SOIL SURVEY OF ILOILO PROVINCE PHILIPPINES

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The Philippines is still primarily an agricultural country. For many years to come the income of the government and the well-being of the people will continue to depend, as they depended in the past, on the productiveness of our soils. It is true that there is an oversufficiency of agricultural lands available at present. But if we exploit our soils the way we did in the past, and continue to do so, without system, without science, without regards to the welfare of the people who will use the same soils after us, there will be a serious problem for the generations to come. In view of this, we must systematize the use of our soils. We must know how much we have, how it should be used, and when it should be used. Such information can be gathered in a soil survey.

"The objects in soil surveying are (1) to determine the morphology of soils, (2) to classify them according to their characteristics, (3) to show their distribution on maps, and (4) to describe their characteristics, particularly in reference to the growth of various crops, grasses and trees. The ultimate purpose is to provide accurate soil maps, necessary for the classification, interpretation, and extension of data regarding agricultural production, the classification of rural lands, and for the factual basis in the development of sound programs of land use, whether planned by public or private agencies, or by individuals."

DESCRIPTION OF THE AREA

Iloilo Province, shaped like a distorted triangle, with an area of approximately half a million hectares, is sprawled along the east-southeastern coast of the Island of Panay, with the apex of the triangle pointed towards the center of the island. Parts of the province are a cluster of islets northeast of the mainland, and Guimaras Island to the southeast. Guimaras Island is close enough to the mainland to act as a natural breakwater for the port of Iloilo, the capital of the province. Iloilo City is 290 airline miles from Manila.

The province is adjacent to Capiz Province in the north and towards the west it is bounded by Antique Province. To the east is the Visayan Sea and towards the south is the Gulf of Panay.

Relief. - The relief of the province varies from level plains to rolling lands and hills to mountain peaks and ranges with long and narrow meandering streams. The level areas are not extensive and are found mostly in the southeastern part as broad level bottoms along the rivers. In the west, in an approximately north-south trend, are the western Cordilleras with a number of prominent peaks, of which Mt. Baloy (1,728 meters), Mt. Inaman (1,350 meters), and Mt. Igdalig (1,288 meters) are among the highest. The mountain range is wide towards its northern end and narrows southward. The southern end forms a hilly promontory at Naso Point. The greater part of the northeastern section of the province is a belt of hills and rolling lands. The hills vary from 90 to 180 meters high.

Guimaras Island is separated from the mainland by the Iloilo Strait which is three miles in width. Its relief is rolling to hilly. Limestone hills rise abruptly from the shore along the western coast forming indentions and bedlands bordering small areas of coastal plains. The interior of the island is a plateau criss-crossed by creeks and ravines. The eastern coast is dotted with small areas of rolling and hilly lands.

The soil cover of the province is given in Table 1.

Table 1.- The approximate areas of the actual soil cover of Iloilo Province as of December 31, 1937 a/

Kind	Area in hectares	Percentage
Commercial fores	20,780.00	3.93
Non-commercial forest	33,520.00	6.35
Open land	191,060.00	36.15
Cultivated land	269,630.00	51.03
Swamps and salt marshes	13,410.00	2.54
Total ..	528,400.00	100.00

a/ - Data from records of the Bureau of Forestry, 1939.

Drainage.- The province drains to the east and south. All rivers drain into the sea.

Most of the rivers in the mainland have their headwaters at the western and northern area. The most important rivers are the Jalaur and the Jaro with their tributaries.

In Guimaras Island there are numerous small rivers, some navigable to a limited extent by small native bancas, flowing from the interior of the island outward to the sea.

Vegetation. - Three main types of vegetation - forests, grasses and halophytic plants - are found in Iloilo Province. The forests, both primary and secondary, are found mainly on the higher slopes and summits of the western Cordilleras and to a limited extent in the western part of the province around Mts. Tagatay, Igdalig, and Llorente. These forests are not extensive. The more important forest trees in the province are as follows:

Scientific Name	Common Name
Nauclea orientalis	Tiga.
Alstonia macrophylla	Batino.
Dracontomelum dao	Dao.
Anisoptera thurifera	Palosapis.
Tarrieta javanica	Lumbayau.
Dipterocarpus grandiflorus	Apitong.
Xylocarpus granatum	Tabigue.
Azadirachta integrifolia	Maranggo.
Terminalia calamansanai	Kalumpit.

Grasses cover extensive areas on the Cordillera foothills, the western uplands, and Guimaras Island. Grass areas, mostly cogonales are also found in the hilly regions of the towns of Balasan, Sara, San Dionisio, Passi, and in the mountainous areas of Calinog, Maasin, Tubungan, and San Joaquin. These grassy areas are extensive and are good grazing lands.

Mangrove and nipa swamps are found only in limited areas. Vegetation in the mangrove swamps includes several kinds of halophytic plants, like nipa palms, bangkal, bakawan, langaray, api-api, and dungon-late, the last five of which are good sources of firewood. The plants form close dense overhead canopy and little undergrowth. The sap that exudes from tapped nipa inflorescence is utilized for the manufacture of alcohol or vinegar. Nipa leaves are used as thatching material for houses.

Organization and population. - Long before the coming of the Spaniards, according to local folklore, a number of datus from Borneo, with their followers and slaves, came to

Panay Island and first landed at a place near Sinogbuhan, near the present site of the town of Miagao. These immigrants found the place inhabited by negritoes from whom they succeeded in buying the island, which was then divided into three sections called "sakops," namely, Hantik, Aklan, and Irong-irong. Later, Irong-irong became Iloilo Province. The original "sakop" of Irong-irong was placed under the rule of a datu named Paiburong, who founded the first Malayan settlement in Iloilo.

The Spaniards came to Iloilo in 1569 and established themselves in the town of Ogton, then the largest settlement. During the time of Governor Ronquillo (1850-1853) the villa of Arevalo was founded. This villa became the seat of the Alcadia, the jurisdiction of which included the whole of Panay and a great part of Negros Island. In 1688 Iloilo became the capital of the province.

During the eighteenth century Iloilo Province lost a great part of its territory as a result of the creation of Capiz Province in 1716 and Antique Province in 1798.

The nineteenth century was a period of prosperity in the history of the province. Culturally and economically there was great progress. But this progress was interrupted at the close of the century when as a result of the Philippine rebellion against Spain, the Spaniards evacuated the province in 1898. It was not until April 11, 1901 that a civil government under the United States was established.

In the four decades of American rule, the economic, social, and political features of the province progressed in an accelerated tempo. Schools were established, the science of government was taught the people, and agricultural activities were expanded. But on December 8, 1941, this situation was once again disrupted because of the outbreak of the war in the Pacific. The province was occupied by the Japanese from April 1942 to its liberation by the American on March 18, 1945.

The population of the province has increased steadily. In 1818 the population was 176,901; in 1870 it was 348,371; in 1905, 410,315; in 1918, 502,949; and in 1939, 744,022. According to the census of 1939, Iloilo City, which was declared a chartered city in 1938, has a population of 90,480. The comparatively rapid development of the city is attributed to the opening of its port to foreign trade in 1855.

Transportation. - The province is ramified by a network of national, provincial, and municipal roads, making all the

municipalities and big barrios accesible from the capital. Interprovincial roads connect Iloilo City with San Jose de Buenavista, the capital of Antique Province and with Capiz, the capital of Capiz province.

A railway line connects Iloilo and Capiz Provinces. It passes through the municipalities of Pavia, Sta. Barbara, Pototan, Dueñas and Passi.

The port of Iloilo is navigable to ocean-going steamers, and ships from foreign countries call at this port to load merchandise, mostly agricultural products, like sugar, abaca, tobacco, corn and copra. Interisland boats also call at Iloilo on their trips between Manila and the many ports in the Visayan Islands and Mindanao.

The Far Eastern Air Transport Incorporated and the Philippine Airlines Incorporated maintain air transportation facilities in Iloilo City linking it with Manila and with the other airports of the country.

Water supply. - Iloilo is one of the few provinces in the country where potable water is scanty. Water from mountain springs and artesian wells is either too low in mineral content or has appreciable iron content or too high in salts (1500 p.p.m.). Potable water for the towns of Cabatuan, Jaro, Maasin, Molo, Pavia, Mandurriao, La Paz, and Iloilo City is supplied by the Metropolitan Water District Co. from the town of Maasin. This water comes from the Tigon River, a tributary of the Jaro River, and is distributed to the different towns after proper clarification and disinfection. The towns of Sara, Barotac Viejo, Passi, San Dionisio, San Joaquin, Dingle, and Pototan have their own municipal water works. People in other towns depend on surface wells, streams, and springs for their supply of household water.

Other cultural features. - There are thirty-five municipalities and one chartered city in the province. Public schools of elementary grades are found in all the towns and in many barrios. Collegiate schools, academic and vocational schools, both publicly and privately owned, are found in the city. In some towns there are regional high schools.

There are three hospitals in the city. A leprosarium is found at Sta. Barbara. A public dispensary run by the Bureau of Health is available in every town.

Most of the people in the province profess the Roman Catholic Religion. A Roman catholic church is found in every town. The Protestant and Aglipayan churches have some followers too.

Industries. - The industries of the province, other than farming which is the main pursuit of the people, are fishing, weaving, pottery making, salt making and cattle raising.

Fishing is mostly done along the southeastern and northeastern coast of the province. At Estancia is located the government fishing station and cannery. The vicinity of Gigantes Islands also abounds in fish. Crustaceans are plentiful in the hydrosol areas.

The province has long been famous for its piña cloth and patadiong. Weaving is a home industry and is mostly done by women on home-made looms. Because of the relatively high cost of production, piña cloth and patadiong can no longer compete with factory made textiles. Piña is made from fibers of the pineapple leaves, and patadiong, from imported cotton yarns.

The making of pottery is a minor industry and is mostly done at Pavia, San Miguel, Sta. Barbara, Estancia, Pototan, and Lambunao.

Salt is made along the coast by solar evaporation of sea water, principally in Carles, Iloilo City, Leganes and Miagao.

Cattle raising is very limited and is confined to San Joaquin, Passi and Sara.

Iloilo City is the principal market and industrial hub of the province.

Climate

Climate is the sum of several factors, namely, rainfall, temperature, intensity of sunshine, wind velocity and direction, and humidity.

Iloilo Province is divided into three regions of different types of rainfall.

First type: In this region there are two pronounced seasons, dry from December to June, and wet from June to December. The rainy season starts in May and continues with

increasing precipitation to October. The rains begin to subside in November. February and March are practically rainless months.

Third type: In this region there is no very pronounced maximum rainfall period, with the dry season lasting only from one to three months. The total amount of rainfall in this type is not as much as that in the first type.

Fourth type: In this region there is no pronounced rainy period and no dry season. Under this type October has the greatest amount of precipitation, while March has the least.

In Table 2 are shown the average monthly and annual rainfall, and the number of rainy days for the different months of the year, from the different weather stations in the province. Each of these stations represents a distinct type of rainfall.

Locality variations in temperature throughout the province are inappreciable except where there are great differences in elevation. Table 3 which shows the monthly and annual temperatures for the City of Iloilo indicates that seasonal temperature variations in this region are not much.

The northern part of the province, north of latitude 11^{0}, is frequently visited by destructive typhoons. The region south of this latitude is seldom hit by typhoons.

Northeast winds prevail in the province from November to May. The rest of the year the winds come from the southwest.

Table 2. Showing the average monthly and annual rainfall for the different weather stations in Iloilo Province from 1903-1918. a/

Months	Rainfall in the first type of climate Iloilo City		Rainfall in the third type of climate		Rainfall in the fourth type of climate	
	Rainfall	Rainy days	Lucena	Hda. Lanjagan	Janiuay	Bitaogan
	mm.		mm.	mm.	mm.	mm.
January	56.6	9	55.8	124.9	119.1	153.9
February	46.1	7	55.1	42.9	55.9	84.1
March	28.6	5	46.9	49.0	66.0	66.0
April	36.7	6	49.0	156.9	87.1	55.1
May	146.0	12	143.0	198.1	182.8	203.9
June	262.3	18	217.9	198.1	202.9	230.1
July	380.6	20	296.9	248.9	265.9	250.9
August	347.0	19	270.0	187.9	219.9	228.1
September	317.8	20	208.0	215.9	230.1	251.9
October	272.2	18	255.0	303.0	262.9	309.1
November	188.6	14	213.1	278.8	239.9	252.9
December	127.6	14	98.0	208.0	124.9	222.0
Annual--	2210.1	162.0	1908.7	2112.4	2057.4	2308.0

a/ The climate and weather of the Philippines. 1903-1918. Bureau of Printing 1 (1920) 291-630. Census of the Philippines: 1918. Manila

Table 3. Showing the average of monthly and annual temperature for Iloilo City. a/

Month	Maximum Temperature	Average Temperature	Minimum Temperature
	o C	o C	o C
January	29.8	25.6	22.6
February	30.3	25.8	22.5
March	31.6	26.8	23.1
April	32.7	27.8	24.1
May	32.5	27.9	24.4
June	31.3	27.3	24.1
July	30.2	26.8	23.9
August	30.1	26.8	23.9
September	30.1	26.6	23.7
October	30.7	26.6	23.7
November	30.4	26.4	23.4
December	30.0	26.0	23.2
Monthly average	30.8	26.7	23.6

a/ The Climate and Weather of the Philippines. 1903 to 1918. Census of the Philippines. 1918. Manila. Bureau of Printing 1 (1920) 291-630

AGRICULTURE

Agriculture, the principal occupation of the people throughout the province, began long before the coming of the Spaniards. In 1939, the total area planted to crops was 190,623.68 hectares with a produce valued at 8,375,115 pesos. The principal crops are rice, corn, coconut, sugarcane, mungo, sweet potato, tobacco, beans and peanuts. Table 4 gives the hectarages of the principal crops in Iloilo with their corresponding production and value of produce in 1939.

Table 4. - Area and value of produce of the ten leading crops of Iloilo Province 1/

Crops	Area	Production	Value	Remarks
	Hectares		Pesos	
Palay	124,785.27	[a] 2,398,428	6,445,359.00	Total of first, second and upland crops.
Corn	23,193.09	[a] 152,384	345,990.00	Total of first, second and third crops.
Coconut	16,395.73	[b] 19,288,510	802,687.00	
Sugar cane	9,693.85	[c] 361,885	[d] 31,234.00	Excluding basi 8,161 liters; canes 2,276,788 units.
Mungo	7,247.70	[e] 1,128,530	157,389.00	
Sweet potatoes	2,809.80	[e] 3,407,415	115,000.00	- - - - - -
Tobacco	1,873.32	[e] 1,102,654	253,264.00	
Cassava	1,054.31	[e] 1,530,192	43,607.00	
Beans	916.49	[e] 228,241	29,581.00	
Peanuts	470.08	[e] 170,000	15,674.00	
Total for ten crops	188,437.64	- - - - -	8,219,785.00	

1/ Data from the Census of the Philippines, 1939. a, Cavans; b, Nuts; c, panochas; d, total value; e, kilograms

Rice is extensively grown throughout the province. The level lands are planted to lowland rice, and the rolling and hilly lands to upland rice. The more common varieties of rice found in the province are Raminad Strains 1 and 3, Elon-elon, Elon-ram, Ram-elon, Khao Bai Shri, Dumali, Kinastila IV and Kandidit. In 1939, 118,402.10 hectares, or 72,43 per cent of the cultivates lands are planted to rice. This area produced 2,285,487 cavans of palay valued at 6,158,775 pesos. In places where there is sufficient water for irrigation, two crops of rice are grown in a year. Of the area devoted to rice cultivation, only 17,848.15 hectares are artificially irrigated.

Corn is planted in rotation with other crops, like tobacco, upland rice, beans, and other legumes. The hectarage of the different crops of corn, with their corresponding production and market value for the year 1939, are given in Table 5. The common local varieties are white flint, dent, and glutinous corn.

Table 5. - Showing the area, yield, and value of corn planted in 1939 a/

Croppings	Area in hectares	Production in cavans	Total value of produce pesos
First crop	16,949.08	115,213	257,474.00
Second crop	5,365.22	31,025	71,515.00
Third crop	348.87	2,226	4,776.00
Green corn crop	530.00	5,556	12,225.00
Total ----	23,193.17	154,020	345,990.00

a/ Census of the Philippines, 1939.

The area planted to coconut trees in 1939 was 16,393.73 hectares, or 10.03 per cent of the total cultivated area in the province. The production for the same year was 19,288,510 nuts valued at 802,687 pesos. Most of the coconut trees are planted along the coastal plains, the hilly areas, and along river banks. Of the 2,064,835 coconut trees in the province 1,099,010 are bearing; 875,802 are nonbearing. Ninety thousand twenty three are being tapped for tuba with a total yield of 12,178,801 liters of juice valued at 577,137 pesos.

In 1939 the production figures from 9,693.85 hectares planted to sugar cane are as follows:

	Pesos
276,778 stalks, cane for chewing	15,107.00
361,885 pieces, panocha	15,422.00
8,161 liters, basi	705.00
Total - - - -	31,234.00

Centrifugal sugar:

Centrals	Piculs
Sara-Ajuy, 1941-1942	108,725.52
Santos-Lopez, 1940-1941	220,209.36
Janiuay, 1940-1941	111,435.49

As a result of the war all the sugar centrals were destroyed, and the bigger plantations were either neglected or abandoned. It will take some time to rehabilitate the sugar industry of the province.

The principal root crops of the province are sweet potato, cassava, gabi, tugui, arrowroot, ginger, sincamas, potato, and radish. These crops are not raised on an extensive scale. Only 4,534.33 hectares, or 2.77 per cent of the cultivated area in the province, are devoted to their culture.

Leguminous crops are usually grown in rotation with the principal crops, or as catch crops. Among the legumes grown in the province are mungo, sitao, patani, cowpeas, soybeans, batao, and peanuts. An aggregate area of 8,658.20 hectares was planted to leguminous crops in 1939.

Tobacco is a minor crop compared to rice. Only 1,873.32 hectares are devoted to its cultivation throughout the province. In 1939, 1,102,654 kilos of cured tobacco leaves were produced valued at 233,264 pesos.

The fiber crops grown in the province are abaca, maguey, kapok, cotton and ramie. The abaca industry has been declining steadily since 1918. For that year 3,648,892 kilos of abaca fibers were produced as compared to the 1939 production of 121,016 kilos. The total area covered by fiber crops, excepting kapok, according to the 1939 census, was 411.85 hectares which produced 139,258 kilos of fibers valued at 19,893 pesos.

The raising of vegetables is mostly done in home gardens and is practiced throughout the province. The province has a liberal supply of vegetables all the year round.

The important fruit trees found in the province are bananas, mango, jackfruit, papaya, orange, seniguelas, santol, pummelo, atis, and breadfuit. Table 6 shows the number of bearing trees, production and value of fruits of the province in 1939. In certain localities coffee and cacao are raised on a small scale.

conservation must be worked out for this province, especially because clean culture is practiced in the raising of most crops.

Only a very small fraction of the cultivated area is irrigated by established irrigation projects. The Aganan River and Sta. Barbara Irrigation System supply water to 9,725 hectares which is only 10.54 per cent of the area planted to lowland rice. Most of the farmlands in the provinces are irrigated by rain water or by temporarily damming up rivers during the dry season to divert their water to irrigation canals. Diversified cropping, catch-cropping, and inter-cropping are practiced in the province but without definite program, objectives, or system.

LIVESTOCK, AND LIVESTOCK PRODUCTS

According to the census of the Philippines in 1939, the different kinds of livestock found in the province are carabaos, buffaloes, cattle, horses, goats, sheeps, hogs, chickens, ducks, geese, turkeys, guinea fowls, rabbits and pigeons. Tables 7 and 8 give the livestock population in 1939 with their corresponding market value. The raising of livestock is only a secondary pursuit of the people. There are no dairy farms in the province. Fowls are raised on farms and in backyards but not on a commercial scale. Attempts were made in the past to introduce foreign stock of cattle and chicken for the raising of dairy and poultry products, but these attempts had not succeeded.

Table 7. - Showing the kinds, number and value of livestock in Iloilo Province in 1939.

Livestock	Number	Value
		Pesos
Carabaos	178,530	5,166,540.00
Buffaloes	33	1,215.00
Cattles	69,221	1,184,546.00
Horses	2 ,884	63,635.00
Sheep	1,258	3,498.00
Goats	11,921	21,630.00
Hogs	109,010	656,832.00
Total	372,857	7,097,896.00

Table 8. - Showing the kinds, number, and value of poultry in Iloilo Province in 1939

Poultry	Number	Value (pesos)
Chickens	1,212,219	351,261.00
Geese	1,606	1,999.00
Turkeys	1,209	3,275.00
Guinea fowls	1,446	898.00
Pigeons	7,432	1,408.00
Ducks	4,885	9,587.00
Total	1,228.797	468,428.00

LAND-USE CHANGES

Iloilo has a total farm area of 250,042.60 hectares classified as follows: Cultivated land, 163,468.93 hectares; idle land 28,357,76 hectares; pasture land, 33,756.59 hectares; forest land, 11,885.74 hectares; and other lands 12,573.58 hectares.

By cultivated land is meant land planted to crops. An idle land is one suitable for growing crops but was not cultivated in 1939. Pasture land is land used exclusively for pasture in 1939. Forest lands are the forest areas within the farms. Other lands include house lots and waste-lands.

According to the Philippine Census of 1939, there were 66,915 farms in the province, 13.64 per cent of the number are less than one hectare in size; 75.92 per cent, less than five but more than one hectare; 7.87 per cent, less than ten but more than five hectares; 1.8 per cent, less than twenty but more than ten hectares; and 0.77 per cent, over 20 hectares.

This classification is based on the total area of the cultivated lands.

FARM TENURE

Farmers, or farm operators, are classified into four groups, namely, owners, part-owners, managers, and tenants. The tenant group is further subdivided into share tenants, share-crop tenants, and cash tenants.

In 1939, there were 66,915 farmers in the province. Thirty-eight and three-tenths per cent of this number owned their farms; 14.21 per cent were part-owners of the land they tilled; 44.80 per cent were share tenants; 0.56 per cent, share-crop tenants; 2.04 per cent, cash tenants; and 0.09 per cent, farm managers.

Of the total farm area in the province, 45.34 per cent of the land is farmed by owners; 13.47 per cent, by part-owners; 33.70 per cent, by share tenants; 0.62 per cent, by share-crop tenants; 2.43 per cent, by cash tenants; and 4.46 per cent, through farm managers.

The average size of a tenant's holding in this province is 3.7 hectares, which yielded the tenant an annual income of one hundred to one hundred thirty-five pesos before the war.

Without a supplementary source of income the tenant can hardly live within his earnings. This situation has given rise to the tenancy problem which now dominates the Philippine agricultural economy.

FARM INVESTMENTS

According to the census of 1939 Iloilo Province had the following farm equipments valued at 879,610 pesos:

	Pieces
Plows	79,555
Harrows	62,336
Carts	4,048
Work animals	110,885
Sleds	44,577

Table 9, taken from the 1939 Philippine Census, gives the number of farms in Iloilo classified according to type. In this classification twelve farm types are defined as follows:

1. Palay farms - those where 50 per cent or more of the cultivated area is planted to lowland and/or upland rice.

2. Corn farms - those where 50 per cent or more of the cultivated area is planted to corn.

3. Abaca farms - those where 50 per cent or more of the cultivated area is planted to abaca.

4. Sugar cane farms - those where 50 per cent or more of the cultivated area is planted to sugar cane.

5. Coconut farms - those where 50 per cent or more of the cultivated area is planted to coconut.

6. Fruit farms - those where 50 per cent or more of the cultivated area is planted to fruit trees.

7. Tobacco farms - those where 50 per cent or more of the cultivated area is planted to tobacco.

8. Palay-tobacco farms - those on which at least 25 per cent of the area cultivated is planted to rice, and 25 per cent or more planted to tobacco.

9. Vegetable farms - those where more than 50 per cent of the cultivated area is planted to vegetables.

10. Livestock farms - those not less than ten hectares in area and having more than ten head of cattle, horses, goats, or sheep, and with less than 20 per cent of the total farm area planted to crops.

11. Poultry farms - those having more than 300 chickens or 200 ducks and with less than two hectares of cultivated land.

12. Other farms - those not falling under any of the above categories.

Table 9. - Number of farms by type in Iloilo Province, 1939.

Number	Type of Farm	Farms	Percentage
1.....	Palay.....	54,602	81.60
2.....	Corn	3,881	5.80
3.....	Abaca	18	0.03
4.....	Sugar cane	555	0.83
5.....	Coconut	3,448	5.15
6.....	Fruit	176	0.26
7.....	Tobacco	219	0.33
8.....	Palay-tobacco	140	0.20
9.....	Vegetable	176	0.26
10.....	Livestock	61	0.09
11.....	Poultry	1	0.002
12.....	Other	3,638	5.44
Total --12		66,915 xxxx	100.00 xxx

SOIL SURVEY METHODS AND DEFINITIONS

Soil survey is an institution devoted to the study of the soil in its natural habitat. It consists of (1) the determination of the morphological characteristics of soils, (2) the grouping and classification of soils into units according to their characteristics, (3) their delineation on maps, and (4) the description of their characteristics in relation to agriculture and other activities of man.

The soils, their landscapes and underlying formation, are examined in as many sites as possible. Borings with the soil auger are made, test pits are dug, and exposures, such as road and railroad cuts are studied. An excavation or road cut exposes a series of layers called collectively the soil profile. The horizons of the profile as well as the parent material beneath are studied in detail, and the color, structure, porosity, consistency, texture, and content of organic matter, roots, gravel and stones are noted. The reaction of the soil and its lime and salt contents are determined. The drainage, both external and internal, and other features, such as the relief of the land and climate, as well as the natural and artificial features, are taken into consideration, and the relationship of the soil and the vegetation and other environmental features is studied.

On the basis of both external and internal characteristics, the soils are grouped into classification units, of which the three principal ones are (1) soil series (2) soil type, and (3)soil phase. When two or more of these units are in intimate or mixed pattern such that they cannot be clearly shown on a small scale map, they are mapped or grouped into a (4) soil complex. Areas of land that have no true soil, such as river beds, coastal beaches, or bare rocky mountainsides are called (5) miscellaneous land types. Areas that are inaccessible like mountain and great forest areas whose classification is of no agricultural importance for the present are classified as (6) undifferentiated soils.

A series is a group of soils that have the same genetic horizons, similar important morphological characteristics, and having similar parent material. It comprises soils having essentially the same general color, structure, consistency, range of relief, natural drainage condition, and other important internal and external characteristics. In the establishment of a series a geographic name is selected, taken usually from the locality or localities where the soil was first identified.

For example, the Culis series was first found and classified in the vicinity of Culis, a barrio in the town of Hermosa, Bataan Province.

A soil series has one or more soil types, defined according to the texture of the upper part of the soil, or the surface soil. The class name such as sand, loamy sand, sandy loam, silt loam, silty clay loam, clay loam, or clay, is added to the series name to give a complete name to the soil. For example, Culis loam is a soil type within the Culis series. The soil type, therefore, has the same general characteristics as the soil series except for the texture of the surface soil. The soil type is the principal mapping unit. Because of its certain specific characteristics it is usually the unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, differing from the soil type only in some minor features, generally external, that may be of special practical significance. Differences in relief, stoniness, and extent or degree of erosion are shown as phases. A minor difference in relief may cause a change in agricultural operation or change in the kind of machinery to be used. The phase of a type with a slight degree of accelerated erosion may present different fertilizer requirements and other cultural management problems from the real soil type. A phase of a type due mainly to degree of erosion, degree of slope and amount of gravel and stones in the surface soil is usually segregated on the map if the area can be delineated.

A soil complex is a soil association composed of such intimate mixtures of series, types, or phases that cannot be indicated separately on a small-scale map. This is mapped as a unit and called a soil complex. If there are several series in an area, as Sara, Sta. Rita, Alimodian, and others, that are mixed together, the two dominant series bear the name of the complex, as Sara-Sta. Rita complex, or Sara-Alimodian complex, as the case may be. If there is only one dominant constituent in a series, that series or type bears the name of the complex, as Sara complex, or Alimodian complex.

Surface soil and subsoil samples for chemical and physical analysis are collected from each soil type or phase, the number of samples being determined by the importance and extent of such soil type or phase. Profile samples are also obtained for further morphological studies of important soil types.

All natural and artificial features found in an area, as trails, roads, railroads, bridges, telephone and telegraph lines; barrios, towns and cities; rivers and lakes; prominent mountains and others are indicated on the soil map.

CHEMICAL CHARACTERISTICS OF THE SOILS OF ILOILO PROVINCE

General consideration.- The capacity of the soil to sustain vegetative life depends to a very great extent on the content of such soils of soluble chemical substances needed by plants. The fertility of soils varies in all degrees, because their content of available plant nutrients differs in all degrees. Soils that are adequately supplied with nutrients needed by growing plants generally are found to be more fertile than soils not so sufficiently endowed. It is important, therefore, that information concerning the chemical composition of soils, particularly of that portion soluble in soil water and commonly known to affect plant growth, is of practical importance to producers of plants and plant products and to persons engaged in soil research or educational work.

To thrive normally a growing plant, like any other growing thing, must be supplied with sufficient amount of food. A plant growing in the soil will have to nourish itself from the soil. If the soil is not possessed of the things that the plant needs, the plant will have to go along without the deficient nutrients, if it can, but if the deficiency is great enough, the plant dies. It is now known just what most plants need to grow normally, and how much they need. A wise planter should know the requirements of his plants and the capabilities of his soil. Whatever nutrients are lacking for the proper growth of his plants must be supplied in correct amounts, and whatever is overabundant must be conserved, or if such overabundance is deleterious to the plants, it must be corrected.

In discussing soil-plant relationship, it must be emphasized, however, that the successful production of plant and plant products is not solely dependent on the soil. There are several factors of plant growth, which may be classified into three main divisions, namely, (1) climatic factors, (2) soil factors, and (3) factors inherent in the plant itself.

Climatic factors include all forces that exert pressure on the plant, involving water, temperature and energy exchanges brought about by changes in the atmospheric conditions.

Soil factors, generally divided into three groups, namely, chemical, physical, and biological factors, affect the plant because it is anchored in the soil and derives most of its nourishment from the soil.

The factors inherent in the plant itself include such forces as the individual capacity of a plant to grow, its ability to weather unfavorable conditions, and to grow only to a definite size, them stop growing, etc.

It can be seen from the preceding paragraph that for a plant to grow successfully all the factors relative to its growth must so coincidentally act that the net result of such action is most favorable to the plant. In other words, the soil must be just right, the climate just right, and the plant just right. Because the climate is generally beyond man's control, and the plant, we usually take it as it is, it is only the soil that we can easily adjust. This adjustment of the soil to suit best the plants we wish to grow involves the whole field of edaphology, and the chemical analysis and adjustment of soils is just one branch of this large field of work.

Plants require in more or less large quantities the following elements: Hydrogen, carbon, oxygen, calcium, magnesium, phosphorus, potassium, nitrogen, sulfur, and iron. And in lesser quantities plants also need boron, manganese, zinc, and copper. Excepting hydrogen, oxygen, carbon and at times nitrogen, all of these elements are obtained by the plants from the soil or its solution.

Nitrogen.- Nitrogen is a nutrient element required by all plants. It is found chiefly in the organic matter of the soil. The nitrogen of the organic matter in the soil, through the action of soil microorganisms, is converted into ammonia, then to nitrite, and finally to nitrate by the process known as nitrification. To have an adequate supply of nitrogen for the plants, the soil must have sufficient nitrogen-carrying organic matter, must be moist, warm, aerated and possessed of the proper soil microorganisms. Soils low in organic matter are generally low in available nitrogen. Productive soils are usually rich in organic matter convertible into substances utilizable by plants. A deficiency of nitrogen can be corrected by the application of nitrogen-bearing fertilizers, like compounds of ammonia or nitrate compounds. Organic matter in the form of manures has been used successfully for ages to make up for nitrogen deficiency.

Because nitrates are easily soluble in water, they are easily lost from the soil, especially well-drained soils, through leaching. The nitrate content of the soil is likely to fluctuate from season to season, depending on the amount made available by the soil organisms and the amount lost due to leaching. A periodic test for nitrates in the soil must be made so that corrections may be applied whenever necessary.

The soils of Iloilo Province, as can be seen in Table 14 nearly like all other soils of the Philippines analyzed in the Division of Soil Survey to date, are quite low in nitrogen content in the form of both nitrate and ammonia. This, of course, suggests the necessity of applying nitrogen-carrying fertilizers to correct the deficiency. For most plants to grow well a minimum of 10 p.p.m. for nitrates and 10 p.p.m. for ammonia must be maintained at all times during the growing period of the plant.

To build up the depleted nitrogen content of the soils of this region, a revision of farming practices will help. Crop rotation, especially the planting of leguminous plants after harvesting nonleguminous crops, green-manuring, application of stable manures and other nitrogen-bearing fertilizers, will tend to increase the organic matter in the soil and ultimately, as we have seen, the nitrogen content.

Phosphorus.- Phosphorus, like nitrogen, is needed by plants in more or less large amounts. It is present in both the organic matter and the mineral part of the soil. It is made soluble in the soil and available to plants by the decay of organic matter and by the weathering of soil minerals. The supply of available phosphorus and the ability of the soil to maintain this supply are two main considerations with respect to available phosphorus. Many agricultural soils are low in their content of available phosphorus, not only because most plants are heavy phosphorus feeders, but also because very often the phosphorus content of the soil is "fixed" or in an unavailable form. While this nutrient element is indispensable to growing plants, too much of it in the soil may be the cause of injury to plants. The three chief effects of phosphorus on plants are (1) stimulating root growth, (2) hastening the maturity of crops, and (3) improving the quality of seeds especially grains.

The soils of Iloilo Province as shown in Table 14, contain a very limited amount of available phosphorus. Not even one of the samples examined and analyzed showed sufficiency of this nutrient element for even the lightest-phosphorus-feeder plant.

For most field crops a test of less than 1 p.p.m. is an indication of insufficiency, and fertilization with phosphatic fertilizers is in order. To maintain a normal phosphorus level in the soil there must be at least 1 to 2½ p.p.m. of available phosphorus throughout the growing and maturing periods of the plant.

Phosphorus can be applied to the soil in two forms, namely, as organic fertilizers like guano, which also contain nitrogen in varying amounts, or as inorganic fertilizers like superphosphates or rock phosphate. In using phosphatic fertilizers it must be remembered that soils revert or make insoluble some of the phosphorus applied to them, and some soils have this power in greater magnitude than others. In case of certain soils, therefore, the application of 100 kilos of superphosphate per hectare may cause a difference in test results between fertilized and unfertilized soils; but in other cases, 400 or 500 kilos or more of superphosphate may be required to show much difference in test results. In other words, the reverting or absorbing power of a soil for phosphorus must be satisfied before a considerable amount of phosphorus will be found in the soil extract.

Potassium.- Potassium belongs to the list of major plant nutrient elements, because like the others in the list, it is needed by plants in considerable quantities. In occurs both in the organic and in the mineral matter of soils and becomes available to plants by solution in the soil water. Most soils, except mucks and peats, (of which we have very limited examples in the Philippines, contain relatively large amounts of total potassium, but the amount available to plants in any one soil may be low, especially in sandy soils. A deficiency of potassium in the soil does not readily become apparent until it becomes more or less critical. Then it is indicated by a stunted growth of the plants with the leaves becoming yellowish or dull colored at the edges, and finally bronze or brown toward the centers. In extreme cases the leaves fall off from the plants. A large portion of small shrunken, misshaped pods and seeds of legumes, or of other fruits, flowers, tubers, and roots may indicate potassium deficiency in the soil. Care must be taken, however, to avoid confusing these symptoms with those caused by diseases or insect infestations.

The soils of Iloilo Province except the Luisiana loam and the coastal beach sand, gave low test for available potassium. These two exceptions gave tests of medium sufficiency. For most crops 5 to 10 p.p.m. of potassium is needed for good growth. As mentioned above the effect of this deficiency is perhaps not apparent because it is not yet at the critical stage, but it is better to correct this condition now, not only to get immediate improvement in the yields of those

soils but also to avoid creating a critical situation which may be difficult to remedy later.

The common carriers for potassium are potassium sulfate and potassium chloride.

Calcium. - Calcium performs many important functions in the soil relative to the growth of plants, and the physical structure and the physiological condition of the soil. Soils well supplied with calcium are known to be less easily puddled than those not so well supplied with it. In some forms calcium is often used to correct soil acidity when it becomes unfavorable to plant growth. This nutrient element is commonly found in relatively large amounts in soil and soil extracts. Soils are seldom deficient in calcium as a plant nutrient, but a low availability of calcium in an acid soil is usually a sign of low productivity, especially for crops that need a good supply of this element. Leguminous crops and most garden plants require a liberal supply of calcium from the soil, but grains and grasses generally require less. Excessive amounts of calcium in the soil is injurious to plants especially for crops that require acidic soil condition for normal growth.

The soils of Iloilo Province, except for five soil types, namely, Barotac clay loam, Barotac loam, Alimodian silt loam, and Sara silt loam, may be considered normal with respect to available calcium. In the case of Sara sandy loam and Sara silt loam, the deficiency is apparently reflected already in the acidity of the soil (refer to pH values) and therefore seems to need correction by liming processes. In the other soil types mentioned the calcium deficiency does not seem to be serious yet because the corresponding pH values for such soil types are not very low, and if these soils are planted to rice the soil acidity would still be within the preference pH range of rice. But even then, the application of lime to bring the test figure to at least 40 p.p.m. of available calcium is necessary throughout the growing and maturing periods of the plant.

Soil reaction.- Soil reaction, generally expressed in terms of pH values, denotes the degree of acidity or alkalinity of the soil. A pH value of 7 means that the soil is neutral neither acid nor alkaline. PH values lower than 7 means that the soil is acidic, and pH values higher than 7 means that the soil is alkaline or basic in reaction. Cultivated plants have soil reaction preferences-some requiring an acid soil, some a neutral soil, and some preferring the alkaline condition. Rice, for instance, thrives best in a pH range of 4.8 to 6.9

Two alternatives are open when the pH value of a soil does not fall within the pH range preferred by a plant. The pH range of the soil can be adjusted to suit the plant, or the plant adapted to suit the pH value of the soil chosen. It is generally easier to choose the latter course but if an adjustment of the pH is necessary, liming is generally resorted to, to shift the pH towards the alkaline side, and where the demand is to shift the pH towards the acid side, sulfur is generally used to accomplish the objective.

The soils of Iloilo Province range in pH from 4.0 to 6.5. The Sara sandy loam and the Sara silt loam are too acidic for most field crops except legumes and grasses which have high tolerance for acid soils. So with regards to these two types, it is advisable to lime the soils, especially if rice is the main crop in the region. All the other soil types are moderately acid and do not seem to need any treatment for pH correction if the soils are planted to rice.

Magnesium and sulfur. - These two elements even when deficient in soils do not present separate problems because both of them are taken care of more or less incidentally when the other major plant nutrients are applied to the soil as amendments. For instance, most limes contain considerable magnesium, dolomitic limestone sometimes carrying 40 per cent magnesium carbonate. Judicious liming, therefore, often takes care of possible deficiencies in this element.

Considerable sulfur is added to the soils in crop residues, green manures, and farm manures. Besides, rain brings to the soil a large quantity of this element from the atmosphere in addition to the amount directly absorbed from the air by the soil. Routine fertility practices automatically take care of this element. Ammonium sulfate and potassium sulfate, for instance, carry with them sulfur to the soil.

The trace elements.- Although it is now admitted that no fertility diagnosis is complete without considering trace elements, the lack of laboratory facilities at the present time prevented the test of the soils of Iloilo Province for these elements. It must be remembered, however, that a deficiency in one trace element will cause just as much difficulty in soil management as a deficiency of, for instance, nitrogen. A nutrient ration can be just as seriously unbalanced because of the lack of a mere trace of zinc or born as from a deficiency of potash to the extent of many pounds.

Table 15.- Chemical analysis of available plant nutrient elements of the soils of Iloilo Province

Soil Types	pH	Nitrate (NO3)		Ammonia (NH3)		Phosphorus (P)		Potassium (K)		Calcium (Ca)	
		p.p.m.	Kilos per hectare per 15 centimeters	p.p.m.	Kilos Per Ha./ 15 cm.	p.p.m.	Kilos per Ha./ 15 cm.	P.p.m.	Kilos Per Ha./ 15 cm.	p.p.m.	Kilos per ha. per 15 cm.
Santa Rita clay	6.5	2	18	3.0	27	0.5	4.3	Low	27	90	810
Santa Rita clay loam	6.0	10	90	3.0	27	1.0	9.0	Low	27	70	640
Barotac clay loam	5.5	a 3	a 27	4.0	36	a 0.5	a 4	4	36	20	180
Barotac loam, rolling phase	5.5	a 2	a 18	8.0	72	a 0.5	4	4	36	20	180
Umingan fine sandy loam	6.0	10	90	6.0	54	0.5	4.5	Low	a 27	80	720
Alimodian clay loam	6.0	5	45	5.0	45	a 0.5	a 4.5	Low	a 27	100	900
Alimodian silt loam	5.0	2	18	3.0	27	0.5	4.5	Low	a 27	30	270
Bantog clay loam	5.0	a 2	a 18	6.0	54	a 0.5	a 4.5	4	30	40	360
Faraon clay loam	6.5	12	108	5.0	45	0.5	4.5	Low	a 27	175	1,580
Sara sandy loam	4.0	a 2	a 18	5.0	45	a 0.5	a 4.5	Low	a 27	30	270
Sara silt loam	4.5	a 2	a 18	8.0	72	a 0.5	a 4.5	Low	a 27	20	180
San Rafael loam	5.5	a 2	a 18	6.0	54	a 0.5	a 4.5	Low	a 27	70	640
Guimaras gravelly loam	5.0	a 2	a 18	7.0	63	a 0.5	a 4.5	Low	a 27	40	360
Luisiana loam	5.5	25	225	9.0	81	0.5	4.5	11	99	50	450
Coastal beach sand	6.0	a 2	a 18	5.0	45	0.5	4.5	15	135	100	900

[a] Less than