieties	starchy root	1901-25	Old World
*yautía	tanier	Xanthosoma sp. 16 varieties	starchy root	1901-25	New World
*yuca	manioc, cassava, tapioca	Manihot Manihot 9 varieties	starchy root	1903-24	New World
*malanga	dasheen or taro	Caladium sp. 4 varieties	starchy root	1903-30	Old World
*batata	sweet Potato	Ipomoea Batatas 286 varieties	starchy root	1911-24	New World
*arroz	rice	Oryza sativa irrigated varieties	grain	1917-25	Old World
*calabazas	squash	Pepo sp. subject to natural hybridization	vegetable	?	Old World
maiz dulce	sweet corn	Zea Mays var. developed on the island	sweet corn	1935	Puerto Rico

The bananas and plantains are usually referred to collectively as bananas. Together they make up the chief vegetable fruit of the working class. Of the 56 varieties of eating banana imported, six are especially popular and the most raised. About the same number of cooking plantains are the most popular. The plants

grow in abundance in the coffee plantations where they furnish shade, but occasional plants are found wherever there is a dwelling. The yield per acre is enormous, sometimes being up to 60,000 pounds of fruit per acre. (225, p. 21) No export in bananas has ever developed. The American market demands large and perfect bunches, while the Puerto Rican product is usually of mixed quality.

The root crops of ñame, yautía, yuca, malanga, and batata were all on the island before the Americans came. The main contribution of the experiment stations was to test all the varieties available, including some imported ones, and to recommend the ones that were found to yield best and to be of highest quality. Such recommendations were not always accepted by the farmers. A malanga or dasheen, *Caladium Colocasia*, var. *esculenta*, sub. var. *globulifera*, was brought from Trinidad in 1903. Dr David Fairchild once said it was the best single plant introduction of the 60,000 introduced by the US Department of Agriculture. It yielded twice the amount per acre of the best yautías, grew in 6-8 months whereas the yautías took 9-12, had a better flavor, and, best of all, was less particular as to soil. (18, p. 255) Twenty-two years passed before the farmers accepted it widely.

Experiments with rice were aimed toward producing paddy or irrigated rice. The upland rice which was already on the island was coarse and brown, while the consumers preferred a whiter rice. At one time the scientists of the Mayaguez station visualized growing rice as a rotation with irrigated sugar cane. Experiments were conducted but nothing came of

them. The price received for rice was much lower than that received for cane. The practice of growing cane continuously on the same land was not disturbed.

Squash is one vegetable that is widely grown. No one knows how many varieties and hybrids are extant, because the plant hybridizes naturally. Seeds rarely come true to type. Preliminary work on the sorting out of types was done by the experiment stations, but much remains unfinished.

One of the outstanding successes of the Mayaguez experiment station was the production of a native sweet corn. Previously only field corn was grown; usually flint corn. There was very little dent and no flour corn. Trials of imported sweet corn brought in from the temperate zone always ended in failure. In 1922 a sport was discovered in the native corn in a field near Lajas. From that sport, a native sweet corn was developed through years of selection and breeding. USDA-34, the new variety, was perfected in 1935. Ears were shipped refrigerated to the New York market in January 1935 and seed was sent to Florida, Louisiana, and Hawaii. (231, 1937, p. 41) The scientists working in Puerto Rico had now produced new kinds of cane, tobacco, and corn.

Forage Plants

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
--	Dallis grass	Paspalum dilatatum	lowland	1910	New World
--	Rhodes grass	Chloris gayana	lowland	1910	Old World

Forage Plants (continued)

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
--	brown teff	Eragrostis abysinica	lowland	1912	Old World
yaragua, yerba de melado	molasses grass	Melinis minutiflora	hills	1912	New World
--	Java grass	Polytrias amaura	lowland	1912	Old World
sorgo	sorghum	Holcus sp. 24 varieties 8 varieties	lowland	1912 1947	Old World
--	Natal grass	Tricholaena rosea	lowland	1913	Old World
*algaroba de Hawaii	mesquite	Neltuma juliflora	drylands	1918	Old World
*yerba elefante	elephant grass or Napier grass	Pennisetum purpureum	lowland	1919	Old World
--	Cayenne grass	Echinochloa polystachya	lowland	1920	New World
yerba de Guatemala	Guatemala grass	Tripsacum laxum	moist lowland	1920	New World
yerba kikuyu	Kikuyu grass	Pennisetum clandestinum	lowland	1920	Old World
*yerba merker	Merker grass	Pennisetum merkeri	lowland	1920	Old World
--	sunn hemp	Crotalaria juncea	lowland	1920	Old World
--	--	Crotalaria usaramoensis	--	1921	Old World
tuna brava	semaphore cactus	Opuntia rubescens spineless variety	drylands	1924	New World

New forage crops had to be brought in before the livestock industry could develop. The native grasses were not adequate

and even the grasses introduced in Spanish times left something to be desired. The long list of successful introductions made it possible for the cattle raiser to be selective and raise the one particular forage plant that would be best for his situation. Some of the plants are grasses; others are plants with more woody stems. All of the plants in the list are not in equal favor today. Some had a period of popularity and were replaced when a better plant came along.

Dallis grass grew well on lowlands, withstood long drought, but required cultivation in the rainy season to keep it from being overgrown by native grasses. It is no longer popular. (231, 1930, p. 45)

Rhodes grass grew well on lowlands but had no outstanding merit and was soon abandoned. (231, 1930, p. 44)

Brown teff is a wire grass which does not produce much leaf. (231, 1912, p. 44) It could not compete with more succulent plants.

Molasses grass is a productive grass which propagates by runners and is adaptable to lowlands or hills. (112, p. 18) Its popularity decreased in the early 1930's, although it is still widely grown.

Java grass was a forage grass which became the foremost lawn grass on the island until a type of cinch bug attacked it and ruined its usefulness. (231, 1936, p. 93)

The sorghums tested were better for harvested forage than for grazing. None of the molasses sorghums were grown. Some of the sorghums were useful for poultry feed. (231, 1947, p. 41)

Natal grass proved not to be well suited to pasturing. It did well on light soils with occasional drought and was chiefly useful for hay or silage. (231, 1930, p. 41)

The Hawaiian mesquite is one of the most valuable forage plants introduced into Southeast Puerto Rico. Being a legume, it improves the soil; the flowers are a source of honey; the pods are relished by cattle; and the wood is useful for charcoal or building purposes. (231, 1930, p. 49)

When it was introduced, Elephant or Napier grass was the sensation of the dairy industry. It produced nearly twice as much cut forage as guinea grass or para grass, the standard grasses of Spanish times, and grew well in moist lowlands. (231, 1930, p. 2)

Cayenne grass had no outstanding characteristic. (25, p. 54)

Guatemala grass and Elephant grass are the mainstays of the dairy industry. Together they supply the best cut forage available. Guatemala grass is slightly more productive than Elephant grass. (231, 1930, p. 41)

Kikuyu grass does not endure pasturing and is not as valuable for cut forage as either Guatemala or Elephant grasses. (231, 1920, p. 39)

Merker grass resembles Elephant grass but is more adaptable to drier locations. It also makes good silage.

Two species of *Crotalaria* serve as forage plants in a variety of circumstances. (231, 1920, p. 12)

A spineless cactus was found growing on the island of St Thomas. It was hoped that the plant would make a first class forage plant on the south coast, but its growth was so slow that

it did not supply much feed. (231, 1930, p. 40)

The Uba cane, which had been introduced to combat the mosaic disease, was widely used as a forage crop. A field in Coamo, which was too dry to be profitably milled, was fed to cattle in 1951.

Despite the introduction of all the foregoing, guinea grass remains the most common forage crop in Southeast Puerto Rico.

Cover Crops

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
canavali	jack or sword bean	Canavalia† ensifomis	cover in orchards	1903	Old World
habichuela soya	soy bean	Soja Max 15 varieties 55 varieties	cover crop	1903 1936	Old World
*mungo	mung bean	Phaseolus aureus	cover in dry areas	1903	Old World
--	velvet bean	Stizilobium Deeringianum	cover in orchards	1904	Old World
--	cowpea	Vigna spp. 3 species	cover & forage	1916	Old World
silani	Philippine cowpea	Vigna marina	cover crop	1924	Old World
*gandul	pigeon pea	Cajan Cajan several varieties	cover & forage	1931	Unknown
*--	Manila grass	Zoysia matrella	lawn grass	1936	Old World

† Britton and Wilson (25, p. 418-419) prefer the Genus form "Canavali."

Cover Crops (continued)

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
--	Abyssinian cowpea	Dolichos hosei	cover for steep banks	1939	Old World
*--	tropical kudzu	Pueraria phaseoloides	cover & forage	1940	Old World
mato de la playa	bay bean	Canavalia maritima	cover & forage	1945	Old World
--	trailing indigo	Indigofera endecaphylla	cover & forage	1938	Old World
--	--	Stizolobium aterrimum	cover & forage	1945-7	Old World

Cover crops and forage crops are sometimes indistinguishable, both being eaten by browsing animals. Cover crops run largely to varieties of peas and beans while forage crops run to grasses. It was thought advisable to list them separately because some cover crops will not stand grazing. Such plants are labeled simply "cover" in the preceding list. Plants that will stand grazing are labeled "cover and forage". It will be noticed that those recently introduced are useful for both purposes.

Cover crops were first introduced in the citrus fruit orchards that developed in the early 1900's, where they served the dual purpose of retarding erosion and enriching the soil. Of the first five cover plants introduced, the velvet bean proved to be the best. (231, 1930, p. 47)

Cover crops have been sponsored by the US Soil conservation Service in order to combat the severe erosion and leaching of the soil under tropical conditions. The peas and beans recommended for planting protect the soil from driving rain and

enrich it at the same time.

The outstanding cover and forage plant introduced in later years is the tropical kudzu which grows almost anywhere and provides forage that is relished by cattle. The rest of the plants are less useful for cover and forage. One, the Manila grass, is included in cover crops because it has proved to be the best lawn grass for Puerto Rico. Before the Americans, there were no lawns on the island.

Plants that Failed to Acclimatize

Intended Export Crops

Drug Plants

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
coca	coca	Erythroxyton coca	source of cocaine	1903	New World
alcanfor	camphor	Camphora Camphora	source of camphor	1905	Old World

Coca and camphor failed to grow under Puerto Rican conditions. Coca was brought in previously during the Spanish times and proved to be a failure then. Natural camphor is suffering from the competition of synthetic. A consoling thought is that Puerto Rico can't lose a market it never had.

Fiber

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
yute	jute	Corchorus capsularis	hurlap	1903	Old World

The production of jute might have enabled Puerto Rico to produce its own sugar bags instead of having to purchase them

abroad. Only one central, Central Aguirre, ships its sugar loose in the holds of ships very much as iron ore is shipped on the Great Lakes of the United States.

Oil Seeds

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
--	tung tree	Aleurites Fordii	tung oil	1910 1927 1933 1936	Old World
--	--	Aleurites montana	paint oil	1937	Old World
chia	chia	Salvia hispanica	chia oil	1939	Unknown
--	--	Perilla frutescens	perilla oil	1939	Old World
--	--	Salvia columbariae	chia oil	1939	Unknown

The failure of the tung tree to grow in Puerto Rico killed most chances for a paint-oil industry, inasmuch as tung is the most-wanted oil. None of the oil seed trees that did grow are as vital to the paint industry. Chia and perilla oil are used for artists' paints.

Spices

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
nuez moscada	nutmeg	Myristica fragrans	source of nutmeg & mace	1903 1937 1938 1939	Old World
clavo de espano	clove	Caryophyllus aromaticus	clove	1938 1939	Old World

Nutmeg and clove trees should have grown in the same re-

gions where coffee grows. Both proved to be victims of collar rot. (231, 1938, p. 32)

Miscellaneous

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
caucho	rubber tree	Castilla elastica	rubber	1903	New World
--	West African silk rubber	Funtumia elastica	rubber	1903	Old World
--	Ceara rubber tree	Manihot dichotoma	rubber	1903	New World
te	tea tree	Thea sinensis 4 varieties	tea	1903	Old World

High hopes went into the experiment in growing rubber trees from the planting of seedlings in 1903 to the first tapping in 1911. By 1914 the Mayaguez scientists decided that rubber growing had no future in the island. Although the trees grew well, the yields were so low that monthly tappings of the trees cost more for labor than the sale price of the product. (231, 1914, p. 25)

None of the four varieties of tea were adaptable to the climate. Most spent themselves in excessive flowering and produced few leaves. (231, 1905, p. 36)

Intended Local Crops

Tree Crops

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
kaki	Japanese persimmon	Diospyros Kaki 6 varieties	fruit	1903	Old World

Tree Crops (continued)

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
ciruela	plum	Prunus americana 5 varieties	fruit	1905	Old World
higo	fig	Ficus Carica many varieties	fruit	1905	Old World
melocotón	peach	Amygdalus persica	fruit	1905	Old World
pecan	pecan	Hicoria Pecan	nut	1905	New World
pera	pear	Pyrus communis 2 varieties	fruit	1905 1909	Old World
manzana	apple	Malus Malus 3 varieties	fruit	1906 1909	Old World
aceituna, olivo	olive	Olea europaea	oily fruit	1929	Old World

The desire to grow temperate zone fruits and nuts never seems to die on the island. The history of former failures was known to the experimenters but they must have thought that the temperate zone fruits were carelessly grown previously and would do well when introduced under scientific conditions. The repeated failures of apples and olives to adjust to Puerto Rico must have been especially galling. Apples are the favorite fruit and olive oil is the preferred kitchen oil.

Berries

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
fresa (true fresa)	strawberry	Fragaria sp. 8 varieties	fruit	1910-29	Old World
frambuesa, zarzamora --	raspberry, blackberry, dewberry	Rubus sp. 46 Rubi varieties 1 Rubus variety	fruit	1911-25 1950	Old World

Berries were unknown before the Spanish period when the *Rubus rosaefolius* (misnamed "fresa" on the island) was introduced. This pretty but insipid-tasting berry grows wild in the upper reaches of the municipio of Guayama and bears the year round. No other introduced berry comes near adjusting, in spite of the intensive experimentation carried on both by the station at Rio Piedras and the one at Mayaguez. Any plants that were not killed by disease produced so few berries that they were not worth raising.

Miscellaneous Food Crops

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
papa	potato	<i>Solanum tuberosum</i> several varieties	starchy tuber	1904	New World
uva	grape	<i>Vitis</i> sp. 60 varieties	fruit & wine	1907-29	Old World
trigo	wheat	<i>Triticum</i> sp. several varieties	flour	1923	Old World

All three of the foregoing had been introduced during Spanish times, unsuccessfully. Potatoes again proved susceptible to potato blight. (231, 1904, p. 14) Grapes needed more of a dry season than most of the island provided. Experiments in the municipios of Coamo and Guayama seemed to prove that while the imported grapes did well in the dry season, they suffered in the wet season. (167, 1929-30, p. 65)

Wheat was tried again in 1923. It failed, as before, due

to diseases. (231, 1923, p. 10) This must have been discouraging because the Puerto Rican is especially fond of bread and soda crackers.

Forage Plants

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
--	Kentucky blue grass	Poa pratensis	forage	1906 1930	New World
--	Sudan grass	Holcus sudanensis	forage arid areas	1914	Old World
alfalfa	alfalfa lucerne	Medicago sativa 54 varieties	forage	1941	Old World

Kentucky blue grass grew well for a while but then died out. Alfalfa has never done well on the island in spite of the fact that it has been tested many times under varying conditions.

Sudan grass provided one of the major disappointments in the search for forage grasses for the semi-arid south coast. It was instantly popular, being a bunch grass similar to the guinea grass which had previously done very well in the south. Sudan grass made a rapid growth for several years only to fall a victim to fungus attack during a rainy season.

Cover Crops

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
--	Bahia grass	Paspalum notatum	lawns	1936	New World
--	carpet grass	Axonopus compressus	lawns	1936	New World
--	centipede grass	Eremochloa ophiuroides	lawns	1936	Old World

Cover Crops (continued)

<u>Spanish</u>	<u>English</u>	<u>Genus & Species</u>	<u>Use</u>	<u>Import Date</u>	<u>Origin</u>
--	Korean lawn grass	Zoysia japonica	lawns	1936	Old World
--	St Augustine grass	Stenotaphrum secundatum	lawns	1936	Unknown
--	velvet grass	Zoysia tenuifolia	lawns	1936	Old World
kudzu	kudzu	Pueraria hirsuta	cover & forage	1940	Old World
--	--	Calopogonium mucunoides	cover & forage	1945-7	New World
--	--	Canavalia sp.	cover & forage	1945-7	Old World
--	--	Desmodium nicaraguensis	cover & forage	1945-7	New World
--	--	Dolichos hosei	cover & forage	1945-7	Old World
--	--	Lespedeza cuneata	cover & forage	1945-7	Old World
--	--	Lupinus angustifolia	cover & forage	1945-7	Old World
--	--	Phaesolus calcaratus	cover & forage	1945-7	Old World
--	--	Sesban sp.	cover & forage	1945-7	Old World
--	--	Vigna sp.	cover & forage	1945-7	Unknown

The first six plants were lawn grasses that proved inferior. Japanese kudzu's failure would have been a blow if tropical kudzu had not been available as a substitute. The remaining plants were mostly leguminous cover and forage plants.

Introduction of New Animals

The animals brought in in this period were usually pure bred and high class varieties of kinds already on the island, although a few entirely new animal species were brought in.

<u>Spanish</u>	<u>English</u>	<u>Date</u>	<u>Origin</u>
abeja	Italian bee	1908	Old World
caballo	horse		
	American saddle	1905	New World
	Belgian (draft)	1905	Old World
	Thoroughbred	1909	Old World
	American trotter	1910	New World
	Morgan	1912	New World
	Arabian	1924	Old World
cabra	goat		
	Toggenburg	?	Old World
	Anglo-Nubian	1922	Old World
cerdo	pig		
	Berkshire	1908	Old World
	Duroc Jersey	1911	New World
	Hampshire	1911	New World
	Poland China	1911	New World
	Tamworth	1911	Old World
conejo	rabbit		
	Flemish Giant	before 1933	Old World
	Belgian Flemish	before 1933	Old World
	New Zealand	before 1933	Old World
faisan	ring-necked pheasant	1928	Old World
ganado	cattle		
	Hereford	1908	Old World
	Aberdeen-Angus	1909	Old World
	Ayshire	1909	Old World
	Guernsey	1909	Old World
	Shorthorn	1909	Old World
	Zebu or Brahma	1909	Old World
	Jersey	1910	Old World
	Brown Swiss	1927	Old World
Holstein-Friesian	before 1928	Old World	
ganso	goose		
	Toulouse goose	1909	Old World

<u>Spanish</u>	<u>English</u>	<u>Date</u>	<u>Origin</u>
gusano de seda	silk worm	1922	Old World
oveja	sheep		
	African woolless Southdown	1908 1910	Old World Old World
paloma	pigeon		
	Homing pigeon	1911	Old World
pato	duck		
	White Pekin Indian Runner	1909 1911	Old World Old World
pavo	turkey		
	Mammoth Bronze	1909	New World
pollo	chicken		
	Plymouth Rock	1909	New World
	White Leghorn	1909	Old World
	Wyandotte	1909	New World
	White Orpington	1912	Old World
	Brown Leghorn	1923	Old World
	Rhode Island Red	1923	New World
	Light Sussex	1941	Old World
New Hampshire	1941	New World	
rana	frog		
	"mountain chicken" edible bullfrog	1929 before 1950	Unknown
sapo	Giant toad	1920	Unknown

The introduction of new varieties of animals during the American period is only partially shown in the foregoing chart. The date shown is the date of first record. Additional importations of the more important animals, like horses, cows, pigs, and chickens continue to the present day. On the other hand, importations of silkworms and pheasants do not.

Bee raising was sponsored by the Experiment Station at Mayaguez and studies were made during the first five years (1908-1913) after the importation. (212) The raising of bees never became widespread in Southeast Puerto Rico although a

good honey can be made from coffee flowers and another good honey from the flowers of the Hawaiian mesquite which became a common tree after it was introduced into the pasture lands of the area. (231, 1930, p. 49) Bees can also be economically valuable to the coffee grower. If rainy weather coincides with the blossoming period of the coffee flowers, the pollen does not spread and a small crop of berries results. Bees spread the pollen in all weathers and insure a large setting of berries.

The introductions of horses are discussed in Chapter VI.

The improvement of the goat strains on the island was attempted at the Experiment Station at Rio Piedras. The locality proved to be so damp that the goats got stomach worms. In 1924 the remaining goats were sent to the southwest coast and the experiment terminated. The goats in Southeast Puerto Rico are probably slightly mixed with the new blood lines introduced, but most are descended from stock long on the island. Goats are rarely kept in herds. Usually a few are owned by a family.

Pigs are also kept in small numbers by most families. The two Experiment Stations have tended to concentrate on the Berkshire strain. Stud service has been provided free to local sows in a program of improving the size and weight of pigs on the island. The lard-type pigs introduced are the Berkshire, Duroc Jersey, and Poland China. The meat-type pigs are the Hampshire and Tamworth. The pigs of the island still resemble the razor-back hog of the US south more than they do the named strains that have been introduced.

Rabbits were brought in as part of a program of increasing the protein content of the common man's diet. The early introductions were a failure due to a combination of diseases, (167, 1927-28, p. 103) but later introductions seem to have succeeded. The larger types of rabbits were preferred because they produce the largest amount of meat in the shortest time. (196, p. 310) Rabbits must be protected from three dangerous enemies; dog, rat, and mongoose. Most poor farmers do not have the means to provide such protection; concrete pens are needed in some cases.

The Chinese ring-necked pheasant was introduced by the Experiment Station at Mayaguez when eleven birds were released. The bird apparently did not thrive, probably because the rat and the mongoose could easily destroy any ground-nesting bird. None were encountered or heard in Southeast Puerto Rico in 1951.

Chicken introductions followed the pattern of horses, pigs, and cattle. An attempt was made to improve the quality by breeding imported chickens to those already on the island. Mostly general-use chickens were brought in so that both egg-laying and meat qualities would be improved. The exceptions were the Leghorns, which are layers, and the Light Sussex, which is a meat bird. The Plymouth Rock has had more effect on the quality of the birds in Southeast Puerto Rico than any other. Chickens are rarely kept in large flocks. Only one grower in Southeast Puerto Rico operates a chicken ranch.

The introductions of cattle are discussed in Chapter VI.

The goose is not a common farm animal in Southeast Puerto

Rico. More seem to be raised in back yards in town than in the country.

Silk worms were never raised on a large scale in Puerto Rico. The worms had previously been imported in Spanish times into Guayama and then permitted to die out. The Rio Piedras Experiment Station imported some directly from China in 1922 and raised one generation of moths but no industry resulted. This in spite of the fact that the mulberry trees imported as food for the worms grew well in the environment of Puerto Rico. (17, p. 153)

Sheep have never been numerous on the island. The animals could not be raised for wool under the tropical conditions. The African wolless was imported to breed in with the sheep already on the island in an effort to improve the quality of the meat. Because the resultant leg of mutton was still too small, a Southdown ram was brought in to increase the quantity of the meat. The sheep breeding experiments, which were conducted at the Mayaguez Experiment Station, were abandoned in 1913. The climate was too damp and the animals suffered from a variety of flukes. (231, 1913, p. 32) The sheep seen in Southeast Puerto Rico in 1951 were a scraggly lot.

Pigeons are kept by many farmers in Southeast Puerto Rico although no evidence was found of the use of pigeons for racing or message-carrying.

Ducks are rather rare in Southeast Puerto Rico. The white Pekin duck is the usual variety kept.

Turkeys are found almost exclusively in the arid south of the island. In the wetter north the birds are too subject to disease, particularly the black head disease. Turkeys are not

common even in Southeast Puerto Rico.

Frogs and toads were introduced at different periods. The toad is the more important, having been brought in to eat the white grubs which feasted on cane, and the ohanga beetle which destroyed tobacco as well. The first shipment of toads came from Barbados and was very small. A larger shipment (40 toads) came later from Jamaica. (13, p. 11) All the myriad toads of the island are descended from those few imports.

The toads have done their assigned job very well, keeping down two dangerous pests of the sugar cane. Beekeepers have found out that they are also fond of honey-bees. Toads have spread to all parts of the island where cane is grown and have been shipped in quantity to other cane-growing parts of the world.

Frogs are a relatively recent importation. Twelve frogs known as "mountain chickens" were brought from Dominica to be released at Mayaguez in the hope that they would provide a supplementary source of protein for the poor. The edible bullfrog is spoken of in the 1950 annual report of the Mayaguez Experiment Station as a beneficial species inasmuch as it eats the predators on the tadpoles of both itself and the toad. (231, 1950, p. 16) Neither of the frog species were seen in Southeast Puerto Rico in 1951.

APPENDIX F

GLOSSARY OF SPANISH TERMS

The English equivalents or explanations that follow apply to the present study. Many of the Spanish terms have other meanings in other circumstances. Spanish plant and animal names are not included as they usually are accompanied by English equivalents wherever they appear in the text.

agregado	originally a sort of serf who lived on a large estate under certain obligations to the master. Technically he was a free man, not a slave. Recently, some agregados live on state parcels. In any case, the agregado owns no land.
alcalde	the mayor of a municipio. In early Spanish days, each settlement had an alcalde.
arroba	a measure of weight roughly equivalent to 25 pounds.
barrio	a subdivision of a municipio. A barrio is similar to a township in the U.S. but has no standard area.
blanco	a white person
bo. (pl., bos)	abbreviation for barrio.
bohío	the present-day country hut, which is patterned after the original Indian hut.
cacique	an Indian chief.
campesino	a farmer or one who lives in the country, a more polite term than jíbaro.
carimbo	a brand formerly put on Negro slaves. Abolished in 1784.
cédula real	royal letters patent.
central	a modern large-scale sugar mill.

- cerro a mountain, usually one with a small summit.
- colono an independent land owner who grows sugar cane and sells it, under contract, to a central.
- Conquistadores the Conquerors, a term used for the original Spanish conquerors of an area.
- conuco a system of migratory or transitory agriculture characterized by clearing the forest, cropping, and then moving on when the land is exhausted.
- conuco anual a piece of land assigned to a slave or agregado on which to raise food for his family. The plot assigned might vary from year to year.
- corso a Corsican.
- criolla creole, a term used to label a "thing of the country" whether it is indigenous or not.
- cuerda .9712 of an American acre. The terms cuerda and acre are used interchangeably in the text, as they are on the island. The area meant is always measured in cuerdas.
- derecho, de de jure, a census term indicating that the figures so labeled include only permanent residents of the area.
- esclavos slaves.
- estancia an estate or plantation.
- frutos menores minor crops. Includes everything raised by farmers except the frutos mayores (major crops) which are sugar cane, coffee, and tobacco. No similar category is used in the United States.
- ganado del pais cattle of the country or creole cattle; those of long standing in the country.
- gallera a cock fight ring.
- gran cultura the first cane crop after a fall planting, which is usually allowed to grow up to 18 months before cutting.
- guarapo juice. Frequently used for sugar cane juice instead of the complete term, guarapo de caña.
- hacienda a sugar raising establishment, an ingenio without a trapiche.

hamaca	a hammock.
hato	a cattle ranch.
hecho, de	<u>de facto</u> , a census term indicating that the <u>figures</u> so labeled include only those present and counted.
hidalgo	an "hijo de algo" or "son of something", usually a land owner or person of property.
ingenio	a sugar grinding apparatus including the cane lands and the settlement that clustered around it.
jíbaro	a peasant or country hick; a derogatory, half-humorous term for a farmer, somewhat similar to the American term "hill billy".
lago	a lake. In Southeast Puerto Rico all the lagos are artificial reservoirs.
latifundia	the large estate system of land ownership.
lechón asado	barbecued suckling pig.
maleza	waste land, usually cut-over land or land that has been allowed to grow up in a tangled mass after cultivation has exhausted the soil.
memoria	a report, usually in book form.
monte	a mountain. Also used to mean mountain woodland.
moreno	a brown-skinned, mixed-blood person.
morenos libres	free brown-skinned, mixed-blood persons.
moscabado	a partially refined, brown sugar made by crude methods.
municipio	an administrative district somewhat similar to a county in the United States. There are six municipios in Southeast Puerto Rico and 77 in the entire island. The municipio ordinarily is named for the largest town in it.
muy buena gente	"very good folks".
negros libres	free Negroes.
palo	a tree or plant. Literally, a stick.

parcela	a parcel of land, usually three cuerdas or less in size. Ordinarily a parcela is the plot of land assigned to an agregado by the Insular Government. The government retains title to the land but the parcelero may build his own house and till the land.
parcelero	one who lives on the parcela assigned him.
pardo	a dark-skinned person, usually not a pure-blooded Negro.
pardos libres	free dark-skinned persons.
peso	a Spanish coin.
pico	a mountain peak.
pilón	a partially refined brown sugar of lower quality than moscabado sugar.
playa	an alluvial lowland, normally nearly level but sloping gently toward the sea. The word is commonly applied to beaches.
puerto	a port.
pueblo	a small settlement, literally, a town.
queso blanco	white cheese.
real	a Spanish coin worth 12 1/2 centavos or one-eighth of a peso. The term is obsolete but is sometimes used today similarly to the American expression "two bits". A twenty-five cent piece is sometimes called "dos reales" (two reales).
repartimientos	the subdividing of land and Indians among the ruling class of Spaniards in the 16th century.
ribera	a settlement, the smallest class of urban agglomeration in early Spanish days.
rio	a river.
sabana	a high tropical grass land.
salinas or las salinas	the salty places. Used for localities where salt is extracted from sea water by solar processes.
situados	remittances of money. The situados from Mexico helped support Puerto Rico up to the 19th century.

- sucesión the estate of a deceased person which is kept intact and administered for the benefit of the heirs.
- trapiche an old-fashioned small sugar mill, usually operated by ox or mule power.
- vecino in early census usage, a head of a family.

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