SOIL SURVEY OF PANGASINAN

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C O N T E N T S

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INTRODUCTION

Settlement and history.- When the Spaniards came to the Philippines in 1521, a native ruler, named Kasikis, ruled a territory called Luyag na Caboloan, which included all of Pangasinan and a large part of Zambales, La Union, and Tarlac. His palace was located somewhere within the present municipality of San Carlos.

In the division of the Island of Luzon in 1587, the Dominicans were assigned to a part of Pangasinan and to all the territories of Cagayan. Kasikis became angry when the friars began converting the population to a new religion. When he was determined to put the missionaries to death he received a message from Rajah Lacandula of Tondo telling him to honor and receive the missionaries kindly. As a result, this ruler, all the members of his family, and his soldiers were baptized.

In November, 1574, Limahong, a Chinese pirate, landed on the shores of the Gulf of Lingayen with more than 2,000 soldiers, sailors, besides workmen and women, and remained up the Agno River for nearly a year, or until Salcedo burned several of their ships and drove them away. Several of them, however, remained. As a result of the invasion we find that many of the most thrifty and intelligent citizens of Lingayen and other towns in this part of the province and along the Agno River are of Chinese ancestry.

"The word Pangasinan seems to come from "Asin", salt, and "panga", region, and means a "country of salt". This is suggestive because of the great quantity of salt manufactured in this province every year.

Civil government under the American regime was established in Pangasinan on February 18, 1901. In 1903, the boundary was changed, the province acquiring the northern portion of Zambales, comprising the towns of Alaminos, Bolinao, Burgos, Mabini, Anda, Bani, Agno, and Infanta. The area of the province classified into various land features is shown in the following table.

Table 1.- Classification of the land features of Pangasinan Province

Kind of land	Area in Hectares	Per cent
Commercial forest	47,778	9.48
Noncommercial forest	18,813	3.73
Cultivated area	369,218	73.23
Open land	56,961	11.30
Fresh-water marsh	1,411	0.28
Salt-water marsh	9,811	1.94
Unexplored	179	0.04
TOTAL	504,171	100.00

a Fisher, A. F. Wealth of our Forest. The Philippines Herald Yearbook 3 (1935) 41-45.

The population according to the 1903 census was 394,516. In the 1918 census the population was 573,944. In 1935 the approximate population was 703,609, and the 1939 census recorded it as 740,293. There are 46 towns in the province.

Transportation and communication.- All the towns of Pangasinan Province, except Bolinao and Anda, are connected to the main provincial road with either first-or second-class roads. The Manila-Baguio road passes through the towns of Villasis, Urdaneta, Binalonan, Pozorrubio, and Sison. In 1936 the province had 594.2 kilometers of first-class roads and 112.1 kilometers of second-class roads. None of the rivers of the province are navigable for large river crafts. Bolinao and Anda are reached by motor boat from the barrio of Lucap, Alaminos. The Manila-Dagupan Railroad enters the province, south of Bautista and passes through Bayambang, Malasiqui, San Carlos, Calasiao, Mangaldan, and San Fabian. Besides the railroad, there are a number of bus transportation facilities which are available throughout the province.

The provincial government of Pangasinan maintains and operates a telephone system connecting all municipalities within the province. The Philippine Long Distance Telephone Company has a branch office at Dagupan and operates a local service at Dagupan besides the long-distance service.

INTRODUCTION

Public health.- Sanitary conditions, medical and dental inspection of school children and teachers, communicable diseases, health centers, industrial hygiene, and other health activities are taken care of by the Philippine Bureau of Health. A detailed account of this work is given in the annual report of that bureau.

Education.- The Bureau of Education has a provincial high school at Lingayen and elementary schools at every town and barrio. The rural high school of the Bureau of Education is located at San Carlos. Private schools, run by the Catholic Church and other private organizations, are available in most of the towns. The Far Eastern University has a junior college at Lingayen. Owing to the large population of the province, these private schools enjoy big enrollments every year.

Industries.- Agriculture is the chief industry. Fishing is also considered an important industry of the people, especially those living along the coast. The manufacture of salt is another important industry along the sea coast. The manufacture of nipa roofing, confectionery, furniture, carromatas, buri mats, Calasiao hats, slippers, baskets, fine jars, bricks, bolos, and other products is done in the various towns of the province.

The most important industry of the people living in the towns bordering the Lingayen Gulf is the manufacture of common salt. This industty is carried in the towns of San Fabian, Dagupan, Binmaley, Lingayen, Labrador, Sual, Alaminos, Bani, Bolinao, and Anda.

The method of salt making in this province is different from that employed by the people around Manila Bay. In Rizal and Cavite Provinces, salt is manufactured by evaporating sea water in salt beds located in bangos fishponds. This method is usually done during the dry season when maximum sunshine, sufficient to effect rapid evaporation of water, is available.

The saltbeds in Pangasinan are the sandy level areas below the tide level. One of such beds is shown in Plate 1, fig. 1. The sand containing the salt is gathered and placed in the filtering receptacle which is usually an old banca with holes at the bottom covered with straw to prevent the sand from passing through. Sometimes the receptacle is made up of bamboo basket, as shown in Plate 1, fig. 2. Then the sand is washed with sea water and the filtrate is collected in jars until a sufficient amount is obtained. The brine is evaporated by boiling in a big vat until salt crystallizes out (Plate 1, fig. 3).

Salt obtained by this process is clean and usually fine-grained. It has been found that salt made by this method produces salted fish (bagoong) which is of better quality than that produced with the use of the salt obtained with the solar method. Because of its better quality, the salt manufactured by the Pangasinan process commands a higher price than the common salt produced by solar evaporation.

The manufacture of salt under the Pangasinan method is expensive and slow. The cost of fuel entails a big item and limits the salt production in Pangasinan. At present the province feels already a shortage of firewood even of home use. The mountains and hills are almost denuded, and only small scattered patches of forest now remain.

PHYSIOGRAPHY AND GEOLOGY

Pangasinan Province lies along the Lingayen Gulf. It is bounded on the west by China Sea and part of Zambales Province; on the north by Lingayen Gulf, La Union Province, and Mountain Province; on the east by Nueva Vizcaya and Nueva Ecija Provinces; and on the south by Nueva Ecija, Tarlac, and Zambales Provinces.

Except on the extreme northern and eastern borders and in the western part, the province is one vast plain. The northern border is the edge of the western part of the "Central Knot", while the western part, up to the town of Sual, is the continuation of the Zambales Range. There are no active volcanoes among those mountains and the peaks are of ordinary heights. From the town of Bolinao down to Dasol the topographic feature is an alternation of plateaus and valleys. In Alaminos there is a valley with an area of several thousand hectares. There is a long stretch of coast line from Infanta to Bolinao measuring about 80 kilometers bordering the China Sea, and from Bolinao to La Union Province, there is a coast line along the Lingayen Gulf of about 100 kilometers. Along the gulf coast there are many estuaries, indentations, and islands. Cabarruyan is the largest island and Santiago is next in size.

Agno River in Pangasinan is the third largest river in Luzon. Its headwaters are in the mountains north of San Manuel and San Nicolas and it meanders its way through the plain to the Lingayen Gulf at Labrador and Dagupan. The principal tributaries are the Tarlac and Camiling Rivers.

DRAINAGE AND IRRIGATION

Geologically the vast plain of Pangasinan province is of recent alluvial deposits of the Agno River. The mountains north, east, and west of this plain consist of tertiary undifferentiated limestone with sandstone facies; marl and limestone; and tertiary and effusive rocks consisting of rhyolites, dacites, andesites, and basalts. Limestones, especially on the plateau of Bolinao and along the hills running south of Infanta, are present in considerable amount. Placer mining is found in the Bued River at Sison, and at the upper part of the Agno River at San Manuel.

DRAINAGE AND IRRIGATION

The western part of the province is drained principally by Alaminos and Balingeaguing Rivers. The town of Alaminos and vicinities are drained by the Alaminos River to the Tomboc Bay, while the Balingeaguing River drains the towns of Mabini, Burgos, and Agno to the Agno Bay. There are several small rivers which drain the region from Dasol to Infanta.

The Agno River, with headwaters in the upland of San Manuel, San Nicolas, and Natividad, irrigates a great portion of the plain of central and eastern parts of the province. The Bued and Pagulatan Rivers and their tributaries drain the north central part of the province, while the Toloring and Sinocatan Rivers drain the region between Manaoag and Caburuan. The Malabago and Ilang Rivers drain the region between the towns of Malasiqui and San Carlos. There are several small streams that join these big rivers. All of these rivers empty into the Lingayen Gulf, along the coast from San Fabian to Labrador.

The town of Dagupan and vicinities are poorly drained areas. Wide areas of agricultural land are covered with water almost throughout the rainy season. These areas could be utilized to advantage by the construction of proper drainage canals.

Irrigation water for agricultural crops, especially rice is obtained by making diversion canals from the river into the rice fields. At present, there is no government irrigation project in this province. There are few irrigation system constructed by individuals or group of farmers. A portion of the farm lands of Sison is irrigated with water from the Bued River. Sugar cane fields around the sugar central at Manaoag are irrigated by canals. The region comprising the towns of San Manuel, Urdaneta, Asingan, Tayug, San Nicolas, Natividad, and San Quintin is irriga-

ted with water from the Agno River. This irrigation work is done by the farmers themselves. Lowland rice, sugar cane, mungo, and vegetables are profitably planted with the use of irrigation water.

CLIMATE

One of the most important factors in soil development is climate. Under similar climatic condition, different kinds of rocks may develop into similar soils provided the vegetation, topography, and age of development are the same. The climate of a region determines the growing season and the types of crops to be planted. Sometimes the nature of the industries of the people is also governed by the climatic condition of the locality.

The climate of Pangasinan, like that of the other provinces in Central Luzon, consists of two well-defined seasons, namely, wet and dry. The wet season of the year is from the middle of May to the end of October, while the dry season is from December to the middle of May. The heavy rainfalls of the year occur during July, August, and September. During these months, floods and typhoons usually occur, causing damages to crops and properties, and loss of human lives. The flood of 1937, which affected the plain of Central Luzon, caused enormous damage to the province, particularly in the towns along the Agno River.

The coolest time of the year is during November, December, and January, while the hottest is during March, April, and May. In general there is slight variation in temperature throughout the year.

The rainfall of the western and northwestern portions of the province is more than that of the southern part. Bolinao, which may represent the northwestern portion, has a mean annual rainfall of 2,550.8 millimeters, while Rosales of the southern part has a mean annual rainfall of 1,883.0 millimeters. Table 2 shows the mean annual rainfall and temperature of five towns representing different sections of the province.

AGRICULTURE

The province had been a flourishing agricultural region even before the Spaniards came to the Philippines in 1521. Agriculture then, as now, was the most important industry of the region. During the early part of the Spanish occupation of the province, palay or rice, sugar cane, wheat, indigo, black pepper, tobacco, coffee, different kinds of vegetables, and several kinds of fruit trees were grown. The soils along the hillsides were found by the Spaniards suitable for the growing of wheat, black pepper, and indigo. These crops were grown extensively during that time.

At present Pangasinan is agriculturally one of the most progressive province in north central Luzon. It is considered one of the premier provinces as far as cultivated area is concerned. The total soil cover of the province is 504,170 hectares.

Diversified farming is practiced. Owing to the variety of soil types found in the province, several kinds of crops can be planted and grown in one season. Besides the annual crops there are grown also permanent crops, such as coconut, mango, citrus, cacao, coffee, and maguey. In 1935, 273,505 hectares were planted to various crops. The total production during this year was valued at 16,983,135 pesos. In 1936, the total area planted was 285,131 hectares and the total area planted was 281,435 hectares while the total crop value was 21,829,060 pesos.

In 1937, the seven leading crops of the province, from the point of view of area cultivated, were rice, corn, coconut, tobacco, banana, sugar cane, and maguey. The area planted and value of produce of these crops for three years, 1935 to 1937, are shwon in Table 3.

CLIMATE

Table 2.- Records of average monthly rainfall and temperature of several towns of Pangasinan Province.

Month	Dagupan			Rosales		
	Rainfall	Temperature		Rainfall	Temperature	
	1902 to 1936	1902 to 1936		1922 to 1930	1922 to 1930	
		Max.	Min.		Max.	Min
	mm.	°C	°C	mm.	°C	°C
January	10.1	31.7	20.8	14.6	32.7	18.6
February	14.9	32.5	20.9	11.5	33.7	18.8
March	23.4	34.3	22.3	32.2	34.4	20.6
April	74.8	35.6	23.8	66.5	35.4	20.0
May	224.3	35.1	24.2	190.0	34.7	23.1
June	228.4	33.8	24.1	290.2	32.5	23.4
July	574.5	32.1	23.8	404.8	31.8	23.2
August	540.7	31.7	24.0	407.9	31.0	23.3
September	405.8	31.9	23.9	242.4	31.6	23.2
October	182.7	32.6	23.5	148.9	32.1	22.0
November	78.9	32.1	22.4	62.9	32.4	20.3
December	22.7	31.8	21.4	11.1	32.4	18.5
Mean Annual	2,506.2	-	-	1,883.0	-	-

Month	Bolinao			Manaoag[b]	Mangatarem[b]
	Rainfall	Temperature		Rainfall	Rainfall
	1892-1932	1902 to 1932		1928 to 1932	1928 to 1932
		Max.	Min.		
	mm.	°C	°C	mm.	mm.
January	8.3	30.8	21.2	4.2	20.8
February	8.8	31.2	21.4	9.0	0.3
March	10.9	32.8	22.7	5.6	15.8
April	34.5	34.0	24.2	29.7	31.8
May	203.4	33.6	24.8	181.0	266.3
June	391.5	32.2	24.3	234.4	281.6
July	615.4	31.0	24.0	521.4	490.0
August	649.0	30.7	23.9	434.7	379.6
September	415.7	31.2	24.0	299.5	253.6
October	154.6	31.9	23.8	156.5	133.4
November	49.6	31.6	22.9	89.8	86.8
December	9.1	31.1	21.9	14.2	21.3
Mean Annual	2,550.8	-	-	1,980.0	1,981.3

[a]Data supplied by the Weather Bureau and from Se'ga, Miguel, S. J., Observation of rainfall in the Philippines. Weather Bureau, Manila (1935) 1-289; (1938) 1-96.

[b]No available temperature records.

Table 3.- Seven leading crops of Pangasinan Province with their area planted and value of produce for three years.

Crops	1935		1936		1937	
	Area planted	Value of produce	Area planted	Value of produce	Area planted	Value of produce
Rice	218,510	13,922.590	224.340	16,160,610	222,670	16,866,610
Corn	11,590	152,000	18,170	424,440	15,470	250,270
Coconut	11,760	487,880	12,140	986,520	12,200	1,610,760
Tobacco	10,130	370,960	9,760	658,280	10,490	615,720
Banana	4,910	531,050	4,799	515,870	4,783	509,870
Sugar cane	4,800	661,920	4,380	688,710	4,580	836,800
Maguey	3,830	30,400	3,940	32,200	4,130	77,420
TOTAL	265,530	16,156,820	277,529	19,466,630	274,323	20,767,440

[a]Data taken from the Bulletin of Philippine Statistic 4-6 (1937-1939).

Table 3.- Seven leading crops of Pangasinan Province with their area planted and value of produce for three years.

Rice. - Rice or palay is the most important crop of the province. Being the staple crop of the people, it is grown in every town in the province. The total area planted to this crop in 1937 was 222,670 hectares with a production valued at 16,866,610 pesos. The leading rice-growing towns are Urdaneta, Rosales, Malasiqui, San Carlos, Tayug, Alaminos, Asingan, Umingan, and San Quintin. The average yield of rice or palay in these towns ranges from 30 cavans for the Sinamporin variety to 80 cavans for the Ramai. The yield varies not only according to the variety planted, but also according to the type of soil and the method of cultivation employed.

There are three general groups of rice varieties planted, which may be classified according to the place, the time, and manner of planting.

(a) The lowland rice varieties include the Inapostol, Elon-elon, Ramai, Ramelon, Minantica, Mimis, Bulastog, Sinamporin, etc. They are planted in paddies where there is a sufficient supply of water either by irrigation or by rain throughout the growing season. Under normal conditions these varieties have an average yield of from 40 to 80 cavans per hectares. The application of commercial fertilizers for rice is not commonly practiced. In highly depleted areas, farm yard manure and to a very limited extend surface of fertile soils and commercial fertilizers are applied by scattering them in the rice field. Results on fertilized field tests conducted by the Division of Soil Survey show decided increases in yield. Irrigation water is available in the towns of San Manuel, Asingan, Tayug, Urdaneta, Sison, Binalonan, Mangatarem, Bugallon, and Aguilar.

(b) The upland rice varieties include the Bagahas, Inaropil, Mala-itiwe, Mangasa, Macaraniag, Dinalaga, Biniteweg, and Balik. These varieties are planted in upland and rolling areas where irrigation water is not available, usually in heavier soils, such as Tarlac clay loam, Annam clay loam, San Fabian clay loam Bani clay, and Bolinao clay loam. The average yield of these upland varieties in these soils ranges from 20 cavans for the Macaraniag variety to 30 cavans for the Bagahas, Mangasa, and Inaropil varieties. The low yield is partly due to poor method of cultivation and soil depletion. The soil becomes poor and depleted easily because of soil erosion, especially in rolling areas, and continuous cropping without the practice of rotation or the application of fertilizers. The problem of bringing the soil to normal fertility is being studied by the Division of Soil Survey. Preliminary field tests with commercial fertilizers were conducted in the province in 1938 and the results obtained are shown in the following table:

Table 4.- Preliminary tests with fertilizer application at the rate of 200 kilograms per hectare in Pangasinan.

Location	Soil Type	Variety of rice	Yield per hectare without fertilizer	Production per hectare with fertilizers			
				Abono Hoz. (NPK)	Corona Arroz (NPK)	Corona No. 1 (NPK)	Ammonium Sulfate (N)
			Cavans	Cavans	Cavans	Cavans	Cavans
Sual, Pangasinan	Alaminos loam	Khao Bai Sri	27.6	40.6	46.5	41.6	29.6
Bani Pangasinan	Bani clay	Birao	26.5	48.1	47.5	43.5	26.5

Fertilizer studies and experiments on rice are still being conducted by the Division with the object of determining the fertilizer requirements of the different soil types of the province.

(c) The usual varieties of rice planted by the palagad system of cultivation are Saigorot, Macaraniag, Sipot, and Mangasa. The palagad system is the growing of rice during the dry season in places where irrigation water is available.

The towns planting palagad rice varieties are Bugallon, Aguilar, and Mangatarem on the western side, and San Manuel, Umingo, Urdaneta, Asingan, Tayug, and Binalonan in the central and eastern parts of the province. The yield under the palagad system ranges from 40 to 50 cavans per hectare depending upon the variety, type of soil, and sufficiency of irrigation water. A number of fertilizer experiments are being conducted on palagad culture every year and the results obtained so far are encouraging. This work will be repeated for a number of years before conclusion can be drawn. However, the results thus far obtained show that certain commercial fertilizer applications increase the yield per hectare.

Corn.- Corn, or maiz, is the second important crop, considering hectarage or extend of cultivation. In some places corn is intercropped with upland rice. Generally, this crop is planted on well-drained sandy loam soils, such as the San Manuel series along both sides of the Agno River from the town of Tayug down to the mouth of the river. It is also planted on rolling lands of the province on such soils as the Alaminos soils, Bani soils, Annam soils, and Tarlac soils. The leading towns growing corn are Aguilar, San Carlos, Mangatarem, Bugallon, Tayug, Bayambang, Malasiqui, Urdaneta, and Urbiztondo.

The varieties planted in this province are mostly the white and the yellow flint. A white glutinous variety is also planted in small areas. Corn is a heavy feeder, depleting the soil of its fertility faster than do other crops. When corn is rotated with upland rice, soil depletion becomes much more rapid. Under this system the yield of either corn or rice is so low that such farming becomes unprofitable. It is suggested that where upland rice is planted especially in rolling upland areas, corn, without the use of fertilizers or the practice of green manuring, should not be used in rotation.

Corn for forage is being grown during the dry season in the towns of Pozorrubio, Manaoag, San Fabian, San Jacinto, and Mangaldan. Drilled or broadcast on fertile soil, corn grows tender, slender, and low, thus increasing its palatability as forage.

Coconut.- Coconut occupies an area of about 12,200 hectares with a total value of production of 1,210,750 pesos in 1937. Lingayen, Labrador, Sual, Binmaley, Calasiao, Dagupan, San Fabian, and Agno are the principal coconut-growing municipalities. In some of the interior towns with light soils coconut planting was still going on at the time of the survey. In 1937 there were 2,846,010 trees planted in the whole province. The trees of bearing age were about 2,156,250. Coconut products in this province are copra, home-made coconut oil, tuba, and native coconut candy. The making of coconut candy, locally known as bucayo, is one of the most important home industries in the towns growing coconut. With proper care and management the province may become one of the best coconut regions of the Philippines. Ipil-ipil may be planted between coconut trees to good advantage.

Tobacco.- Tobacco is planted only in a small number of towns in the province. The leading towns growing tobacco are Sta. Maria, Balungao, Umingan, San Jacinto, San Fabian, Urdaneta, Manaoag, Pozorrubio, Alcala, and Bautista. In 1937, the area planted to tobacco in this province was 10,490 hectares and the total value of produce was 615,720 pesos. The yield per hectare of leaf tobacco averages 9.02 quintals. This is a little higher than the yield in Ilocos Norte, Abra, and Cagayan. Tobacco is planted mostly on sandy soils to silt loam of San Manuel series which is one of the most productive soils of the province. Fertilizer application in connection with tobacco culture is not practiced. The tobacco produced in Pangasinan is not of good quality, but scientific methods of cultivation, such as improved tillage and application of proper fertilizers, will materially improve the quality and increase the yield.

Banana.- Banana, a common fruit in the Philippines, is produced on a limited scale in all the towns of Pangasinan. However, there is no regular banana plantation of any area. Banana is usually planted in backyard and along the sides of fields. The principal banana producing municipalities are San Carlos, Malasiqui, Bautista, Villasis, Urdaneta, Calasiao, Santa Barbara, Mangaldan, and Manaoag. In 1937, the area planted to banana was 4,783 hectares. The total production of the province for that year was 1,961,030 bunches valued at 509,870 pesos. The average yield per hectare was 410 bunches. The most common varieties of banana grown in this province are Saba, Latundan, Bungulan, Lakatan, and Ternate. Bananas when planted and taken are of properly would yield an income much more than upland rice. Where the soil is already depleted of its fertility, the area may be planted to bananas provided leguminous crops are also planted between the rows.

Sugar cane.- Sugar cane, although one of the important crops of the province, is planted only in a comparatively small area. The total area planted in 1937 was 4,580 hectares and the total value of produce was 836,800 pesos. There is only one sugar central in the province and it is located at Manaoag. The capacity of this central is 400 tons of cane per 24 hours. The towns producing sugar cane are Bayambang, Santa Barbara, Malasiqui, Bautista, Mapanoam, Manaoag, and San Carlos. The varieties of cane grown are P. O. J. 2878, Badila, H-109, Pampanga red, and Luzon white. The average yield per hectare is 65 piculs, while in the Arayat district in Pampanga is 60 piculs.

Commercial fertilizer is applied at rates ranging from 250 to 300 kilos per hectare. Sulphate of ammonia is the common fertilizer used, especially in the sandy soils of the San Manuel series. Leunaphos, Ammo-phos, and complete fertilizers are used with very favorable results. Besides centrifugal sugar, muscovado, basi, and molasses are manufactured from sugar cane. Basi is a home-made wine from sugar cane juice and rivals in quality the coco wine of Laguna and Tayabas made from Tuba, or the juice of coconut.

Maguey.- Maguey is a fiber plant adapted to dry climate and poor soil. This is one of the leading agricultural crops of the province. The area planted to maguey in 1937 was 4,130 hectares and the total value of produce was 77,420 pesos. Most of the maguey crops are grown in the towns of Bolinao, Anda (Cabarruyan Island), Agno, Bani, Dasol, Burgos, and Infanta.

The soils in the area planted to maguey are Bolinao clay loam, Bani clay, Alaminos sandy loam, Alaminos loam, degraded phase and Alaminos soil, undifferentiated. The rolling area of these soils which is badly depleted owing to over cropping and overgrazing has been profitably utilized for the planting of maguey. The yield in this area is 4.33 piculs of fiber per hectare. This yield is very low compared with the yield obtained in Oriental Negros, which is 20.69 piculs of fiber per hectare, that in Cebu, which is 16.90 piculs, and that in Bohol, which is 15.69 piculs. The yield in Pangasinan is, however, similar to the yield in Zamboanga (4.84 piculs) and Ilocos Norte (3.17 piculs per hectare). Rehabilitation of the maguey industry in this province can be made by planting ipil-ipil trees along the rows or by planting the whole area with ipil-ipil for a few years, and then opening it again for maguey. Additional benefit that may be derived there-from is the production of a sufficient supply of firewood from the ipil-ipil trees, which material is at present lacking in these towns.

Fruit crops.- The fruit trees of the province show richness in variety. Among these, mango, papaya, pomelo, pineapple, mandarin, duhat, makopa, anonas, guayabano, atis, chico, mabulo, kasui, tamarind, rimas, nangka, and lansones are the most important. In 1937, the total area planted to fruit trees was 2,727 hectares and the total value of produce was 332,090 pesos. Mango occupied the largest area planted. In 1937, there were 1,871 hectares planted to mangoes with 100,590 trees. About 54,000 trees were of bearing age with an average of 230 fruit trees per year. This yield was about normal compared with the yields in other provinces, as for example, those in Pampanga, Tarlac, Zamboanga, Capiz, and Isabela. Nueva Vizcaya had the highest average yield, which was 350 fruits per tree.

The fruit trees are grown mostly in rolling lands of the province, especially in the western part which can be planted to other crops. The Bolinao Plateau where the soils are derived from coralline limestone is good for citrus trees.

Root crops.- The root crops of the province are sweet potato, cassava, gabi, tugi, ubi, and Irish potato. In 1937, 1,777 hectares were planted to root crops and the total value of produce was 116,900 pesos. Sweet potato had the largest area planted, which was 955 hectares. The sandy soils of the San Manuel series are best suited to the growing of root crops. Gabi, tugi, and ubi may be grown extensively on San Manuel fine sandy loam and San Manuel sandy loam. Cassava may also be grown commercially with success in these types of soils especially if properly fertilized. The yield of cassava roots in this province ranges from four to six tons per hectare. This yield is about the average yield for the whole Philippines. In Pampanga province, the yield reaches as high as 40 tons of cassava roots per hectare with the use of commercial fertilizers.

Vegetables.- Beans and other vegetables are grown in considerable amounts in the province. Next to rice, mungo and other beans are the most widely grown crops in central and eastern Pangasinan, in places where there is irrigation water. After the harvest of rice the field is flooded and then mungo is broadcast. This rotation of legume with rice accounts for the maintenance of soil fertility to a certain extend. The yield of rice in those regions is very much higher than in other parts of the province, where mungo and other beans are not rotated with rice.

Other minor crops of the province are Kapok, cotton, cacao, coffee, pili nut, forage grass, and lumbang. The total area planted to these crops in 1937 was 237 hectares and the total valued of produce was 53,530 pesos. Kapok trees may be planted in any type of soil. Such trees have been planted as fence posts around fields. Cotton has been found to grow successfully, especially on light soils where there are good drainage and abundance of moisture. Cacao and coffee, which thrive in high altitudes, may be planted in the higher portion on the eastern side of the province. On the western side of the province, when soil conditions are favorable, pili nut may be grown. Because of the scarcity of trees in this region, the planting of fruit trees would help in the reforestation program of the province.

Livestock.- The livestock lands in the towns is not well developed. The pasture lands in the towns of Anda, Dasol, Agno, Bolinao, and Burgos are not suitable to extensive raising of cattle, goats, and horses. A number of poultry project in the central and eastern parts of the province supply to a certain extent the eggs and chickens for local consumption.

The province is highly agricultural. With the use of modern agricultural methods, particularly in cultivation, fertilization and farm management, the yield per unit area can be increased.

At present all the soils of the province, as classified, are under cultivation to various crops, as shown in Table 5.

Table 5.- Area, location, and principal crops grown in each soil type in Pangasinan.

Type No.	Soil Type	Area Hectares	Location	Uses
1	Pangasinan hydro-	7,398.36	Municipalities of Labrador, Lingayen, Binmaley Dagupan, and San Fabian along the coast.	Fishponds, nipa, palm and mangrove trees; salt beds during dry season.
91	Pangasinan beach sand	3,051.44	Along the Gulf coast from barrio Uyong of Labrador to San Fabian.	Coconut, vegetables, and salt beds.
92	Pangasinan river sand	6,662.80	Along the river beds and river sides of northern and eastern Pangasinan.	Waste land
93	Pangasinan fine sand	7,118.37	Calasiao, Lingayen, Dagupan, and Mangaldan.	Lowland rice, corn, vegetables and a little of sugar cane.
77	La Paz fine sand	1,588.53	In the municipality of Bautista, near the Tarlac Pangasinan boundary.	Corn, tobacco, and vegetables.
82	San Manuel silt loam	65,219.01	Lowlands of Bautista, Sto. Tomas, Rosales, Balungao, Sta. Maria, Urdaneta, Malasiqui, San Carlos, Calasiao, Manaoag, and Mangaldan	Lowland rice, corn, sugar cane, coconut, banana, fruit trees, cassava, camote, tobacco, and vegetables.

Table 5.- Area, location, and principal crops grown in each soil type in Pangasinan Province.

Type No.	Soil Type	Area Hectares	Location	Uses
94	San Manuel silty clay loam	17,894.76	Portions of Bugallon Mangatarem, Aguilar, Sta. Barbara, San Jacinto, Pozorrubio, Binalonan, and Manaoag.	Lowland rice, corn, sugar cane, vegetables, banana, citrus, and tobacco.
95	San Manuel fine sandy loam	42,026.02	Along the Agno River in Bugallon, San Carlos, Urbiztondo, Bayambang, Bautista, Villasis, also Sta. Barbara, San Jacinto, Manaoag, Mapandan, and San Fabian.	Rice, corn, sugar cane, vegetables, banana, citrus, and tobacco.
96	San Manuel sandy loam	23,871.16	Binalonan, San Manuel Asingan, Tayug, San Quintin, and Sta. Maria.	Lowland rice, banana (mungo and cowpeas) sugar cane, legumes, fruit trees, and tobacco.
97	San Manuel sand	8,852.00	Along the Agno River from barrio Mabalbalino, Lingayen to Villasis and Rosales; also at Sta. Maria and Tayug.	Corn, watermelon, peanut, vegetables, and root crops such as gabi.

Table 5.- Area, location and principal crops grown in each soil type in Pangasinan Province.

Type No.	Soil Type	Area	Location	Uses
86	Tarlac clay loam	4,902.95	Southern part of Mangatarem, barrio Caridad of Umingan and also Malasiqui.	Lowland rice, corn, banana, and a little of sugar cane.
88	Tarlac clay loam lowland phase	1,803.30	In the municipality of Mangatarem near the Pangasinan-Tarlac boundary.	Lowland rice, corn, coconut, vegetables, and fruit trees.
64	Tarlac soil, undifferentiated	3,171.06	Headwaters of Bacalan creek, in Mangatarem.	Forest and deforested areas, kaingin fields.
98	Annam clay loam	52,051.58	The highlands and mountains of the northern and northeastern parts of Pangasinan.	Forest; kaingin planted to upland rice, camote, and banana.
99	Umingan silt loam	16,186.04	Umingan, San Quintin, Pozorrubio, and Sison.	Lowland rice, corn, mungo, and other beans, tobacco, camote, sugar cane & banana.
100	Umingan sandy loam	10,557.84	Sison, San Nicolas, and Natividad.	Lowland rice, corn, mungo, tobacco, sugar cane, banana, and camote.
101	Umingan fine sand	4,842.35	San Manuel and vicinities.	Lowland rice with irrigation, corn, camote, camachili trees, and banana.

Table 5.- Area, location and principal crops grown in each soil type in Pangasinan Province.

Type No.	Soil Type	Area	Location	Uses
102	San Fabian clay loam	17,063.72	Manaoag, Pozorrubio, San Fabian, Balungao, Urdaneta and Malasiqui.	Sugar cane, tobacco, upland rice, banana and fruit trees.
103	Alaminos loam	63,399.96	The rolling lands from Mangatarem to Labrador, Sual, Alaminos, Mabini, Dasol and Infanta.	Upland and lowland rice, banana, and a little of tobacco and corn.
104	Alaminos loam, degraded phase	6,679.72	Cabarruyan Island	Upland and lowland rice, banana, corn, a little of sugar cane, and fruit trees.
105	Alaminos sandy loam	16,481.72	Burgos, Dasol, and Infanta.	Mostly pastures, upland rice, a little of tobacco and banana.
106	Alaminos soil, undifferentiated	52,908.95	Mountain regions from Mangatarem to Labrador and Infanta.	Forest, kaingin for upland rice.
107	Bani clay	45,295.64	Bani, Alaminos, Agno Burgos and Mabini.	Upland and lowland rice, banana, coconut and tobacco.
108	Bolinao clay loam	25,143.72	Bolinao Plateau	Upland rice, corn, banana, and a little of tobacco and coconut.

PANGASINAN SOILS

The soils of Pangasinan Province represent a wide range in age or stage of development, from young soils of comparatively recent deposits of alluvial material, to old soils with some accumulations of limestone precipitates and colloidal material in the subsoil and a firmly cemented material or hardpan in the lower subsoil or in the substratum. The younger soils are located in the plain or valley floor and in alluvial fans. The semimatured soils are in the higher terraces and the matured soils on the upland mesas, or tablelands, and mountain areas.

The soils considered important agriculturally are those formed from materials which are of rather recent deposition representing the young or immature stages of development. The inherent properties of the parent rock material are readily traced to these young soils. In due time, however, the soils will reach a mature stage. The properties of the resulting soils are those which are influenced by the climate, vegetation, topograph, and age.

Those soils which are light in texture and young are preferred for agricultural purposes. Consequently, agricultural development of the province began in these soils. It was due to the necessity of agricultural expansion that areas in heavier and poorer soils were utilized and occupied.

The dominant geological parent materials of the soils of the province are of four classes, as follows: (a) The area consisting of the young soils of alluvial deposition derived from the disintegration and decomposition of different rocks in the mountains in the northern and northeastern parts of the province. The geological materials had been carried and deposited by the waters of the Agno and Bued Rivers. (b) The area on the northern and northeastern parts consisting of basalts, andesites, rhyolites, and dacites. (c) The area consisting of the Alaminos soil derived from basaltic rocks. (d) The area consisting of Bani soils derived from white fine-grained water-laid tuff together with the Bolinao soils which originated from coralline limestone rocks.

Soil series, types, and phase.- The system of soil classification groups the soils according to their characteristics both internal and external, emphasis being given to those features influencing the adaptation of land for the growing of crop plants, grasses, and trees. On the basis

of these characteristics, soils are grouped into classification units, the three principal ones being soil series, soil type, and phase.

A series includes soils having the same range of color, the same characteristics of profile as regards constitution and structure, the same natural drainage condition and relief, and a common or similar origin.

Within a soil series are one or more soil types, defined according to the texture of the surface soil thus a soil texture, such as sand, loamy sand, loam, silt loam, clay loam, clay, etc., is added to the name of the series so as to give the complete name of the type. The San Manuel silt loam and San Manuel fine sandy loam are types within the San Manuel series. Except for the texture of the surface soil, these soil types have approximately the same external and internal characteristics. Because of its specific character, the agronomic value of the soil type is very much related to that of the soil series.

A phase of the soil type differentiates the soils within a type in some minor soil characteristics that may have important practical significance. For example, differences in slope within the range of the relief, stoniness, degree of erosion, and heaviness of texture are frequently shown as phases.

The following example illustrate the significance of the word "soil type".

Series: Guadalupe. This means a group or an area of dark gray to nearly black soil; the reaction ranges from slightly acidic to alkaline, usually sticky, plastic and oftentimes wazy in clay area; developed from a massive volcanic tuff material. The area is rolling to nearly flat and level; surface soil sometimes very shallow, barely covering the parent material.

Texture: Clay. Means the soil contains more than 30 per cent clay, the rest being silt and sand.

Type: Guadalupe clay. Dark-gray to nearly black, slightly acidic to alkaline, sticky, plastic and sometimes wazy clay, surface soil. Developed from massive vol-

canic tuff material. Area is rolling to nearly flat and level; surface soil very shallow, barely covering the tuffaceous materials.

The soil series, types, and phases of Pangasinan Province are as follows:

1. Pangasinan series
   (a) Pangasinan hydrosol
   (b) Pangasinan beach sand
   (c) Pangasinan river sand
   (d) Pangasinan fine sand

2. La Paz series
   (a) La Paz fine sand

3. San Manuel series
   (a) San Manuel silt loam
   (b) San Manuel silty clay loam
   (c) San Manuel fine sandy loam
   (d) San Manuel sandy loam
   (e) San Manuel sand

4. Tarlac series
   (a) Tarlac clay loam
   (b) Tarlac clay loam, lowland phase
   (c) Tarlac soil, undifferentiated

5. Annam series
   (a) Annam clay loam

6. Umingan series
   (a) Umingan silt loam
   (b) Umingan sandy loam
   (c) Umingan fine sand

7. San Fabian series
   (a) San Fabian clay loam

8. Alaminos series
   (a) Alaminos loam
   (b) Alaminos loam, degraded phase
   (c) Alaminos sandy loam
   (d) Alaminos soil, undifferentiated

9. Bani series
   (a) Bani clay

10. Bolinao series
    (a) Bolinao clay loam

The area and percentage of various types are shown in Table 6.

Table 6.- Area and percentage of each soil type mapped in Pangasinan Province.

Type No.	Soil Type	Area	Per cent
1	Pangasinan hydrosol	7,398.36	1.44
91	Pangasinan beach sand	3,051.44	0.60
92	Pangasinan river sand	6,662.80	1.32
93	Pangasinan fine sand	7,118.37	1.21
77	La Paz fine sand	1,588.53	0.31
82	San Manuel silt loam	62,219.01	12.94
94	San Manuel silty clay loam	17,894.76	3.55
95	San Manuel fine sandy loam	42,026.02	8.33
96	San Manuel sandy loam	23,871.16	4.73
97	San Manuel sand	8,852.00	1.75
86	Tarlac clay loam	4,902.95	0.97
88	Tarlac clay loam, lowland ph.	1,803.30	0.36
64	Tarlac soil, undifferentiated	3,171.06	0.63
98	Annam clay loam	52,051.58	10.32
99	Umingan silt loam	16,186.04	3.50
100	Umingan sandy loam	10,557.84	2.09
101	Umingan fine sand	4,842.35	0.96
102	San Fabian clay loam	17,063.72	3.38
103	Alaminos loam	63,399.96	12.57
104	Alaminos loam, degraded phase	6,679.72	1.32
105	Alaminos sandy loam	16,481.72	3.27
106	Alaminos soil undifferentiated	52,909.95	10.49
107	Bani clay	45,295.64	8.98
108	Bolinao clay loam	25,143.72	4.98
	TOTAL - - - - - - -	504,171.00	100.00

The figures for areas of the several soil types have been obtained by the use of planimeter. Areas thus determined are totals and show no deductions for space occupied by roads, rivers, houses, towns, or for other non-agricultural areas.

PANGASINAN SERIES

The Pangasinan series consists of soils found along the mouth and beds of the Agno, Calmay, and Bued Rivers. These are mostly sands accumulated from various sources through the agency of streams. Because of the similarity of origin and mode of information, the differ soils were placed under one series name. The types are as follows:

Pangasinan hydrosol.- This soil is under water during the greater part of the year. Such soil is found in swamps, nipa, and mangrove areas, fishponds, and salt beds. The soils in

salt beds are usually pale-gray to brownish-gray sand; the fishpond soils are a mixture of silt, sand, and a very small amount of clay; the soils in the nipa and mangrove areas are a mixture of organic matter, a small amount of clay and a large quantity of silt and sand. Thousands of hectares under this type are adapted for fishpond purposes.

Pangasinan beach sand.- This type of soil consists of sandy areas along the beach from the town of San Fabian to Sual. The sand is usually greenish gray and fine in texture. There are many silt beds within this type.

Pangasinan river sand.- This type consists of sandy areas along the river flood plains and river beds. It is characterized by the presence of some gravel both in the surface soil and in the subsoil. It is greenish gray, mixed with whitish and brownish shades. A large portion of this type is located at the mouth of the Bued River and in eastern Pangasinan along the headwater of the Agno River.

Pangasinan fine sand.- This type consists of reddish-brown fine sand along the elevated portions of the hydrosol areas. It is planted to rice during the rainy season and vegetables during the dry season. Portions of it that are reached by the tide-water are converted into salt beds during the dry season and fishponds during the rainy season.

LA PAZ SERIES

This series is the continuation of the same soil found in Tarlac Province. As it occurs in Pangasinan, the area is comparatively insignificant. The soil consists of brownish-gray to ash-gray loose surface soil and pale-gray to yellowish-gray porous sandy subsoils. The lower subsoil and substratum contain a small amount of gravel. In Tarlac and Pampanga Provinces this series is considered one of the most productive soils. A number of vegetables, such as eggplant, radish, pechay, and beans are grown on this soil. Sugar cane is the principal crop grown. La Paz fine sand is the only type of this series found in Pangasinan.

SAN MANUEL SERIES

This series is a continuation of the soil series established in the northeastern part of the province of Tarlac. It is the largest series in area in Pangasinan and is totally devoted to agriculture.

The soil consists of pale-brown, light-gray to pale brownish-gray surface soil and a brown to grayish-brown subsoil ranging in depth from 70 to 110 centimeters. The substratum is yellowish-brown to reddish-brown fine to medium sand. The surface soil when wet is brown to pale brown. Generally, the soil is of recent alluvial origin, with the Agno and the Bued Rivers as the main agencies of formation. The series occurs in low-lying and flat areas, and is, therefore, subject to floods during the rainy season.

The surface soil of the uncultivated area is compact and cracks into big clods when dry. Boring with auger is somewhat difficult until the moist layer is reached. Where the water table is shallow, the soil is always planted throughout the year. Mungo is planted just after the rice is harvested. Where the water table is deep and the soil has sufficient moisture content, corn and vegetables are grown after rice. In places where the water table is very deep, the field is allowed to fallow after rice is harvested.

In uncultivated areas the natural vegetation is mostly cogon some agingai, and mangrove and swamp types of trees like talisai. Kamachili, bamboo, and some shrubs are also found.

Rice is the prinvipal crop grown in this series. However, corn, sugar cane, banana, coconut, tobacco, vegetables, and a number of other crops are also grown.

There are several types of this series ranging from sand to silty clay loam.

San Manuel silt loam.- The surface soil is of pale brownish-gray to light grayish-brown silt loam and with brown to grayish-brown loam subsoil. When wet it is brown. The substratum is yellowish-brown to reddish

brown fine to very fine sand to sandy loam. The depth of the surface soil varies from 25 to 35 centimeters, while that of the subsoil ranges from 70 to 85 centimeters. The substratum is sandy.

In the undisturbed and dry condition the soil is almost compact and hard, and cracks into big clods. The cracks allow considerable amount of moisture to evaporate. When plowed and harrowed with optimum moisture content, this soil type produces a good tilth, making a very fine mulch during the dry season. Under this condition the surface soil is porous, somewhat cheesy and dusty.

The profile description of the typical silt-loam type is as follows:

San Manuel silt loam

Depth of soil cm.	Characteristics
0-40	Grayish-brown to pale-brown silt loam. Coarse granular and friable. Surface soil is brown when wet. Makes good tilth when plowed at optimum moisture content.
40-80	Yellowish-brown to pale-gray silt loam with splotches of yellowish brown.
80-120	Darker in color than the above horizon, heavy silt loam, coarse granular to cloddy in structure. Slightly friable.
120-160	Yellowish-brown to light-brown fine sandy loam to fine sand.

This profile was noted on a highly eroded rice field near kilometer 190 of the Urdaneta road.

Lowland rice with irrigation is the principal crop on this soil. However, not all the area of this type is under irrigation owing to the differences in elevation. Areas near creeks and rivers where irrigation is available are devoted to lowland rice.

On slightly elevated areas sugar cane is grown. These upland areas are located within the towns of San Carlos, Calasiao, Sta. Barbara, and Malasiqui. Only a small portion of the silt-loam type is planted to tobacco. Banana plantings between young coconut trees were found in the barrio of Talospating, Malasiqui. In the vicinities of Urdaneta and Villasis, mungo is planted in rotation with rice. Vegetables of various kinds grow well in this type of soil. Under proper cultivation and management intensive vegetable farming may be profitably carried on in this soil type.

San Manuel silty clay loam.- The surface soil is brownish gray to dark-gray silty clay loam. Its depth ranges from 25 to 30 centimeters, and below this is a reddish-brown fine sand substratum. The subsoil and substratum vary in depth depending upon the elevation of the area.

This type occurs in three places in the north-western part of Pangasinan. One area of this type is located on the lowland of San Jacinto; another is along the road between Santa Barbara and Mangaldan; and the third is between Binalonan and Manaoag-Pozurrubio.

Rice is the principal crop grown on this soil. Because of excess water and poor drainage, the soil cannot be planted to other crops after the harvest of rice.

San Manuel fine sandy loam.- The surface soil of this type is loose, fine granular, and very friable, brownish-gray fine sandy loam. Its depth ranges from 25 to 35 centimeters. The subsoil is dark brownish-gray sandy loam with a depth of 60 to 70 centimeters. Below this horizon is reddish-brown fine sand.

This type is located along the flood plains of Agno, Bued, and Aloragat Rivers, adjacent to San Manuel sand. The drainage is fairly good. This soil is considered one of the most productive soil types in the province, adapted for different kinds of crops, such as rice, corn, tobacco, banana, vegetables, camote and cassava. However, this area is subject to frequent floods.

San Manuel sandy loam.- The sandy-loam type of the San Manuel series consists of brown to light grayish-brown sandy loam surface soil ranging in depth from 30 to 35 centimeters. The subsoil is loam to silt loam, grayish brown to brown, somewhat gritty owing to the sandy texture. Its depth varies from 50 to 70 centimeters. Below this zone is light reddish-brown fine sand.

This type is located in the eastern part of the province, between the region of Binalonan-Urdaneta-Villasis and Tayug. This is also one of the most productive soils of the province. It has sufficient moisture content throughout the year; consequently, it is capable of being cultivated even during the dry season.

Rice is the principal crop, with mungo and cowpea in rotation. The average yield of rice per hectare ranges from 50 to 65 cavans.

San Manuel sand.- This type consists of brownish-gray loose fine to coarse sand from the surface down to the underlying reddish-brown sand. This type is usually found along the flood plains.

TARLAC SERIES

The Tarlac series was first established in Tarlac Province. It consists of light-gray, gray, dark-gray to nearly black granular to cloddy surface soils. When dry, they are hard, compact, and crack into big clods. The subsoil, or "B" horizon, is gray, dark-gray to nearly black, columnar to coarse-granular clay loam with accumulation of lime precipitates. In some places, besides the limestone precipitates, the subsoil contains several iron concretions and white specks scattered throughout the horizon. The parent material is whitish-gray fine-grained water-laid tuffaceous rock.

In deforested areas the vegetation is mostly cogon with thinly scattered trees of duhat, binayoyo, alibangbang, bamboo, kasui, ligas, and guava. In highly depleted areas only a few shrubs eroded, exposing the limestone precipitates throughout the surface. Lowland rice is the

most important crop of the lowland area. In the upland, upland rice, banana, and fruit trees are grown.

Tarlac clay loam.- The surface soil of this type is gray to grayish-brown clay loam with a depth varying from 35 to 40 centimeters. Below this horizon is a zone of lime precipitates and iron concretions scattered throughout the subsoil. The substratum is pale-gray to ash-gray sandy clay which is silty and friable. The area is slightly rolling to nearly level land devoted to the cultivation of rice, coconut, fruit trees, and vegetables.

The surface soil of this phase is extremely susceptible to erosion. It cracks when dry and when soaked the big clods are easily carried away by water forming a gully. In neglected places the soil is badly eroded.

Tarlac clay loam, lowland phase.- The surface soil of this phase is deeper than that of the clay-loam type. The "B" horizon, which contains the limestone concretions, varies in depth from 85 to 110 centimeters from the surface.

This phase is devoted to lowland rice. The yield ranges from 35 to 50 cavans per hectare. Coconut, fruit trees, and vegetables are also planted on a small scale.

Tarlac soil, undifferentiated.- The area is mountainous and is covered with forest. This condition makes the delineation of the soil boundaries very difficult. Examination, however, showed that the soil belongs to Tarlac series.

ANNAM SERIES

The soils of the Annam series consist of grayish-brown, light reddish-brown to reddish-brown surface soils and reddish-brown to brick-red subsoils. The substratum is highly weathered parent material and is reddish-brown to yellowish-red loam. There is no distinct or marked horizon of differentiation in the profile except in the variation of concretions and gravel accumulation in the lower subsoil horizon.

The difference between this series and the Alaminos series is that the Alaminos soil is loose and sandy in texture while the Annam series is slightly compact and heavier in texture both in the surface soil and in the subsoil. There are plenty of concretions in the Alaminos series, while in the Annam series only an occasional amount of gravel and concretions is scattered in the subsoil. The Annam series is developed from a variety of highly weathered rock materials, occuring extensively throughout the area, while the Alaminos series has developed purely from basaltic rocks.

The topographic feature of the Annam series is rolling to hilly and mountainous. The series consists of the deforested area of the eastern mountain regions of Pangasinan and the savanna in the southeastern part toward Nueva Ecija.

Upland rice is the principal crop grown in this kind of soil. This soil could be utilized for other crops especially fruit trees provided cover cropping is practiced to prevent or minimize erosion. Severe erosion has already taken place, as observed during the survey.

Annam clay loam.- In plowed condition the surface soil is friable, slightly loose and granular loam with some gravel. The depth of the surface soil ranges from 30 to 50 centimeters. Because of the presence of organic matter the upper surface soil is darker in color than the subsoil. The subsoil down to a depth of 80 centimeters or more is reddish brown with concretions and gravel accumulation. The substratum is friable, yellowish-red highly weathered parent material.

The deforested areas are utilized mainly for grazing, but because of long dry seasons, grasses are not sufficient for the livestock throughout the year. Agricultural improvement of this soil may be brought about by planting the area with trees and cover crops, especially with ipil-ipil. This is due time, will modify to some extent the environmental conditions of the area and at the same time give the soil sufficient time to further develop the surface soil and increase its organic-matter content.

A typical profile with actual field measurements, taken at the barrio of Cabalitaian, San Nicolas, along the road to Nueva Vizcaya, is as follows:

Annam clay loam

Depth of soil cm.	Characteristics
0-20	Brown, slightly loose, granular and gravelly loam to clay loam; presence of organic matter in the upper surface soil; sticky when wet.
20-50	Light reddish-brown, slightly compact and friable loam, heavier in texture than the above horizon.
50-80	Chocolate-brown to reddish-brown, friable loam to clay loam with gravel accumulation and concretions.
80-120	Reddish-brown loam with iron concretions; yellowish-red spots scattered about the zone; friable and granular.
120-160	Yellowish-red loam; parent material, soft, and friable.

Umingan Series

The soils of the Umingan series consists of brown, yellowish-brown to light reddish-brown surface soils and subsoils. The lower subsoils consist of a horizon of an accumulation of gravel and small stones with individual size ranging 3 to 8 centimeters in diameter. From this horizon extends a layer of soil of an indefinite depth. The accumulation of gravel and small stones is the distinguishing characteristic of this series.

The topographic feature of this series is slightly rolling to level areas. The soils were considered good during the first few years after the opening of the forest

area. Because of the continous cropping and excessive erosion, the soils become very unproductive and in some cases it does not pay to farm them.

On uncultivated areas the most common plants are cogon, agingai, and talahib. Kamachili, some binayoyo, and alibang-bang trees are also found.

Rice is the principal crop grown on this soil. Because of insufficient moisture the land is fallowed during the dry season, or until the next rice season. In certain sections, especially around the town of Sison where irrigation water from the Bued River is available for small areas, minor crops such as corn, camote and various vegetables are also grown.

Umingan silt loam.- A typical profile description of this type is as follows:

Umingan silt loam

Depth of soil cm.	Characteristics
0-30	Brown, friable, loose, and fine granular silt loam, chocolate-brown, friable, and fine granular silt loam, heavier than the above horizon, and no marked horizon differentiation.
60-100	Light reddish-brown, friable, and fine granular loam.
100-150	Gravel and small stones of considerable individual size, as large as 8 centimeters in diameter, are present.

This type of soil is undoubtedly of recent alluvial soil deposit.

The most common plants in the uncultivated areas are cogon and talahib. During the dry season the soil is so dry that no economic crops can be raised. There is not a single flowing stream during the dry season. During the rainy season, water rushes into floods along canals and quickly accumulates in the lowlands.

Umingan sandy loam.- The surface soil of this type is yellowish-brown sandy loam ranging in depth from 20 to 25 centimeters. The subsoil is gravelly and loose. Below it is a zone of an accumulation of gravel and small stones to a depth of 80 centimeters.

Around the towns of San Nicolas, Natividad, and Sison large areas of this soil type are under irrigation. Because of the availability of irrigation water, lowland rice is the principal crop and its planting season starts as early as the middle of May. Mungo, corn, and tobacco are planted in rotation with rice.

Umingan fine sand.- The surface soil of this type consists of yellowish-brown fine sand to a depth of 30 to 45 centimeters. Below this horizon is an accumulation of gravel and small stones which is very near the surface in some areas.

This type is located between the headwaters of Milara and Agno Rivers. Kamachili, aroma trees, and bamboo are found growing on this soil. The open area is planted to rice, corn, camote, tobacco, and other economic crops.

San Fabian Series

The soils of this series consist of very dark-brown to dark-gray gritty surface soils and grayish-brown to dark-brown subsoils. When dry, the surface soil is coarse to cloddy and hard; when wet, it is fine granular, but sticky, or it puddles when it is worked. The substratum is a mixture of gravelly materials and highly weathered chalk-white soft rock. Within the series are included areas that are reddish-brown from the surface down to the parent material. These areas, however, occur only in small patches and cannot be delineated on the map because of the scale. They are, however, noted down.

The topographic feature of this series is hilly to rolling and only small areas which are slightly level are found here and there. Rice, which is the principal crop in this type, is planted in terraces. The buri palm is the characteristic vegetation growing on this soil. In hilly areas cogon takes the place of trees that were cut.

San Fabian clay loam.- A typical profile description of this type, taken near Balungao hills along the road from Rosales, Pangasinan to Guimba, Nueva Ecija, is as follows:

San Fabian clay loam

Depth of soil cm.	Characteristics
0-25	Dark-brown to dark-gray clay loam, nutty to cloddy in structure; gravelly and plastic when wet, hard and cloddy when dry.
25-45	Grayish-brown clay loam; granular to nutty in structure; cloddy when dry, sticky and plastic when wet.
45-120	Pale-gray to whitish-gray, soft, cheesy, or powdery, clay loam to clay; highly weathered parent material of chalk-white soft rock.

The unplowed soil during the dry season is compact hard, and cracks into big clods to a depth of 30 or more centimeters. The surface soil is coarse and fragmental. This structure is attained during the first rain. Plowing is, therefore, possible at this time without producing clods.

Upland rice is planted during the rainy season. On reddish-brown, friable areas corn is planted. Fruit trees with cover crops would do well in this type of soil.

Alaminos Series

This series of soils is the largest group in western Pangasinan. The topography is usually rolling, hilly, and of the savanna type.

The distinguishing characteristics of this soil are its color which ranges from pale reddish brown, reddish brown to brick red; and its considerable depth with no defined horizons (layers or section) from the surface down to the substratum.

However, the amount of gravel and iron concretions varies with the depth. The physical characteristics are almost uniform from the surface down to the underlying parent materials, which consist of limestone, basalts, conglomerates, and other volcanic rocks. In many places cobblestones of basalt rocks are abundant in the surface soil.

The soil cracks easily on drying. When wet, it is sticky, but dries so quickly that plowing is possible within a few hours after a heavy rain. In cultivated areas along the hill sides and foothills, the soil dries to a depth of 50 to 70 centimeters or more, and becomes hard and compact making boring with an auger difficult. The soil is very friable and water percolates through easily.

Evidently this series represents a typical red loam soil in the Philippines. There are several series of red loams or reddish-colored soils already found and established in the Archipelago. This group of soils constitutes one of the largest groups in tropical countries.

The natural vegetation of this series consists of tropical forest trees of commercial and non-commercial species. The plants in deforested areas consist mostly of cogon, talahib, and sambong. Alibangbang, duhat, and binayoyo are also found in patches. Several species of bamboo are also growing in the southwestern part especially towards Infanta.

Most of the grassland areas are devoted to cattle raising. Because of long dry seasons, grasses dry up, and practice of burning the area thins the trees growing therein.

Under this series three soil types were established, namely Alaminos loam, Alaminos sandy loam, and Alaminos loam, degraded phase. A large area in the mountains is undifferentiated.

Alaminos loam.- This type covers the largest area of the series and it is located in the western part of the province. It is well developed along the towns of Labrador, Sual, and Alaminos. The surface soil to a depth of 20 centimeters or more is slightly brown loam because of the presence of organic matter especially in lowland and level areas. In many places, however, it is practically reddish brown to brick red. The lower horizon to a depth of 40 centimeters or more is reddish

brown to red granular loam. The hillsides and lowland areas have surface soils with iron concretions. Gravel is always present in the upland areas. The subsoil is quite deep. The substratum down to the parent rock material varies in depth from one meter to two meters from the surface.

Lowland rice is the principal crop grown in this type of soil. It is planted in terraced rolling uplands as well as irrigated lowlands. In upland areas, rain is the source of water supply, while the lowlands irrigation water is obtained from nearby creeks or from rivers. Vegetables are not commonly grown in this soil type. Some areas are utilized as pastures.

Alaminos sandy loam.- This type is located in the southeastern part of Pangasinan. The surface soil is light reddish-brown, loose, sandy loam ranging in depth from 20 to 30 centimeters. Below this horizon is a reddish-brown loam, underlain by poor-grade limestone rocks mixed with highly weathered basalts, and chalk-white water-laid tuff. Apparently this mixture of rocks is the parent material of this soil.

So far this type of soil is devoted exclusively to pasture lands. Grasses, however, do not thrive well especially during the dry season.

Alaminos loam, degraded phase.- This phase of the Alaminos loam is found at Cabarruyan Island. The soil in general is a mixture of sandy loam and clay loam in a degraded form. The color is pale reddish brown. Poor-grade limestone is found in patches throughout. In several areas, where the drainage is poor, the soil, instead of having the light color, becomes gray, dark gray to black in the surface horizon. The principal crops planted on this soil are coconut, corn, upland rice, banana, vegetables, and maguey. Generally, the soil is used as pasture land.

Bani Series

This series has a very dark-gray to nearly black surface soil of granular structure and slightly friable consistency, a light brownish-gray cloddy loam to sandy clay loam subsoil, and a highly weathered white fine-grained water-laid tuff substratum.

The surface soil when wet is sticky and waxy. When dry, it forms crumbs of sharp angular shape but not as hard as that of the Guadalupe soil. In the hillsides, where the soil is badly eroded, the white tuffaceous rock parent material is so exposed that it is visible even at a distance.

The subsoil of the lowland areas devoted to rice contains some lime precipitates in various forms, which may be spherical, elongated, or angular. The rolling portion is used for pasture. Considerable areas are under forest of semi-commercial value. Limestone deposits are found in certain areas and these are mined for road surfacing.

The characteristic vegetation of this series of the savanna type. Few scattered trees such as duhat, alibangbang, kamachili, madre cacao, lumbang, and binayoyo are found. Madre cacao which frowns well is planted for fencing the fields. It may also be utilized as shade tree for certain fruit trees which require shade.

A typical profile obtained along the road cut at kilometer 262 on the Bani-Bolinao road shows the following characteristics:

Bani Clay

Depth of soil cm.	Characteristics
0-35	Very dark-gray to nearly black nutty to coarse granular clay loam to clay; surface is coarse fragmental; sticky when wet.
35-65	Light brownish-gray, cloddy with sharp angular shape clay loam to sandy clay loam; waxy when moist; sticky when wet.

Depth of soil cm.	Characteristics
65-90	Highly weathered whitish-gray and fine drained tuffaceous rock; reddish-brown soil along sides of the rock crevices.
90-150	Soft, whitish-gray water laid tuffaceous rock, evidently highly weathered material, with yellowish red soil along side of the rock crevices apparently parent material of the soil.

Bani clay.- In lowland and level areas devoted to rice the surface soil is very dark-gray to black nutty and coarse-granular clay. Its depth varies from 30 to 40 centimeters. Below this horizon is a slightly mottled with brown dark-gray and black clay loam. When dry the surface soil cracks to a depth of more than 50 centimeters. Lime precipitates in various forms are present in the lower subsoil. The substratum, or parent material, which contains also certain amount of lime concretions, is just below this zone.

In the lowland fields of the town of Mabini, the soil is gray clay loam. This area, however, is quite small and cannot be shown in the map.

In upland and hilly areas the soil is thin, exposing the whitish-gray, fine grained, water-laid tuffaceous parent material because of erosion. Limestone is present in some areas. This is mined and used for oral surfacing. The soil in this area is used as pasture land. Maguey is sometimes planted in badly depleted areas.

Bolinao Series

The soils of the Bolinao series consist of reddish-brown dark reddish-brown to chocolate-brown soils, friable and fine to coarse granular in structure. The subsoil consists of a mixture of highly weathered calcareous material usually yellowish gray. The substratum consists of coralline limestone rocks.

The topographic feature of this series is a highly rolling upland. The greater part, however, is a plateau. In slightly

rolling areas, limestone outcrops are the characteristic features. Wherever the land is terraced for the growing of rice, these rock outcrops are utilized in re-enforcing the dikes of the terraces. This terraced area was under forest several years ago. The present vegetation in uncultivated areas consists of the remnants of the original forest and trees of the second growth forest.

Rice and maguey are the most important crops of this series. Banana, fruit trees, and a small amount of vegetables are also planted. Rice is planted in terraces and gets its water from rain. Because of long dry season the rice land is not planted to other harvest.

Citrus trees may be planted in this series. To develop the worn-out surface soil, ipil-ipil trees may be planted as a cover crop. In highly depleted areas ipil-ipil or madre cacao may rehabilitate the soil and at the same time supply firewood which is quite insufficient in this area.

Bolinao clay loam.- The surface soil of this type varying in depth from 20 to 35 centimeters is loose friable fine granular clay loam. The color ranges from light reddish-brown to chocolate-brown to red. In depleted areas the surface soil is hallow and in most cases it is so badly eroded that the subsoil is already exposed. Limestone outcrops are present in several places. The subsoil consists of coarse granular loam to gravelly clay loam consisting of highly weathered limestone rock in the lower subsoil. The depth of the subsoil varies from 40 centimeters in highly eroded and depleted areas, to 70 or 80 centimeters in areas that are newly opened for agriculture.

Rice is the most important crop. There are two methods of planting rice, namely; by broadcasting in the unterraced upland area and by transplanting the seedlings in rice paddies which are in terraced areas. The yield of rice in this soil type is very low, ranging from 15 to 20 cavans per hectare, while in terraced areas the yield varies from 25 to 35 cavans. Near the town of Bolinao maguey is grown extensively. Coconut, banana, and fruit trees are also grown near the sea coast and in the town of Bolinao. A resume of Pangasinan soils, showing their areas, locations, and present uses, is shown in Table 5.

CONSERVATION OF PANGASINAN SOILS

Good farming is synonymous to soil conservation. Soil conservation is the wise utilization and proper management of the soil for the definite objective of obtaining the greatest return. The depletion of most of our agricultural and non-agricultural soils is due mainly to: (a) lack of a certain conservation policy regarding the utilization of such soils. Unchecked accelerated erosion, overgrazing of pasture lands, unchecked exploitation of forest trees in areas where the soils are unsuited for gainful agricultural occupation growing of heavy feeder crops without provisions for replenishing the loss of soil fertility, and the kaingin system are the most important problems that require the setting up of a definite soil-conservation policy.

The soils of the province have been classified, mapped, and described fully as to their important characteristics in relation to crop production. A conservation policy for the proper utilization of these soils may then be laid out with a general appeal to the agricultural public concerned.

The San Manuel soils are the most important soils of the province. The great bulk of rice, sugar cane, corn, banana, vegetables, fruit trees, and other economic crops produced in the province is grown on these soils. There has been a decreasing yield of rice, sugar cane, and corn on these soils. The main cause of this decreased yield is the loss of soil fertility because of erosion and failure to replenish the plant food removed by the crops. Commercial fertilizers should be applied in the cultivation of these crops to maintain or increase to the maximum the yield of the land. In connection with rice production the results of fertilizer field tests have shown profitable increases with the use of commercial fertilizers containing high concentrations of nitrogen and phosporous. Dru crop farming should be practiced in San Manuel soils during the dry season so as to minimize the loss of moisture in the soils. The growing of leguminous plants as cover crop between fruit trees should be practiced to conserve and maintain the soil fertility and to minimize if not to prevent entirely the effect of erosion.

For the heavier soils, like the San Fabian, Bani, Annam and Alaminos soils, which occur in rolling areas, the utilization of such soils should be modified. Accelerated soil

erosion is very serious in these soils, and the continuous loss of surface soil has rendered the remaining soil practically useless for agriculture. A very effective control of such destruction is to plant trees that grown readily, to prevent the soil from further erosion. This condition would give the soil sufficient time to develop once more to a normal soil profile and consequently to be useful again to agriculture.

The Bolinao clay loam soil occupies the extensive Bolinao Plateau. This soil has developed from the underlying coralline limestone rock making it well adapted to citrus growing. However, its location does not have that mild climate and altitude favorable to citrus culture. The moisture problem can be solved by planting the whole area to forest trees, preferably ipil-ipil. These trees would serve as a cover crop and would keep the moisture content of the soil to the optimum for the growth of citrus trees.

Where the soils are practically depleted, maguey has been found to grow well. As a source of fiber the extraction of which constitutes a local home industry, maguey is really one of the best to grown on poor soils.

ANALYSES OF PANGASINAN SOILS

Mechanical analysis.- In the field the texture of the soils is determined by the "feel method". Experienced soils men can with utmost degree of accuracy, determine the textural classification of various types of soils. In some cases, however, where the soil contains certain colloidal materials which modify the feel of the material owing to certain chemical properties, the mechanical analysis of the soil samples is made.

In the determination of the various soil grades the hydrometer method devised by Bouyoucos is used. Table 7 shows the results of this determination. In many instances the results of the analysis serve as check against the doubtful textural classification of the types in the field. Soils containing considerable amount of friable clay, do not exhibit the heavy clay characteristics as examined by the "feel method" in the field. If the field classification does not differ much from the results obtained from the mechanical analysis, the former

is retained and the textural grades are noted.

As shown in Table 7 about half of the soils of Pangasinan are light soils, the others are medium to heavy in texture. The heavy soils containing considerable amount of clay which exhibited the clay characteristics in the field are Bani clay, San Fabian clay loam, and Annam clay loam. The Alaminos loam and Bolinao clay loam contain plenty of clay, but owing to their friability, the classification in the field was maintained.

Chemical analysis.- As an aid or guide in the proper identification and classification of soils, chemical analysis of the soil-survey samples is also made. Samples from the surface soils of the different major soil types identified in the field are brought to the laboratory for analysis. The depth of sampling, of coarse, varies with the depth or thickness of the soil horizon.

The primary object of chemical analysis is to determine the potential fertility of the soil, or its deficiencies as regards essential plant-nutrient elements. For this purpose, several representative samples of the surface soil are analyzed for the total contents of the principal plant-nutrient elements which are often found deficient in soils. These elements are nitrogen, phosphorus, and potassium. Organic carbon, calcium, magnesium, and soil reaction are also determined. Organic carbon is measure of the organic matter content which affects such important characteristics of the soil as structure, moisture retaining power, and beneficial microbiological population of the soil calcium and magnesium, besides being essential elements in plant metabolism, affect soil consistency. With a low ratio of calcium to magnesium, the soil has a tendency to become plastic and sticky.

Soil reaction, or pH value, is a very important limiting factor for plant growth, as different plants have different optimum soil-reaction requirements and tolerance limits.

The nitrogen, the phosphoric acid, the potash, the lime, and the magnesia contents of the soil samples were determined according to the "Method of Analysis" of the Association of Official Agricultural Chemists of the United States. The determination of organic carbon was in accordance with Parr's

method. The hydrogen-ion concentration, or pH value, was determined by the electrometric method, using the antimony electrode. The results of the analysis, calculated on the dry basis, and presented as averages for the different soil types, are shown in Table 8.

It will be noted that most of the Pangasinan soils are slightly acidic in reaction, and a few are almost neutral or slightly basic in reaction. The organic carbon content is generally low, especially in the sandy soils. Green manuring may improve the soil condition in this respect. The nitrogen content, with the exception of a few which is quite low, is about normal. The total phosphorus and potassium contents are quite low in general and seem to show the need for fertilizers containing these elements.

Table 7.- Mechanical analysis of the surface soils of different soil types of Pangasinan Province.

Type No.	Soil Type	Fine gravel sand (2.0-0.05 mm.)	Silt (0.050-0.005 mm.)	Clay (0.005-0.0 mm.)	Total Colloids
		Per cent	Per cent	Per cent	Per cent
1	Pangasinan hydrosol	37.2	27.0	35.8	46.4
91	Pangasinan beach sand	95.6	4.2	0.2	1.2
93	Pangasinan fine sand	47.8	35.0	16.6	21.6
82	San Manuel silt loam	26.2	36.7	37.1	54.4
94	San Manuel silty clay loam	31.2	25.4	43.4	52.4
95	San Manuel fine sandy loam	57.8	25.6	16.6	32.5
96	San Manuel sandy loam	28.7	49.4	29.1	34.4
86	Tarlac clay loam	39.5	33.2	27.3	36.6
98	Annam clay loam	47.5	25.4	27.1	34.8
99	Umingan silt loam	37.5	30.2	32.3	4.8
100	Umingan sandy loam	50.0	28.1	21.9	31.0
101	Umingan fine sand	82.3	12.0	5.7	9.2
102	San Fabian clay loam	41.8	19.7	38.5	45.9

Table 7.- Mechanical analysis of the surface soils of different soil types of Pangasinan Province.

Type No.	Soil Type	Fine gravel sand (2.0-0.05 mm.)	Silt (0.050-0.005 mm.)	Clay (0.005-0.0 mm.)	Total Colloids
		Per cent	Per cent	Per cent	Per cent
103	Alaminos loam	47.7	20.2	32.0	38.1
104	Alaminos loam, degraded phase	44.6	13.3	42.1	46.8
105	Alaminos sandy loam	54.2	20.8	25.0	30.5
107	Bani clay	26.0	22.3	51.7	59.1
108	Bolinao clay loam	40.9	15.2	43.9	49.0

Table 8.- Chemical analysis of the surface soils of the different soil types of Pangasinan Province.

Type No.	Soil Type	pH Value	Organic Carbon %	Nitrogen (N) %	Phosphoric acid (P_2O_5) %	Potash (K_2O) %	Lime (CaO) %	Magnesia (MgO) %
1	Pangasinan hydrosol	6.60	1.35	0.11	0.23	0.45	3.34	2.84
91	Pangasinan beach sand	7.48	0.57	0.04	0.25	0.05	7.02	2.04
93	Pangasinan fine sand	6.24	1.92	0.13	0.13	0.10	3.28	1.39
82	San Manuel silt loam	6.89	1.67	0.13	0.26	0.13	3.41	2.37
94	San Manuel silty clay loam	7.02	2.05	0.17	0.17	0.11	4.77	2.52
95	San Manuel fine sandy loam	6.82	1.10	0.09	0.18	0.17	4.83	1.97
96	San Manuel sandy loam	6.49	2.11	0.16	0.17	0.09	4.24	0.92
86	Tarlac clay loam	7.30	1.48	0.07	0.11	0.10	3.48	0.87
98	Annam clay loam	6.51	1.54	0.15	0.17	0.16	2.30	0.94
99	Umingan silt loam	6.21	2.05	0.12	0.13	0.09	3.20	1.94
100	Umingan sandy loam	6.30	1.70	0.09	0.15	0.12	3.01	1.36

Type No.	Soil Type	pH Value	Organic Carbon %	Nitrogen (N) %	Phosphoric acid (P_2O_5) %	Potash (K_2O) %	Lime (CaO) %	Magnesia (MgO) %
101	Umingan fine sand	6.18	0.52	0.03	0.14	0.10	4.20	1.58
102	San Fabian clay loam	6.04	2.26	0.18	0.14	0.10	3.20	1.12
103	Alaminos loam	6.13	1.55	0.10	0.11	0.25	1.03	0.88
104	Alaminos loam, degraded phase	5.71	2.11	0.18	0.08	0.22	1.92	0.80
105	Alaminos sandy loam	6.22	1.87	0.10	0.07	0.09	3.69	1.89
107	Bani clay	6.58	2.82	2.18	0.11	0.09	3.59	1.70
108	Bolinao clay loam	6.28	2.83	0.27	0.17	0.16	1.80	1.01

* Soil reaction means the degree of acidity or alkalinity of the soil, expressed mathematically as the pH value. A pH value of 7 indicates neutrality, lower values indicate acidity, and higher values indicate alkalinity.

SUMMARY

Pangasinan province, with Lingayen as the capital, was established on February 18, 1901. The province had a total area of 504,171 hectares with a population of about 703,609 during 1935 and 740,293 in 1939. There are 46 towns of which the towns of Dagupan, San Carlos, Bayambang, Lingayen, Urdaneta, Tayug, Rosales, and Binalonan are the most important.

The province has a net work of first, second, and third class roads connecting all the towns of the province except those on the islands of Cabarruyan and Santiago. The Manila-Baguio road passes through the central part of the province, while the Manila Railroad, north bound, passes through the west-central part.

Mail, telegraph, and telephone services are available throughout the province.

Public schools, elementary and secondary, are available in the province. Private schools and colleges, run mostly by the Catholic Church, are also available in most big towns.

Churches of different sects are established in all towns. The health activities are undertaken by the Bureau of Health.

The province is divided into two general parts, namely; the central part and the western part. Geologically, the vast plain consists of recent alluvial deposits. The mountains, north, east, and west, consist of tertiary undifferentiated limestones, sandstones, and tertiary effusive rocks consisting of rhyolites, decites, andesites, and basalts.

There are several rivers in the province, the most important of which are the Agno, Bued, Alaminos, and Balingeaguing Rivers. Irrigation water comes mostly from the Agno and Bued Rivers.

The climate is of distinct wet and dry seasons. Destructive typhoons sometimes occur, damaging properties and crops.

Agriculture is the most important industry of the province. Diversified farming is practiced and the important crops planted are rice, corn, coconut, tobacco, banana, sugar

cane, and maguey. The total area planted to various crops in 1937 was 281,435 hectares, with a total value of produce of about 21,829.060 pesos.

There are ten soil series in the province, with a total of twenty-four soil types. The largest soil type is the San Manuel silt loam, followed by the Alaminos loam, then the Alaminos soil, undifferentiated, Annam clay loam, Bani clay, and San Manuel fine sandy loam. The San Manuel series is the most important soil of the province.

The mechanical analysis of the soils shows that almost one-half of the soil types of the province are light soils ranging from sand to silt loam.

The results of chemical analysis show that on the average, the nitrogen content is normal. The phosphorus content, however, is below that of average soils. On the average the reaction of Pangasinan soils is slightly acidic.

The soil survey data reported herein represent the actual condition of the soils of the province.

The laboratory data, supplemented by field findings, serve as a guide in the proper treatment and management of the different soil types within the province for maximum crop production.

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GLOSSARY OF COMMON ECONOMIC PLANTS FOUND IN PANGASINAN PROVINCE

Common names	Scientific names	Family names
Agingai	Rottbaellia exaltata Linn	Gramineae
Alibangbang	Bauhinia malabarica Roxb	Leguminosae
Anonas	Anona reticulata Linn	Anonaceae
Aroma	Acasia farnesiana (Linn) wild	Leguminosae
Atis	Anona squamosa Linn	Anonaceae
Banana	Musa sapientum Linn	Musacae
Binayoyo	Anti esma ghaes mbilla Gaertn.	Euphorbiaceae
Black pepper	Piper nigrum Linn	Piperaceae
Buri	Coryha elata Roxb	Palmae
Cabbage	Brassica oleracea Linn	Cruciferae
Cacao	Theobroma cacao Linn	Sterculiaceae
Cassava	Manihot utilissima Pohi	Euphorbiaceae
Castor oil bean	Ricinus communis Linn	- do -
Chico	Achras apota Linn	Sapotaceae
Coconut	Cocos nucifera Linn	Palmae
Cogon	Imperata cylindrica (Linn) Veauv.	Gramineae
Corn	Zea mays Linn	- do -
Cotton	Gossypium hirsutum Linn	Malvaceae
Duhat	Eugenia cumini (Linn) Druce	Myrtaceae
Eggplant	Solanum melongena Linn	Solanaceae

GLOSSARY OF COMMON ECONOMIC PLANTS FOUND IN PANGASINAN PROVINCE

Common names	Scientific names	Family names
Gabi	Colocasiaescuentum (Linn) Schott	Araceae
Guava	Psidium guajava (Linn)	Myrtaceae
Guayabano	Anona muricata (Linn)	Anonaceae
Indigo	Indigofera suffruti cosa Mill	Leguminosae
Ipil-ipil	Leucaena glauca (Linn) Benth	- do -
Irish potato	Solanum tuberosum (Linn)	Solanaceae
Kamachili	Pithecolobium dulce (Roxb) Benth	Leguminosae
Kapok	Ceiba pentandra (Linn) Gaertn	Bombacaceae
Kasui	Anacardium occidentale (Linn)	Anacardiaceae
Lansones	Lansium domesticum Correa	Meliaceae
Lemon	Citrus limonia Osbeck	Rutaceae
Ligas	Semecarpus cuneformis Blanco	Anacardiaceae
Lumbang	Aleurites muluccana (Linn) Wild	Euphorbiaceae
Madre cacao	Gliricidia sepium (Jacq) Steud	Leguminosae
Maguey	Agave cantala Roxb	Amaryllidaceae
Makopa	Eugenia jaranica Lam	Myrtaceae

GLOSSARY OF COMMON ECONOMIC PLANTS FOUND IN PANGASINAN PROVINCE

Common names	Scientific names	Family names
Mandarin	Citrus nobilis Lam	Rutaceae
Mango	Mangifera indica Roxb	Anacardiaceae
Manzanitas	Zizyphus jujuba (Linn)	Rhamnaceae
Mungo	Phaseolus aureus Roxb	Leguminosae
Papaya	Carica papaya Linn	Cariceae
Peanut	Arachis hypogea Linn	Leguminoseae
Pilinut	Canaruium luzonicum (Blume) A-Gray	Burseraceae
Pineapple	Ananas comosus (Linn) Merr.	Bromeliaceae
Pomelo or lukban	Citrus maxima (Burm) Merr.	Rutaceae
Radish	Raphanus sativus Linn	Cruciferae
Rice or palay	Oryza sativa Linn	Gramineae
Sanbong	Blumea balsamifera (Linn) DC	Compositae
Sweet potato	Impmoea batata (Linn) poir	Convolvulaceae
Talahib	Saccharum spontaneum Linn	Gramineae
Talisai	Terminalia catappa Linn	Combretaceae
Tobacco	Nicotiana tabacum Linn	Solanaceae
Tomato	Lycopersicum esculentum Mill	- do -
Tugi	Dioscorea esculenta (Lour) Burkill	Dioscoreaceae

GLOSSARY OF COMMON ECONOMIC PLANTS FOUND IN PANGASINAN PROVINCE

Common names	Scientific names	Family names
Ubi	Dioscorea alata Linn	Dioscoreaceae
Wheat	Triticum vulgare Vill	Gramineae
Zacate	Leersia hexandra Sw	- do -

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ILLUSTRATIONS

Plate 1

Fig. 1. Salt beds of Pangasinan consist of sandy areas where the sand is scraped during low tide and washed in containers.

2. Sand containing salts is being washed. The filtrate is collected in jars.

3. The filtrate from washing the sand with salt water is evaporated to dryness to crystallize the salt.

Plate 2

Fig. 1. Profile of Bani clay taken in the vicinity of the town of Bani.

2. Profile of Alaminos loam taken between the towns of Sual and Alaminos.

3. Profile of Umingan silt loam taken in the vicinity of the town of Umingan.

Plate 3

Fig. 1. The Annam series landscape. This is a deforested rolling upland of the Annam soils of Pangasinan Province.

2. An eroded portion of Annam clay loam. The Annam soils are easily eroded.

3. The beginning of a gully erosion in Alaminos loam.

Plate 4

Fig. 1. Tobacco is planted extensively on San Manuel silt loam and San Manuel sandy loam along the sides of [illegible] River.

2. Sugar cane is grown mostly on San Manuel silt loam and San Manuel fine sandy loam.

3. Kaingin is grown extensively on Bolinao clay loam in the vicinity of the town of Bolinao.

Plate 5

Fig. 1. Preparing the land for rice on San Manuel sandy loam between the towns of Asingan and Urdaneta.

2. Removing the sediments deposited in an irrigation canal on San Manuel sandy loam in the town of San Manuel. The sediments were brought down by the Agno River.

3. Lowland rice on San Manuel sandy loam.

Plate 6

Fig. 1. A slightly rolling land of the Bolinao plateau. The soil is Bolinao clay loam. The limestone is mined for road surfacing.

2. Lowland rice on Bani clay.

3. An Alaminos series landscape. The rolling land between Sual and Alaminos is deforested.

MAP

Soil survey map of Pangasinan province, Luzon, Philippines (in pocket).