Soil Survey Report

Province of CAVITE

CAVITE

SOIL SURVEY OF CAVITE PROVINCE PHILIPPINE ISLANDS

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INTRODUCTION

Settlement and history. --- At the time and City of Manila was first occupied by the Spaniards, Cavite Province was very thinly populated. In 1591, there were only two towns, Kawit and Maragondon, with a population of about 2,000. The towns of Cavite and Binacayan were then small villages having a parish priest. In 1614, Cavite Province was created a politico-military province. The town of Cavite was established before the year 1600 and used by the Spanish Government as a naval station. It is the capital of the province and is located in the northern part. This town was strongly fortified by the Spanish Government. It is reported that it required a number of years to build the fortifications which were not completed until 1750.

Civil government was established in Cavite on June 10, 1901. During the administration of Governor Taft, the vast Friar haciendas were purchased by the Government, divided into lots, and sold to the people.

The population of the province was estimated in 1918 at 154,347 and in 1935 at 180,881.

Transportation and communication. --- All lowland towns are connected by good roads. The upland towns, including Indang and Mendez, have a first-class road is being constructed from the Tagaytay-Batangas road to Alfonso. The town of Silang has a first-class road to the lowland towns, connecting the provincial road at Binacayan. The Tagaytay road to Batangas shortens the Manila-Nasugbu trip by 66 kilometers.

Cavite Province has 110.09 kilometers of first-class road, [illegible] of second-class, and 70.23 of third-class.

Every town in the province is connected by telephone, with the central at Novelata and the subcentral at Indang. Mail is received every other day in the remote upland towns and daily in the lowland towns.

Public health. --- The sanitary condition of the province is well taken care of by the Philippine Bureau of Health. The Bureau of Education employs Red Cross nurses and dentists for the schools. A clinic for tuberculosis is maintained in the capital once a week by the Bureau of Health. Puericulture center nurses are employed in some towns.

Education. --- Every town has public schools. There are two secondary schools in the province, one in Caridad and the other in Indang. The one in Indang is classified as a rural high school. Besides the public schools there are a number of private schools, most of which are conducted by the Catholic church.

Industries. --- Agriculture is the chief industry of the province. Bangos fishing and salt making are the main industries of the people along the coasts of Bacoor, Kawit, Novelata, Tanza, and Salinas. Production of oysters is an important industry at Bacoor Bay. The Philippine Bureau of Science has a fish station at Binacayan for the scientific production of oysters.

The manufacturing activity of Cavite Province is very limited. The barrios of Julugan and Amayan manufacture cordage for fish nets. Bamboo baskets are made on a small scale in most of the towns. Some salacots (hats) are made in Naragondon. Bolos and wooden shoes of the products of the province is Manila.

PHYSIOGRAPHY AND GEOLOGY

Cavite Province is situated in the southeastern part of Luzon. It is bounded by Batangas Province on the south and southwest, Laguna Province on the east and northeast, and Manila Bay on the west and northwest.

Topographically, the province is divided into two parts; namely, the highland and the lowland. The highland which comprises the towns of Silang, Amadeo, Mendez, Alfonso, Bailen, Magallanes, Indang, Naic, Carmona, is in the western and southwestern part of the province. The mountains in the western part of the province, it appears, were at one time the continuation of the Zambales Range of which the fortified island of Corregidor was the connecting link. The southern part of the province is a slope, which continues until an abrupt precipice of 2,100 feet is reached. This is known as the Tagaytay Ridge. From the top of this ridge the land slopes gradually northwestward to Manila Bay.

The lowland in the northern and northwestern part of the province comprises the towns of Bacoor, Imus, Kawit, Noveleta, Cavite, General Trias, Tanza, Salinas, Ternate, Naic, Dasmarinas, and part of Carmona.

The greater part of the province is underlain by waterlaid volcanic tuff. Mount Gonzales, Dos Picos, and Pico de Loro are composed principally of andesite. The coast line from Bacoor to Ternate consists of alluvial and littoral deposits. From Ternate to Batungan, the coast line consists of marine conglomerates.

IRRIGATION AND DRAINAGE

The upland region of Cavite is well drained by several rivers. These rivers are deep and narrow. The headwaters of the Malaubon and Alamang Rivers, which empty at Naic, are in the uplands of Indang, Amadeo, and Silang. There are several other small rivers in Silang and Dasmarinas which empty at the towns of Salinas and Tanza. The Malabon and Ilang-ilang Rivers, which empty into Bacoor Bay, often swell and flood the towns of

Imus Estate and Kawit, causing damages to crops and property. The Bacoor Bay and Zapote River is the boundary of Cavite and Rizal Provinces.

The lowland area, which is devoted to lowland rice, is irrigated by several small rivers. Most of the irrigation projects are handled privately. The big dams, however, like the Poblacion and the Tres Cruces, are managed and maintained by the Bureau of Lands. These dams were built by the Friars during the Spanish times.

CLIMATE

In general, the climate of Cavite has two seasons; dry from the end of December to the middle of June, and wet from the middle of June to the end of December. However, the climate in the lowland part of the province is different from that of the upland. The lowland climate is almost the same as that of Manila, both in temperature and rainfall. The upland, however, especially at Mendez, Indang, Alfonso, and Amadeo, differs from the lowland both in temperature and rainfall. Violent typhoons seldom pass over the province. The Tagaytay Ridge has refreshing sea breezes from Balayan Bay, while the lowlands have breezes from Manila Bay.

Table 1 shows the average monthly rainfall and temperature of the three lowland towns, while Table 2 gives the average monthly rainfall and temperature for the three representative upland towns of the province. A special weather observation was made at Tagaytay Ridge by the Weather Bureau. The results of two years observations were published in the Bureau of Science Popular Bulletin No. 6, by Father Selga.

AGRICULTURE

Agricultural development started as far back as the founding of the province by the Spaniards. However, much progress did not take place until the middle of the nineteenth century. At that time new varieties of plants were introduced. Coconuts and abaca plantations were established in the upland region. Abaca was once an important crop of the province. Because of the occurrence of the bunchy-top disease, the abaca industry was wiped out.

The old Spanish irrigation dams at Lolino and Tres Cruces are still in use, supplying the irrigation water for lowland rice. Fertilizer application is not generally practiced by the farmers. In a few cases fertilizer has been applied in small amounts. Crop cultivation has been applied in small amounts. Crop rotation with lowland rice is practiced in very few cases. In general, farming in the lowlands is not diversified; rice is the only yearly crop. In the upland section however, farming is more or less diversified.

The tenancy system is still practiced. Absentee landlord is prevalent in the lowland.

During the year ending July 11, 1934, the area cultivated in the province was 54,431 hectares. The open land which is available for cultivation was 53,628 hectares, making a total of 108,059 hectares of agricultural lands. This is equivalent to 8.92 per cent of the total surface area of the province. This is shown in Table 3.

The ten leading crops of Cavite, arranged in the order of area planted, are rice, coconuts, sugar cane, corn, bananas, forage grass, mango, ube, beans, and tomatoes. The area and corresponding value of the above crops are shown in Table 4.

Rice is the leading crop of the province. It is grown in both the upland and lowland sections of the province. However, the largest amount of rice is produced in the lowland section. In the non-irrigated section the water supply for rice depends upon rain. Planting rice, is therefore, done during the middle part of June to August and sometimes September, the months of heavy rainfall. The varieties of lowland rice are elon-elon, macan, macan ala, macan bino, and other minor varieties. The upland varieties are Pulard bigas, Sanglay, Kinada, Kinastila, Inosio, and several varieties of glutinous rice. Planting rice in the upland is usually done after the first rain of April. Farmers who are late in the preparation of the field sow their seed in the middle of May.

The yield per hectare of lowland rice varies from 35 to 50 cavans. Rice under irrigation gives higher yields than the non-irrigated rice. With the exception of irrigated rice the yield of rice per hectare in the lowland section hardly varies irrespective of localities.

Although ammonium sulphate is used in very limited areas, fertilizer application for rice is, in general, not practiced in this province. On the average, the upland rice gives much lower yield than the lowland rice.

Coconut is the second crop in importance. The plantations are usually located in the upland region of the province, particularly at Bilang, Iba, Alfonso, Magallanes, and Bailon.

Abaca was formerly the major crop before the out-break of bunchy-top, a disease which wiped out the abaca industry of the province. The areas thus vacated were planted to rice as catch or staple crop with coconut as the permanent crop. The standing coconut trees in this region, according to the latest calculation, were 222,578, of which 171,649 are bearing trees. The nuts are made into copra. Coconut plantations are also found in the lowland section of the province.

Sugar cane is the third important crop. This crop is planted both in the lowlands at Barerinos, Naic, and Naragondon, and in the uplands at Bailon, Magallanes, and the southeastern part of Alfonso. The canes which are grown in the upland region are milled at the Hacienda Central, Batangas Province. The varieties of cane planted are the P. O. J. 2878, the Luzon white, and the Mauritius.

The crop is the fourth important crop of the province. The upland regions of Bilang, Amadeo, Indang, Mendez, Alfonso, Bailon, and Magallanes are the principal growers of corn. The varieties are usually the common yellow flint and the white corn.

Bananas rank fifth among the important crops of the province. There are no regular banana plantations. Bananas are usually planted along the sides of the fields. They are also grown in both the upland and lowland regions. The principal varieties are latundan, lacatan, bungulan, ternate, and saba. These five varieties are always found in the local markets.

Forage grass, locally known as zacate, is mostly grown in the lowland. A number of farms in Cavite are entirely occupied in zacate growing. The growing of zacate has been a paying enterprise because of the demand for zacate as food for horses used in the transportation business in the City of Manila.

Mango trees are scattered here and there in the province both in the upland and lowland areas. Most of the upland mangoes are either the Pico or the Zapadera variety. Only a few carabao mangoes are found in the uplands. The lowland varieties are the Pico and the carabao. The best carabao mango is found in Cerifad. There are several mango plantations in the lowland region near the town of Imus and Naic.

The root crops of the province consist of ube (Dioscorea alata Linn.), tugue (Dioscorea fasiculata Roxb.), gabe (Colocasia esculentus Linn.) (Schott), and cassava (Manihot utilissima Pohl). The area planted to these crops in 1934 was 426 hectares, and the value of produce was 3,430 pesos. A cassava-starch factory was established at Naic, between Indang and Naic. Several hectares of land were planted to cassava.

Beans and tomatoes are considered valuable crops of the province. The tomato is an important money crop of the farmers. Tomatoes are planted in both upland and lowland sections of the province. The American variety of tomatoes, which is produced only in the lowland section, is always sold at a higher price than the native varieties.

Other vegetable crops, such as eggplant, mongo, raddish, pechay, mustard, peas, and cabbages are also grown. During 1934, these crops covered an area of 941 hectares, and the value of the produce was 57,880 pesos.

Fruit trees, such as chico, avocado, sugar apple, pomelo, mandarin, orange, papaya, and pineapple, are also grown. These trees occupy about 2,947 hectares. The value of the produce in 1934 was about 2,053,750 pesos. In the upland region covering the towns of Indang, Mendez, Alfonso, and Amadeo, there are at present about 469,000 avocado trees and 282,000 coffee trees. The planting of cacao trees has been increasing from year to year. In Bailon, the planting of coffee has also been increasing yearly.

CAVITE SOILS

The most important factors affecting the utilization of the land and distribution of the crops in Cavite are the soil, topography, climate, and water supply. The development of several types of soil in the province is closely related to the topography, climate, and water supply of the regions. Although the general rock formation of the whole province is volcanic tuff material, yet in the lowland the soil is heavy in texture, while in the upland region the soil is friable and light in texture.

Soil series and types. --- A soil series is a group of soils having the same range in color, the same character of subsoil (particularly in color, structure, and consistency), the same type of relief and drainage, and a common or similar origin. A series is divided into soil types, which are the unit of classification and mapping.

The different soil types within the series differ from one another only in the texture of the surface soil. Subordinate differences in the character of a soil are designated as phase.

The soil type determines to a considerable extent, the kind of crops that may be grown profitably, and serves as a basis for diversification. A particular group grown on several special soil types would likely produce different yields.

The soils of Cavite Province are divided into soil series and types, as follows:

1. Hydrosol series.

    (a) Cavite hydrosol.

2. Quingua series.

    (a) Quingua fine sandy loam.

3. Guadalupe series.

    (a) Guadalupe clay.
    (b) Guadalupe clay adobe
    (c) Guadalupe clay loam.
    (d) Guadalupe silt loam.
    (e) Guadalupe sand.

4. Magallanes series.

(a) Magallanes clay loam.
(b) Magallanes clay loam, steep phase.
(c) Magallanes loam.

5. Tagaytay series.

(a) Tagaytay sandy loam.
(b) Tagaytay loam.
(c) Tagaytay loam, steep phase.

6. Carmona series.

(a) Carmona sandy clay loam.
(b) Carmona clay loam.
(c) Carmona clay loam, steep phase.

7. Obando series.

(a) Obando sand.
(b) Obando fine sandy loam.

8. Patungan sand.

(a) Patungan sand.

9. Mountain soils, undifferentiated.

The location and distribution of these soils are shown in the accompanying map. The relative areas and proportional extent are given in Table 5.

Cavite hydrosol. ---This particular type of soil consists of the submerged soils of the swamps and fishponds along the Bacoor Bay. The texture of the subaqueous horizons varies from sand to sandy clay. The work of Rosell and Arguelles (1935) on this particular group of soil describes the hydrosol of Cavite as sandy in texture with small amount of clay and organic matter.

Quingua fine sandy loam. ---As found in Cavite Province, this type occurs only in one place along the lower part of Malabon and Ilang-Ilang Rivers. This type is well developed at Bovuleta. The soil is typically a river deposite of sandy

material. The depth of the surface soil varies according to the level of the river flood terrace. Usually it ranges from light brown to pale brown. This type of soil is mostly utilized for vegetable growing, particularly tomato, bean, sitao (cowpea), and mango. Sweet corn is also grown on this soil. During the dry season, the best water melons in Cavite are raised in this type of soil. Sincamas is also grown in great quantities.

GUADALUPE SERIES

The Guadalupe series found in Cavite is the continuation of the series established in Rizal Province. Like the Novaliches series, the Guadalupe soil is underlain by volcanic tuffaceous material of various degrees of disintegration and weathering. The resulting soil profile is, however, very different from that of the Novaliches series in consistency, color, structure, and texture of the surface and subsoil. The surface soil is dark-brown to nearly black, sticky and plastic clay. In cultivated areas, the soil is coarse granular to cloddy in structure and very slightly friable. During the dry season, the undisturbed soil is hard and compact and cracks into several big clods.

The subsoil is lighter in color than the surface soil. Spherical tuffaceous concretions are present. Leaching is evidently present as shown in the profile. The substratum consists of volcanic tuffaceous material of undetermined depth.

A typical profile of this series is shown from the excavations of the clay loam type. This profile was obtained in the vicinity of Amaya Barrio, in the town of Tanza.

Depth (cm.)	Characteristics
0 to 20	Dark-brown to nearly dark brownish-gray clay. Concretions present; plastic and sticky.
20 to 40	Yellowish-brown tuffaceous rock, soft and highly weathered.
40 to 100	Very dark-brown to dark-gray clay with yellowish-brown concretions. Whitish specks are present. Sticky when wet, coarse granular to cloddy when dry.
100 to 135	Pale-gray tuffaceous rock, hard and compact.

135 to 170 Yellowish-brown tuffaceous rock softer than above.

This series is found in both lowland and slightly upland sections of the province. The highest elevation in which it is found is 300 feet above sea level. The lowland portion is devoted to lowland rice with or without irrigation. In the slightly upland area, the soil is utilized for pasture and in some places planted to upland rice and fruit trees.

Guadalupe clay. --- The depth of the surface soil ranges from 20 to 30 centimeters. It is very dark brown to nearly black coarse granular to cloudy when dry. The undisturbed soil is hard and compact, and bakes and cracks easily, rendering the cultivation quite difficult. When wet, the soil is very finely granular and sticky. The subsoil is clay, lighter color than the surface soil. The depth ranges from 50 to 80 centimeters. It is finely granular when dry but sticky and plastic when wet. Tuffaceous concretions are present. The lower subsoil is highly weathered tuffaceous rock with crevices containing colored soil from above. The substratum is volcanic tuffaceous material of varying degrees of weathering. This type of soil is utilized mostly for rice. In general, this soil gives a fair yield of lowland rice due to lack of moisture in the substratum. Rice plants suffer badly during drought. Forage grass (zacate) is extensively grown on this type of soil.

Guadalupe clay adobe. ---Like the Guadalupe clay, the surface of the Guadalupe clay adobe is very dark brown to nearly black in color. The depth ranges from 20 to 25 centimeters. When dry the soil is coarse granular to cloddy; when wet it is very plastic and sticky. The undisturbed soil is hard and compact, and bakes easily when dry.

The upper subsoil to a depth of from 40 to 45 centimeters is lighter in color than the surface. It is clay, finely granular, and sticky. The lower subsoil is a zone of volcanic tuff material with crevices filled with dark-colored soil leached from the surface by the percolating water. The degree of weathering varies in many localities. The substratum is solid volcanic tuff. This type consists of slightly rolling upland, a continuation of the same type in Rizal. The lower portion is devoted to lowland rice, while the higher portion is devoted to orchard planted with cover crop or catch crop. Uncultivated area are used for pasture.

Guadalupe clay loam. ---The surface soil of this type is dark-brown to brownish-gray clay loam. The depth ranges from 15 to 30 centimeters. The subsoil is mottled with dark-gray, reddish gray to dark-brown clay. In many small areas, especially the protions devoted to lowland rice, the surface soil is very shallow and the subsoil is just a few centimeters above the tuffaceous rock substratum. In places, however, where the soil has been under cultivation for a number of years the depth of the substratum of volcanic tuff ranges from 50 to 70 centimeters from the surface. This type of soil is mostly devoted to lowland rice with irrigation. In some places the soil has been utilized for corn after the rice is harvested. Besides rice, zacate grass, which is an excellent food for horses, is grown in this type of soil.

Guadalupe silt loam. ---The surface soil is brownish-gray to light grayish-brown silt loam. The depth ranges from 20 to 30 centimeters, and below this is dark brownish-gray to dark-gray clay. The substratum is volcanic tuff. Rice is planted in this type of soil, which occupies only a small portion of the area.

Guadalupe sand. --- The surface soil is dark-brown to light grayish-brown sand. Just below this is a thin layer of dark-brown to gray clay resting on a volcanic tuff. This type of sand occurs along the seashore portion of the seashore portion of the Guadalupe series.

MAGALLANES SERIES

The soil of the Magallanes series is brown, pale brown to light reddish-brown or yellowish-brown friable and coarse granular surface soil, and yellowish-brown tuffaceous subsoil. The surface and subsoil are underlain by varying thickness of volcanic tuff ranging in depth from 80 to 120 centimeters. Below this tuffaceous rock is another layer of soil similar to that of the surface soil and subsoil. This soil layer, however, is below two meters deep. The soil profile of 1.5 meters does not show this layer.

This series is lower in elevation than the Tagaytay series. The area is slightly rolling and gently undulating in topography. Deep rivers flowing north cut through the whole area.

Where the surface soil is shallow, the subsoil upon plowing modifies the physical and morphological characteristics of the surface soil. Tuffaceous concretions are present. The soil that had been under vegetative cover is brown to dark brown. During continuous rains, the surface soil swells and consequently erodes easily.

Like the Tagaytay series, the soil of this series is devoted to diversified farming. Rice and sugar cane are the most important crops. Mango, coffee, citrus, bananas, and several other fruit trees are grown. Coconut plantations, mostly 10 to 15 years old, are already bearing fruits profitably.

Sheet erosion is not extensive in this series as in the Tagaytay series. However, gully erosion prevails, especially in the newly made kaingin areas.

A typical clay loam type of Magallanes series located between Boilen and Magallanes towns shows the following characteristics:

Depth (cm.)	Characteristics
0 to 30	Brown to pale-brown friable clay loam, fine to coarse granular. Mixture with small amount of decayed organic matter on the upper surface.
30 to 50	Pale-brown to yellowish-brown clay loam, slightly friable and granular. When dry, the soil breaks into big clods.
50 to 80	Pale-brown clay loam with plenty of tuffaceous concretions.
80 up	*Yellowish-brown tuffaceous rock, soft.*

Magallanes clay loam. --- The Magallanes clay loam consists of pale-brown to light yellowish-brown friable and fine granular clay loam of somewhat gritty or sandy texture. The undisturbed soil is hard and bakes when dry. In this kind of soil plowing is somewhat difficult. It can be plowed only at the right moisture content. The depth ranges from 15 to 30 centimeters. The upper subsoil is pale yellowish-brown, coarse granular and cloddy, and slightly friable clay loam. The lower

subsoil is a highly weathered tuffaceous material yellowish-brown in color, stratified and cloddy. The substratum is volcanic tuff of undetermined depth. Drainage is fairly good.

The Magallanes clay loam occupies large portion of the towns of Magallanes, Bailen and the upper part of Maragondon. The elevation is slightly lower than the Tagaytay loam type. This type is cut by several deep rivers flowing towards the north; several deep rivers flowing towards the north; several gullies are made by their small tributaries.

This type of soil is devoted mostly to sugar cane, coconut, and upalnd rice. The varieties of sugar cane planted are Luzon White, P. O. J. 2878, and Mauritius. These canes are milled in the Nasugbu Central, Batangas Province. Coffee and Batangas mandarins are also planted in this type of soil. These trees seem to thrive well. Coconut plantations of 10 to 15 years old are in full bearing.

Magallanes clay loam, steep phase. ---This phase is nothing but the Magallanes clay loam with steep slopes. This usually occurs in valleys and along the sloppy sides of the creeks and rivers. The surface soil varies in thickness according to the length of time the soil is under cultivation. The areas are allowed either to be forested with shrubs and trees to prevent erosion or to be planted to bananas, gabe, ube, and other root crops. Kaingin, a system of farming, is sometimes practiced in this type of soil and as a consequence it encourages erosion.

Magallanes loam. ---Next to the Magallanes clay loam to the west is a large body of Magallanes loam soil that extends from two or three kilometers from Bailen to the western part of the Carmona series. The surface ranging in depth from 20 to 35 centimeters is pale-brown to light yellowish-brown friable and fine to coarse granular loam of somewhat sandy in texture. In wooded areas, where the soil has not been disturbed or cultivated, the color is darker and the texture is heavier than in the cultivated field. The soil is easily worked when it has a sufficient amount of moisture. The undisturbed or unplowed soil is hard, and bakes and craks when dry.

Like the clayloam type of this series, the subsoil is pale yellowish-brown coarse granular to cloddy clay loam in the upper horizon. It also contains a highly weathered volcanic tuff material of yellowish brown in color. The substratum is tuff of undetermined depth.

This type of soil, like the Magallanes clay loam and the soils of the Tagaytay series, is devoted to diversified farming. Upland rice, corn, and sugar cane are grown under rotation. Fruit trees, such as mango, citrus, and others, are raised in this type of soil. Some vegetables of various kinds are produced, while coconuts and coffee are grown in the upper section of this area. Mango and citrus plantations are found between Pelerang and Calumpang. Between Buenavista and Libing Bersies considerable areas are devoted to sugar cane. In places where roads are available, the soil is highly utilized. In the interior sections, however, where transportation facilities are scarce, the soil serves mostly for forest or pasture purposes.

TAGAYTAY SERIES

The surface of the Tagaytay series is brown, dark brown to nearly black in color. The virgin soils that have been recently under vegetation are dark brown to nearly black, while those soils that have been under cultivation for a number of years are brown to dark brown. The thickness of the surface soil depends upon the elevation and topography of the land. The surface soils in the upper part of the rolling area are shallow, while those in the valley and sloping districts are deep.

The subsoils are either brown or light yellowish brown, depending upon the extent of the weathering of the tuffaceous parent material. Both the surface soils and subsoils are friable and granular, containing some tuffaceous concretions.

The substratum is tuffaceous material of volcanic origin. The tuffaceous rock extends to indefinite thickness.

The soils of this series are devoted to diversified farming. Crop rotation is practiced throughout the area. Upland rice is planted during April and May with corn and mongo (lumme) as rotation. Tomatoes, peanuts, and several seasonal crops are also used in rotation. In wooded and shaded areas, coffee or cacao trees are planted. Batangas mandarin (citrus), avocado, chico, jackfruit, kaimito, mango, and casoy are found growing well in this soil. A number of small and coconut plantations of about 10 to 15 years old are found in the series.

Sheet and gully erosions are very evident, this soil being friable. Several critical areas are already badly eroded. Soil conservation should be the first consideration in the operation of this soil series.

Tagaytay sandy loam.---The surface soil of 12 to 50 centimeters is dark-brown to nearly black, friable, and granular sandy loam with a considerable amount of volcanic sand. The subsoil is dark brown to very dark brown, and varies in texture from clay loam to clay. It is underlain by reddish-brown to yellowish-brown adobe clay. This adobe clay varies in depth depending on the topography of the place.

A preliminary study of the soil in Tagaytay Ridge was reported by Rosell and Arguelles. In this study, the chemical and physical analyses were made and the morphological characteristics of the soil noted.

Tagaytay loam. ---The surface soil of the Tagaytay loam consists of a layer, 15 to 35 centimeters, of brown to dark-brown loam which contains more or less fine sandy material. The soil is moderately friable when moist. In the undistributed condition it becomes hard and bakes when dry. In places where the soil is shallow, tuffaceous concretions are present.

The subsoil ranges from dull-brown compact clay loam to light yellowish-brown friable clay. At a depth ranging from 40 to 60 centimeters, this layer rests on partly consolidated tuffaceous material of volcanic origin. The tuffaceous material extends downward to indefinite depth.

The Tagaytay loam soil is easy to work. About half of this area is devoted to upland rice. Other crops, such as corn, sugar cane, coconuts, citrus, coffee, pineapple, avocado, and various vegetables, are also grown in this soil.

Tagaytay loam, deep phase.---The deep phase of the Tagaytay loam soil is no other than Tagaytay loam soil itself; only the surface soil is much deeper. This phase occurs in slopes and along the sides of the creeks and valleys. This area is usually covered with wild, small climbing bamboos, palm trees (cabonegro), and various species of shrubs.

On the whole, the soil in Tagaytay Ridge is subject to excessive erosion. The present system of farming, which leaves the surface soil without vegetative cover for approximately one-half of the year, is conductive to serious erosion. If this practice continues, the soil on Tagaytay Ridge will soon be useless for agricultural purposes.

CARMONA SERIES

The surface soil of the Carmona series is pale brownish gray to gray and the subsoil is pale brown to pale yellowish brown. The substratum is a pale brown to pale yellowish brown. The substratum is a pale yellowish-brown and highly weathered tuffaceous material.

The subsoil is mottled brown, gray and yellowish gray, sticky clay with a considerable amount of concretions. In an exposed profile, the soil forms a sharp columnar structure, sometimes cloddy in rectangular form.

The lowland area of this series is devoted to rice and the slightly elevated portion is planted to sugar cane. The upland section is planted to upland rice, bananas, and fruit trees, such as mango, avocado, and citrus.

A typical profile of the clay loam type obtained near Paliparan Barrio shows the following characteristics:

Depth (cm.)	Characteristics
0 to 30	Brown to light grayish-brown clay loam to clay, cloddy and granular with few concretions.
30 to 50	Brown to light grayish-brown clay with tuffaceous material and concretions.
50 to 75	Light yellowish-brown to light grayish-brown highly weathered tuff with concretions.
75 to 140	Mottled brown and dark-gray clay, cloddy.
140 plus	Tuff, light yellowish brown to yellowish gray.

Carmona sandy clay loam. ---The surface soil of 20 to 25 centimeters in depth is pale-brown to gray sandy clay loam with plenty of concretions. When moderately dry the soil is friable. When wet it is sticky and sometimes plastic.

The subsoil is pale brown to yellowish gray plastic clay with plenty of dark-brown and reddish-brown concretions. It is compact and hard when dry and sticky and plastic when wet. The substratum is mostly weathered sulfaceous material. This covers the lowland part of the Carmona town.

The irrigated area of this soil is devoted to lowland rice. The slightly non-irrigated portion is planted to sugar cane. Mango trees are grown in patches.

Carmona clay loam.---The surface soil of 20 to 35 centimeters in depth is pale-gray to dark-gray clay loam with plenty of concretions. When dry, the undisturbed soil is hard and compact and cracks considerably. When wet the soil is sticky and plastic. The lower subsoil is mottled dark-gray, pale-gray, and reddish-brown clay. The drainage is poor. The substratum is volcanic tuff material.

A great portion of this type is uncultivated. Aroma, ipil-ipil, and alibangbang trees grow abundantly. The location and the topography of the land are somewhat favorable to orchard planting. There are already a number of mango trees planted in this soil. The upper section, where considerable vegetation growth is found, is utilized mostly for pasture.

Carmona clay loam, steep phase.---This phase is the clay loam type which occurs in wet areas along the sides of the creeks and rivers. These areas are usually covered with shrubs and trees. The surface soil is deep in some portions, while in the open areas the subsoil is just a few centimeters from the surface.

Obando sand.---The Obando which occurs in Caridad, San Roque, Cavite, Bacoor, and Kawit is brown to light brown. It ranges in depth from 20 to 50 centimeters. Below this horizon is a coarse sand mixed with marine shells. In spite of its being sandy, other kinds of vegetation are grown normally in this soil.

Obando fine sandy loam.---The Obando fine sandy loam occurs in two places within the Obando sand in Caridad and San Roque. These portions are covered with bamboo. The soil is utilized for vegetable growing.

Patunan sand.---The Patunan sand is found along the shore between Ternate and Pabuyan. The sand is pale gray to almost white, with a substrata of marine conglomerate and tuffaceous rocks.

Mountain soils, undifferentiated.---This particular type of soil occurs in the mountains and surrounding areas. The mountains are Gunger in the southeastern part, and Pitaas na Gulod, Dos Picos, and Pico de Loro in the southwestern part. The southwestern part is covered with forest of some commercial value. Caogas are found on the seacoast side of the mountain region.

ANALYSIS OF CAVITE SOILS

Soil surveys made in the Philippines include also, for completeness, mechanical and chemical analyses of the soil.

Samples of soils are collected from each soil type, and the number of samples obtained depends upon the extent and agricultural importance of the type. In our survey, the mechanical and chemical analyses were confined to the surface samples. These samples were taken at a depth of about 16 centimeters. Subsoil samples were also taken in conjunction with this work.

Mechanical analysis.---In Table 6 are given the mechanical analyses of the surface soils of the different types found in Cavite Province. In general, these data give us further information regarding the physical characteristics of the soil types.

Chemical analysis.---Chemical analysis gives data concerning the principal plant food elements contained in the soil. The major soil types are sampled and these samples analyzed for nitrogen, phosphorus, and potassium. The analysis also includes calcium, magnesium, and organic carbon. The pH value is also determined by the electrometric method by the use of the antimony electrode.

As shown by the data in Table 7, the Cavite soils register very slight acidity, with the exception of the Guadalupe series and the Carmona sandy clay loam with pH above 7. The soil of the Tanauan series gives the highest acidity with a pH range of from 5.46 to 6. A careful examination of the chemical data indicates that the soils in various districts in Cavite Province

are low in phosphoric acid and potash; hence fertilizer containing phosphorous and potassium and also nitrogen is required to increase the yields of these soils. The amount of fertilizer to be applied per hectare will depend entirely on the kind of crop to be grown. It is suggested, however, that field trials should be conducted for the fertilizer requirement of each crop in each type of soil.

SUMMARY

Cavite Province was first created a politico-military province in 1614. The town of Cavite which is the capital is situated in the northern part of the province. It was established before 1600 and used by the Spanish government as a naval station. In 1901, civil government was established in this province.

The population of the province was estimated in 1918 at 157,347; and in 1935 at 180,881.

Practically all the towns in the province have transportation facilities. Electrical and telephone services are available in the lowland towns, but a number of upland towns are not yet provided with these services.

The Philippine Bureau of Public Health maintains the sanitation and other public health activities.

Public schools are available in all the towns. Private schools, conducted by the Catholic Church, are also available in some places.

Cavite Province is situated in the southeastern part of Luzon. On the south and southwest, it is bounded by Batangas province, on the west and northeast by Laguna Province, and on the west and northwest by Manila Bay.

The province is divided into upland and lowland districts. The greater part of the province is underlain with volcanic tuff and tuffaceous materials.

The climate is generally an alternation of wet and dry. In the upland sections there is a more even distribution of rain than in the lowlands.

The soils of Cavite as shown by this survey comprise eight series with nineteen soil types. The most extensive soil type classified was the Tagaytay loam, followed by Guadalupe clay and Guadalupe clay loam.

Agriculture is the main industry in this province. Salt making and bongus making are also becoming important industries.

Rice is the leading crop, followed by coconut, sugar cane, bananas, mango, beans, and forage grass.

Chemical and mechanical analyses of soil samples from different soil types were made. The results showed that there are a number of soil types which are low in essential plant food elements. In general, the soils of Cavite are only slightly acidic. However, a few soil samples give a pH as high as 7.50.

Table 1. --- Records of average monthly rainfall and temperature of three lowland towns of Cavite Province.

Month	Cavite Naval Station			General Trias			Imus [a]
	Rainfall	Temperature		Rainfall	Temperature		Rainfall
	1902 to 1904 1920 to 1936	1902 to 1903 1920 to 1936		1920 to 1932	1920 to 1936		1919 to 1932
		Max.	Min.		Max.	Min.	
	mm.	°C	°C	mm.	°C	°C	mm.
January	14.2	30.2	22.1	7.0	30.2	20.4	9.9
February	14.3	31.5	22.1	10.4	31.4	20.7	13.1
March	7.7	32.9	22.9	7.4	33.2	21.8	8.0
April	14.5	34.3	24.4	24.4	35.0	25.9	13.0
May	165.9	33.8	24.9	180.9	33.7	23.5	179.5
June	244.5	32.4	24.7	282.2	31.4	23.2	284.2
July	420.8	31.9	24.0	427.0	30.4	23.1	416.4
August	499.4	41.0	24.1	459.2	30.2	23.1	529.9
September	325.2	31.2	24.2	288.6	30.7	23.0	295.5
October	153.8	31.4	24.1	139.7	30.7	22.7	134.7
November	146.2	30.6	23.5	174.7	30.0	22.1	158.4
December	60.0	30.2	22.8	52.2	29.7	21.1	50.4
Mean Annual	2,066.5	-	-	2,026.7	-	-	2,093.0

[a] No available temperature records.

Table 2. --- Records of average monthly rainfall and temperature of three upland towns of Cavite Provinces.

Month	Silang			Indang			Mendez-Nuñez		
	Rainfall	Temperature		Rainfall	Temperature		Rainfall	Temperature	
	1904 to 1914 1919 to 1932	1920 to 1932		1920 to 1932	1920 to 1932		1920 to 1932	1920 to 1932	
		Max.	Min.		Max.	Min.		Max.	Min.
	mm.	ºC	ºC	mm.	ºC	ºC	mm.	ºC	ºC
January	40.5	28.2	18.5	28.5	27.2	20.0	31.4	25.3	18.3
February	21.4	29.3	18.8	14.9	28.9	20.2	19.5	26.7	18.3
March	28.9	30.5	19.6	17.4	30.5	21.0	18.9	28.2	19.0
April	30.5	32.1	20.7	46.9	32.4	22.0	38.5	30.0	19.8
May	190.1	31.5	20.6	251.2	31.5	22.7	190.3	29.4	20.3
June	279.4	30.1	20.1	355.4	29.8	22.3	247.3	27.8	20.4
July	454.8	29.1	19.7	636.1	28.6	22.1	553.1	26.9	20.4
August	423.8	29.5	19.7	640.7	28.5	22.2	544.6	26.6	20.3
September	344.2	29.5	19.9	395.5	28.9	22.0	361.7	27.1	20.3
October	187.2	29.6	19.9	228.6	28.9	21.8	211.9	27.1	20.0
November	190.1	28.8	19.6	236.1	27.9	21.5	223.6	26.4	19.7
December	108.2	28.0	19.0	68.5	7.1	20.6	61.8	25.5	18.9
Mean Annual	2,314.2	-	-	2,918.9	-	-	2,496.5	-	-

Table 3. --- Classification of the soil cover of Cavite Province, 1934.

	Area	Per cent
	Ha.	
Commercial forest	3,763	3.13
Non-commercial forest	8,017	6.67
Cultivated area	[b]54,431	45.30
Open land	[b]53,628	44.62
Salt marsh	233	0.19
Unexplored area	104	0.09
Total soil cover - - - -	120,176	100.00

[a] Fischer, A. F. Wealth of our Forest, Philippines Herald Yearbook 3 (1935) 41-44.

[b] Philippine Statistical Review 2 No. 2 (1935).

Table 4. --- Ten leading crops of Cavite with their area and value during the year ending July 1, 1935.

Crop	Area	Value
	Ha.	Pesos
Palay	37,930	1,494.980
Coconuts	6,080	166,000
Sugar cane	2,430	489,600
Corn	2,220	239,030
Bananas	2,120	239,260
Forage grass	510	65,100
Mangos	438	75,730
Ubi	312	14,700
Beans	217	8,520
Tomatoes	214	15,270
Total - - - - - - - - -	52,471	2,609.050

Table 5. --- Area and proportionate amount of each soil type mapped in Cavite Province.

(The figures of the types have been obtained by the use of planimeter. Areas determined this way are totals and show no deductions for space occupied by roads, houses, towns, streams, etc.)

Type No.	Type of Soil	Area	Per cent
	Cavite hydrosol	691.15	0.57
1	Quingua fine sandy loam	875.67	0.72
4	Guadalupe clay	13,989.46	11.64
18	Guadalupe clay adobe	3,899.95	3.25
19	Guadalupe clay loam	12,050.50	10.02
30	Guadalupe silt loam	676.59	0.56
31	Guadalupe sand	1,261.42	1.05
32	Magallanes clay loam	8,286.59	6.89
33	Magallanes clay loam, steep phase	6,217.00	5.17
34	Magallanes loam	14,713.66	12.24
35	Tagaytay sandy loam	5,490.89	4.56
36	Tagaytay loam	21,904.35	18.22
37	Tagaytay loam, steep phase	5,860.20	4.87
38	Carmona sandy clay loam	1,527.82	1.27
39	Carmona clay loam	6,391.88	5.31
40	Carmona clay loam, steep phase	2,173.01	1.80
41	Obando sand	1,595.59	1.32
42	Obando very fine sand	41.39	0.03
43	Patungan sand	128.34	0.11
44	Mountain soils, undifferentiated	12,403.85	10.40
45			
	Total Area - - - - - - - - -	120,179.31	100.00

Table 6. --- Average mechanical analyses of important types of Cavite surface soils.

Type No.	Type of Soil	Sand 2-0.05 mm. %	Silt 0.05-0.005 mm. %	Clay 0.005-0.0 mm. %
4	Quingua fine sandy loam	66.4	25.2	8.4
18	Guadalupe clay	31.4	23.8	44.8
19	Guadalupe clay adobe	34.4	20.4	45.2
30	Guadalupe clay loam	46.6	23.4	30.0
31	Guadalupe silt loam	37.4	36.4	26.2
33	Magallanes clay loam	31.4	22.0	46.6
35	Magallanes loam	34.8	27.4	37.8
36	Tagaytay sandy loam	59.4	26.0	14.6
37	Tagaytay loam	25.0	22.4	42.6
39	Carmona sandy clay loam	35.4	35.0	29.6
40	Carmona clay loam	28.4	21.8	49.8
43	Obando fine sandy loam	68.6	18.3	13.0

Table 7. --- Average chemical analyses of different types of Cavite surface soils.

Type No.	Type of Soil	pH value	Organic Carbon	Nitrogen (N)	Phospheric anhydride (P_2O_5)	Potash (K_2O)	Lime (CaO)	Magnesia (MgO)
	Quingua fine sandy loam	6.29	1.8	0.04	0.12	0.38	3.91	1.18
	Guadalupe clay	6.69	2.2	0.10	0.19	0.46	2.17	0.93
	Guadalupe clay adobe	7.42	2.40	0.08	0.13	0.19	1.23	0.48
	Guadalupe silt loam	6.94	2.36	0.12	0.21	0.39	1.94	0.88
	Magallanes clay loam	7.50	2.17	0.06	0.11	0.39	2.23	0.62
	Magallanes loam	6.00	2.75	0.15	0.33	0.18	1.51	1.21
	Tagaytay sandy loam	6.18	2.02	0.12	0.30	0.22	1.54	0.91
	Tagaytay loam	6.00	3.87	0.17	0.37	0.52	4.94	1.89
	Carmona sandy clay loam	5.46	2.91	0.16	0.32	0.33	1.27	1.17
	Carmona clay loam	7.02	1.92	0.09	0.20	0.28	1.59	0.55
	Obando fine sandy loam	6.14	2.33	0.10	0.16	0.35	1.43	0.72
		6.32	1.23	0.08	0.10	0.36	5.61	0.88

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