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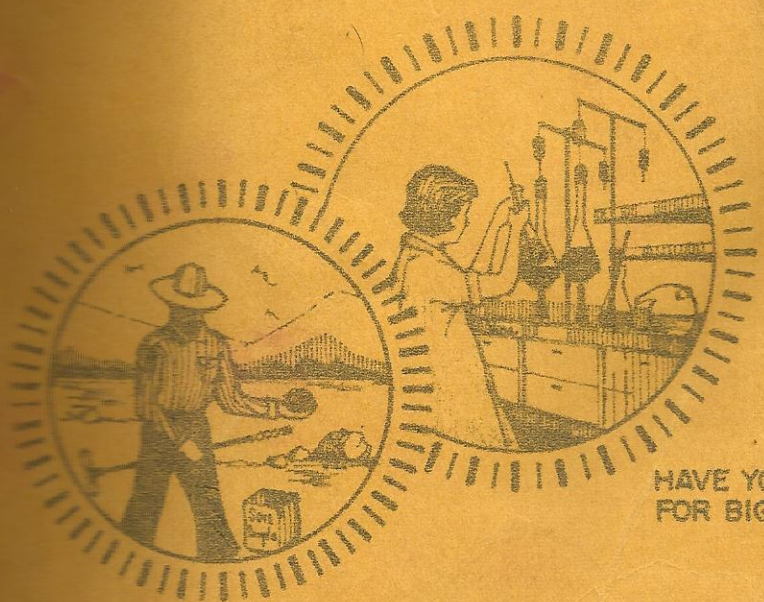
Soil Survey Report

Province of BATANGAS



COMMONWEALTH OF THE PHILIPPINES
DEPARTMENT OF AGRICULTURE AND COMMERCE
MANILA

Soil Report 4

SOIL SURVEY OF BATANGAS PROVINCE

PHILIPPINE ISLAND

BY

M. M. ALICANTE, D. Z. ROSELL, R. ISIDRO

AND S. HERNANDEZ

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PREFACE

When the limitation on Philippine sugar was sugar was imposed, the area devoted to sugar cane in Batangas Province has been greatly reduced. The problem is to look for other economic crops that will serve as supplement to sugar cane. In order to be able to determine the different crops adapted to the soils of Batangas it is very important that the soil condition of this province be thoroughly studied. In view of this, the soil survey of Batangas Province has been conducted. Data obtained from this soil survey will serve to determine the crops adapted to the different soils found in this province.

The main purpose of the present soil survey are (1) to classify the soil as to series and types, (2) to determine the potential fertility of the soil, and (3) to furnish certain degree of information as to what crops are most suited to different soil types. In addition the results from the soil survey will serve as a guide to the proper methods of soil management for different crops for maximum yield per unit area.

Considering the general topography and layout of the entire Batangas Province, the most promising crops that may be used as substitute for, or supplement to, sugar cane are fruit trees, of which coconuts, citrus, cacao, and coffee are the most important. From the standpoint of soil conservation the planting of fruit trees is very desirable, provided that the system of farming is such that the land between the trees is continually under cover. It has been observed that the majority of cultivated fields in this province are left exposed, especially during the rainy season when the degree of erosion and soil depletion is at its maximum. Because of favorable physical property of the soil, the degree of erosion in the different parts of the province is very pronounced. If the system of farming is not modified to check or at least minimize the effect of erosion, the crop return per unit area will always be low. In connection with the soil-survey program, field experiment to determine fertilizer requirements of different crops for certain soil types are being conducted in various places of this province. The application of fertilizers is not the only factor concerned in successful

farming. Field operation with respect to soil conservation is also necessary in order to give the maximum efficiency to the fertilizer applied. During the course of field experiments cover cropping, tillage, and cultivation are included in the field program.

The system of cover cropping with leguminous crops between fruit trees has been tried in the Bureau of Plant Industry at Lipa Experiment Station and at Tanauan Substation. The results derived from this cover cropping have been very satisfactory. Previous to the application of cover cropping the citrus trees in these stations had not been growing normally nor producing plenty of fruits. The fruiting period of these trees did not occur yearly but possibly every other year. When cover cropping has been applied between these trees, the results show that the trees are healthy and fruit heavily every year. It is expected that with the data of soil analysis from the soil survey and with those obtained from actual field experiments, the program for crop diversification in this province can easily be formulated.

M. M. ALICANTE
Chief, Soil-Survey Division, Bureau of Science. In Charge, Soil-Survey Project of the Department of Agriculture and Commerce

SOIL SURVEY OF BATANGAS PROVINCE PHILIPPINE ISLANDS

By M. M. ALICANTE, D. E. ROSELL, R. ISIDRO, AND S. HERNANDEZ

INTRODUCTION

Settlement and history.- Long before Martin de Goiti and Juan de Salcedo ascended the Pansipit River to Taal Lake in 1570, the region known today as Batangas Province had been already populated by the natives. A flourishing settlement around Taal Lake was engaged in farming, fishing, and commerce. But due to the repeated destructive eruptions of Taal Volcano and the frequent attacks of Moros, all towns were moved into the inland portions of the province.

The territory of Batangas was originally included in the then province of Caliliya, with Balayan as its capital. There is no clear record regarding the existence of this province. It was reported, however, that Mindoro, Marinduque, Tayabas, and Palawan were included in this province. Later on the outlying districts were detached and the province was called Balayan, with Comintang as capital.

In 1581 Batangas Province was founded, with Balayan as capital. There were a number of Balayan-Mohamedan settlements founded in the towns of Nasugbu, Balayan, Batangas, and in the regions around Taal Lake.

In the early part of the Spanish domination the people made considerable progress. The Jesuit Order established the towns of Lian, Nasugbu, and Bauan. The present towns of Taal, Lemery, Bauan, and Lipa were founded in about 1603. The capital of the province was transferred from Balayan to Taal, and in 1754 it was transferred to Batangas, the present capital. It was during this time that Taal church was built. This church is supposed to be the largest in the Philippines. It measures 40 meters in width, 25 meters in height, and 75 meters in length.

Civil government, with Batangas as capital, was established on May 2, 1901.

The province has 26 municipalities with a population of 426,159 (July, 1935).

Transportation and communication.- The province has a network of first and second class roads connecting all towns except the town of Lobo. The approach to the province from Manila can be made by way of Laguna, leaving at Calamba or by way of Cavite throughout the whole province. The route to the western part of the province from Manila via the Tagaytay Ridge shortens the distance by about 66 kilometers.

Only two rivers of the province are navigable by small boats; namely, Calumpang River in the town of Batangas, and Pansipit River in Taal. The wharf at Batangas affords the docking of small inter-island boats. These boats maintain regular shipping schedule between Batangas and Mindoro via the town of Lobo.

Telephone and telegraph lines, operated and maintained by the provincial government of Batangas, connect almost all the towns of the province. Long distance telephone from Manila is operated by the Philippine Long Distance Telephone Company.

Public Health.- The Bureau of Health maintains the services of doctors, nurses, and sanitary inspectors throughout the province, with headquarters in the provincial capital. In addition to the regulatory service the province maintains a hospital in the capital.

Education.- Public schools are available in every town of the province. In some big towns there are also private schools mostly operated by the Catholic church. The provincial high school and trade school are located in the town of Batangas, the capital of the province.

Industries.- Agriculture is the main industry of the province. Stock raising, which constitutes horses, cattle, and hogs, is also considered an important industry of the province. It has been claimed that the Batangas horses are the best in the islands.

Fishing is an industry next to agriculture in importance. Fresh and salted fish are constantly exported to Manila from Batangas, Balayan, Bauan, Taal, and Nasugbu.

Lumbering on a small scale is done in Nasugbu and in San Juan. Most of the timbers are out from the remaining small area of forest around Nasugbu. Besides timbers there are patches of bamboo forest in the upland sections of the province.

Manufacturing is considered an important industry. Saddles and harnesses are manufactured in Lipa. Among the other products manufactured are whips, ropes, bamboo baskets, buri hats, blankets, towels, mosquito nets, and fish nets. The manufacture of fish nets is mostly done in the towns along the seashore.

PHYSIOGRAPHY AND GEOLOGY

Batangas Province lies in the southwestern volcanic region of Luzon and is situated within 13° 32' north latitude, and 120° 30' longitude. It is bounded on the north by Cavite and Laguna Provinces and on the east by Tayabas Province. The whole coast borders on the China Sea.

In general the province is rolling, except in the slope along Nasugbu, Balayan, and Batangas Bay. In other parts along the coast the shore line is rough and broken by several points and identations. In the northern part of the province lies Taal Lake, with an area of approximately 359 square kilometers. This lake is believed to be of volcanic origin. It is drained by the Pansipit River which flows south into the Balayan Bay.

There are several prominent mountains in the province. The Maquiling and Malaraya Mountains separate the province from Laguna and Tayabas Provinces. The Natulso and San Pedrino Mountains are located in the western part, while Mount Baboy and Batangas Bay. The Tagaytay Ridge separates Batangas Province from Cavite Province.

Geologically, the province consists principal-

ly of water-laid volcanic tuff. This tuffaceous formation covers the agricultural region of the province. The Lobo Mountain consists principally of andesites of the western Cordillera. Mounts Maquilling, Malaraya, Batulac, Babuyan, and Panay consist of andesite with basalts of the southwestern volcanic regions. Mount San Pedrino, the whole of Santiago peninsula, and the coast southeast of Lobo Mountain are coral reefs and marls. Marine conglomerates occur from Limbones coves to Nasugbu Point just west of Dos Picos and Pico de Loro Mountains. Alluvial and littoral deposits occur along the coasts between Batangas and Bauan, between Taal and Balayan, and also at Nasugbu.

IRRIGATION AND DRAINAGE

The province as a whole is a well-drained country. The gently rolling and undulating elevated land of Lipa, San Jose, Cuenca, Ibaan, and Tayaan are drained by the Calumpang River. The western region of this area is drained by the Taal lake. The Tanauan and Santo Tomas area is drained by the San Juan River.

The western part of the province from Taal to Nasugbu is drained by several rivers. The Pansipit River is the outlet of the Taal Lake. The rolling land of the region between Lemery and Balayan is drained by the several rivers that flow from the upland of Batulao Mountain. The level and sandy areas below are irrigated by these rivers. The Palico River and its tributaries drain the upland of Tuy and Nasugbu, and irrigate the lowland area of Lian and Nasugbu.

The Bubutong River at Birinayan supplies drinking water for the people of the town of Mendez Nuñes in Cavite Province. Rice fields at Rosario are irrigated by the tributary of Calumpang River. At present there is no government irrigation system established in this province.

CLIMATE

In any agricultural country, climate is a deter-

mining factor affecting the growing season of crops. Upland rice can only be grown during the first part of the rainy season. Other crops depend to a certain degree on the availability of rainfall. The adaptability of the several permanent crops is also influenced by climatic conditions.

There are two distinct seasons in Batangas Province. The dry season begins in the later part of December and ends in the later part of May or the early part of June. The remaining part of the year is the wet season.

In general the rainfall is almost equally distributed throughout the province. The western part of the province covering the regions within the Talisay-Nasugbu-Calatagan-Calaca area, however, has slightly more rainfall than the other districts of the province. Lipa represents the northern part; Batangas, the southern part; Nasugbu and Balayan, the western part; and San Juan de Bolbok, the eastern part.

The northern part is cooler than the rest of the province. The maximum temperature during April in Lipa is 32.5° C; in Batangas, 34.9° C; in Nasugbu, 34.1° C; and in Balayan, 32.6° C.

Because it is being protected by the Banahao, the Maquilling, and the Malaraya Mountain on the southeastern part, and Mindoro on the southern part, the province is seldom visited by violent typhoons. Big floods seldom occur. With the exception of the violent eruption of Taal Volcano, Batangas Province is almost free from destruction as far as climatic hazards are concerned.

Table 1 shows the climatic records of the five towns of Batangas Province.

AGRICULTURE

Agriculture is the main industry of the people of Batangas Province. The agricultural history during the nineteenth century was a period of economic growth. In 1814 coffee plant (coffea arabica

Table 1. Records of average monthly rainfall and temperature of five towns representing the four different sections of Batangas Province.

	Lipa			Batangas			Nasugbu			Balayan			San Juan		
	Rainfall	Temperature		Rainfall	Temperature		Rainfall	Temperature		Rainfall	Temperature		Rainfall	Temperature	
	1920 to 1932	1920 to 1932		1907 to 1936	1907 to 1936		1920 to 1932	1920 to 1932		1920 to 1932	1920 to 1932		1928 to 1932		
		Max.	Min.		Max.	Min.		Max.	Mi.		Max.	Min.		Max.	Min.
	mm.	°C	°C	mm.	°C	°C	mm.	°C	°	mm.	°C	°C	mm.	°C	°C
[illegible]	13.8	27.9	19.3	24.4	30.6	20.8	14.6	31.5	220	8.3	30.8	21.5	32.6	–	–
[illegible]	7.7	29.1	18.8	17.7	31.7	21.0	9.4	32.3	217	2.9	31.0	21.5	3.1	–	–
[illegible]	21.3	30.7	19.8	8.8	33.6	22.0	5.2	33.6	228	2.1	31.7	21.9	5.1	–	–
[illegible]	23.2	32.5	20.4	25.9	34.9	23.2	22.8	34.1	232	17.8	32.6	22.6	25.9	–	–
[illegible]	145.5	32.0	21.3	108.4	34.3	24.0	207.4	33.8	240	134.2	32.5	23.1	142.8	–	–
[illegible]	201.3	30.1	21.2	157.2	32.9	23.8	346.9	31.7	237	233.3	31.7	23.2	190.1	–	–
[illegible]	346.6	29.0	21.5	305.2	31.4	23.5	520.2	30.9	235	487.9	30.8	23.1	208.5	–	–
[illegible]	340.6	29.2	21.4	257.2	31.5	23.5	590.7	31.0	240	529.2	30.9	23.1	271.3	–	–
September	307.1	29.6	21.2	279.7	31.2	23.2	394.5	31.1	235	326.3	33.1	22.9	200.9	–	–

	174.5	29.5	20.9	185.4	31.5	22.7	239.0	31.4	23.0	184.6	31.4	22.6	192.0	-	-
	191.6	28.5	20.5	174.3	31.1	22.2	139.0	31.4	22.6	120.0	31.1	22.2	150.6	-	-
	70.9	27.7	19.8	95.1	30.5	21.5	27.7	30.9	22.1	27.0	30.4	21.7	85.7	-	-
	1,845.3	-	-	1,639.3	-	-	2,517.4	-	-	2,074.2	-	-	1,508.6	-	-

* No available temperature records.

Linn) was introduced and it became the most important crop. In 1887 the town of Lipa alone produced 70,000 piculs, or 4,427,500 kilos, of coffee which was four times greater than the total Philippine production in 1933. The industry, however, did not last long because of the occurrence of coffee blight (Homileia vastatrix) which attacked the plant, and in 1892 the different coffee plantations were practically destroyed. Today very few coffee plantations can be found in the province. Judging from the present agricultural program of the people, the coffee industry in Batangas Province is abandoned. The total soil cover of the province is approximately 325,170 hectares. In 1932 the Bureau of Forestry classified this soil cover, as shown in Table 2.

Table 2.- Classification of the soil cover of Batangas Province, December 31, 1932.

	Area in hectares	Per Cent
Commercial forest - - - - -	19,078.0	5.87
Noncommercial forest - - - -	18,734.0	5.76
Cultivated area - - - - - -	144,936.0	44.57
Open land - - - - - - - - -	140,380.0	43.17
Salt marsh - - - - - - - -	1,847.0	0.57
Unexplored - - - - - - - -	191.0	0.06
Total soil cover	375,170.0	100.00

Data from Fischer, A. F. Wealth of the Forest, Philippines Herald Yearbook 3 (1935) 41-44.

The system of agriculture in the province is diversified. The types of soils of the province make such system possible. During 1932, 144,946 hectares were cultivated and planted to different crops. The total value of produce was 8,739,540 pesos. In 1933, 108,209 hectares were cultivated, with a total value of 8,437,620 pesos; in 1934,

106,184 hectares, with a total value of 10,814,160 pesos; and in 1935, 91,162 hectares, with a total value of 5,244,600 pesos.

The seven leading crops of the province arranged in the order of their importance are palay, sugar cane, corn, coconuts, bananas, mandarin, and mangoes. The area planted and the value of the produce of these crops are shown in Table 3.

Rice, being staple crop, is grown in every town. In 1935, 52,470 hectares were cultivated and planted to rice. Most of the rice planted are upland varieties, such as Pulang bigas, Kinanda, Kinastila, Inosiw, Inapostol, Binirhen, and several others. The yield per hectare varies according to the type of soil and the varieties of palay planted. The average, however, ranges from 20 to 25 cavans per hectare. In newly opened land the yield is between 25 and 35 cavans per hectare. Glutinous rice is also planted but the area devoted to it is very small. The Lipa, Tagaytay, and Magallanes soils, if properly cultivated, give a high yield per hectare. This yield, however, can be increased by the application of commercial fertilizers.

Lowland rice is planted in Rosario, part of Tayaan, Batangas, Calaca, Balayan, Nasugbu, and Lian. In Rosario and Tayaan the lowland rice is planted on Guadalupe soils. In Nasugbu and Lian the rice is planted on Calumpang and Magallanes soils. Irrigation water is available at Nasugbu and Lian areas. The average yield ranges from 35 to 40 cavans. During good season, however, the yield reaches as high as 75 cavans per hectare.

Sugar cane is the second most important crop of the province. Due to the limitation placed on sugar production, the area planted to sugar cane in 1935 was reduced to 7,590 hectares. The total value of the produced was 2,599,920 pesos, which is very much lower than that in former years. There are two sugar centrals in Batangas, which are located on the extreme western part of the province one at Calatagan and the other at Nasugbu. The Central Azucarera de Calatagan has a daily capacity of 700 tons.

Table 3.- Seven leading crops of Batangas Province with their area cultivated and value of produce for 3 years.

Crops	1933		1934		1935	
	Area planted	Value of produce	Area planted	Value of produce	Area planted	Value of produce
	Hectares	Pesos	Hectares	Pesos	Hectares	Pesos
Palay	57,200	1,241,980	61,880	1,652,690	52,470	1,391,910
Sugar cane	17,420	5,520,670	16,190	7,907,210	7,590	2,599,920
Corn	16,670	277,690	11,520	180,500	14,300	184,410
Coconuts	8,010	188,450	7,990	174,300	7,950	242,940
Bananas	4,053	576,280	3,308	347,308	3,534	328,275
Mandarin	1,181	158,910	1,168	147,470	1,104	132,930
Mango	594	55,830	580	57,930	664	30,220

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used for home consumption or is manufactured into muscavado and panocha sugar.

The varieties of cane planted are mostly P.O. J. 2878, Mauritius, and Luzon white. These are grown in various types of soils. Regardless of soil types, commercial fertilizers are heavily applied to increase the yield of cane per hectare. Most of the soils utilized for sugar cane are light-textured soils. In the preparation of Sugar cane land, tractors and other modern implements are used. Because of the friability of the soils in sugar-cane district, the land is easily prepared. The average yield per hectare in Calatagan and Don Pedro sugar districts is from 50 to 60 piculs of sugar. This yield compares favorably with those of other sugar districts in Luzon.

Corn is next to sugar cane in importance as staple crop and is grown in almost every town of the province. Sometimes it is planted in rotation with rice or side by side with rice. In 1935 the area planted to corn was 14,300 hectares, and had a total value of produce amounting to 184,410 pesos. The varieties of corn grown are the native yellow faint and the white. White corn is planted mostly on Lipa loam and on Ibaan soils. This variety is sold green in Manila markets, and the yellow flint is marketed dry. The green corn commands much higher price than dry corn. The biggest amount of corn produced is utilized as feed for stocks and poultry.

When the abaca industry of Cavite and Batangas was destroyed by the bunchy-top disease ten years ago, some of the areas vacated were planted to coconuts. Thus the number of coconuts increased without sacrificing the existing areas for the other crops. In 1935 there were 7,950 hectares planted to coconuts. The value of the produce amounted to 242,940 pesos. Most of the trees are found on Tagaytay and Magallanes soils on the western part. Around Taal Lake from Bayuyungan, Talisay, Balite, and Cuenca, to San Nicolas at Pansipit River, coconut trees are planted in great quantities. In Santo Tomas, Malvar, Lipa, Rosario, and Ibaan, coconut is also grown. In Laiya Barrio the coconut

trees grow well on Patungan soils. Big and healthy coconut trees are also found in the vicinity of San Juan de Bolbok. Coconut trees are found growing even on a small scale in every town of the province.

Banana is one of the important fruit trees in Batangas Province. In 1935, 3,534 hectares were planted and the produce amounted to 328,270 pesos. The important varieties planted are latundan, lacatan, saba, bongolan, and tarnate. This plant is grown in every town in the province. Around the shore of Taal Lake bongolan and lakatan varieties are grown on a large scale and great quantities are sold at Balite Barrio.

Mandarin orange (Citrus nobilis Lour.), known in Tagalog as sintoris, or dalanhita, is the pride of Batangas Province. The rich and well-drained Lipa and Ibaan soils with favorable mild climate favor greatly the production of Batangas mandarin. In 1935, 1,104 hectares were planted to mandarin. This area is equivalent to one-half of the total area planted to mandarin for the whole Philippine Islands in 1933. The citrus experiment stations at Tanauan and at Lipa are responsible for the improvements of the varieties, culture, and management of citrus industry of the province.

The Tanauan Citrus Experiment Station has demonstrated that cover cropping of the mandarin plantation with ipil-ipil (Leucaena glauca (Linn.) Benth.), cacauate (Gliricidia sepium (Jacq.) Steud.), and Tephrosia candida gave successful results. Experiments with commercial fertilizers likewise give successful results. The Calatagan hacienda has successfully established an orchard of Batangas mandarin on Sibul soils. The trees are growing normally.

Mango is considered one of the most delicious fruits grown in the Philippines. In Batangas Province several trees are grown in almost every town. The total area planted in the province up to 1935 was 664 hectares. During that year the total value of the produce amounted to 30,220 pesos. There are two varieties of mango planted. Other important fruit trees grown in the province are sugar apple,

pomelo, orange, papaya, lanzones, custard apple, chico, and avocado. These trees are planted in small lots. Avocado trees are, however, increasing in number. It has been observed that the number of trees planted has been increasing every year.

The root crops of the province consist of sweet potatoes, cassava, gabi, ubi, tugue, arrowroot, and radish. These crops are well adapted to the loose and sandy volcanic soils on the western part of the province. Native and Bermuda onions constitute one of the most important crops of Lemery, Calaca, and Balayan, Ubi, tugue, and arrowroot are used for making candies and other delicacies.

The vegetable crops of the province are beans, eggplant, tomato, cabbage, pechay, cauliflower, chayote, upo, and squash. Cabbage, cauliflower, and strawberry are grown with success on the Lipa loam soil in Lipa.

The animal industry of the province consists of native cattle, carabaos, horses, goats, hogs, and poultry. The cattle industry is carried on the western part of the province. Some carabaos and cattle are also raised in the Lobo Mountain area.

In the rolling and mountain areas of Tuy, Balayan, Calaca, and Lemery are several hundred heads of cattle. In the Taal Volcano area several heads of cattle are raised. Pigs and chickens are raised in almost every barrio and town of the province.

The Batangas horses are famous in the Tagalog regions. The Bureau of Animal Industry maintains a breeding station at Batangas, Batangas, on the San Jose-Batangas road.

BATANGAS SOILS

As in Cavite Province, the nature of the topography and the several soil types are responsible for the distribution of several crops and the type

of farming in Batangas Province. In the southwestern region the soils are mostly volcanic in origin.

The soils of Batangas are divided into several soil series and soil types, as follows:

1. Batangas series

   (a) Batangas hydrosol

2. Guadalupe series

   (a) Guadalupe clay loam
   (b) Guadalupe clay

3. Magallanes series

   (a) Magallanes loam
   (b) Magallanes loam gravelly phase
   (c) Magallanes sandy loam

4. Tagaytay series

   (a) Tagaytay sandy loam

5. Patungan series

   (a) Patungan sand

6. Sibul series

   (a) Sibul loam
   (b) Sibul clay loam

7. Calumpang series

   (a) Calumpang sandy loam
   (b) Calumpang silt loam
   (c) Calumpang clay loam

8. Taal series

   (a) Taal fine sandy loam
   (b) Taal sandy loam
   (c) Taal fine sand
   (d) Taal volcano sand
   (e) Taal sand

9. Ibaan series

   (a) Ibaan silt loam
   (b) Ibaan loam
   (c) Ibaan loam gravelly phase
   (d) Ibaan clay loam
   (e) Ibaan soil undifferentiated

10. Lipa series

   (a) Lipa loam
   (b) Lipa loam deep phase

In the following pages the various series and soil types are described in detail. The old series, such as Sibul, Guadalupe, Tagaytay, Patungan, and Magallanes, established and mapped in Bulacan, Rizal, and Cavite Provinces, are not described, but their corresponding soil types are noted. The area and proportionate extent of the different soil types are shown in Table 4. The location and distribution of these types are shown in the accompanying colored map.

Batangas hydrosol.- The hydrosol found in this province is of small area and is limited to small patches in the towns of Lemery, Bauan, and Batangas. Generally, the subaqueous horizons are mostly mud. The soils of Batangas Province are light in texture and consist of sandy soils and loam soils. The sandy mud subaqueous horizons are commonly present and below these horizons is sand. This type of soil is devoted to bangos fishponds.

Guadalupe clay loam.- The surface soil of Guadalupe clay loam is dark brown to brownish gray. The depth ranges from 15 to 30 centimeters. The subsoil is mottled with dark-gray, reddish-brown, and dark-brown clay. In many small areas, especially the lowland rice field, the surface soil is very shallow and the subsoil is just a few centimeters below. In places where the substratum is well developed or weathered, the thickness of the volcanic tuff ranges from 50 to 70 centimeters from the surface. The lowland portions of the soil are devoted to rice, while the uplands are planted to coconut. This type is found in the vicinities of Taysan, Rosario, and San Juan.

Table 4.- Hectarage and proportions to extent of soil type mapped in Batangas Province

Type No.	Types of Soil	Area	
		Hectares	Per cent
1	Batangas hydrosol	318	0.1
18	Guadalupe clay	26,944	9.0
30	Guadalupe clay loam	15,230	5.1
35	Magallanes loam	23,168	7.7
36	Tagaytay sandy loam	9,318	3.1
46	Sibul loam	9,370	3.1
47	Sibul clay loam	15,030	5.0
48	Magallanes sandy loam	13,226	4.4
49	Magallanes loam gravelly phase	2,114	0.7
50	Calumpang sandy loam	7,497	2.5
51	Calumpang silt loam	1,053	0.4
52	Calumpang clay loam	318	0.1
53	Taal sand	5,460	1.9
54	Taal volcano sand	1,696	0.6
55	Taal fine sand	7,501	2.5
56	Taal sandy loam	11,650	3.9
57	Taal fine sandy loam	22,242	7.4

58	Ibaan silt loam	2,968	1.0
59	Ibaan loam	27,393	9.1
60	Ibaan loam gravelly phase	23,046	7.7
61	Ibaan clay loam	29,587	9.9
62	Lipa loam	25,817	8.8
63	Lipa loam deep phase	11,309	3.6
64	Patungan sand	2,156	0.7
65	Ibaan soil undifferentiated	5,178	1.7
	T O T A L - - - - - - - - -	299,587	100.00

Guadalupe clay.- The surface soil of Guadalupe clay ranges in depth from 25 to 30 centimeters. It is dark to nearly black, coarse granular to cloddy when dry. The undisturbed soil is hard and compact. This bakes and cracks, making it hard to plow and harrow. When wet, the soil is very fine granular and sticky. The subsoil, ranging in depth from 50 to 80 centimeters, is clay and is lighter in color than the surface soil. It is fine 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 the surface. The substratum is volcanic tuffaceous material in varying degree of weathering. Rice is mostly grown in this type of soil with or without irrigation.

Guadalupe clay is found between the towns of Rosario and San Juan along the lowland and poorly drained areas. Coconut trees are grown on a large scale, especially in Laiya Barrio. The whole area is thinly populated.

Magallanes loam.- The surface soil of Magallanes loam, ranging in depth from 25 to 35 centimeters, is pale-brown to light reddish-brown friable and fine to coarse granular loam of somewhat sandy in texture. In wooded areas where the soil is not disturbed or cultivated, the color is darker and the texture is heavier than the soil of the open field.

With proper amount of moisture this soil is easily worked. The undisturbed, or unplowed, soil is hard, and bakes and cracks when dry. The average topography is rolling, broken by creeks and rivers, and this makes the drainage fairly efficient. The subsoil is pale yellowish-brown, coarse granular to cloddy clay loam in the upper horizon and a highly weathered, yellowish-brown volcanic tuff material in the lower horizon. The substratum is tuffaceous rock of undetermined depth.

Magallanes loam is planted mostly to sugar cane. The sloppy and hilly areas are planted to upland rice. Bananas, citrus, chicos, and vegetables are grown. The forested areas contained several first-and second-class timber. In the north-

ern part of Nasugbu, near Looc, the forested area is inhabited by deer and wild hogs.

Magallanes loam gravelly phase.- The gravelly phase of the Magallanes loam consists of the mountain areas of the Batulao Mountain. The mountain sides were deforested and badly eroded, exposing the gravelly subsoil. At present the hillsides are covered with cogon. The whole area is utilized mostly for pasture.

Magallanes sandy loam.- Next to the Magallanes loam is the Magallanes sandy loam. This type is located and mapped in the vicinities of Lian, Nasugbu, Tuy, and Balayan. The surface soil, ranging in depth from 20 to 30 centimeters, is loose and almost structureless pale-brown to grayish-brown sandy loam. The subsoil is darker in color and heavier in texture, being loam to clay loam with tuffaceous concretion and gravel in the lower subsoil horizons. The substratum consists of volcanic tuff.

The soil is heavily eroded. In many areas the subsoil is exposed, rendering the soil area unproductive.

The most important crop planted in this type of soil is sugar cane. The cane is milled in the Central Azucarera de Don Pedro in Nasugbu. For sugar cane the soil is heavily fertilized with sulphate of ammonia.

Tagaytay sandy loam.- The 12 to 50 centimeters of surface soil of the Tagaytay sandy loam is dark-brown to nearly black friable and granular sandy loam soil with considerable amount of volcanic sand. The subsoil is dark brown to very dark brown, and varies in texture from clay loam to clay. This subsoil rests on reddish-brown to yellowish-brown adobe clay or volcanic tuff. The tuffaceous material varies in debth according to the topography of the place.

In some places, especially near the ridge, there is a zone of volcanic ash accumulation just below the surface soil. This zone, however, disappears in well-cultivated or highly eroded areas.

As found in Batangas Province, the soil is partly covered with cogon (Imperata cylindrion Linn.), Talahib (Saccharum spontaneum Linn.), and low-grade forest trees. The cogonal, talahib, and anguingay areas are used for pasture.

The whole area extends from Caylaway Barrio, Nasugbu, to Tranca Barrio, Talisay. The mountain sides along Talisay are planted to sugar cane, rice and coconut trees. Bananas, coffee, avocado, and other fruit trees are also grown.

Patungan sand.- Patungan sand, which was first established in Cavite, is pale-gray to almost white sand. This type has been the result of disintegration and weathering of light-colored rocks in the upland and carried down by the river. A wide area of this type is found along the Lobo River and in Ladya Barrio. Coconut is the principal crop grown.

Sibul loam.- The surface soil of Sibul loam, ranging in depth from 25 to 35 centimeters, is dark-brown to dark grayish-brown fine granular and slightly friable loam. The soil makes a very good tilth when plowed and harrowed several times at optimum moisture condition. The subsoil is dark brownish-gray clay loam to clay with limestone gravels.

Sugar cane is the most important crop grown in this type of soil. Peanuts, tomatoes, bananas, and some vegetables are also grown. A large citrus plantation is being planted by the Calatagan Central, near Calumpang Barrio.

The topography of the land is gently rolling to hilly.

Sibul clay loam.- The surface soil of Sibul clay loam, ranging in depth from 25 to 35 centimeters, is dark-brown to light grayish-brown clay loam with reddish to dark-brown spherical concretions. The soil is finely granular, somewhat porous when dry but sticky when wet. The upper part of the subsoil is dull brown to dull grayish brown, almost compact in some places. It consists of calcareous material and is appreciably heavier in texture than the surface soil. The lower subsoil, which extends to a depth

ranging from 45 to 70 centimeters, is coarse granular to cloddy friable clay with varying quantities of calcareous material. The substratum, which is highly calcareous, resembles that of weathered whitish-gray tuffaceous material.

The vegetation of the surrounding area is luxuriant, as is always the case of a limestone region. Sugar cane is planted in large number along the hillsides. Bananas, peanuts, and vegetable crops are planted on Lobo Mountain and its vicinities. On the newly opened areas corn and upland rice are planted.

Guadalupe Series

The soils of the Calumpang series are characterized by gray to brownish-gray surface soil and dark-brown to grayish dark-brown heavy-textured subsoils. The substrata are mottled either with grayish-brown or with yellowish-brown clay tuffaceous materials. This series was first established by Dorsey in 1903 in this province.

Generally, these soils are alluvial soils. They represent the accumulation of fine sediments brought down by stream and deposited in shallow areas. Soils that have been formed in this manner are with a few exceptions fertile.

The topography is generally level, becoming rolling as the soil boundary merges into another type. The principal crops grown are sugar cane, corn, and rice. Tobacco is being tried in some portions of the area.

As established in the province, this series is located in Lian, Nasugbu, and Batangas, along the rivers and creeks.

The typical soil profile of this series is shown by the silt loam type, as follows:

Silt loam

Depth of soil cm.	Characteristics
0 to 10	Light-gray, compact, and hard silt loam, highly plastic and slightly sticky.
10 to 40	Dark-gray to very dark-brown clay loam, cloddy in structure, and sticky.
40 to 150	Mottled with gray-brown, and yellowish-brown clay loam to clay with some sandy material. Sticky and plastic.

Calumpang sandy loam.- The surface soil of the Calumpang sandy loam is light grayish-brown loose and structureless sandy loam. The depth ranges from 35 to 40 centimeters. The lower subsoil is dark-brown clay, becoming mottled with light brown and light gray. The substratum is a highly weathered tuffaceous rock.

The principal crop grown in this type of soil is sugar cane. Lowland rice with irrigation is planted on the low area. Planting of tobacco wrapper in this type of soil in the neighborhood of Nasugbu central is being tried. This type of soil is also found in Lian, Calatagan, and Batangas. Being transported by streams, it is fertile if properly handled.

Calumpang silt loam.- This type, as classified and mapped, is located near the mouth of the Calumpang River and the town proper of Batangas. The surface soil, ranging in depth from 15 to 20 centimeters, is brownish-gray silt loam and is compact. This soil, on account of its large proportion of silt, bakes and cracks when dry and forms firm clods that are hard to pulverize. The subsoil is dark, brownish-gray, and dark-brown mottlings in the lower subsoil horizons. The substratum is dark-brown to brownish-red waxy clay with sandy texture.

Corn and lowland rice are the principal crops grown. Vegetables of verious kinds are also grown on this soil, but because of poor drainage the growth is not as good as in loose soils. Poor

drainage may be remedied by proper cultivation.

Calumpang clay loam.- The surface soil of Calumpang clay loam is brownish-gray hard and compact clay loam. The subsoil is dark-gray stiff and waxy clay loam to clay. This is small area found near Utud Barrio, town of Nasugbu, and Batangas.

Every year this soil is grown to sugar cane but the yield is somewhat low. Proper cultivation and drainage will materially increase the yield per hectare.

TAAL SERIES

The taal series comprises several soil types, the formation of which was influenced largely by the successive eruptions of Taal Volcano. The surface soil is generally grayish brown to light gray when dry and dark brown to nearly black when wet. The subsoil is light gray to grayish brown. The substratum is composed of loose sand and gravel in some places and tuffaceous sand and gravel in other places. Near Calaca the substratum consists of burnt volcanic tuff which is somewhat resistant to erosion. In lowland areas the subsoil and substratum consists of burnt volcanic tuff which is somewhat resistant to erosion. In lowland areas the subsoil and substratum consist of several thin layers of volcanic sand. These different strata of sand indicate different stages of deposition.

The topography is gently level in the lowland and rolling in the upland. In the uncultivated areas the characteristic vegetation is aroma (Acacia farnesiana (Linn.) Willd.) and ipil-ipil (Leucaena glauca (Linn.) Benth.) trees. Camachile trees (Pithecolobium dulce (Roxb.) Benth.) grown wild in the hilly areas along the shores of Taal lake.

Soils of this series are best suited to root crops, such as ubi (Diozcerea alata-Linn.), tugue (Dioscera fasiculata Roxb.), gabi (Colocasia esculentun (Linn.) Schott), arrowroot (Maranta arundinacea), and cassava (Manihot utilissima Pohl.).

Bermuda onions and native onions are grown extensively in Balayan, Calaca, and Taal.

A typical profile of this series is shown by the Taal fine sandy loam type, as follows:

Taal fine sandy loam

Depth of soil	Characteristics
0 to 40	Light-gray loose fine sandy loam of volcanic origin.
40 to 75	Gray fine sand, loose and structureless.
75 to 120	Brown sandy loam, loose and structureless.

Taal fine sandy loam.- Taal fine sandy loam consists of light-gray loose and structureless fine sandy loam surface soil. When wet the color is dark brown to black. The depth ranges from 30 to 40 centimeters. Below this surface soil are several thin layers of volcanic sand separated by thick horizons of fine sand. In general the surface and subsoil are loose and seldom compact.

The Taal fine sandy loam is the biggest type of the Taal series. This comprises the rolling lands, hills, and mountains east, north, and west of Taal, covering portions of the towns of Lipa, Tanauan, Taal, and Calaca.

This soil produces good crop of sugar cane every year. Because of its physical properties it is easily prepared. Sugar cane is extensively planted in Calaca, Taal, and Talisay. Corn, rice, vegetables, and citrus trees are also grown. Cacao and coffee are planted in patches along shaded areas, especially in the backyards. In Talisay and Tanauan upland rice and coconut are also planted in this type.

Taal sandy loam.- The surface soil of Taal sandy loam consists of brownish-gray loose and

structureless sandy loam soil ranging in depth from 40 to 45 centimeters. In level areas the surface soil is deeper than in rolling areas. The subsoil consists of two or more this layers of volcanic sand and between these layers is light-gray sandy loam soil. The substratum is either light-gray volcanic sand or gray volcanic tuff with sands.

Taal sandy loam is second in area to Taal fine sandy loam of the Taal series. It is located in the town of Balayan and in the northwestern part of the Calaca. Sugar cane is the most important crop. The canes are milled in Nasugbu, Corn, upland rice, citrus, and other fruit trees are grown. The upland area is used for pasture purposes.

Taal fine sand.- Taal fine sand consists of gray loose and structureless fine sand surface soil ranging in depth from 25 to 45 centimeters depending upon the topography of the place. The subsoil has several thin layers of coarse and ranging in thickness from 3 to 5 centimeters. The substratum is gray fine sand.

This type of soils is found along the lake shore, extending from Birinayan Barrio to San Nicolas at Pansipit River. Two large areas separated by a strip of sandy loam type were mapped at Taal and Calaca.

Sugar cane is an important crop. Vegetables are grown in Bayuyungan, Balakilang, and Birinayan. Coffee, cacao, avocado, and other fruits are also grown on this soil. Camachile trees grown wild along the lake shore.

Because of the topography of the place and the physical characteristics of the soil, this type is always subject to heavy erosion every year.

Taal Volcano sand.- Taal Volcano sand is found bordering Taal Volcano. The sand is mixed with reddish-brown gravel with volcanic boulders here and there scattered over the sea.

The characteristic vegetation of this area is aroma trees and some camachile. This place is also utilized for pasture.

Taal sand.- Taal sand consists of dark-gray volcanic sand carried by water and deposited along the sides of the streams and seashores of the Balayan Bay. It is also found in Nasugbu, Lian, and Calatagan. Sugar cane is being planted in Taal, Calaca, and Balayan.

IBAAN SERIES

The Ibaan series was established, classified, and mapped by Dorsey in 1903 in Batangas Province. In the present classification the same area is classified as Ibaan series. Several other series, or types, as classified by Dorsey in this area were included in Ibaan soils. These types are Taysan clay, Malabo clay, Talumpoc clay loam, and Macolod gravelly loam. In the future, when detailed survey will be made in this area, these types and other soils will be classified.

The Ibaan series consists of brown to light reddish-brown slightly friable coarse granular soil ranging in texture from silt loam to clay loam. When allowed to dry in uncultivated state, the soil bakes and cracks, and it is difficult to plow. The soil is easily made in good tilth when plowed and harrowed at its optimum moisture content. The subsoil is reddish-brown tenacious clay loam to clay with tuffaceous gravel and concretion in the lower subsoil. The substratum is highly weathered tuffaceous rock with some sand. In the lower areas the substratum is compact, dark-gray sand horizon, while in the elevated areas the tuffaceous rock is of indefinite depth.

Where this series is typically developed, the surface soil ranges in depth from 20 to 30 centimeters, and the subsoil in from 45 to 55 centimeters. In highly eroded areas the surface is entirely gone, thus exposing the subsoil. On the average the surface and subsoil rarely exceed 30 centimeters. In lowland portion, however, the surface and subsoil extend as deep as 80 centimeters.

Generally the topography is rolling and hilly. There are almost level areas around Alitagtag and

Cuenca. The whole area of this series including the mountains and hills is greatly eroded and critically exposed. Various crops are grown on these soils, from lowland rice and sugar cane to citrus trees and vegetables. A typical profile of this series is represented by the clay loam type.

Ibaan clay loam

Depth of soil cm.	Characteristics
0 to 30	Brown to dark-brown cloddy or coarse granular clay loam and friable.
30 to 55	Brown to dark-brown clay loam heavier in texture than surface soil. Friable, fine and granular.
55 to 90	Highly weathered tuffaceous material with plenty of concretions.
90 to 120	Soft yellowish-brown tuff, highly weathered.
120 to 130	Some of fine-grained tuffaceous material with some sand.
130 to 150	Sandy-textured tuffaceous rock.

Ibaan silt loam.- The surface soil of Ibaan silt loam is light reddish-brown to brown slightly friable and granular silt loam. The depth ranges from 15 to 25 centimeters, shallow in rolling and hilly areas, and deep in lowland areas. When allowed to dry, the soil bakes and cracks, and is hard to plow. The subsoil is light reddish-brown to brown clay loam with some tuffaceous concretions and gravels. The upper subsoil is coarse granular to cloddy in structure, becoming structureless in the lower subsoil which contains plenty of concretions and tuffaceous gravels. The parent material is tuffaceous rock.

The topography is rolling. The level areas are planted to either sugar cane or lowland rice. The hillsides are badly exposed to erosion.

Generally, the surface soil has been badly eroded, leaving the subsoil exposed. Upland rice and sugar cane are important crops grown. Other crops, such as citrus, corn, and various kinds of vegetables, are also grown.

Ibaan loam.- Ibaan loam is one of the biggest single types of soil mapped in Batangas Province. It comprises most of the agricultural lands in the towns of Batangas, Bauan, San Luis, Taal, Alitagtag, Cuenca, and San Jose. The surface soil is brown to light reddish-brown slightly friable and granular loam. Its depth ranges from 20 to 30 centimeters. The subsoil is brown to dark-brown tenacious clay loam with tuffaceous concretions in the lower subsoil. The substratum is a weathered tuffaceous rock.

In some areas of this type the surface soil is sandy in texture. In highly eroded areas tuffaceous concretions and gravel are very pronounced. The topography of the land ranges from gently level to rolling and hilly.

Upland rice is the principal crop, while corn, sugar cane, citrus, coffee, cacao, bananas, and various kinds of vegetables are also grown on this soil. Due to lack of vegetative covers, soil erosion in this type of soil is becoming very serious.

To check up as much as possible the effect of soil erosion, it is suggested to use cover crops in places where it is feasible.

Ibaan loam gravelly phase.- The gravelly phase of Ibaan loam consists of the mountains and the prominent hilly areas where the gravel and tuffaceous concretions are the characteristic feature of the surface and subsoil. In the towns of Bauan, Mabini, and San Luis the hillsides are covered with coconut trees, citrus trees, and a few cacao and coffee trees. Small hilly areas in San Jose are utilized for rice, corn, and sugar cane. This type connects the Lipa loam on the north and the Guadalupe clay loam on

the southeast.

This soil is subject to erosion due to topography and physical characteristics. At present the surface soil is badly eroded, exposing the subsoil.

Ibaan clay loam. - The surface soil of Ibaan clay loam is dark-brown to light reddish-brown slightly friable clay loam. Its depth ranges from 20 centimeters in shallow areas to 35 centimeters is well-developed areas. The subsoil is dark-brown to reddish-brown cloddy and columnar clay loam to clay with tuffaceous concretions in the lower horizon. The depth of the subsoil ranges from 50 to 60 centimeters and below this is a tuffaceous rock, the parent material of the soil.

Like the other types of the series, Ibaan clay loam tends to bake and crack when allowed to dry under uncultivated condition. When this soil is plowed under dry condition, it clods heavily; however, under optimum moisture it crumbles easily and produce good tilth.

There are a number of streams cutting this soil. These represent headwaters of the Calumpang River. On the whole the topography is slightly rolling. The whole area slopes gradually toward the town of Batangas.

Ibaan soils undifferentiated.- The soils of the Maricaban and Verde Islands are the undifferentiated Ibaan soils.

LIPA SERIES

The Lipa series, like the Ibaan series, consists of soils representing the decomposition products of the underlying volcanic tuff materials. The underlying strata of rocks are uniform and deeply weathered. The soils of this series consist of dark-brown, rich-looking surface soil that is mellow, very friable, and easy to plow and pulverize. The subsoil is dark, loam to clay loam in texture, with concretions in the lower horizons.

The substratum is a volcanic tuffaceous rock.

Generally the topography is slightly rolling. Sheet erosion has been actively operating in these soils to the extent that in hilly cultivated areas the surface soils were all washed away, leaving the subsoil exposed.

On this series of soils a number of crops are grown. Corn, sugar cane, and rice are the principal annual crops, and oranges and coffee are the permanent crops. Vegetables of various kinds are also grown in this series of soil.

A typical soil profile of this series is represented by the loam type.

Lipa loam

Depth of soil cm.	Characteristics
0 to 30	Very friable, mellow and loose fine granular loam, usually brown to light brown.
30 to 65	Friable fine granular tuffaceous material with concretions, heavier than the surface soil.
100 to 120	High weathered tuff with tuffaceous gravel and concretions.
120 to 150	Tuff, light brown, fine-textured to sandy.

Lipa loam.- Lipa loam, like the Ibaan loam, is a residual soil representing the decomposition products of the underlying volcanic tuff material. It is dark brown, very friable, mellow, and easy to cultivate. Its depth ranges from 25 to 35 centimeters. The subsoil is dark, loamy in texture, and becomes heavy and waxy at a depth of 75 centimeters or more. In some areas there are gravels and tuffaceous concretions in the lower subsoils. These gravels and concretions are exposed in highly eroded sloppy and hilly portions.

According to Dorsey this type of soil has evidence of lasting fertility. In fact it has the best physical characteristics that can be found in any soil. However, the present system of agriculture has led to the depletion of the soil because of the pronounced effect of erosion.

This type of soil is well developed in Lipa, Malvar, and Tanauan.

Lipa loam deep phase.- Lipa loam deep phase consists of 25 to 35 centimeters of surface soil and 75 to 100 centimeters of subsoil. The parent material is about 120 to 150 centimeters from the surface. These areas are located on the lowland of Santo Tomas, and east of Lipa, near Malaraya Mountain.

SOIL EROSION AND WATER CONSERVATION

Because of climatic conditions and the present methods of farming, the effect of erosion on Philippine soils is very pronounced. It cannot be doubted that soil erosion has contributed materially to the low yield per unit area.

The topographic features of Batangas Province is such that soil erosion takes place easily. The friability of most of the soils, their lightness in texture, and the present method of agricultural operation help to facilitate the activity of soil erosion.

Sheet erosion is the gradual removal of the total surface soil. This type of erosion has a greater effect on soil productivity than any other type of erosion, because it actually carries away the rich surface soil. It has been observed that such erosion has been taking place in the Lipa, Ibaan, Magallanes, and Tagaytay soils every year. Field observations showed that approximately 5 to 6 inches of surface soil is being removed every year in the cultivated areas. Similar observations have been found in a number of places in the province.

The soils of the Taal series between Lemery and Tuy are badly eroded to the extent of forming gul-

lies along the hillsides. As a result of this erosion sandy materials are being deposited at the lower portions of the area. In many cases these materials greatly reduced the fertility of the surface soil in which they have been deposited. To minimize this erosion effect, it has been suggested that cover cropping in highly critical areas, especially along the hillsides of Mabini and San Luis, should be practiced. The rolling areas of Lobo Mountain that are under cultivation and overgrazed should be planted to some kinds of permanent crops, such as coconuts, citrus, and other fruit trees, and between these there should be cover crops. It has been suggested further that overgrazing of pasture lands should be avoided as much as possible in order to allow grasses to grow, thus preventing the excessive effect of erosion and depletion of soil fertility. Around the regions of San Jose, Lipa, and Malvar the soils which are highly erosive should be handled properly to conserve their fertility. Care must be taken that the surface area is always under cover and that farming operations are done in such a way as to check the activity of erosion.

Conservation of soil moisture and erosion control go hand in hand. Wherever erosion control is practiced the conservation of soil dries up easily due to intense heat, tillage practice should be employed. A compact soil cracks easily when heated. The network of cracks, or crevices, on the surface soil serves as avenues for moisture evaporation. The cultivation of surface soil serves as mulch during dry season. The planting of permanent crops also prevents rapid evaporation from the soil. Critical areas in submarginal lands should always be under cover with trees, shrubs, and other vegetations in order to prevent the rapid flow of water during the rainy season.

It is believed that the major floods caused by Calumpang River have been due to excessive cultivation and deforestation of the shaded areas above this river. The flood problem can be minimized, and its effect on life and properties avoided by a very simple remedy-keeping the border areas, particularly the water source, under permanent cover.

ANALYSIS OF BATANGAS SOILS

Chemical analysis.- In the Philippine soil survey the surface and the subsoil samples are collected from important soil types aside from the profile samples of each series. The number of samples from each type is determined by the extent and importance of the soil type. The depth of the surface soils varies from 20 to 35 centimeters, while that of the subsoil varies from 35 to 50 centimeters. The surface soils are analyzed chemically for the essential plant-food elements, such as nitrogen, phosphorus, and potassium. The analysis also included pH value, organic carbon, calcium, and magnesium. The determination for the pH value was made by the electrometric method, using the antimony electrode. The organic carbon was determined in accordance with Parr's method. All the other chemical analyses consisted of total determination.

These chemical determinations are presented in Table 5 in terms of percent of dry soil. Wide variation in the composition of different soils is noticeable from this analysis. In general the majority of the types are slightly acidic in reaction. There are, however, types which are neutral to very slightly alkaline in reaction. The nitrogen content of the Batangas soils is normal, although the analyses of Taal sand, Sibul clay loam, and Taal sandy loam show comparatively low nitrogen content. The lime content shows great variations, ranging from 1.43 percent of lime in Ibaan clay loam to 5.80 percent in Taal fine sand. The magnesium content varies only to small extent.

The chemical analysis performed in connection with soil survey ascertains the chemical composition of the different soil types. This will reveal at once any outstanding deficiencies in the amount of the various plant-food elements present.

The processes of soil development leave an impression upon the soil both in its physical conformation and in its chemical characteristics. Likewise, every operation in the handling of the soil,

Table 5.- Chemical analysis of the surface soil of different soil types of Batangas Province.

Type No.	Type of Soil	pH value	Organic Carbon	Nitrogen (N)	Phosphoric anhydride (P_2O_5)	Potash (K_2O)	Lime (CaO)	Magnesia (MgO)
			Percent	Percent	Percent	Percent	Percent	Percent
18	Guadalupe clay	7.03	2.75	0.15	0.18	0.09	1.58	0.57
30	Guadalupe clay loam	6.76	4.25	0.15	0.25	0.13	1.38	0.46
35	Magallanes loam	6.72	3.39	0.14	0.61	0.19	2.33	0.96
48	Magallanes sandy loam	6.75	2.30	0.10	0.38	0.23	3.37	1.16
36	Tagaytay sandy loam	6.00	3.87	0.17	0.37	0.52	4.94	1.89
46	Sibul loam	6.97	2.55	0.14	0.35	0.18	3.42	1.37
47	Sibul clay loam	7.05	2.29	0.05	0.14	0.09	1.61	0.80
50	Calumpang sandy loam	6.67	3.45	0.12	0.25	0.11	2.98	0.82
51	Calumpang silt loam	7.25	2.60	0.14	0.21	0.11	1.99	0.72
52	Calumpang clay loam	6.91	2.56	0.11	0.17	0.10	1.99	0.66
53	Taal sand	6.17	2.26	0.03	0.28	0.47	5.69	0.94

55	Taal fine sand	6.78	1.79	0.09	0.35	0.14	5.80	0.89
56	Taal sandy loam	6.62	2.16	0.07	0.41	0.14	5.17	0.74
57	Taal fine sandy loam	6.89	3.06	0.08	0.30	0.29	4.81	0.89
58	Ibaan silt loam	6.59	3.59	0.12	0.30	0.19	2.57	0.88
59	Ibaan loam	6.72	3.20	0.12	0.21	0.21	2.43	0.72
60	Ibaan loam gravelly phase	6.75	3.83	0.08	0.05	0.11	1.83	0.50
61	Ibaan clay loam	6.67	3.30	0.12	0.28	0.16	1.43	0.72
62	Lipa loam	6.46	3.90	0.15	0.30	0.21	2.33	0.80
63	Lipa loam deep phase	6.43	3.33	0.14	0.31	0.25	2.45	0.88
64	Patungan sand	7.48	2.60	0.10	0.39	0.20	3.10	0.79

including the application of fertilizers, materially disturbs its equilibrium, setting up new reactions which cause variation in crop adaptability, productions, and agricultural usefulness. The chemical analysis, therefore, aids in the classification of soils as well as in making possible more accurate determination of their agricultural value and fertility needs and their response to different methods of management.

Mechanical analysis.- The mechanical analysis of the several soil types was determined in accordance with the latest hydrometer method devised by Bouyoucos. This analysis is shown in Table 6. The results show the actual nature of the soil separates as found. In many instances the results of mechanical analysis serve as a check against the doubtful classification made in the field. Highly friable soils, such as the Lipa and the Tagaytay soils, do not exhibit their textural characteristics, as shown by the mechanical analysis. The field classification of these and other friable soils, as determined by the feel method of the soil mass in its natural condition, is maintained. The mechanical analysis, however, further shows the amount of respective separates present in the soil mass.

SUMMARY

The civil government of Batangas Province was established in 1901. The town of Batangas was made the capital of the province on May 2, 1901. This province has at present 26 municipalities with a total population of approximately 426,159 (July, 1955).

Transportation facilities, telephone system, public and private schools, and sanitation are available throughout the province. In some big towns water and electric systems are also available.

The province is bounded on the north by Cavite Province and part of Laguna Province, on the east by Tayabas Province and part of Laguna Province, and on the south by China Sea.

Table 6.- Mechanical analysis of the surface soil and important soil types of Batangas Province.

Type No.	Type of Soil	Sand 2 - 0.05 mm	Silt 0.05 - 0.005 mm	Clay 0.005 - 0.0 mm
		Percent	Percent	Percent
18	Guadalupe clay	29.8	17.8	52.4
30	Guadalupe clay loam	31.0	31.4	37.6
35	Magallanes loam	34.8	27.4	37.8
48	Magallanes sandy loam	37.6	32.8	29.6
36	Tagaytay sandy loam	59.4	26.0	14.6
46	Sibul loam	36.0	30.4	33.6
47	Sibul clay loam	28.2	16.0	55.8
50	Calumpang sandy loam	55.6	24.4	20.0
51	Calumpang silt loam	37.2	31.0	31.8
52	Calumpang clay loam	37.2	25.6	37.2
57	Taal fine sandy loam	56.1	27.0	16.9
58	Ibaan silt loam	36.2	32.0	31.8
59	Ibaan loam	34.6	26.4	39.0

61	Ibaan clay loam	32.0	29.8	38.2
55	Taal fine sand	83.1	12.0	4.9
56	Taal sandy loam	59.4	23.2	17.4
62	Lipa loam	59.8	26.0	31.0

The general topography is hilly and mountainous, with the exception of small portions along Nasugbu, Balayan, and Batangas.

Geologically the underlying materials of the soils consist principally of water-laid volcanic tuff covering the major portions of the agricultural region of the province. The mountain region consists of andesite with basalts of the western Cordillera and southwestern volcanic region.

Agriculture is the most important industry of the province. The leading crops, arranged in the order of their importance, are rice, sugar cane, corn, coconut, banana, citrus, and mango.

The soils of the province consist of 10 series with 25 types. The biggest soil type mapped is Ibaan clay loam, followed by Ibaan loam and then by Guadalupe clay. The Ibaan and Lipa soils may be considered the best in the province.

The chemical and mechanical analyses of the surface soils were made. The chemical analysis shows normal nitrogen content. Most of the soils are slightly acidic in reaction, with the exception of 3 to 4 types which are almost neutral to slightly alkaline in reaction. The analyses indicates that on the average the soils of Batangas require fertilizers for normal crop production.

Mechanical analyses shows that the soils of the province favors erosion activity.

Soil survey gives basic scientific data which show the actual soil conditions in a given area. The laboratory data are supplemented by the results of field experiments to determine the adaptability and the treatment of soils for certain crops.

Table 7. - Showing area, location, and crops grown in each type of soil in Batangas Province

Type No.	Type of Soil	Area	Location	Crops grown
		Hectares		
1	Batangas hydrosol	318.00	Wawa, Galicanto, and Sta. Clara Barrios, Batangas.	Fishponds
18	Guadalupe clay	26,944.00	Eastern part of Rosario western and northern parts of Bolbok.	Rice, Coconuts, Bananas, Corn, Vegetables, and fruit trees.
30	Guadalupe clay loam	15,230.00	Eastern part of Rosario and Taysan.	Rice, coconuts, some sugar cane, bananas, vegetables, and fruit trees.
35	Magallanes loam	23,168.00	Uplands of Nasugbu, Lian, and Tuy.	Coconut, sugar cane, rice, corn, vegetables, and fruit trees.

36	Tagaytay sandy loam	9,318.00	Southern side of Tagaytay Ridge.	Cogonal and forest trees, and some upland rice.
46	Sibul loam	9,370.00	Calatagan	Forest area; sugar cane, corn, bananas, vegetables, and citrus.
47	Sibul clay loam	15,030.00	Northeastern part of Calatagan and Balingit Point.	Forest area; sugar cane, corn, and citrus, particularly mandarin.
48	Magallanes sandy loam	13,226.00	Rolling lands of Lian and Tuy.	Kaingin for rice, sugar cane, bananas, and vegetables.
49	Magallanes loam gravelly phase	2,114.00	Mount Batulao	Cogonal; kaingin for rice, and sometimes corn and vegetables.
50	Calumpang sandy loam	7,497.00	Batangas, Nasugbu, and portion of Lian.	Sugar cane, bananas, rice, and vegetables.
51	Calumpang silt loam	1,053.00	Batangas	Rice, sugar cane, Bananas, corn, and vegetables.

52	Calumpang clay loam	318.00	Utud and Dayap Barrios, Nasugbu.	Sugar cane, rice and corn.
53	Taal sand	5,460.00	Along the seashore from Lemery to Balayan.	Onions, bananas, vegetables, and root crops (ubi, tugui, etc.)
54	Taal Volcano sand	1,696.00	Taal Volcano	Forested with aroma trees; used for pasture.
55	Taal fine sand	7,501.00	Taal Volcano, lakeshore from Biniriyan to San Nicolas, Calaca.	Bananas, sugar cane, coffee, cacao, citrus, and other fruits.
56	Taal sandy loam	11,650.00	Balayan and upland Calaca.	Sugar cane, peanuts, bananas, citrus, root crops, and onions.
57	Taal fine sandy loam	22,242.00	Mountains and rolling lands of Calaca, Lemery, Talisay, and Mataas na Kahoy.	Rice, coconuts, citrus, bananas, and root crops.

Table 7.- Showing area, location, etc. - Continued.

Type No.	Type of Soil	Area	Location	Crops grown
		Hectares		
58	Ibaan silt loam	2,968.00	Bauan, Mabini, San Luis, and Cuenca.	Rice, corn, vegetables, bananas, and fruit trees.
59	Ibaan loam	27,393.00	Batangas, San Jose, Ibaan, Cuenca, Alitagtag, Bauan, and Taal.	Sugar cane, rice, corn, coconuts, citrus, vegetable, etc.
60	Ibaan loam gravelly	23,046.00	Mount Macolod, hills at Ibaan, San Jose, Mabini, San Luis, Lipa, and Lobo.	Coconuts, bananas, sugar cane, rice, and forest trees.
61	Ibaan clay loam	29,587.00	Batangas, Ibaan, Taysan, Rosario, and Lobo Mountain.	Sugar cane, coconuts, citrus, other fruit trees, rice, and corn.

62	Lipa loam	25,817.00	Lipa, Malvar, and Tanauan.	Sugar cane, rice, coconuts, citrus, corn, coffee, and others.
63	Lipa loam deep phase	11,309.00	Santo Tomas, Tanauan, and Lipa.	Coconuts, rice, and sugar cane.
64	Patungan sand	2,156.00	Lobo town.	Coconuts, rice, and corn.
65	Ibaan soils undifferentiated	5,178.00	Maricaban and Verde Island.	Coconuts, rice, corn, and forest trees.

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