REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
BUREAU OF SOILS
MANILA

Soil Report 30

SOIL SURVEY OF ANTIQUE PROVINCE PHILIPPINES

RECONNAISSANCE SOIL SURVEY

BY

FRANCISCO CALIMBAS
Chief of Party

FRANCISCO B. LOPEZ and JORGE TINGZON
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SOIL EROSION SURVEY

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Chief of Party

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MANILA
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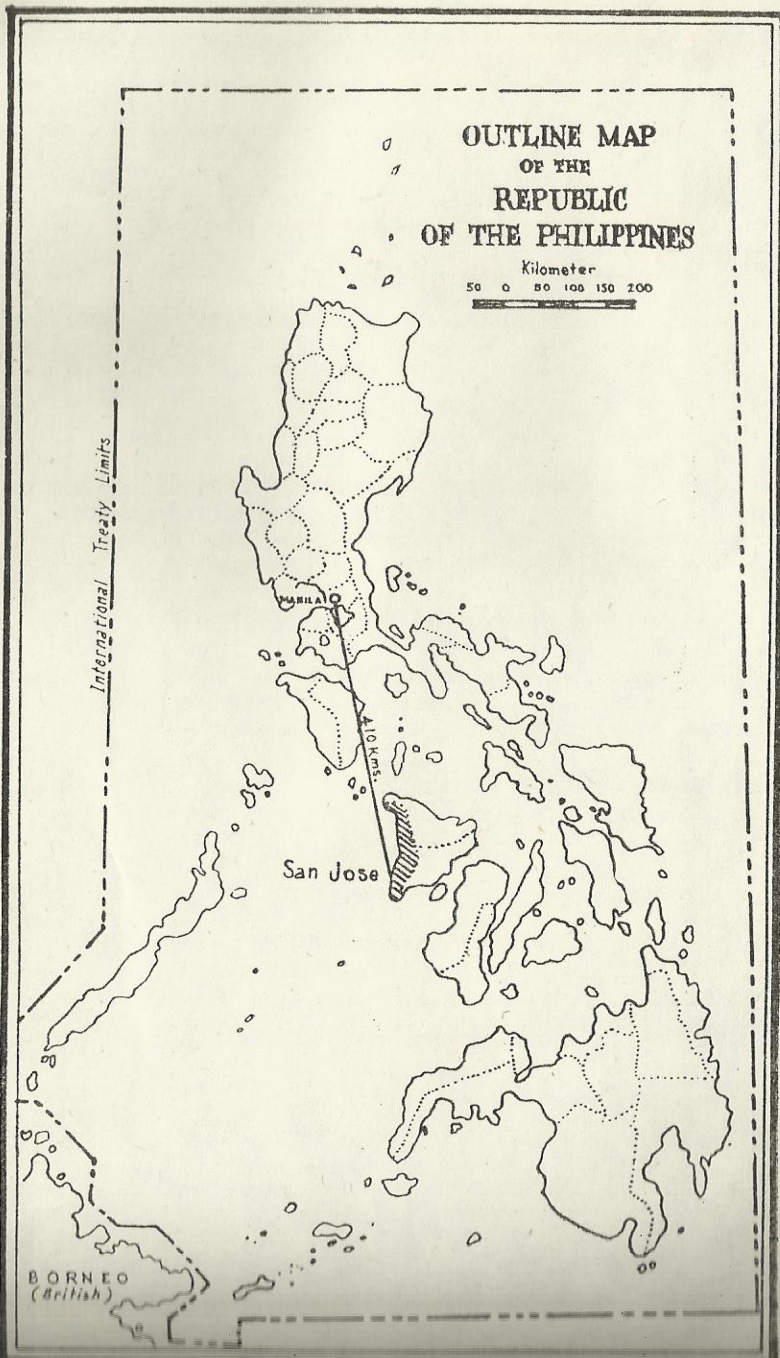

Figure 1. Map of the Philippines showing location of Antique Province

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With a Discussion on the Chemical Characteristics and Fertilizer Requirements of the Soils of Antique Province

BY

EUSEBIO A. AFAGA, GLORIA B. QUERIJERO
and MARTIN V. TIANGCO

MANILA
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DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES

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INTRODUCTION

Proper soil management and sound farm practices conserve the soil, its fertility, and increase production. Soil classification and erosion survey are some of the means to attain these ends. It is not uncommon to see farmers applying fertilizers regardless of the physical and chemical properties of the soils of their farms. Soil studies are a must in any farming program. Soil erosion, until recently, has not been considered in the management of Philippine farms. Farms are cultivated and left after they are depleted of their fertility. Latest studies brought home the fact that erosion endangers the very existence of our civilization.

The soil and erosion survey in Antique was conducted from April 10, 1948 to June 15, 1948, inclusive, by the Bureau of Soil Conservation (now the Bureau of Soils) under the directorship of Dr. Marcos M. Alicante and during the incumbency of Hon. Mariano Garchitorena as Secretary of Agriculture and Natural Resources. The soil report was updated and edited by Mr. Agripino F. Corpuz, Soil Survey Supervisor and proofread by Mr. Juan N. Rodenas, Soil Technologist of the Bureau of Soils.

in Bugasong and Culasi. Private schools are found in San Jose, Dao, and Pandan.

A provincial hospital is located in San Jose and some towns have puericulture centers. Most of the people are Roman Catholics and in every town there is a Roman Catholic Church. Some towns also have the Independent and Protestant churches besides the Roman Catholic Church.

Farming is the most important industry of the people. Fishing, trading, manufacturing, mining, and weaving are the other important industries of the province.

The province has the first type of rainfall wherein the wet season generally begins in the later part of May and ends about the end of October when the dry season begins. The temperature is more or less uniform throughout the year. The normal annual temperature of the province is 27.1° C. Typhoons are frequent on the northern part of the province than in the southern part.

Rice is the principal crop. Corn, coconut, mungo, sugar cane, root crops, vegetables, and fruit trees are the other important crops. The total farm area cultivated in 1948 was 43,720.69 hectares and the corresponding total value of production was ₱2,614,772.

Farming practices are generally similar to those employed in other provinces. Commercial fertilizers are seldom used. A communal irrigation system is used to great advantage by some farmers in Bugasong, Culasi, Tibiao, Barbasa, and Valderrama. The San Jose–Sibalom Irrigation System irrigates about 4,800 hectares in San Jose and Sibalom. The average production of non-irrigated lowland rice ranges from 20 to 30 cavans of palay per hectare, while on irrigated land it is from 40 to 80 cavans per hectare.

Livestock and poultry raising before World War II was profitable, but during the Japanese occupation most of the livestocks were slaughtered.

The expansion of agricultural activities is due to the increase in population. Forests, open grass lands, hills and rolling regions were opened for cultivation. Hence, the cultivated land increased from 32,137 hectares in 1918 to 43,720.69 hectares in 1948.

The average area of farm land by farm tenure in the province are: owner, 2.99 hectares; part owners, 3.03 hectares; all tenants, 2.22 hectares; and for all farmers, 2.85 hectares.

The soils of the province were classified under three general groups; namely, (1) soils of the plains and valleys, (2) soils of the hills and mountains, and (3) miscellaneous land types. There are seven soil types under the first group; one soil type and one soil complex under the second; and three under the last group.

The hydrosol is principally planted to nipa palms. A small area was converted into fishponds for the culture of *bañgus*. Beach sand is planted to coconut. The soils of the Sta. Rita series are the most extensive of the soils of the plains. The series is mostly cultivated to lowland rice. The Umingan and San Manuel series are primarily planted to lowland rice and secondarily to sugar cane and corn. The Patnongon and Magcalon series, the two new series identified and mapped in the province, are also devoted to lowland rice, corn, and other crops.

The Alimodian series is the widest and most important soil of the hills and mountains. It is extensively cultivated to upland rice, corn, vegetables, and root crops. The Alimodian–Bolinao complex is also cultivated to upland rice, corn, and some root crops.

The parent materials of the soils of Antique Province are consolidated sedimentary rocks of which stratified shale is the most dominant. The alluvial deposits are due to degradation and aggradation. The stages of their occurrence are manifested by the various degrees of soil development as characterized by different profiles.

Based on the origin, degree of profile development, and topography, the different soil series of Antique were classified into four profile groups.

The productivity ratings and the physical land classification of the soils of the province are shown in table 14. The ratings present the relative productivity of the various soil types.

Erosion is the most pressing problem of the soils of the hills and mountains. Systematic crop rotation, terracing, addition of more organic matter, contour and strip cropping are important in the cultivation of these soils to minimize run-off and the resulting erosion.

I. RECONNAISSANCE SOIL SURVEY

DESCRIPTION OF THE AREA

Location and extent.—Antique is a relatively long and narrow province. It occupies the western side of Panay Island. It is bounded on the north and northeast by Capiz Province; on the southeast by Iloilo Province; and on the south and west by the Sulu Sea. Including the small islands of Semirara, Caluya, Batbatan, Nagus, Maralison, and several other minor ones the province has an area of approximately 2,679.27 square kilometers. San Jose de Buenavista, 410 air kilometers south of Manila, is the capital.

Relief and drainage.—Antique is a mountainous province. A mountain range runs from north to south. Mounts Cong-cong, Tiguran, Madias, Baloy, Nangtud, Sipang, and Balabac are the highest peaks. Between the narrow coastal plains and the foot of the mountain range is a rolling hilly terrain trenched by narrow valleys of streams originating from the mountains.

The coastal plains are narrow. Hill spurs from the mountain range extend toward the sea. There is a fairly wide fertile plain in Sibalom while a few well-watered valleys are found in San Jose. The plain at Sibalom and the adjacent valleys of San Jose are popularly called the San Jose–Sibalom plain. Along the coast especially near river mouths are occasional small swampy areas.

The province is adequately drained. Most of the rivers and streams discharge on the west coast. They are relatively short with steep gradients because the province is narrow. Deltaic plains are small and very few. The largest river of Antique is the Sibalom River. Other large streams are Cangaranan, Paliwan, Dalanas, Tibiao, and Hantik Rivers. The larger streams are perennial, but many small tributaries run dry during the dry season. Their flow is highly variable during the dry season but fairly constant during the wet season. High waters and destructive floods generally occur in May, July, October, and November.

Water supply.—Numerous small springs occur in the mountains and uplands. Water from these springs are low in mineral content. In most parts of the province water is obtained from deep or shallow wells. San Jose and Sibalom have a good water system.

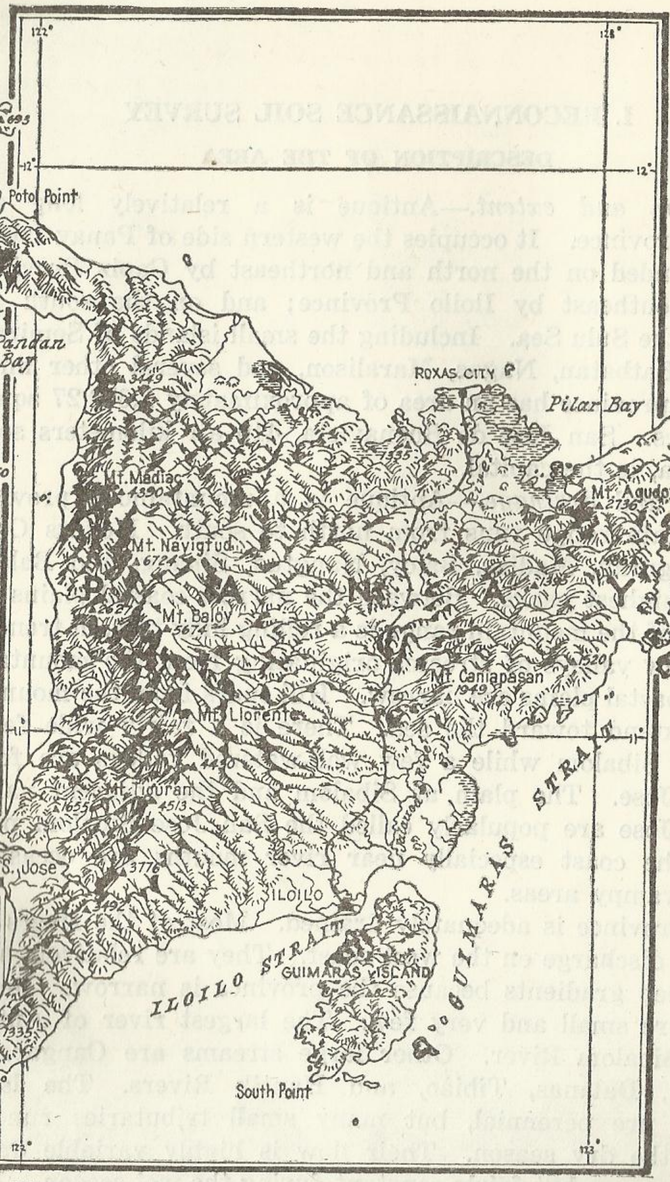

Figure 2. Map of Panay Island showing relief and drainage pattern.

Geology.—The high mountains of the province are of igneous and metamorphic rocks, largely volcanic in origin. The lower hills and the rolling areas are of sandstone, shale, conglomerate or limestone formation. A number of mineral deposits are found in these mountains. A deposit of white and colored marble of various grades is located in Mount Cresta de Gallo. There are quite a number of caves in the mountains where guano is obtained for fertilizer purposes.

Vegetation.—The natural vegetation may be grouped generally into four classes; namely, swamps and marshes, cultivated crops, grasses, and secondary and primary forests. The swamps and marshes are found along the coastal plains, near river mouths, and at the heads of protected bays. The common plants of these areas are nipa palms, *bakawan, langarai, tabau,* and *dungon-late.* Nipa palms are made into thatching material. The four latter plants are gathered and sold for firewood.

Alluvial plains and valley floors are the principal croplands. The most important crops are rice, corn, sugar cane, root crops, fruit trees, vegetables, and coconuts.

Grassland areas are extensive. This is partly due to *kaiñgin,* the native method of agriculture. Forest areas are cleared and cultivated for a few years and then abandoned. Cogon, *talahib* and other associated grass species usually grow on abandoned clearings.

Primary and secondary forests are mostly found in the interior eastern part of the province. The areas are covered with dense growth of low trees, a few large trees, and vines.

TABLE 1.—*The approximate area of the soil cover of Antique Province, 1946* [1]

Kind	Area in hectares	Percentage
Commercial forest	43,530.00	16.25
Non-commercial forest	64,547.00	24.09
Open land	115,929.31	43.27
Cultivated land	43,720.69	16.32
Swamps (fresh marshes and mangroves)	200.00	0.07
Total	267,927.00	100.00

[1] Bureau of the Census and Statistics, *Yearbook of Philippine Statistics:* 1946. (Manila: Bureau of Printing, 1947), p. 182; Bureau of the Census and Statistics, *Summary and General Report on the 1948 Census of Population and Agriculture,* Vol. III. (Manila: Bureau of Printing, 1954), p. 2884.

Organization and population.—Before the coming of the Spaniards, ten datus from Borneo with their followers landed on Panay Island at a place called Sinogbuhan, near the present site of Miagao, Iloilo. The Borneans bought the island for one "sadod" and a golden necklace from the Negrito inhabitants headed by a man named Mariculo. The new settlers called the island Madias after a high mountain bearing the same name. In later years the island was divided into three "sakops"; namely, Hantik, Aklan, and Irong-irong. "Hantik," which is now the province of Antique was assigned to Datu Sumakuel who founded Malandog, the first Malay settlement in the province.

The Spaniards found their way to Antique after establishing their first settlement at Oton, Iloilo. Their influence, however, was not felt until about the end of the sixteenth century. At the beginning of the seventeenth century the Spaniards found it necessary to build a fort near the town of Antique where they maintained a small garrison.

By 1790, Antique was organized into a politico-military province with the town of Antique as the capital. Later, the provincial government was moved to Bugasong. In 1802, the capital was transferred to San Jose de Buenavista where it remained ever since.

The general reorganization of the provincial governments of the Visayas in 1860 did not affect Antique. It remained politico-military in character which continued until the end of the Spanish rule.

The Spaniards evacuated the island of Panay after the outbreak of the Philippine Revolution in 1898. Antique came under the control of the Philippine Revolutionary Government and Leandro Fullon as its military and civil commander. On April 13, 1901, the civil government under the American regime was established.

In 1810, the population was 19,325. It has increased steadily. In 1818, it was 50,597; in 1840, it was 57,495; and in 1870, it was 93,010. In the 1918 census, Antique had a population of 154,343 excluding the non-Christian tribes of about 5,301. The 1939 census recorded population was 199,414. In 1946, the estimate was 221,700 while the last census, 1948, recorded the population of the province as 233,510.

Transportation and market.—There are first, second, and third class roads, with a total length of 314.30 kilometers, in Antique. Caluya is a municipality of the province separated

from the mainland by the Sulu Sea. A first class national highway connects the province with Capiz and Iloilo Provinces.

TABLE 2.—*Class, kind, and length of roads in Antique Province, June 30, 1946* [1]

Class of road	National	Provincial
	Km.	*Km.*
First class road	160.20	66.80
Second class road	----	83.00
Third class road	----	4.30
Total	160.20	154.10

[1] Bureau of the Census and Statistics, *Yearbook of Philippine Statistics: 1946*. (Manila: Bureau of Printing, 1947), p. 306.

Several transportation companies operate passenger and freight buses throughout the province. They are the Panay Autobus Company, Antique Bus Company, Aklan Transportation Company, A. Reyes Transportation Company, Velasco Transportation Company, and some small operators. The first three big companies operate throughout the island of Panay.

The port of San Jose de Buenavista is not much used. During the northeast monsoon, however, it offers a fair shelter for ships. Lipata and Pucio offer refuge to vessels during the southweast monsoon. Coastwise trade is not very active. A few motor boats and sailboats ply between Antique and Iloilo and other nearby provinces.

Two telegraph stations are found in San Jose de Buenavista. One is run by the Bureau of Posts and the other is handled by the Philippine Constabulary.

Trading is more or less local and there are no big trading centers in the province. This is partly due to the lack of facilities as well as the mountains terrain.

Every town and big barrio have public markets. A certain day is set aside as market day in each. The different market days are arranged in such a manner to enable travelling merchants to sell their goods in the towns as well as in barrios.

Cultural development and improvement.—Public schools with primary and intermediate grades are found in all towns and big barrios. Other barrios have only the primary grades. The central public high school is located in San Jose. Regional public high schools are found in Bugasong and Culasi. Private schools are also located in San Jose and Pandan.

A provincial hospital is located at San Jose and some towns have puericulture centers.

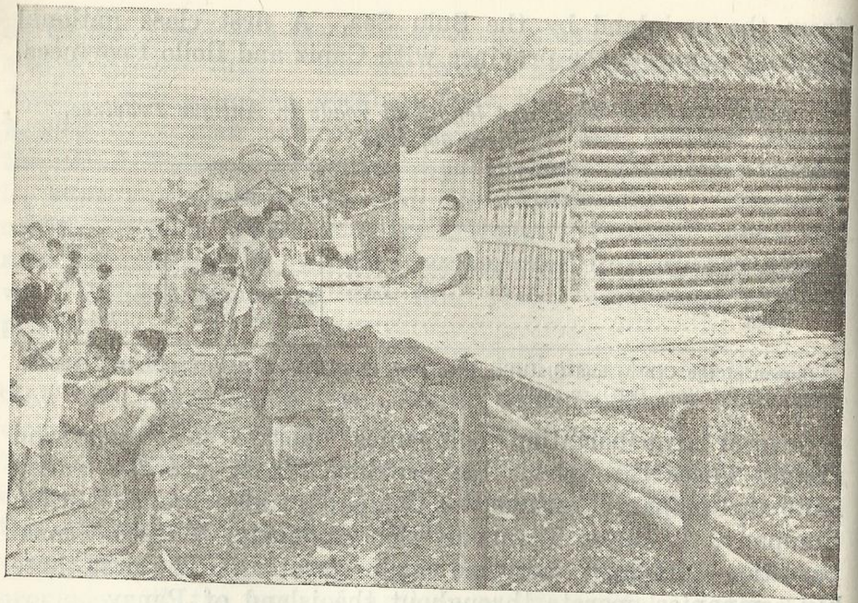

Figure 3. Excess catch is dried and sold in the interior towns and barrios.

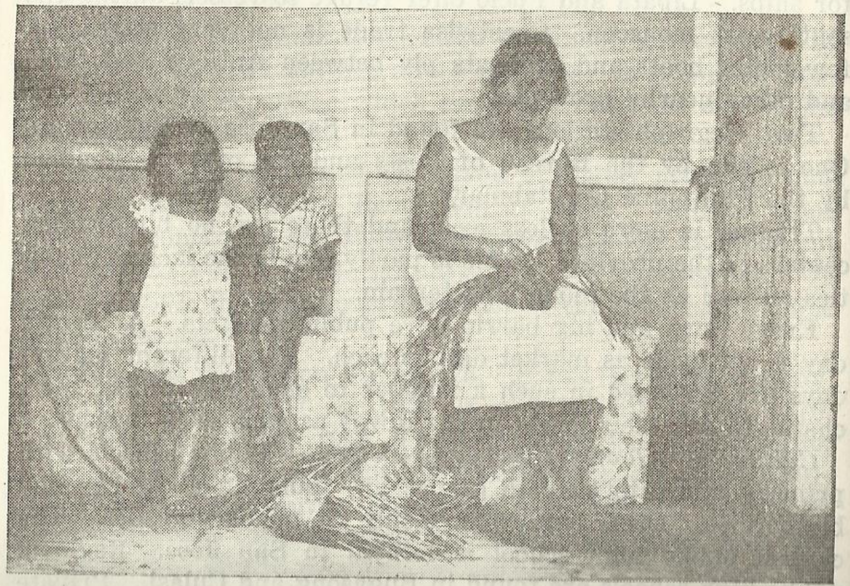

Figure 4. Weaving is an important cottage industry. It adds to the family income. Woman weaving hats.

PLATE I

Roman Catholic is the predominating religion and every town has a Roman Catholic Church. Some towns have also Independent and Protestant churches besides the Roman Catholic Church.

Industries.—Farming is the most important industry. Other industries are fishing, trading, manufacturing, mining, and weaving. Rice is the main crop grown. Corn, sugar cane, tobacco, root crops, vegetables, and fruit trees are the secondary crops. Coconuts are planted as permanent crops along the shore.

Majority of the towns of Antique are coastal towns and the Sulu Sea abounds with different kinds of fishes. The plains of Antique available for agriculture are relatively limited and the total area is not in proportion to the population. This makes many people pursue fishing. The method of fishing in the open sea is the general method commonly used throughout the Philippines. Enough fish is caught for the supply of the province.

The culture of milkfish is only in its inception stage. In San Jose, a part of the hydrosol area is devoted to *bañgus* culture.

The coastal towns of the province manufacture salt and supply the needs of Antique. Nipa thatch making is popular in San Jose, Dao, Pandan, Bugasong, Culasi, and other towns. Pot making is also common in some of the towns. Other articles manufactured are shoes, slippers, bolos, tables, chairs, wooden shoes, etc.

Weaving is a cottage industry. Buri and pandan hats, mats and *patadiongs* are the important articles woven. *Sawali,* out of bamboos, are also made.

Except for the coal mine in Semirara Island, about 140 miles off the shore of San Jose, the other mines in the province are inactive. Bongbongan Copper Mine Company in San Remigio was in operation before World War II, but at present it has not resumed operations. There are several mining claims for iron, aluminum, copper, pyrites, and gold. Prospectors still comb the province for more mining prospects.

CLIMATE

The climate of Antique is of the first type in which there are two pronounced seasons; dry from November to April, and wet during the rest of the year. June, July, August, and

September are the months of maximum rainfall, while February, March, and April are the driest months. December and January are the cool months, while the hot months are April and May.

Table 3 presents data from three weather stations which are strategically situated in the province for climatological observations; namely, San Jose de Buenavista in the south, Bugasong in the central part, and Culasi in the north. The rainfall in the southern and central parts of the province does not vary very much. The average annual rainfall in San Jose is 115.71 inches and in Bugasong it is 112.79 inches, or a difference of 2.92 inches. On the other hand, Culasi has an average annual precipitation of 156.38 inches which is 40.67 inches greater than San Jose, and 43.59 inches greater than Bugasong. Culasi has an average annual number of rainy days of 173, Bugasong has 136 days and San Jose has 145 days. Culasi has the highest number of rainy days while Bugasong has the lowest.

The high average annual rainfall and number of rainy days in Culasi is due to the absence of high mountains on this part of the province to cut off the rains due to the northeast monsoon, unlike that in the central part where along the eastern side high mountain peaks prevent the northeast monsoon rains to reach the central and southern part of the province.

TABLE 3.—*Monthly and annual average rainfall and number of rainy days in San Jose de Buenavista, Bugasong, and Culasi, Antique Province.*[1]

Month	San Jose (31 years)		Bugasong (12 years)		Culasi (21 years)	
	inches	*days*	*inches*	*days*	*inches*	*days*
January	1.30	4	1.40	4	4.35	9
February	0.90	3	0.72	4	1.65	5
March	0.75	3	0.68	2	2.35	7
April	1.80	4	1.02	4	2.19	6
May	8.76	14	8.97	13	11.32	15
June	14.58	20	19.02	18	17.24	20
July	24.24	23	25.03	23	25.77	22
August	20.89	21	16.69	19	26.15	22
September	19.31	20	18.40	18	23.00	19
October	13.85	16	10.42	14	18.71	18
November	7.22	10	8.45	11	15.11	16
December	2.11	7	1.99	6	8.54	14
Annual	115.71	145	112.79	136	156.38	173

[1] Weather Bureau, "Monthly Average Rainfall and Rainy Days in the Philippines" (Manila: Weather Bureau, 1956), p. 8. (Mimeographed.)

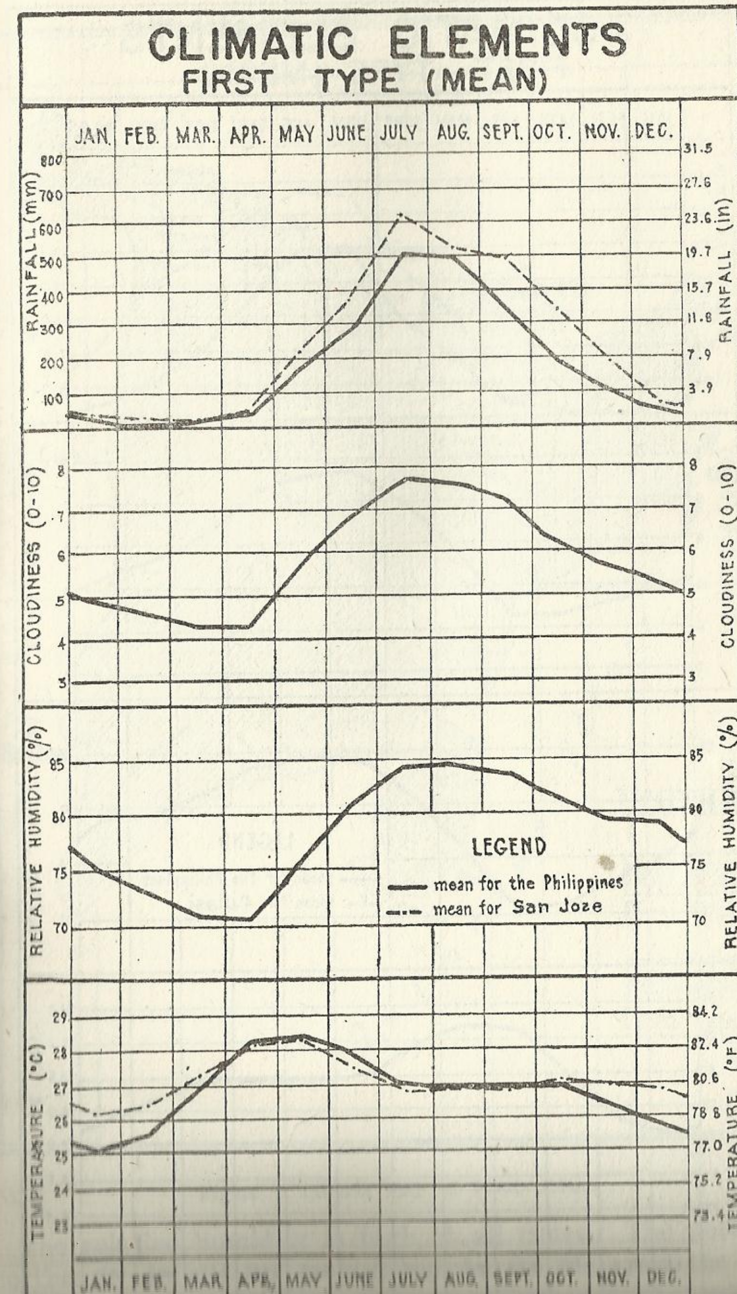

Figure 5. Graph of the first type of climate in the Philippines and of San Jose de Buenavista, Antique.

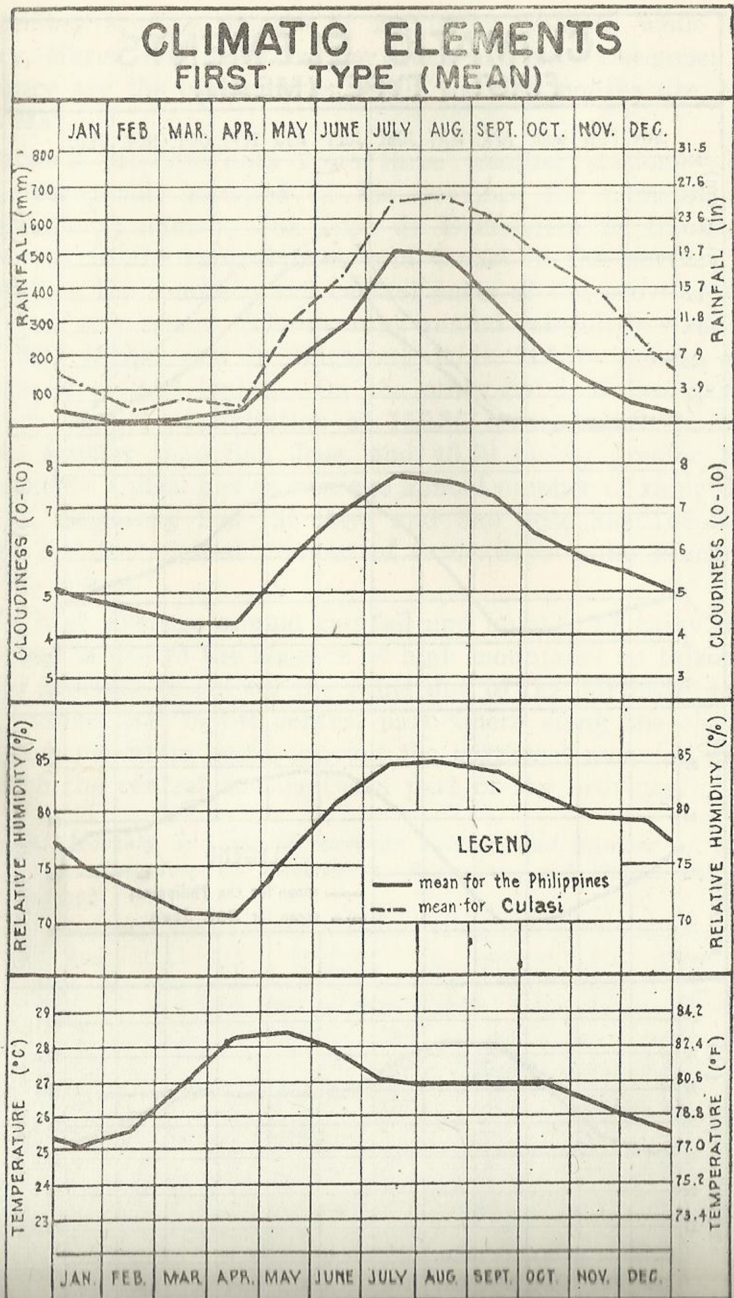

Figure 6. Graph of the first type of climate in the Philippines and of Culasi, Antique.

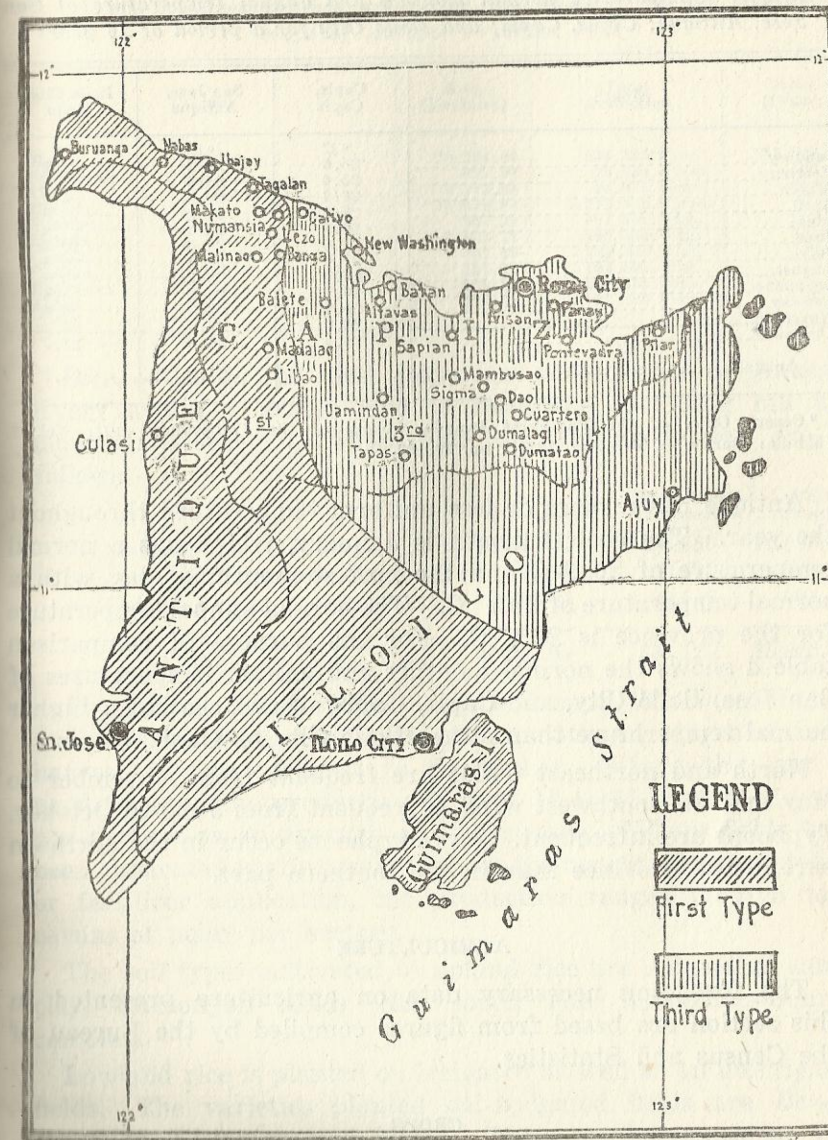

Figure 7. Climate map of Panay Island.

The relative humidity is high at all times. The north and northeast winds occur from November to May and the southwest wind from June to October. Typhoons are relatively frequent in the northern half of the province.

TABLE 4.—*Comparative normal monthly and annual temperature of San Jose, Antique; Capiz, Capiz; and Iloilo City for a period of 16 years* [2]

Month	Capiz, Capiz	San Jose, Antique	Iloilo City, Iloilo
	° *C*	° *C*	° *C*
January	25.6	26.2	25.6
February	25.6	26.4	25.8
March	26.6	27.3	26.8
April	27.6	28.2	27.8
May	28.0	28.3	27.9
June	27.5	27.5	27.3
July	27.0	26.8	26.8
August	27.0	26.9	26.8
September	26.7	26.8	26.6
October	26.7	27.1	26.6
November	26.6	27.0	26.4
December	26.3	26.8	26.0
Annual	26.8	27.1	26.7

[2] Census Office of the Philippine Islands, *Census of the Philippines: 1918*. Vol. I. (Manila: Bureau of Printing, 1920), pp. 298–99.

Antique has a more or less uniform temperature throughout the year. The coolest month is January, which has a normal temperature of 26.2° C and the hottest month is May with a normal temperature of 28.3° C. The normal annual temperature for the province is 26.1° C. For the purpose of comparison table 4 shows the normal monthly and annual temperatures of San Jose, Iloilo City, and Capiz, Capiz. San Jose has a higher normal temperature than either Iloilo City or Capiz, Capiz.

North and northeast winds are frequent from November to May and the southwest wind is frequent from June to October. Typhoons are infrequent. More typhoons occur in the northern part of the province than in the southern part.

AGRICULTURE

The foregoing necessary data on agriculture presented in this section are based from figures compiled by the Bureau of the Census and Statistics.

CROPS

The ten leading crops of the province in 1948 were rice, sugar cane, corn, coconut, tobacco, mungo, camote, cassava, eggplant, and abaca. Table 5 shows the area, production, and value of these crops.

TABLE 5.—*Area planted, production, and value of the ten leading crops of Antique Province, 1948*

Crops	Area (Hectares)	Total production	Value (Pesos)
Rice	30,294.00	534,125.0 cav.	₱5,920,565
Sugar cane	697.92	18,784.8 tons	528,654
Corn	5,770.08	46,576.0 cav.	466,334
Coconut	12,615.64	7,572,615.0 nuts	363,957
Tobacco	657.98	307,936.0 kg.	263,823
Mungo	1,621.71	245,385.0 kg.	171,472
Camote	891.49	1,249,379.0 kg.	120,758
Cassava	707.10	997,863.0 kg.	102,667
Eggplant	166.92	247,408.0 kg.	43,001
Abaca	293.66	62,779.0 kg.	39,743

Rice.—Rice is the most important staple crop of Antique. Every available arable land is cultivated including hill and mountain slopes. In 1948, data on rice production are as follows:

Crop	Area (Hectare)	Production (Cavans)	Value (Pesos)
Lowland rice, first crop	22,504.93	436,589	₱4,865,492
Lowland rice, second crop	3,560.81	62,990	670,620
Upland rice	4,228.26	34,546	384,453
Total	30,294.00	534,125	₱5,920,565

The upland rice varieties such as *Dumali, Kutsiam, Hagini,* and *Lubang* are planted during the months of May and June; harvest is from August to September. Where the land is newly opened the production is from 10 to 15 cavans of palay per hectare or an average of 12.5 cavans. Where fields have been cultivated continuously without the benefit of crop rotation or fertilizer application, the production ranges from 5 to 7 cavans of palay per hectare.

The soil types cultivated to upland rice are Alimodian sandy clay, Patnongon sandy clay loam, and Alimodian–Bolinao complex.

Lowland rice is planted on irrigated as well as on unirrigated fields. The varieties planted on irrigated fields are *Ramai, Raminad, Elon-elon,* and *Micao*. These are late-maturing rice varieties which are planted from about the middle of May to June, and harvested from about the end of December to January. The production is 50 cavans of palay per hectare for *Micao*, and 80 cavans for *Ramai* and *Raminad*. Wag-wag, a new and high yielding variety, was recently introduced and is now extensively cultivated on the irrigated plains of Sibalom.

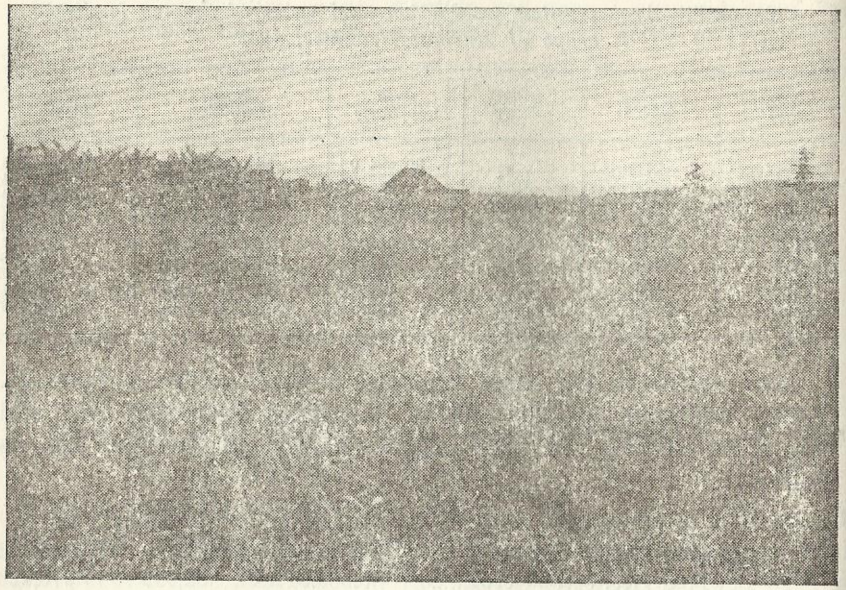

Figure 8. Rice is the main crop. It is grown in all types of soil both in the upland and lowland areas.

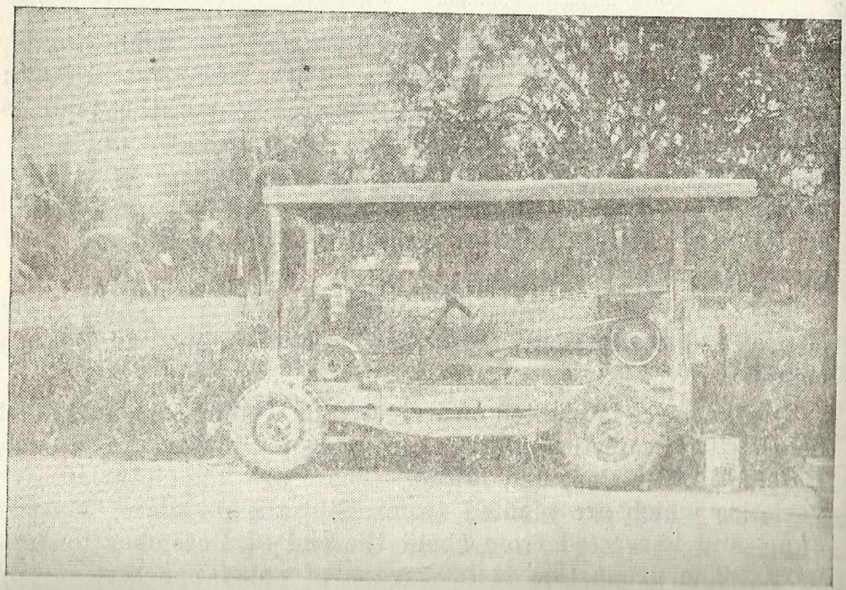

Figure 9. A portable rice huller serving outlying barrios. It cleans rice in several minutes what it takes a man hours to pound in a mortar.

PLATE II

The medium–late varieties such as *Apostol, Durao, Dadidit, Macan,* and *Dumagaan* are planted on unirrigated rice fields. These are planted from about July to the early part of August, and harvested from October to November. The *Dumagaan* variety yields about 25 cavans of palay per hectare while the *Apostol, Macan,* and *Dadidit* varieties yield about 35 cavans of palay per hectare.

Corn.—Corn is the second food crop. The 1948 production of this crop was 46,576 cavans of shelled corn from an area of 5,770.08 hectares and valued at ₱466,334. The average production is about 8 cavans per hectare which is quite low compared to that of the production of some central Luzon provinces. Dao, San Jose, Sibalom, Valderrama, and San Remigio are the best corn producing towns of the province.

Coconut.—There are no big coconut plantations in Antique but this crop ranks second in the area planted, and fourth in the value of production. In 1948, 12,615.64 hectares were planted to coconuts with a corresponding value of the produce amounting to ₱363,957. The total harvest for that year was 7,572,615 nuts.

The coconut products are coconut oil, *tuba,* copra, and coconut candy. Sun-dried copra is prepared for export while the rest are for local consumption. Coconuts are grown in almost every town. The coastal towns of Pandan, Dao, San Jose, Culasi, and Caluya are the chief copra producing areas of the province.

Sugar cane.—Sugar cane is the only crop in Antique which is intensively fertilized. It is extensively grown in Patnongon, Bugasong and Culasi. The average production per hectare in these places is about 45 piculs of muscovado sugar from the unfertilized fields and 65 piculs of sugar from the fertilized fields. The common cane varieties planted are Badila, Negros Purple, Alunan, and POJ 2878. Elsewhere, especially in the upland regions, the production of muscovado sugar ranges from 10 to 20 piculs per hectare. The rather low yield is partly due to the absence of irrigation water and poor management practices as well as the crude native mills used:

The total area planted to this crop in 1948 was 697.92 hectares and the value of production estimated at about ₱528,654.

Tobacco.—Tobacco is planted for local consumption rather than for export. There were 657.98 hectares planted to this crop in 1948 with a total production of 307,936 kilograms of crude leaves valued at ₱263,823.

Figure 10. Coconut is the main crop along the narrow coastal plains which are usually sandy.

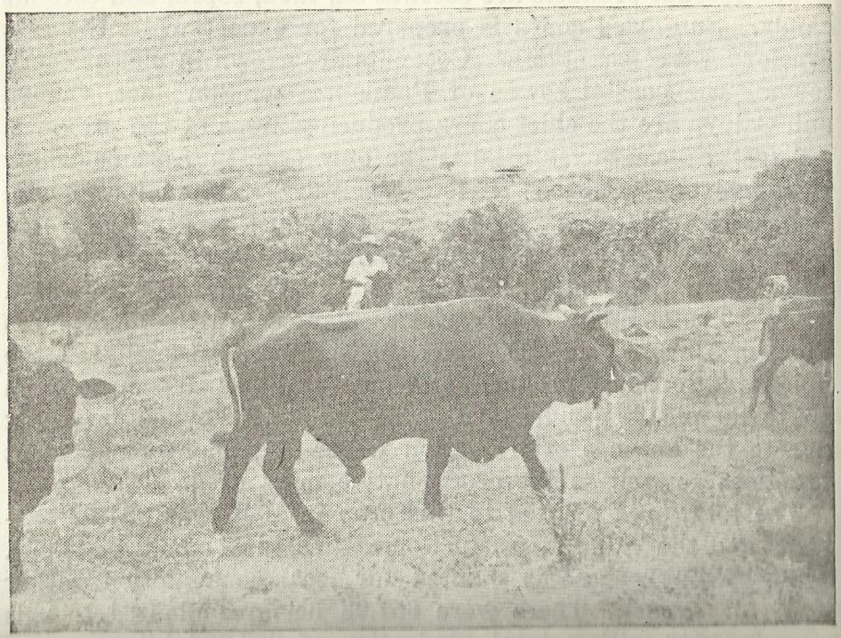

Figure 11. A fine specimen of a bull. Stock such as this will greatly improve the kind of animals raised on a farm. The rolling grassy uplands are best suited for pasture.

PLATE III

Leguminous crops.—The leading leguminous crops of the province are mungo, cowpeas, soybeans, peanut, patani, and cadios. Mungo occupied an area of about 1,621 hectares in 1948 with a corresponding production of about 245,385 kilograms valued at ₱171,472. Beans and peanuts are usually grown as catch crops. Peanuts and cadios are sometimes interplanted with corn and upland rice, respectively.

Vegetables.—The common vegetables planted in the province are eggplants, tomatoes, squash, ampalaya, patola, etc. These are mostly planted on garden plots or on home yards. The supply of leafy and fruit vegetables for local consumption is quite adequate.

Root crops.—Camote, cassava, *ubi*, *gabi*, and *tugue* are the important root crops of the province. Camote ranks first in importance among the root crops and seventh among the ten leading crops of the province. It is also the third food crop of the people. The area cultivated to camote in 1948 was 891.49 hectares with a production of about 1,249,379 kilograms valued at ₱120,758.

Fruit trees.—The ten leading fruit trees are banana, mango, jackfruit, papaya, tamarind, breadfruit, *siniguelas*, *kamachile*, *caimito*, and sugar apple.

TABLE 6.—*Number of trees, production, and value of ten leading fruit trees in Antique Province in 1948*

Fruit trees	Number	Production	Value
Banana	647,515	650,578 bunches	₱417,108
Mango	15,041	4,361,133 fruits	155,873
Jackfruit	68,642	593,787 fruits	152,831
Papaya	44,043	1,301,574 kgs.	77,724
Tamarind	2,502	36,551 *kaings*	51,469
Breadfruit	6,925	541,516 fruits	18,267
Siniguelas	10,450	5,927,837 fruits	15,957
Kamachile	7,181	9,737 *kaings*	13,889
Caimito	3,784	244,558 fruits	10,997
Sugar apple	10,073	265,986 fruits	9,494

Banana is the most commonly grown fruit tree throughout the province. The number of banana hills recorded in the province in 1948 was 647,515 and the harvest valued at ₱417,108.

Other crops.—The other important products of Antique are bamboos, pineapples, and buri palms. Bamboos are used especially in the construction of native houses. Buri is used for weaving mats and hats.

AGRICULTURAL PRACTICES

The wooden plow and harrow pulled by carabao are still the principal farming implements in the province. With an exception of a few progressive farmers who raise sugar cane, all the farmers depend on manual and animal power not by choice but more because of financial handicaps, the nature or topography of the fields they till, as well as the present system of landholding.

The introduction of selected standard seeds for planting and thorough land preparation before planting are being extensively waged by the extension workers of the Bureau of Plant Industry and the Bureau of Agricultural Extension. The application of commercial fertilizers is not very much practiced. Its importance, nevertheless, is realized specially by farmers who have benefited considerably through fertilization under the guidance of different governmental agricultural agencies.

The communal irrigation system is used to a great advantage by the farmers of Bugasong, Culasi, Tibiao, Barbasa, and Valderrama. The San Jose–Sibalom Irrigation System irrigates about 4,800 hectares of lowland rice fields in San Jose and Sibalom. This irrigation system raised the productive capacity of the farms served by the system.

Most of the farmers practice clean culture. The diking of the lowland rice fields incidentally helps the conservation of water and minimizes soil erosion. Terracing of the moderately undulating areas in some regions is also practiced. In the rolling and hilly areas the farm practices used enhance soil erosion. Soil conservation measures such as a sound system of crop rotation, green manuring, strip cropping, contour cropping, and terracing should be adopted.

LIVESTOCK AND POULTRY INDUSTRY

Before World War II, there were some promising cattle ranches in the province but all the animals were lost during the Japanese occupation. The rehabilitation of the livestock industry has not yet fully attained its pre-war level. Work animals, however, are quite adequate for the needs of the farmers.

Tables 7 and 8 present data on the kinds, number, and value of livestock in Antique Province in 1948.

TABLE 7.—*Number and value of five leading livestock in Antique Province, 1948*

Livestock	Number	Value
Carabaos	42,648	₱4,998,400
Cattle	16,714	1,713,559
Hogs	49,977	1,326,316
Horses	1,289	96,001
Goats	2,983	19,441

TABLE 8.—*Number and value of the five leading poultry fowls in Antique Province, 1948*

Poultry	Number	Value
Chickens	332,386	₱286,586
Ducks	7,691	9,247
Turkeys	34	221
Geese	60	138
Guinea fowls	11	17

The milking of cows, goats, and carabaos is done by a few individuals which they sell to local consumers. The 1948 census records milk production in the province as follows:

Source	Quantity (liters)
Carabaos	16,310
Cattle	4,850
Goats	585
Total	21,745

The poultry industry before World War II was quite progressive. Semi-commercial poultry raising was widely practiced and breeds of chicken such as Cantonese, Rhode Island Red, White Leghorn, and Nagoya were imported to improve the local breeds. In 1939 there were about 297,028 chickens of different breeds valued at ₱78,551; in 1948 the number of different breeds was 332,386 valued at ₱286,586.

LAND-USE CHANGES

The level agricultural area of Antique is so small for the needs of the people, especially of late because of the steady increase in population. Agricultural activities were intensified by clearing forests. Open grass lands, pasture lands, hills, and rolling areas were converted into crop lands. The swampy areas, deltas, and shores of shallow protected bays were planted to nipa palms while some areas were converted into fishponds or salt beds. On the other hand, croplands are utilized for one or more crops a year by irrigation. Table 9 shows the farm land classification of Antique Province in 1948.

TABLE 9.—*Farm area of Antique Province classified according to kinds of lands, 1948*

Kind of land	Area in hectares
1. Cultivated land	43,720.69
2. Idle land	8,361.11
3. Pasture land	12,585.83
4. Forest land	2,192.40
5. Other lands	3,506.54
Total	70,366.57

In the 1918 census, there were 32,137 hectares cultivated as compared to 43,720.69 hectares in 1948. Since 1948 additional areas were opened to cultivation.

FARM INVESTMENT

From the census of 1948 farm equipment in the province, their corresponding number, and value are as follows:

Farm equipment	Number	Value
Plows	29,143	₱551,954
Harrows	26,260	
Carts	765	
Sleds	17,531	
Tractors	4	
Stripping machines	13	

FARM TENURE

Farmers in Antique are grouped into four classes based on the manner in which they operate the land; namely, full owners, part owners, tenants, and managers. The tenants may still be subdivided into share tenants, share-cash tenants, cash tenants, and other tenants. In the 1948 census, there were 24,662 farms operated by all farmers in the province. Of these farms 65.5 per cent were operated by full owners; 15.2 per cent operated by part owners, and 19.3 per cent operated by tenants. The division shows that a great majority of the farms were operated by owners and only about 1/5 of the total number were operated by tenants. For the hectarage cultivated by each class, the full owners had the largest area constituting about 28,083.30 hectares or 64.2 per cent; part owners, 7,492.77 hectares or 17.1 per cent; all tenants, 8,099.65 hectares or 18.6 per cent,

and the farm managers, 44.97 hectares or 0.1 per cent. The average areas of farms for the various farm operators are: full owners, 2.99 hectares; part owners, 3.03 hectares; all tenants, 2.22 hectares; farm managers, 8.22 hectares; and for all operators, 2.85 hectares.

TABLE 10.—*Number, cultivated area, and total area of farms by tenure of farm operator in Antique, 1948*

Tenure of farm operator	Farms		
	Number	Cultivated area (Hectares)	Total area (Hectares)
Full owner	16,163	28,083.30	48,386.22
Part owners	3,714	7,492.77	11,258.08
Share tenants	4,613	7,694.36	10,060.88
Share-cash tenants	25	73.68	137.59
Cash tenants	57	109.90	193.31
Other tenants	79	221.71	240.10
Farm managers	11	44.97	90.39
Total	24,662	43,720.69	70,366.57

Farm land distribution in Antique is more or less even. It may partly account for the absence of social unrest in the province.

TABLE 11.—*Number and percentage of farms by size of farms in Antique in 1948*

Size of farms	Farms	
	Number	Percentage
Less than 1 hectare	5,608	22.7
From 1 to less than 2 hectares	8,555	34.7
From 2 to less than 3 hectares	4,463	18.1
From 3 to less than 4 hectares	2,246	9.1
From 4 to less than 5 hectares	1,109	4.5
From 5 to less than 10 hectares	1,796	7.3
From 10 to less than 20 hectares	561	2.3
From 20 and over	324	1.3
Total	24,662	100.0

TYPES OF FARMS

The Bureau of the Census and Statistics scheme of farm classification is outlined hereunder:

1. Palay farms are farms in which the area planted to lowland and/or upland palay is 50 per cent or more of the total area cultivated.
2. Corn farms are farms in which the area planted to corn is 50 per cent or more of the total area cultivated.
3. Abaca farms are farms in which the area planted to abaca is 50 per cent or more of the total area cultivated.

4. Sugar cane farms are farms in which the area planted to sugar cane is 50 per cent or more of the total area cultivated.
5. Coconut farms are farms in which the area planted to coconut is 50 per cent or more of the total area cultivated.
6. Fruit farms are farms in which the area planted to fruit trees is 50 per cent or more of the total area cultivated.
7. Tobacco farms are farms in which the area planted to tobacco is 50 per cent or more of the total area cultivated.
8. Vegetable farms are farms in which the area planted to vegetables (camotes, mungo, soybeans, tomatoes, sitao, beans, squash, ampalaya, onions, radish, eggplants, etc.) is 50 per cent or more of the area cultivated.
9. Root crop farms are farms in which the area planted to root crops is 50 per cent or more of the area cultivated.
10. Livestock farms are farms which have (1) an area of 10 hectares or more, (2) more than 10 heads of cattle, horses, goats, and sheeps, and (3) less than 20 per cent of the total farm area is used for the production of crops, fruits or nuts.
11. Poultry farms are farms in which there are 300 chicken or 200 ducks and usually less than two hectares of cultivated land.
12. Other farms are farms which could not be classified under any of the above groups.

Table 12 shows the number of farms according to farm types in Antique.

TABLE 12.—*Number and percentage of farm types in Antique Province, 1948*

Types of farms	Number	Percentage
Palay	19,554	79.3
Corn	385	1.5
Abaca	47	0.2
Sugar cane	170	0.7
Coconut	851	3.4
Fruit	93	0.4
Tobacco	6	less than 0.1
Vegetables	20	0.1
Root crops	93	0.4
Livestock	18	0.1
Poultry	4	less than 0.1
Others	3,421	13.9
Total	24,662	100.0

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying 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.

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. These 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 content of lime and salts are determined either in the field or in the laboratory. The drainage, both external and internal, and other features such as the relief of the land, climate, natural and artificial features are taken into consideration, and the relationship of the soil and the vegetation and other environmental features are 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 mapping units are in such intimate or mixed pattern that they cannot be clearly shown on a small-scale map, they are mapped or grouped into a (4) 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 mountains 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 similar parent material. It comprises soils which have 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 where the soil was first identified. For example, the Patnongon series was first found and classified in the municipality of Patnongon, Antique 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, silty clay loam, clay loam or clay is added to the series name to give the complete name of the soil. For example, Patnongon clay is a soil type within the Patnongon 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 characteristic 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 need fertilizer requirement and cultural management different from those of the real soil type. A phase of a type due mainly to degree of erosion, degree of slope and amount of gravel and stone 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 is called a soil complex. If, in an area, there are several series such as Bolinao, Alimodian, Sta. Rita and others that are mixed together, the two dominant series must bear the name of the complex, as the case may be. If there is only one dominant constituent, that series or type bears the name of the complex as Bolinao or Sta. Rita complex.

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

The soil survey party, composed of two or three technical men, maps the area and delineates the various soil types, phases,

complexes, and miscellaneous land types. All natural and cultural features found in the area are indicated on the soil map, such as trails, roads, railroads, bridges, telephones and telegraph lines; barrios, towns, and cities; rivers and lakes; prominent mountains, and many others.

THE SOILS OF ANTIQUE PROVINCE

The soils of the province were divided into three groups, namely:

	Soil type Number
A. Soils of the plains and valleys	
1. San Manuel loam	190
2. Umingan sandy loam	100
3. Umingan clay loam	168
4. Magcalon sandy loam	217
5. Sta. Rita clay	120
6. Sta. Rita sandy loam	226
7. Patnongon sandy clay loam	219
B. Soils of the hills and mountains	
1. Alimodian sandy clay	225
2. Alimodian–Bolinao complex	707
C. Miscellaneous land types	
1. Hydrosol	1
2. Mountain soils, undifferentiated	45
3. Beach sand	118

Table 13 presents the corresponding area, percentage, and present use of each soil and miscellaneous land type. The distribution of soil types and miscellaneous land types are shown in the accompanying soil map of the province.

Soils of the Plains and Valleys

The narrow coastal plains have an aggregate area of about 50,676.25 hectares, or 18.91 per cent of the total area of the province. The widest plain is found between San Jose and Sibalom. It is irrigated by the San Jose–Sibalom Dam. The secondary soils of the plains and valleys have undeveloped to moderately developed profiles. They are cultivated principally for rice, corn, and sugar cane.

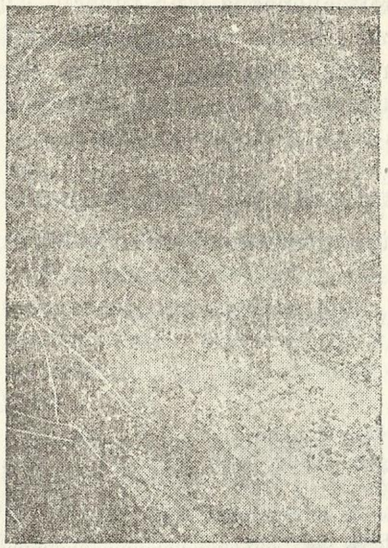

Figure 12. Soil profile of San Manuel loam. Note the deep and loose soil in the profile. This soil is very productive.

Figure 13. Landscape of San Manuel soil in the foreground. Principally grown to lowland rice; corn and sugar cane are also grown.

PLATE IV

SAN MANUEL SERIES

Soils of this series are level to nearly level; loose, friable and fairly well drained. Lowland rice is the crop most intensively grown, followed by sugar cane and corn. The other crops grown are tobacco, coconuts, vegetables, and fruit trees.

San Manuel loam (190).—The typical profile characteristics of this soil type are as follows:

Depth (cm.)	Characteristics
0– 25	Surface soil, loam; pale brown to brown, brick red streaks present in lowland rice fields; moderately fine granular structure; loose and friable; contains fair amount of organic matter; affords good root penetration. Diffused and smooth boundary with underlying layer.
25– 60	Upper subsoil, clay loam; pale brown; granular; slightly compact; contains fair amount of organic matter.
60–100	Lower subsoil, silt loam; grayish brown; fine granular; moderately loose. Boundary with the substratum is clear and smooth.
100–150	Substratum, fine to coarse sand, yellowish brown, loose and structureless.

This soil type occupies the level and slightly undulating area around Bugasong, the plain in Barbaza between the barrios of Asperer and Igpalge, and part of the plain of Tibiao. It covers an area of about 3,565 hectares.

The drainage is fair. It is principally cultivated to rice and sugar cane, the former yielding about 35 to 50 cavans of palay per hectare and the latter about 35 piculs of muscovado sugar on unfertilized fields and 60 piculs on fertilized fields. Ammonium sulfate is applied to sugar cane fields at the rate of 200 to 250 kilos per hectare. Increased production shows that San Manuel loam responds well to nitrogenous fertilizers.

UMINGAN SERIES

The surface soil of the Umingan series is generally brown to light brown and coarse in texture. The subsoil is brown to light brown silt loam underlain by an accumulation of gravels, pebbles, and stones sometimes 6 to 8 centimeters in diameter. Underneath these stones and gravels is a layer of sand, silt loam, or sandy loam, which in some places is again followed by another layer of stones and gravels. The layer

Figure 14. Soil profile of Umingan sandy loam. Note the layer of stones which characterizes the series.

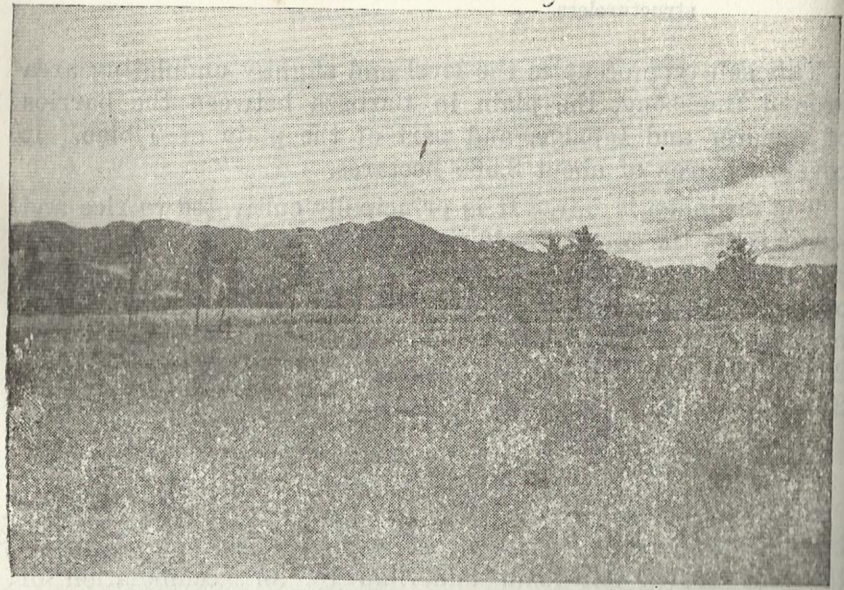

Figure 15. Landscape of Umingan sandy loam. The mountains in the background show the limited extent of the flood plains characteristic of a rugged country.

PLATE V

or layers of stone accumulation distinguishes the Umingan series from other alluvial soils.

The topography is level to slightly undulating. The drainage is generally adequate. The principal crops grown are rice, sugar cane, corn, camote, cassava, peanuts, bananas, coconuts, vegetables, and fruit trees.

Umingan sandy loam (100).—The typical soil profile of the Umingan series is represented by Umingan sandy loam with profile characteristics as follows:

Depth (cm.)	Characteristics
0– 30	Surface soil, sandy loam; light brown to brown; fine granular structure; friable; contains fair amount of organic matter; affords good root penetration. Stones are sometimes found on the surface. Boundary with subsoil, clear and smooth.
30– 60	Subsoil, silt loam; light brown; fine granular; friable and loose; abrupt and smooth boundary with underlying horizon.
60–100	Fine sand; light brown to ash brown; structureless.
100–130	Layer of gravels, pebbles and stones. Its depth varies in several places.
130–below	Sand; light brown to brown; loose and structureless.

The soil type is found along the big rivers of the province and is therefore subjected to occasional floods. It covers an area of about 10,860 hectares. It is devoted mostly to the cultivation of lowland rice and sugar cane. Rice yields about 30 to 40 cavans of palay per hectare; sugar cane about 35 to 40 piculs of muscovado sugar per hectare on unfertilized fields.

The yield of rice in the Umingan sandy loam ranges from 30 to 40 cavans a hectare at normal times. That of sugar cane is 35 to 40 piculs of muscovado sugar a hectare of the unfertilized field. In Patnongon fertilized sugar cane fields yield about 65 piculs of muscovado sugar per hectare. Other crops grown are corn, cassava, camote, peanut, vegetables, fruit trees, and coconuts.

Umingan clay loam (168).—The clay loam surface soil is brown to light brown. It is hard to cultivate when dry, but when with the right moisture, it is soft, quite friable, and easy to cultivate. The drainage is fair to adequate. This soil type has an area of 7,018.50 hectares and is found in Culasi and Pandan. It is principally devoted to lowland rice.

Lowland rice yields from 35 to 45 cavans of palay per hectare. The low production may be attributed to the variety of rice planted, absence of irrigation and the non-application of commercial fertilizers. The common varieties of rice usually planted are *Candidit, Kinita, Calubad, Macan, Cabonlog,* and *Micao.* If the standard varieties of rice such as *Apostol, Macan, Sta. Rosa,* and *Macan Bino* are substituted, together with the application of the right kind and amount of fertilizer, an adequate water supply, and a system of crop rotation wherein leguminous crops are included, rice production may substantially increase. Sugar cane, corn, mungo, coconut, banana and some fruit trees are the other crops grown.

MAGCALON SERIES

Magcalon series was first identified and mapped in the province of Antique. This series is closely related to Umingan series. While the latter's subsoil is silt loam, that of Magcalon series is dark grayish brown to black fine sand. Underlying this horizon is a layer of light brown sand with gravels and stones. The layer of stone accumulation varies in depth from 35 to 150 centimeters from the surface. In some sections there are two layers of stones separated by a layer of sand.

The relief is nearly level to gently undulating. External and internal drainage are good to excellent. The cultivated portions are planted to coconuts, rice, corn, sugar cane, root crops, fruit trees, mungo, bananas, and vegetables. The uncultivated areas are grasslands with patches of bamboo groves, shrubs or trees.

Magcalon sandy loam (217).—The profile characteristics of this soil type are as follows:

Depth (cm.)	Characteristics
0– 25	Surface soil, sandy loam; grayish brown to brown when dry, dark grayish brown when wet; granular; loose and very friable; and easy to cultivate. Root penetration is good. In certain places, gravels are present in this layer. The boundary with the subsoil is clear and smooth.
25– 45	Subsoil, fine sand; dark grayish brown when dry, almost black when wet; loose and friable. Clear and smooth boundary with the underlying layer.
45– 75	Layer of mixed sand, gravels, pebbles and stones. The sand is light brown with reddish mottlings.
75–150	Light grayish brown sand; loose and structureless.

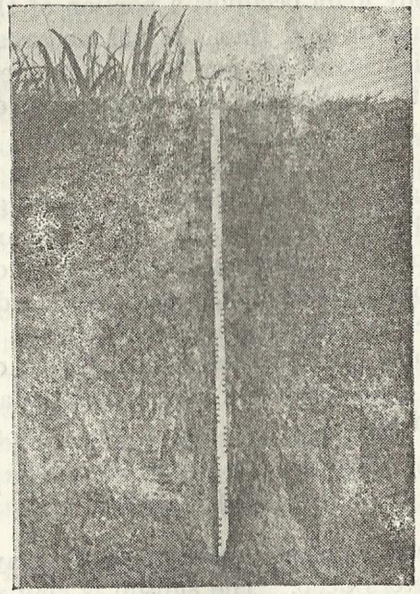

Figure 16. Profile of Sta. Rita clay. This is a deep fine-textured soil. Surface soil is black and granular.

Figure 17. Landscape of Sta. Rita clay. The soil is usually planted to lowland rice.

PLATE VI

Magcalon sandy loam occupies a portion of the coastal plains of San Jose, Pandan, and Dao. It has an area of about 4,018 hectares of which about 70 per cent is devoted principally to rice and coconut. In Pandan, the average yield of coconut per hectare per year is from 2,500 to 2,900 nuts; in San Jose, it is about 2,600 nuts. The production of rice is about 15 to 25 cavans of palay per hectare on the unirrigated fields and 35 cavans on the irrigated areas. It is apparent that application of appropriate fertilizers, a system of crop rotation with leguminous crops included in the sequence, and the utilization of farm manures and green manures are some necessary practices to be adopted for this soil type. Other crops grown on Magcalon sandy loam are corn, root crops, bananas, vegetables, and some fruit trees.

STA. RITA SERIES

The surface soil is dark brown to black clay loam to clay, 20 to 30 centimeters deep. The subsoil is clay which is lighter in color than the surface soil. Soils of this series were developed from recent alluvial deposits. The relief is level and external drainage is poor. Internal drainage is also poor because of the compactness and fine texture of the soil. It is, however, one of the best lowland rice soils of the province. A wide area of it is irrigated by the San Jose–Sibalom irrigation system.

Sta. Rita clay (120).—The typical profile characteristics of this soil type are as follows:

Depth (cm.)	Characteristics
0– 30	Surface soil, clay; dark brown to black; moderately coarse granular structure; highly plastic and soft when wet, shrinks and cracks and becomes very hard upon drying. Contains a fair amount of organic matter. Affords good root penetration. Boundary with subsoil is diffused and smooth.
30– 70	Subsoil, clay; brown to dark brown; hard when dry, soft and plastic when wet; coarse granular structure. Poor in organic matter content. Boundary with underlying horizon, clear and smooth.
70– 95	Lower subsoil, silty clay; light brown to brown; medium granular structure; compact.
95–150	Substratum, silt loam; light brown; fine granular structure; soft and friable.

Sta. Rita clay occupies the largest area irrigated by the San Jose–Sibalom irrigation system. It has an aggregate area of about 10,602 hectares. This soil type is found in San Jose, Sibalom, San Remigio, Dao, and Pandan.

Rice is the main crop grown on Sta. Rita clay. In San Jose and Sibalom, where this soil type is irrigated, the late maturing high yielding rice varieties, *Elon-elon*, *Ramai*, and *Raminad*, are planted. *Wagwag* was introduced during the time of the survey. The production of lowland rice on the irrigated rice paddies in San Jose and Sibalom ranges from 50 to 80 cavans of palay per hectare. In Dao and Pandan where this soil type is not irrigated the production is about 35 cavans of palay per hectare. The other crops grown on this soil type are corn, sugar cane, camote, vegetables, banana, mungo, and some fruit trees.

Sta. Rita sandy loam (226).—This soil type is found in Sibalom, Patnongon, and San Jose with an aggregate area of 3,711 hectares.

The relief is level to slightly undulating. It is fairly drained. The greater portion of this soil type in San Jose and Sibalom is irrigated by the San Jose–Sibalom irrigation system. The irrigated rice fields yield from 50 to 70 cavans of palay per hectare. In Patnongon where this soil type is not irrigated the production ranges from 25 to 40 cavans of palay per hectare. The other crops grown on this soil type are corn, sugar cane, cassava, camote, peanuts, mungo, beans, tobacco, coconuts, bananas, vegetables, and fruit trees.

PATNONGON SERIES

Patnongon series was first identified in the province of Antique. It is found on older alluvial fans or alluvial plains and has a moderately developed profile like that of the Sta. Rita series. These two series, however, differ in the color and texture of their subsoil and substratum. Furthermore, in the Patnongon series gravels and stones exist in the subsoil and substratum, whereas in the corresponding layers of the Sta. Rita series gravels and stones are not present.

The relief is level to moderately rolling. The external drainage is fair but the internal drainage is poor.

Patnongon sandy clay loam (219).—The typical profile characteristics of this soil type are as follows:

Depth (cm.)	Characteristics
0– 20	Surface soil, clay loam; light brown to brown with dark brown mottlings; granular structure; compact and hard when dry,

	sticky when wet. Affords fair root penetration. Boundary with the subsoil is diffused and smooth.
20– 45	Subsoil, clay; light brown to brown; moderately coarse granular structure; gravels and stones present occasionally.
45– 70	Lower subsoil, sandy clay; brown with reddish mottlings, coarse granular structure. Boundary with the substratum, clear and smooth.
70–150	Substratum, sandy clay with some gravel; light brown to light grayish brown; coarse granular structure; slightly compact.

This soil type is found in Patnongon, Dao, Laua-an, and Pandan. It has an aggregate area of about 4,807 hectares. The main crop grown is lowland rice. Corn, banana, coconut, vegetables, and some fruit trees are the secondary crops. Farmers in Patnongon and Pandan produce about 25 to 30 cavans of palay per hectare; in Dao about 10 to 15 cavans. Being low in organic matter content as well as fertility, this soil type needs better farming practices such as fertilizer application, farm and green manuring, crop rotation, thorough preparation of the soil, as well as irrigation facilities.

SOILS OF THE HILLS AND MOUNTAINS

The province of Antique is hilly and mountainous. The primary soils of the hilly and mountainous regions have well developed soil profiles. They have been formed mostly from stratified rocks such as limestone, sandstone, and shales.

The drainage is good to excessive. The native vegetation consists of cogon, and secondary and primary forests.

ALIMODIAN SERIES

Alimodian series covers the foothills of the higher cordilleras on the eastern part of the province. It was developed from soft sedimentary rocks, like shale and sandstone. The native vegetation consists of cogon as well as primary and secondary forests.

Alimodian sandy clay (225).—The profile characteristics of this soil type are as follows:

Depth (cm.)	Characteristics
0– 30	Surface soil, sandy clay; brown to reddish brown; medium granular structure; slightly friable when moist, hard and brittle when dry; fair organic matter content; affords fair

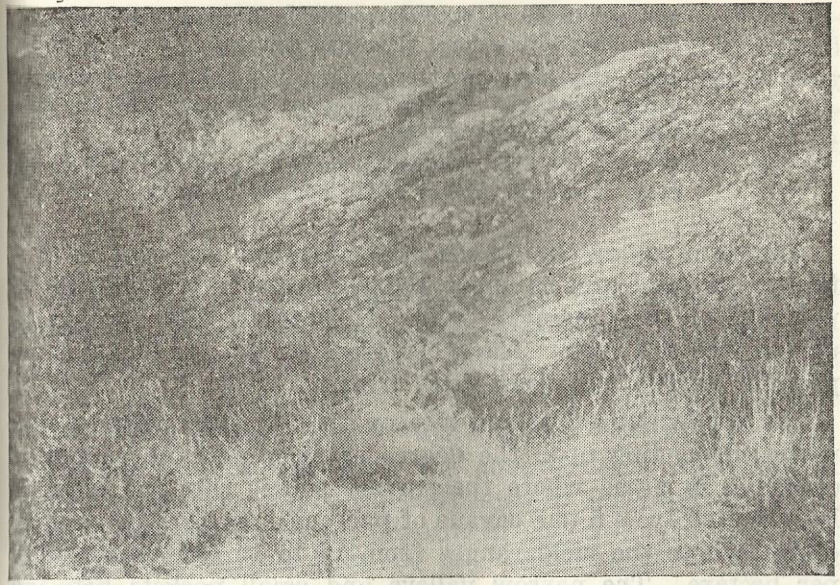

Figure 18. Profile of Alimodian sandy clay. Soil is developed largely from shale.

Figure 19. Landscape of Alimodian sandy clay. Note the rugged terrain.

PLATE VII

	root penetration. Gravels and stones occasionally present. Boundary with subsoil clear and smooth.
30– 60	Subsoil, clay loam; light brown; medium columnar structure; brittle, hard, and slightly compact. Boundary with the substratum, clear and smooth.
60–150	Substratum, highly weathered shale or stratified sandstone; gray to grayish brown; platy; slightly compact.

Alimodian sandy clay is the most extensive soil type in Antique. Its total area is about 105,992 hectares or about 39.56 per cent of the provincial total. It is principally devoted to upland rice and corn. The other crops grown are sugar cane, peanuts, mungo, and some fruit trees.

The production of upland rice on the Alimodian sandy clay varies, depending upon the degree of slope and the extent of erosion. In areas where the surface soil is thin the yield is low ranging from 5 to 8 cavans of palay per hectare; on slightly eroded slopes the yield ranges from 12 to 15 cavans of palay per hectare. The narrow valleys and small pockets between the hills produce better yields, about 20 cavans of palay per hectare. The yield of corn is also low on highly eroded slopes, and only a little higher on the more level areas, lower slopes, small pockets and narrow valleys. Camote, cassava, vegetables, mungo, peanut, beans, banana, coconut, and some fruit trees are also grown on this soil type. Many sections of this soil type were depleted of fertility or severely eroded and are now abandoned.

Alimodian–Bolinao complex (707).—The Alimodian–Bolinao complex covers an area of 3,379 hectares. It occupies the rolling and hilly areas between the towns of Culasi and Pandan. The soils of this soil complex were developed from weathered shale, sandstone, and limestone. The dominant texture is clay loam on the upper slopes and clay on the lower areas, especially where limestone is the main parent material. The surface soil is light brown to reddish brown, sticky when wet and very hard when dry. Limestone outcrops are found in some places.

The external drainage is good to quite excessive; internal drainage is fair to good. In some areas where the external drainage is quite excessive gullies have formed and the surface soil is only a few centimeters thick.

Some of the lower and rolling areas are terraced and cultivated. The higher hills are covered by secondary forests where *kaiñgin* farming is widely practiced. The open areas not cultivated are cogonal while those cultivated are planted to upland rice, corn, camote, cassava, banana, coconut, and some fruit trees. The yield of rice is from 5 to 8 cavans of palay per hectare. On the narrow valleys and pockets rice yields about 15 cavans of palay per hectare.

Miscellaneous Land Types

Hydrosol (1).—The hydrosol area of the province is not extensive. This miscellaneous land type is found in San Jose, Bugasong, Barbaza, Culasi, and Pandan. It has an aggregate area of about 1,572 hectares. The common vegetation consists of *bakauan, api-api, tangal, langarai,* and nipa palms.

The horizons or layers are the aqueous layer consisting of the water portion, the subaqueous layer of mud, and the basal layer. Hydrosol areas are deposits of silt, clay, and sand. At high tide they are covered by sea water, while at low tide the subaqueous layer is exposed.

Hydrosol areas may be converted profitably into fish ponds or salt beds. In San Jose parts of the area were made into fishponds for *bañgos* culture. Elsewhere, nipa palms are gathered for native hut thatching and *bakauan* and other halophytic plants are gathered and sold as firewood.

Mountain soils, undifferentiated (45).—The mountain range running north to south along the eastern side of the province was classified under this land type. It covers an area of about 101,952 hectares or 38.05 per cent of the provincial total. The vegetation consists of grasses, secondary forest, and primary forest. Scattered over the area are *kaiñgin* farms where upland rice, corn, and root crops are planted. Mountain soils are considered non-agricultural because of the rough terrain. Where grasses and sparse trees grow intensive re-forestation should be done. *Kaiñgin* farming should be banned.

Beach sand (118).—This miscellaneous land type occurs as a narrow strip along some parts of the shore of the province. The relief is level to slightly undulating. Dark brown to gray coarse sand covers the area to a depth of more than 150 centimeters. The mass is structureless. Drainage is excellent. The most important crop grown is coconut. The secondary crops are corn, banana, and fruit trees such as *siniguelas, atis,* guayabano, star apple, and jack fruit.

TABLE 13.—*Area, percentage, and present use of each soil type in Antique Province*[1]

Soil Type No.	Soil type	Area in hectares	Per cent	Present use
1	Hydrosol	1,572.00	0.59	Fishponds, nipa palms, and mangrove.
118	Beach sand	6,093.00	2.27	Planted to coconuts, corn, camote, peanuts, and fruit trees. Also use for salt beds.
100	Umingan sandy loam	10,860.75	4.05	For lowland rice, sugar cane, corn, root crops, vegetables, tobacco, and fruit trees.
168	Umingan clay loam	7,018.50	2.62	For lowland rice, corn, sugar cane, coconut, mongo, fruit trees, root crops and vegetables.
217	Magcalon sandy loam	4,018.00	1.50	Lowland rice, corn, peanut, camote, cassava, coconut, banana, bamboo, fruit trees and vegetables.
190	San Manuel loam	3,565.00	1.33	Lowland rice, corn, sugar cane, tobacco, root crops, fruit trees, vegetables, coconuts and bananas.
120	Sta. Rita clay	10,602.50	3.96	Lowland rice, corn, sugar cane, coconut, mongo, bananas, and fruit trees.
226	Sta. Rita sandy loam	3,711.00	1.39	Lowland rice, corn, sugar cane, coconut, camote, cassava, mongo, fruit trees, banana, and tobacco.
219	Patnongon sandy clay loam	4,807.50	1.79	Lowland and upland rice, corn, fruit trees, banana, mongo, and camote.
225	Alimodian sandy clay	105,992.50	39.56	Principally cultivated for upland rice and corn, coconut, mongo, cassava, peanuts, fruit trees, bananas, and vegetables are the secondary crops. Some sections are used for pasture.
707	Alimodian–Bolinao complex	3,379.25	1.26	Upland rice, corn, bamboos, fruit trees, bananas, coconuts, cassava, camote, and also used for pasture.
45	Mountain soils, undifferentiated	101,952.00	38.05	Primary, mossy, and secondary forests. In some places are cogonals.
	All other areas (all islands near and off coast of the province	4,355.00	1.63	Coconuts, rice, corn, root crops, vegetables, fruit trees. In Semirara Island, Coal Mine is in operation.
	Total	267,927.00	100.00	

[1] The area of each soil type was determined by planimeter.

MORPHOLOGY AND GENESIS OF SOILS

Soils are formed from "materials produced as a result of the interaction of climate and living organisms upon the parent materials as conditioned by local relief. The character of the ultimate product is modified by time." Thus, parent material, climate, vegetation, relief, and time are the primary factors of soil formation. The variations in the influence of each factor over the others, or the collective influence of a combination of factors over the rest, as well as their complex interrelationship result in the formation of different kinds of soils. Thus the physical characteristics of a soil are mainly influenced by the kind of parent material, although in the process of soil formation these inherent characteristics are modified in one way or another by the other factors.

Alimodian sandy clay, which is the most extensive soil type in the province, was developed from stratified shale and sandstone. Alimodian–Bolinao complex was formed from coralline limestone, shale, and sandstone. These rocks are found mostly in the hills and mountains along the eastern part of the province.

The alluvial soils of the province were developed from sediments washed down from the surrounding uplands. These alluvial deposits are the results of degradation and aggradation. The stages of their occurrence are manifested by the various degrees of soil profile development.

The different profile groups into which the different soils and miscellaneous land types of Antique fall are enumerated hereunder.

Profile Group I.—Recent alluvial fans, flood plains or other secondary deposits with undeveloped profiles and underlain by unconsolidated materials:

1. Beach sand

Profile Group II.—Young alluvial fans, flood plains or other secondary deposits with slightly developed profiles and underlain by unconsolidated materials:

1. Umingan series
2. San Manuel series
3. Magcalon series

Profile Group III.—Older alluvial fans, alluvial plains or terraces having moderately developed profiles and underlain by unconsolidated materials; generally deep soils, without clay pan or hardpan between horizons:

1. Sta. Rita series
2. Patnongon series

Profile Group VIII.—Upland areas; developed on consolidated sedimentary rocks or formed on stratified rocks such as shale and sandstone; topography is generally rolling:

1. Alimodian series

LAND-USE AND SOIL MANAGEMENT

Farm practices should be along conservation principles to protect the soil from erosion and fertility depletion. The present state of the majority of farms in Antique is submarginal in nature. Farm management in the province should, therefore, be corrected and adjusted to fit the soils and the physical relief of the land.

Fertility is affected to a great extent by farm practices and soil management. While the general trend of agricultural efficiency has increased and that there are reasons to believe that it will continue to improve in the future, the average yield of palay per hectare in the province is quite low. This is also true with other crops. According to C. C. Taylor of the U. S. Department of Agriculture, land misuse consists of much more than permitting soil losses to occur and the most serious soil losses are almost always either an effect of economic and social maladjustments or the result of haphazard public land policy. During the soil survey of the province, it was noted that a large number of farmers were working farms that were either marginal or submarginal. A good portion of the land being cultivated might be considered too poor for the cultivation of agricultural crops, a condition which was brought about by soil erosion and exhaustion due to incorrect farm practices and extractive farming.

The population of the province is not proportionate to the arable land of Antique, so that the tendency is for the people to farm every available piece of land. As long as there are unoccupied areas, although not fitted to agriculture, population flows constantly toward them. As a result, slopes of more than 30 per cent are extensively cultivated. Strictly speaking, Alimodian sandy clay, a soil type of the hills and mountains, is the most important soil type agriculturally and economically in the province because it is the most extensively cultivated. For this reason, it is deemed important that proper soil management be followed in the cultivation of this soil type. Where steep slopes are cultivated, a proper system of crop rotation, strip cropping, contour planting, and terracing should be observed.

The indiscriminate cutting of trees and *kaiñgin* farming have taken a toll of good and valuable forest lands. Increased yields through scientific means should be the answer to meet the food needs of the people rather than the cultivation of more land which for the most part should strictly be left under forest or grass cover.

WATER CONTROL ON THE LAND

In an agricultural enterprise, one of the potent factors that determines its success or failure is water control and conservation. Water activates and controls the chemical and biological activities connected with plant growth and affects the physical functions of the soil. When properly regulated, tillage operations are improved and become more satisfactory for proper plant growth. On the other hand, when there is a rapid and excessive flow of water on the farm, erosion is imminent. Water as one of the contributing factors in crop production necessitates control and conservation for economical crop yields.

The effective control of water on the land depends on agricultural practices that tend to regulate runoff and maintain favorable soil moisture conditions. The control of runoff refers to the measures employed in preventing the rapid and excessive flow of water from fields, pastures, and forests. The amount of rain water absorbed by a given area is not equal to the amount of rainfall on the area because a greater portion may be lost through runoff. The water that is absorbed may in turn partly be lost through evaporation. The amount lost through runoff depends upon the topography of the area, the concentration and duration of rainfall, the vegetative cover, and the characteristics of the soil. There is always a certain amount of runoff on a sloping area even when it is thickly covered with vegetation. When this area is cultivated and deprived of its protective covering runoff increases. The steeper the slope of the land the greater the velocity of runoff. The physical condition of the soil and its other characteristics also greatly enhance the amount of runoff. The amount of absorbed rain water depends upon the looseness and permeability of the soil. An area with a compact and shallow surface soil underlain by a dense subsoil of low permeability or by clay or hardpan cannot absorb much water.

The aim in the control of runoff is to obtain maximum absorption of water by the soil and to provide a passageway for that which runs off in such a manner that the amount of soil materials carried away in the flow is minimized. Strip cropping, contouring, cover cropping, terracing, construction of diversion ditches, construction of farm ponds, maintenance of grassed waterways, and improving the structure of the soil through better soil management practices are some of the measures in water control and conservation. Proper use of the land as to its capabilities is also necessary in surface runoff control.

PRODUCTIVITY RATINGS OF THE SOILS OF ANTIQUE PROVINCE

Productivity ratings of soils help in the assessment of soil types and phases. The productivity rating of a soil type refers to its relative productivity as compared to a standard. The standard represents the approximate yield obtained without the use of fertilizers or soil amendments on the extensive and better soil types of the regions of the Philippines in which the crop or crops are most widely grown.

Table 14 shows the productivity ratings of the soils of Antique for the major crops of the province. In this table an index of 50 means that the soil is half as productive for the specified crop as the standard. On the other hand, an index of 120 indicates that the soil is 1.2 times more productive for the specified crops than the standard.

The average yields of the different crops on the different soils of the province were gathered directly from farmers, as well as from census, bulletins, and from reports of the provincial agricultural supervisor. These average yields are based on production without the benefit of commercial fertilizers or soil amendments.

TABLE 14.—*Productivity ratings of the soils of Antique*

Soil type No.	Soil type	Crop productivity index for [1] Lowland rice 100=60 cavans	Upland rice 100=20 cavans	Corn 100=17 cavans	Sugar cane 100=80 piculs	Coconut 100=3,750 nuts	Camote 100=8 tons	Cassava 100=15 tons	Mungo 100=7 cavans
190	San Manuel loam	75		85	100	65	150	110	90
120	Sta. Rita clay (irrigated)	110		70					110
120	Sta. Rita clay (unirrigated)	70		65					90
168	Umingan clay loam	70		65	80		85		95
226	Sta. Rita sandy loam (irrigated)	100		80	80		140	95	110
226	Sta. Rita sandy loam (unirrigated)	60		60	60	60	95	95	70
109	Umingan sandy loam	65		85	100	65	140	110	90
219	Patnongon sandy clay loam	50	60	35					
217	Magcalon sandy loam	35		30		85	120	60	
225	Alimodian sandy clay		90	55	50	55	90	75	85
707	Alimodian-Bolinao complex		50	30		60	65	55	75
118	Beach sand	25		30		80	60	2	
1	Hydrosol								
45	Mountain soils, undifferentiaed								

[1] Under present system of management the average yields per hectare of the following crops have been established as standards for 100.

KEY TO THE SOILS OF ANTIQUE PROVINCE

TABLE 15.—*Key to the soils of Antique and soil conservation practices recommended*

Soil type No.	Soil type	Parent materials	Dominant relief	Drainage		Conservation practices necessary	Present land use
				External	Internal		
100	Umingan sandy loam	Alluvium	Level	Good	Good	Green manuring; crop rotation; fertilization; liming.	Rice, corn, tobacco, sugar cane, root crops.
190	San Manuel loam						
168	Umingan clay loam	Alluvium	Level to nearly level.	Fair	Good	Green manuring; crop rotation, fertilization, liming.	Rice, corn, tobacco, sugar cane, root crops.
129	Sta. Rita clay	Alluvium	Nearly level	Poor	Poor	Green manuring; crop rotation; fertilization; liming.	Rice, corn, sugar cane, mungo, vegetables, fruit trees.
219	Patnongon sandy clay loam	Alluvium	Nearly level	Fair	Poor	Green manuring; crop rotation; fertilization; liming; contouring; cover cropping; strip cropping.	Rice, corn, sugar cane, tobacco, mungo, beans, vegetables, coconut, banana, root crops.
226	Sta. Rita sandy loam						
217	Magcalon sandy loam	Alluvium	Gently sloping.	Good	Good	Green manuring, crop rotation; fertilization, liming; contouring.	Rice, corn, sugar cane, coconut, vegetables, root crops, banana, mungo fruit trees.
225	Alimodian sandy clay						
707	Alimodian–Bolinao complex	Shale and sandstone.	Hilly, steep; rugged.	Excessive	Fair	Cover cropping; strip cropping; crop rotation; contouring; terracing, fertilization; liming; selective logging.	Upland rice, corn, sugar cane, mungo, peanuts, fruit trees, pasture; forest.
118	Beach sand	Alluvium	Level to gently sloping.	Good	Good	Green manuring, fertilization, cover cropping.	Coconut, corn, some fruit trees.
45	Mountain soils, undifferentiated.		Steep, rugged.	Excessive	Fair to good.	For forest only, selective logging.	Forest.
1	Hydrosol	Alluvium	Level	Poor	Poor	Diking	Fishpond, salt bed.

FIELD DETERMINATION OF SOIL TEXTURAL CLASS

The determination of the soil textural class is made in the field mainly by feeling the soil with the fingers. While this requires skill and experience, accuracy can be had if the field scientist frequently checks his field textural classification against laboratory results.

Hereunder are definitions and descriptions of the basic soil textural classes in terms of field determination.

Sand.—Sand is loose and single-grained. The individual grains can readily be seen or felt. Squeezed in the hand when dry, individual particles will fall apart when the pressure is released. Squeezed when moist, the particles will form a cast, but will crumble when touched.

Sandy loam.—Sandy loam contains much sand with enough silt and clay to make it somewhat coherent. The individual sand grains can be readily seen and felt. Squeezed when dry, the soil particles will form a cast which readily fall apart, but if squeezed when moist, a cast can be formed which will bear careful handling without breaking.

Loam.—Loam consists of relatively even mixture of different grades of sand, silt, and clay. It is mellow with a somewhat gritty feel, yet fairly smooth and slightly plastic. Squeezed when dry, the soil particles will form a cast that will bear careful handling, while the cast formed by squeezing the moist soil can be handled quite freely without breaking.

Silt loam.—Silt loam contains a moderate amount of the fine grades of sand and only a small amount of clay, over half of the particles being of the soil separate called "silt." When dry, it may appear cloddy but the lumps can be readily broken, and when pulverized, it feels soft and floury. When wet, the soil readily runs together and puddles. Either dry or moist, the soil particles will form into a cast which can be freely handled without breaking. When moistened and squeezed between the fingers, it will not "ribbon" but will give a broken appearance.

Clay loam.—Clay loam is a fine-textured soil which usually breaks into clods or lumps that are hard when dry. When the moist soil is pinched between the thumb and fingers, it will form a thin "ribbon" which breaks readily, barely sustaining its own weight. The moist soil is plastic and can be formed into a cast that will bear much handling. When kneaded in the hand it does not crumble readily but tends to form into a heavy compact mass.

Clay.—Clay is a fine-textured soil that usually forms very hard lumps or clods when dry, and is quite plastic and usually sticky when wet. When the moist soil is pinched between the thumb and fingers, it will form into a long, flexible "ribbon." Some fine clays very high in colloids are friable and lack plasticity under all conditions of moisture.

The above definitions are descriptive only. None could be made in these or similar terms that would apply adequately to all soils. The dependable definitions, the standards, are those developed from mechanical analyses.

SOIL TEXTURE AND MECHANICAL ANALYSIS

Soil texture as defined by the soil survey staff of the United States Department of Agriculture is the relative proportion of the various size groups of individual soil grains, better known as soil separates, in a mass of soil. Specifically, it is referred to as the proportion of *clay, silt,* and *sand* (below 2 millimeters in diameter) in a given soil mass.

The texture of the soil in any soil horizon is its most nearly permanent characteristic. Other properties, like structure and consistence, depend on the kind and amount of clay, and on other soil constituents. Structure, for example, can be quickly modified by certain soil management practices. On the other hand, the texture of the surface soil, for instance, can only be modified by an actual and appreciable change in the proportionate content of that surface soil of its clay, sand, and silt components.

Texture greatly influences the soil aeration, capillarity, erosion, nitrogen and organic matter content, percolation, and temperature. A sandy soil, generally, has less organic matter and nitrogen content than that of a finer textured soil. It is often too loose and wanting in the ability to absorb and hold sufficient moisture and nutrients. Clay soils, because of their texture, have better capillarity than sandy soils.

The three basic soil separates are sand, silt, and clay. Sand is further classified into five classes according to their relative fineness; namely, very coarse sand, coarse sand, medium sand, fine sand, and very fine sand.

TABLE 16.—*Size limits of soil separates, U. S. Department of Agriculture scheme of analysis* [1]

Name of separate	Diameter range (Millimeter)
Very coarse sand	2.00 -1.00
Coarse sand	1.00 -0.50
Medium sand	0.50 -0.25
Fine sand	0.25 -0.10
Very fine sand	0.10 -0.05
Silt	0.05 -0.002
Clay	0.002 and below

[1] United States Department of Agriculture, Soil Survey Staff, *Soil Survey Manual.* United States Department of Agriculture, Handbook No. 18 (Washington: Government Printing Office, 1951), p. 207.

There are twelve basic textural classes established by the USDA; namely, sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The terms, very fine, fine, medium, coarse and very coarse are used to denote more specific soil classes in terms of the nature of sand in the combination. The basic soil textural class names previously mentioned are defined in terms of *size distribution* as determined by mechanical analysis in the laboratory.

Soil textural class can be determined by two methods: (1) field determination and (2) laboratory determination. In the field, the determination is based merely on visualization and feeling. In the laboratory, the determination is done by mechanical analysis using either the Pippete method or the Bouyoucos method.

The mechanical analyses of the surface soils of the different soil types in Antique are presented in table 17. The hydrometer method of mechanical analysis devised by Bouyoucos was used.

TABLE 17.—*Average mechanical analyses of the surface soils of the important soil types in Antique by the Bouyoucos method*

Soil type No.	Soil type	Sand (2.0-0.05) (mm.)	Silt (0.05-.002) (mm.)	Clay (.002-below) (mm.)
		%	%	%
100	Umingan sandy loam	66.6	20.6	12.8
168	Umingan clay loam	47.0	28.2	24.8
120	Sta. Rita clay	39.4	24.4	36.2
190	San Manuel loam	49.8	30.0	20.2
217	Magcalon sandy loam	77.8	6.2	16.0
219	Patnongon sandy clay loam	61.8	14.5	23.8
225	Alimodian sandy clay	50.2	16.0	33.8
226	Sta. Rita sandy loam	57.8	26.0	16.2

LAND CAPABILITY CLASSIFICATION AND CONSERVATION GUIDE FOR THE SOILS OF ANTIQUE

The nine soil types and three miscellaneous land types found in the province are grouped into their respective land capability classes. A land capability class is a unit of classification to which a soil type belongs from the standpoint of its apparent and potential agricultural or economic capabilities. It is, therefore, a necessity for one to know the physical as well as chemical characteristics of each soil type to enable one to judge correctly the capability of any soil type. The three major factors to consider in land capability classification are (1) the soil type, (2) the slope of the land, and (3) the degree of erosion. In the Philippines the three major problems on soils are (1) erosion and runoff, (2) wetness and drainage, and (3) root zone and tillage limitations, such as shallowness, stoniness, droughtiness, and salinity. These problems further divide each class into subclasses for the soil type and are indicated by "e" for erosion and runoff; "w" for wetness and drainage; and, "s" for root zone and tillage limitations.

The different land capabilities are as follows:

CLASS A.—This is a good land that can be cultivated safely and extensively to crops with ordinary good farming practices.

CLASS B.—This is a good land that can be cultivated safely using easily applied conservation practices.

CLASS C.—This is a moderately good land that can be used regularly for cultivated crops in a good rotation but needs intensive conservation treatments.

CLASS D.—This is a fairly good land that is best suited for pasture but can be cultivated to crops in a good rotation but needs intensive conservation treatments.

CLASS L.—This land is flat but is too wet or stony and is suited for pasture or forestry.

CLASS M.—This land is too steep, eroded, or shallow for cultivation but is suited for grazing or forestry if well managed.

CLASS N.—This land is very steep, eroded, rough, shallow, or dry. It is good for forestry or grazing if handled with great care.

CLASS X.—This land is level but wet most of the time and cannot be economically drained. It can be used for farm ponds or recreational purposes.

CLASS Y.—This land is too steep, eroded, barren, and rugged, and should be reserved only for wildlife or recreational purposes.

LAND CAPABILITY CLASS A

Soil types: Umingan sandy loam
Umingan clay loam
San Manuel loam
Magcalon sandy loam

Deep, level, well drained easily worked soil

Class A land is nearly level. The soils are deep, dark and usually fertile or can be made fertile under good management. They are usually deep alluvial soils which vary from silty to sandy texture. Erosion is not much of a problem. They do not need drainage or other special practices. The land is rarely flooded. It is easy to work and can be cultivated safely with ordinary good farming methods.

Class A land is suited for intensive cropping. All crops common to the area can be grown on this land. Since soils of this class have good permeability, they are better adapted for crops other than rice. When used for lowland rice puddling of the soil is usually necessary to prevent excess seepage.

Conservation farming requires such practices as liming (agricultural lime) when needed; the use of the correct kind and quantity of fertilizers; and rotation of crops, which includes a legume or a soil improving crop for sustained production.

For better efficiency in the use of lime and fertilizers, a regular practice of green manuring or the plowing under of any young green plants such as any legume crop or any farm manure or compost is advisable. Waterways through or adjacent to this class of land should be well vegetated with adapted grass, shrubs, or trees.

LAND CAPABILITY CLASS Bw

Soil types: Sta. Rita clay
Patnongon sandy clay loam
Alimodian sandy clay
Sta. Rita sandy loam

Land that can be cultivated safely but needs drainage in addition to good farm management practices to maintain productivity.

Class Bw is good land but because of poor drainage conditions some effort to drain the excess water is needed. Included in this class are wet lands that can be easily drained. They usually occur on low bottoms near large streams. The soils are deep but the subsoils are heavy or the water table is very shallow and restricting water movement. Small ditches are needed to drain off surplus water. Diversion ditches should be constructed for runoff coming from adjoining uplands. Protection from occasional overflow of nearby streams may be needed.

When properly drained, corn, sugar cane, legumes, and many other row crops common in the area may be grown. Lowland rice is especially suited to this land with the construction of paddies.

Lime and fertilizers of the recommended kinds and quantities, soil improving crops, farm manure, and compost are needed to maintain the productive capacity of this class of land.

LAND CAPABILITY CLASS Be

Soil type: Alimodian sandy clay

Good land that can be cultivated safely but needs certain erosion control measures in addition to good farm management practices to maintain productivity.

Class Be land is good from various standpoints but certain physical characteristics make it susceptible to moderate erosion due to the gently sloping relief. The soils are deep but their subsoils are rather heavy. The slope in any place is not more than 8 per cent and the soil is susceptible to moderate erosion when unprotected. This land, therefore, needs protection against erosion such as contour farming, terracing, and strip cropping. Excess water must be channeled into grassed waterways. Diversion ditches should be constructed for the runoff from the adjoining uplands.

All crops common to the area can be grown. Liming and fertilizing with the recommended quantities and kinds should be done. Crop rotation, with a legume or soil improving crop such as mungo or soybean at least once in 3 or 4 years should be observed. For all legumes, the soil should be well supplied with lime and phosphate carrying fertilizer and if the soil does not contain the right kind of bacteria inoculation should be done. The use of farm manure or compost is recommended.

LAND CAPABILITY CLASS Ce

Soil type: Alimodian sandy clay

Moderately good upland that can be cultivated safely if a carefully planned combination of conservation practices is applied.

Class Ce is moderately good land suitable for cultivation provided soil conservation practices are carefully observed to prevent erosion. The soils are good, deep to moderately deep, with slopes that range from 8 to 15 per cent. This class of land is moderately to severely eroded or is subject to erosion if unprotected.

To farm this land safely terracing supported by contour farming and strip cropping is necessary. Terraces should empty into well-grassed waterways or natural drainage.

After establishing the needed conservation measures, a good soil management program should be adopted. This should include a good crop rotation using a legume as a green manure crop, judicious use of lime and fertilizers, farm manure, and compost to build up the soil.

Many crops common in the area can be grown but contouring should be observed. Fruit trees should also be planted on the contours and a leguminous cover crop should be maintained to protect the soil from erosion.

LAND CAPABILITY CLASS De

Soil type: Alimodian sandy clay

Land good enough for occasional cultivation if handled with care but best suited to pasture and forest.

Class De land has slopes up to 25 per cent with moderate to severe erosion or is subject to moderate to severe erosion if left unprotected. The topsoil is generally thin with heavy, slowly permeable subsoil. It is fairly good land that can be cultivated occasionally with proper safeguards.

To farm the land a system of properly laid out terraces, with suitable outlets included in the absence of natural outlets, should be installed. Terrace outlets must have a vegetative cover preferably grass at all times. If the grass is not well established, reseeding and fertilizing are necessary.

Plowing and other farm operations must be done on the contour. Planting of row crops is not advisable. This land when used for orchards, should be planted on the contour and a good stand of leguminous cover crop should be maintained.

Where erosion on a moderately deep soil is not severe, gullies should be smoothened and then seeded either to grass or legume. The soil thus scraped should be limed and fertilized to give a good start for the grass or legume. In this case legume seeds will need inoculation.

LAND CAPABILITY CLASS Ds

Soil type: Beach sand

Land good enough for occasional cultivation if handled with care but best suited to pasture and forest.

Class Ds land is nearly level to sloping. The soil may be deep but the topsoil is usually thin and light. The subsoil has rapid permeability with low available moisture. Included in this class are level or nearly level lands with deep soils but because of climatic conditions enough moisture is not available for good crop growth in which case artificial irrigation is needed.

This class of land is subject to erosion during intermittent rainfalls of heavy intensity or when there is an excess application of irrigation water.

This land is best suited to vegetables or truck farming. Root crops would do well too if planted at such time of the year when rainfall is abundant.

The application of animal manures is necessary to increase the organic matter content as well as the water holding capacity of the soil.

It is not likely that this soil will need any lime, but should it be desired, lime may be added only after soil analysis is done. Fertilizers needed, as soil analysis may show, would be nitrogenous ones for leafy vegetables and ammonium phosphate or complete fertilizers for the fruiting vegetables.

LAND CAPABILITY CLASS M

Soil types: Alimodian sandy clay
Alimodian–Bolinao complex

Land not suited for cultivation but good for grazing or forestry if handled with great care.

Class M land is usually on steep slopes up to 40 per cent. The soil is generally shallow or highly eroded making it unfit

for seasonal cultivation. Stones or gravels may be present or even numerous that they interfere with tillage operations. The land may be used for pasture or trees with careful management. In order to grow good legumes or grass for pasture the land should be well prepared using lime and fertilizers as recommended in order to give the young plants a good start. Diversion terraces around the heads of active gullies, if any, should be constructed. Gullies that are about to develop should be smoothened and sodded. Newly developed pastures should not be grazed severely. On well established pastures grazing should be well controlled and rotated. Wherever possible, stock ponds should be constructed to supply water for the animals.

Where climatic conditions permit, this land can be devoted to orchards such as citrus, coffee, mango, or the like. The trees should be planted along the contours and a good cover crop to protect the soil from washing should be provided.

As for forest purposes, native trees should be protected from fires or *kaiñgin* and the bare spaces planted to wood trees like *ipil-ipil*.

LAND CAPABILITY CLASS N

Soil types: Alimodian sandy clay
Alimodian–Bolinao complex
Mountain soils, undifferentiated

Very steep land, eroded, rough, with shallow soils that can be used for grazing or for forestry if handled with great care.

This kind of land is not suitable for tillage except those which are needed to establish permanent vegetation for permanent pasture land or woodland. This class has slopes up to or more than 40 per cent. The land is rugged and broken by many large gullies. The soil is badly eroded or very shallow. Stones may also be very abundant making cultivation difficult or impractical.

This land has very limited use. Where grasses grow grazing may be allowed but must be managed very carefully to prevent erosion. The pasture land will need very liberal fertilization, liming, and reseeding.

Gullied lands are best used for trees which grow well in the locality. *Ipil-ipil* is specially recommended. Where trees are already growing, they should be protected from fires or *kaiñgin*.

LAND CAPABILITY CLASS X

Soil type: Hydrosol

Land suited only for wildlife and recreation

Land in this class is usually level or is slightly depressed wherein water, either sea or fresh, stays most of the time making it unsuitable for cropland, pasture land or forest. This land type is termed hydrosol.

This land class may be used for salt bed or for fish pond sites. Ordinarily, this land is covered by mangroves or nipa palms when inundated by sea water or grasses as in the case of fresh water ponds. When the site is made into fish ponds or salt beds the trees or palms may be disposed off but a wide strip should be left standing along the outer borders of the shore line to protect the site from the scouring effect of waves.

For fish ponds the site should be dug to not less than a meter in depth. To produce a good growth of algæ, the feed for most fishes, the water in the pond should be fertilized.

TABLE 18.—*Land capability classification of the different soil types of Antique*

Soil type No.	Soil type	Possible soil unit[1] (Slope-erosion class)	Land capability class
100	Umingan sandy loam	a-0	A
168	Umingan clay loam		
190	San Manuel loam		
217	Magcalon sandy loam		
120	Sta. Rita clay	a-0	Bw
219	Patnongon sandy clay loam		
225	Alimodian sandy clay		
226	Sta. Rita sandy loam		
225	Alimodian sandy clay	b-1 c-1 d-1	Be Ce De
118	Beach sand		Ds
225	Alimodian sandy clay	e-1 f-1	M N
707	Alimodian-Bolinao complex		
45	Mountain soils, undifferentiated		N
1	Hydrosol		X

[1] The slope-erosion units are the possible conditions that may exist in each soil type. Any other unit with an erosion class more than the one specified above will be classed under the next capability class. Thus, Alimodian sandy clay with a b-2 classification will be classed as Ce.

CHEMICAL CHARACTERISTICS AND FERTILIZER REQUIREMENTS OF THE SOILS OF ANTIQUE PROVINCE

BY

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and

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The chemical investigations of the soils of Antique; namely, (*a*) soil reaction,[2] (*b*) amount of plant nutrients,[3] (*c*) presence of toxic substances, and (*d*) lime and fertilizer requirements, were done in conjunction with the reconnaissance soil survey of the province.

INTERPRETATION OF RESULTS

Soil reaction.—Soil reaction refers to the hydrogen ion concentration in the soil otherwise known as the pH value. A pH value of 7.0 is neutral; below pH 7.0 is acidic; and, above pH 7.0 is alkaline. The second column of table 19 presents the pH values of the soil types of the province. Alimodian sandy clay and Alimodian–Bolinao complex (derived from shale, limestone, and sandstone) have soil reactions which are strongly acidic. The fact that the former contains 2800 p.p.m. and the latter 4500 p.p.m. of available calcium suggests that the high analysis of available calcium does not necessarily mean an alkaline reaction. The other soil types whose parent materials are either limestone, shale, or sandstone are of medium or slight acidity. Acid forming substances, residual effect of fertilizers, soil management, cropping practices, etc., produce acidity. Definite soil reaction or pH value is a factor for plant growth and development. Table 20 shows the pH requirements of some economic plants.

Soil reaction affects the availability of nutrient elements to plants. Iron and manganese are more available in acidic soils, whereas phosphorus availability is reduced markedly; potas-

[1] Soil physicist, Soil Research Division; Supervising Analytical Chemist, Soil Research Division; and Chief, Laboratory Services Division, respectively.

[2] Soil reaction determined with Beckman pH meter.

[3] Potassium, calcium, magnesium, manganese, and iron determined by Peech and English method; phosphorus by Truog method; nitrate-nitrogen and ammonia-nitrogen by Spurway method; and total nitrogen by modified Kjeldahl method.

sium, calcium, and magnesium are more available in neutral to moderately alkaline soils. The availability of nitrogen is likewise affected by soil reaction. Figure 20, Pettinger's chart, indicates the general trend of the relationship of soil reaction to availability of nutrient elements to plants.[1] Each element is represented by a band. The width of the band at a given pH value indicates the relative favorability of this soil reaction to the availability of the corresponding nutrient element. The wider the band the more favorable the influence of soil reaction is on the availability of the nutrient elements represented and vice versa, but a wide band does not necessarily mean a satisfactory supply of the nutrient element is in its available form, or a narrow band a deficiency. The influence of soil reaction to the supply of a food element present in the soil for its availability to plants is therefore indicated by the chart. Factors other than soil reaction that promote or retard the supply of plant nutrient elements are not covered by the chart.

Ammonia and nitrate.—Table 19 indicates that all the soil types of the province are low in ammonia-nitrogen. They all contain less than 0.14 per cent, the average total nitrogen content of Philippine cultivated soils already analyzed.

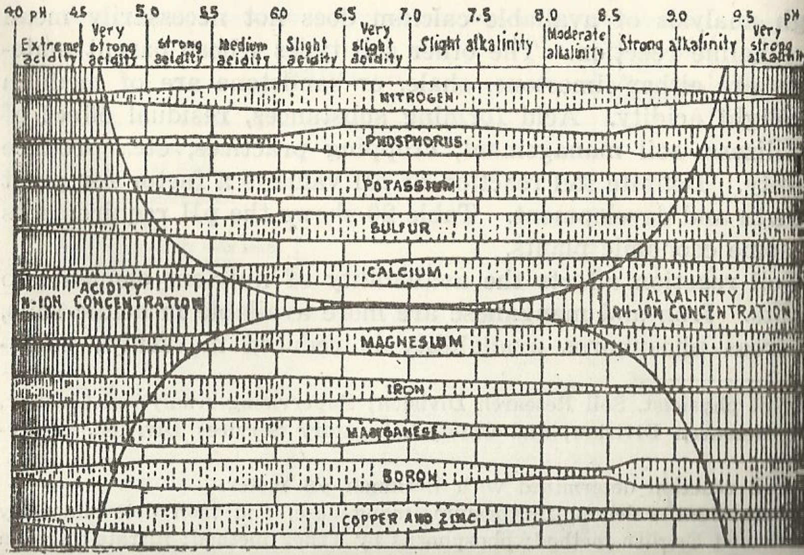

Figure 20. Chart showing general trend of relation of reaction to availability of plant nutrients.

[1] Emil Truog, "Lime in Relation to Availability of Plant Nutrients," *Soil Science*, 65, 1–7 (1948).

TABLE 19.—*Chemical analyses of the different soil types of Antique Province*

Soil types	pH value	Total (N) %	Available constituent in parts per million (p.p.m.)							
			(NH'₃)	(NO'₃)	(P)	(K)	(Ca)	(Mg)	(Mn)	(Fe)
Alimodian sandy clay	5.00	0.12	2	2	64	150	2800	460	200	8
San Manuel loam	5.90	0.10	2	25	50	60	2700	720	134	3
Patnongon sandy clay loam	5.90	0.09	2	10	27	82	2000	460	118	2
Sta. Rita clay	5.80	0.12	2	25	42	78	4000	1240	155	5
Sta. Rita sandy loam	5.70	0.08	2	25	96	121	2000	590	151	5
Umingan clay loam	6.20	0.10	2	25	105	89	3000	990	76	1
Umingan sandy loam	6.50	0.07	2	5	114	139	2900	480	65	1

TABLE 20.—*The pH requirements of some economic plants*

Plant	Strongly acid pH 4.2–5.4	Medium acid pH 5.5–6.1	Slightly acid pH 6.2–6.9	Neutral reaction pH 7.0	Slightly alkaline pH 7.1–7,8	Medium alkaline pH 7.9–8.5
Abaca, *Musa textilis* Nee [1]	Y	X	X	X	Y	O
Caimito, *Chrysophyllum cainito* Linn [1]	Y	X	X	Y	O	O
Coffee, *Coffea arabica* Linn [1]	Y	X	X	Y	O	O
Cowpea, *Vigna sinensis* (Linn.) Savi [2]	Y	Y	X	Y	Y	------
Corn, *Zea mays* Linn. [2]	Y	Y	X	X	Y	Y
Durian *Durio zibethinus* Linn. [1]	Y	X	X	Y	O	O
Peanut, *Arachis hypogaea* Linn. [2]	Y	Y	X	X	Y	------
Petsai *Brassica pekinensis* Rupr [4]	Y	Y	X	X	X	X
Rice, *Oryza sativa* Linn. [1]	Y	X	X	Y	Y	O
Sugar cane, *Saccharum officinarum* Linn [2]	O	Y	X	X	X	Y
Tobacco, *Nicotiana tabacum* Linn. [2]	Y	X	Y	O	O	O
Sweet potato, *Ipomoea batatas* (Linn.) Poir [1]	Y	X	X	Y	O	O
Cassava, *Manihot esculenta* Crantz.	Y	X	X	X	Y	Y
Pineapple, *Ananas comosus* (Linn.) Merr	Y	X	Y	O	O	O
Banana, *Musa sapientum* Linn. [1]	Y	X	X	X	Y	O
Tomato, *Lycopersicum esculentum* Mill [2]	Y	Y	X	X	Y	Y
Onion, *Allium cepa* Linn. [2]	O	Y	X	X	Y	Y
Soybean, *Glycine max* (Linn.) Merr [2]	Y	X	X	X	Y	Y
Orange, *Citrus aurentium* Linn. [3]	------	Y	X	X	X	Y

LEGEND:

X—most favorable reaction

Y—reaction at which plants grow fairly well or normally

O—unfavorable reaction

[1] Based from the soil reactions where they are grown with the productivity ratings of the soil types in 11 provinces. A pH range of 5.7 to 6.2 was found to be most suitable for the growth of upland rice, variety *Inintiw* by Rola, Nena A., and N. L. Galvez, 1949. (Effects of soil reaction on the growth of upland rice and on its nitrogen, calcium, phosphorus and iron content. Philippine Agriculturist 33: 120–125.)

[2] Data taken mostly from Weir Wilbert Weir. 1936. Soil Science. Its principles and practice. J. B. Lippincott Co. Chicago and Philadelphia.

[3] From Spurway, G. H. 1941. Soil reaction (pH) preferences of plants. Mich. Agr. Expt. Sta. Sp. Bull. 306. Optimum range given was pH 6.0–7.5.

[4] From Arciaga., Antonio N. and N. L. Galvez. 1948. The effect of soil reaction on the growth of petsai plants and on their nitrogen, calcium and phosphorus content. Philippine Agriculturist 32:55–59. Normal growth reported was pH 4.2–8.6; optimum range was pH 5.9–8.6.

The pronounced dry and wet season of Antique favors nitrogen volatilization from November to April and leaching and loss of the element through drainage from May to October.

Soil management practices also influence the supply of this element.

Nitrogen is the most important factor in the growth and reproduction of plants. Its various compounds make up 2 to 4 per cent of a plant's average weight. Nitrogen is an essential component of the protoplasm of the living cells of plants. Shortage of this element causes stunted growth, yellowing of leaves, and non-succulence of leafy vegetable crops.

Organic matter.—Organic matter is a great source of nitrogen in the soil. Mineralized decomposed organic matter yields ammonia and the nitrate forms of nitrogen which are available to plants. Carbon, oxygen, hydrogen, phosphorus, and sulfur are also liberated when organic matter is mineralized. Green manuring, application of composts and farm manures are ways and means of increasing organic matter in the soil. Adequate supply of organic matter improves soil structure, enhances soil moisture holding capacity and cation-exchange capacity in the soil.

Phosphorus.—From the tentative estimation of phosphorus sufficiency level of 30 to 40 p.p.m. (for rice and other grain crops), table 19 shows that Patnongon sandy clay loam falls below this level. Low organic matter content, excessive drainage especially in the latter, long period of cropping to grain crops without phosphatic fertilization, as well as low pH are some of the causes of low availability of phosphorus in these two soil types.

This element is indispensable to plants. It is essential for growth; the synthesis of proteins, fats, and carbohydrates; root development; and it hastens maturation of fruits, as well as offsets too luxuriant growth due to excess nitrogen. Phosphorus deficiency is indicated by duller and darker green of the leaves of most plants and purpling of corn and tomato plant leaves. Deficiency of phosphorus delays fruit formation and maturation; causes abnormal root and trunk development, acidity of fruits and poor quality of sugar cane juice.

Potassium.—By the Peech and English method of analysis, 100 to 150 p.p.m. of available potassium in the soil seem to be an adequate supply of this element for most crops. Alimodian sandy clay, Sta. Rita sandy loam, and Umingan sandy loam contain sufficient supply of available potassium. The other soil types are deficient of this element and require potash

fertilization. To maintain their optimum potassium level the three aforementioned soil types should also be fertilized with commercial potash fertilizers in lesser amounts. Crop residues, farm manure, and wood ash are also good and cheap sources of potassium.

Plants contain about 0.5 to 2.5 per cent potassium on the dry basis. Potassium is essential in the synthesis of sugar, starch, fat, and protein in plants; gives firmness to fruits and is responsible for the well development of fruits such as citrus, pineapple, tomatoes, and bananas. According to Millar and Turk this element increases plumpness in grains and makes plant stalks rigid and strong so that lodging of grain crops is minimized.

Early symptom of potassium deficiency in legumes, corn, cotton, and tobacco is the appearance of small, white, yellow or reddish brown spots on the leaves and later followed by scorching or burning of the edges. In potato plants the foliage turn dark green followed by browning. Deficiency of this element causes undersized and deformed leaves, flowers, pods, fruits, or tubers; and plant resistance to pests and diseases is lowered.

Potassium deficiency may occur through the potassium-fixing power of soils, leaching, or cropping practices.

Calcium.—Sta. Rita clay analyzed the highest in available calcium. Patnongon sandy clay loam and Sta. Rita sandy loam analyzed the lowest. For crop production the soils of the province contain enough available calcium, except when "high lime" crops such as sugar cane, alfalfa, and other legumes are grown.

Aside from being a plant nutrient element, calcium improves the physical and physiological characteristics of soils. It also increases the availability of other nutrient elements in acid soils as most of them are rendered available at pH 6.5. In proper amounts it helps in the release of nitrogen, sulfur, phosphorus, etc., found in plant residues in their available forms. Calcium is a constituent of the binding agent that holds plant cell walls together.

Calcium deficiency is characterized by the stunted growth of a plant's growing points, distortion of new leaves, and appearance of yellow and brown spots along the leaf margins and between the veins.

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Magnesium.—San Manuel loam, Sta. Rita clay and Umingan clay loam have enough available magnesium for the normal growth and development of most crops. The other soil types have a rather low supply of available magnesium.

Magnesium is an important constituent of chlorophyll, the green pigmentation of the leaves of higher plants. Chlorophyll is essential in photosynthesis, a plant process for the production of sugar, starch, and carbohydrates.

Deficiency of this element results in chlorosis of tobacco ("sand drown"), the purplish-reddish coloration of cotton leaves, the green veins and yellow color between veins of corn leaves, and the chlorotic leaves of leguminous crops. The size and quality of fruits, especially citrus, are impaired due to magnesium deficiency.

Manganese.—Deficiency of available manganese is generally confined to alkaline and heavily limed soils. Its availability is very much greater in acid soils. The soil reactions of the different soil types of the province fall within the pH range of 5.0 to 6.5. As far as soil reaction influenced is concerned, the soils of the province have a satisfactory supply of available manganese. Agricultural soils generally contain very small amounts of available manganese, about less than 0.1 per cent. However, plant requirements for this element are so small that they are usually satisfied. Concentration of about 0.25 per cent of manganese in soils is toxic for pineapples and leguminous crops.

Manganese deficiency is characterized by the chlorotic and spotted leaves of plants especially tomato, bean, and tobacco.

Iron.—The availability of iron is greater in soils with a low pH, diminishing as the pH increases. Its availability also is greater under anaerobic condition as well as poorly drained soils including those submerged because the unavailable oxides of manganese are reduced to available form. Alimodian sandy clay is the lowest in pH value and under this condition alone, this soil type may be expected to give a higher analysis of available iron. Umingan clay loam and Umingan sandy loam seem deficient in iron. The rest appear to have a fair supply of available iron.

Iron deficiency results in the loss of the green color of leaves except along the principal veins. Iron moves slowly in the

plant sap so that this symptom appears initially in the new or upper leaves.

LIME AND FERTILIZER REQUIREMENTS

The lime and fertilizer requirements of the soil types of Antique for lowland rice, upland rice, corn, coconut, and sugar cane are given in table 21. Algæ in fishponds need the same kind of fertilizer and lime application as that of lowland rice; garlic, onion, and ginger as that of corn; and papaya and black pepper as that of coconut.

A reasonable increase in crop yields could be attained by the judicious use of fertilizers and soil amendments. To obtain maximum results from commercial fertilizers, green manuring, application of farm manures, and organic matter should be observed in conjunction with fertilizer application.

Some important points to observe in fertilizer and lime application are: (*a*) correct rate of application of fertilizer or lime as per analysis, (*b*) apply agricultural lime at least a month before planting, (*c*) thorough weeding of fertilized fields, (*d*) sufficient soil moisture, (*e*) time of application.

For the fertilization of rice fields, split application of a nitrogenous fertilizer like ammonium sulfate gives better effects. One-half of the recommended amount is applied during the last harrowing and the other half is applied three weeks before the flowering stage. All of the recommended amounts of superphosphate and muriate of potash are incorporated into the soil during the last harrowing of the field.

Basic slag, rock phosphate, or any phosphatic fertilizer which is not readily available to plants upon application is applied at least a month before planting. These fertilizer materials are preferable for acid soils than for alkaline soils. Farm manures are likewise mixed with the soil several weeks before planting to assure their plant nutrient contents to be first transformed into their available forms.

Lime application is similar to that of fertilizer. It is usually applied at least one month before planting. When lime requirement is relatively high, two or more fractional applications rather than a single heavy application is recommended. Split or fractional applications prevent overliming of certain spots of the area or the increase in the pH value to not more than one unit per application. A radical change of soil reaction is detrimental to plants and microorganisms in the soil.

TABLE 21.—*Fertilizer and lime requirements of the different soil types of Antique*

Soil types	Agricultural lime [1]	Ammonium sulfate 20% N	Super-phosphate 20% P_2O_5	Muriate of potash 60% K_2O
	For lowland rice			
Alimodian sandy clay [2]				
San Manuel loam				200
Patnongon sandy clay loam		200	100	150
Sta. Rita clay				150
Sta. Rita sandy loam				50
Umingan clay loam				100
Umingan sandy loam		200		50
	For upland rice			
Alimodian sandy clay		200		50
San Manuel loam				200
Patnongon sandy clay loam		200	100	150
Sta. Rita clay				150
Sta. Rita sandy loam				150
Umingan clay loam				100
Umingan sandy loam		200		50
	For sugar cane			
Alimodian sandy clay	2.50	500		50
San Manuel loam	1.50	100		400
Patnongon sandy clay loam	1.50	500	115	300
Sta. Rita clay	1.50	100		300
Sta. Rita sandy loam	1.50	100		100
Umingan clay loam		100		200
Umingan sandy loam		500		50
	For corn			
Alimodian sandy clay		300		50
San Manuel loam		100		250
Patnongon sandy clay loam		300	100	200
Sta. Rita clay		100		200
Sta. Rita sandy loam		100		100
Umingan clay loam		100		150
Umingan sandy loam		300		50
	For coconut			
Alimodian sandy clay		300		50
San Manuel clay		100		200
Patnongon sandy clay loam		300	100	150
Sta. Rita clay		100		150
Sta. Rita sandy loam		100		50
Umingan clay loam		100		100
Umingan sandy loam		300		50

[1] Limestone ($CaCO_3$) pulverized to 20 mesh and about 50% to pass 100 mesh.

[2] Not suited for lowland rice.

II. SOIL EROSION SURVEY

EROSION SURVEY METHODS AND DEFINITIONS

The primary purpose of the erosion survey is to determine the degree of erosion of the different soils of the province—the extent to which the removal of the soil cover has progressed and the amount of gullying with reference to its effect on the cultivation of the land.

METHODS OF CONDUCTING THE SURVEY

The soil erosion survey was conducted in the same manner as the soil survey. A base map, in this case a scale of 1:150,000, of the province of Antique was used. A soil auger and a Brunton compass were used in the determination and delineation of the different erosion classes respectively. Traverses were made and boundaries of the different erosion classes were determined. Borings with the soil auger were made to calculate the amount of soil washed away by comparing the actual depth with the original depth of the soil. In this connection, the depth of the different layers of soils classified in the soil classification survey was used as the basis in determining the depth of surface soil as well as subsoil removed. Pits and road cuts (new) were examined in addition to borings made with the soil auger to give better estimates of the amount of soil washed away. The depth of the surface layer of a virgin soil is used as the basis of comparison. In the absence of a virgin soil the depth as established in the soil classification of the province is used. It must be borne in mind that in the Philippines, where the practice of *kaiñgin* farming is very common, even the steep mountain sides are cleared and converted into *kaiñgin*. Only the high mountains and inaccessible forest areas have escaped the axe and bolo of the inhabitants. Such a condition precludes the existence of a virgin soil in agricultural areas. The Brunton compass is used in the determination of the slope expressed in per cent. One per cent is one meter vertical drop for every 100 meters horizontal distance.

Variations in the depth of soil together with the presence of gullies are delineated into the different erosion classes. The depth and frequency of occurrence of gullies are also noted and the classification of the area affected is made accordingly as these affect the cultivation of the land. Table 22 shows under what erosion classes the different soil types are delineated.

In the classification of erosion conditions in the province and in the use of symbols, reference was made of Miscellaneous Publication 352 of the United States Department of Agriculture, with slight modifications. The different classes of erosion and the corresponding symbols as mapped in the province of Antique are described as follows:

0—No apparent erosion, no sheet erosion and no gullying;

1—Slight sheet erosion, no gullying, less than 1/4 of original surface soil eroded;

2—Moderate sheet erosion, 1/4 to less than 3/4 of original surface soil eroded;

3—Serious sheet erosion, 3/4 of original surface soil to less than 1/4 of subsoil removed;

38—Serious sheet erosion with frequent gullies, 3/4 of surface soil to less than 1/4 of subsoil washed away;

4—Severe sheet erosion, all surface soil and 3/4 of subsoil eroded;

5—Excessive sheet erosion, all surface soil and over 3/4 of subsoil eroded; and

W—Normal erosion (active). Removal of the surface soil is counterbalanced by the formation of soil underneath. Such condition exists where the native vegetation protects the soil from the beating action of the raindrops and the scouring effect of surface run-off. In the heavily forested areas the thick canopy of leaves and ground litter combine to protect the soil, and in the grassland the lush vegetation and the roots binding the soil minimize the loss of surface soil. This loss is balanced by the formation of soil beneath the surface.

DEFINITION OF TERMS USED

Erosion is the process of soil detachment and transportation by either wind or water. Both normal or geologic and accelerated erosion are recognized. Geologic erosion takes place in a natural undisturbed condition with forest canopy, stems, ground litter, and underground network of binding roots retarding the transportation of the soil by the action of wind and water. Geologic erosion is a slow process; the removal

of the soil is balanced by the formation of soil from the parent material underneath. Accelerated soil erosion, on the other hand, is brought about by man's activity thereby disturbing the equilibrium between soil building and soil removal.

Original surface soil refers to the uppermost layer of the land which is of uniform texture and color. This layer is often referred to as the A horizon.

Sheet erosion is the even removal of the surface soil over a wide area.

Rill erosion is the cutting of small shallow incisions into the land by surface runoff. These could be easily erased by simple tillage operations.

Gullying refers to the condition of the land where the surface runoff has cut deep into the land making it impossible to erase the gullies by simple tillage operations.

Shallow gullies refer to those which can be crossed by tillage implements and which do not seriously hamper the cultivation of the land.

Original depth of surface soil refers to the accepted depth of the surface soil as determined in the establishment of the different soil types in the classification of Philippine soils. The barren condition of the land including the hills and mountain sides in the province of Antique offers no possibility of locating a virgin soil profile. *Kaiñgins* have been made all over the province. Lack of good agricultural lands has forced the people to cultivate even the very steep slopes. All agricultural lands and most of those which are fit only for forest or grazing lands have suffered from erosion at one time or another. Most of the foothills which are barren are seriously eroded.

FACTORS AFFECTING SOIL EROSION

Soil erosion is always associated with the clearing of the land of its vegetative cover for the production of crops for the needs of man. To increase the yield it is always necessary to eliminate other plant weeds which compete with the more important plants. In so doing, the soil is left practically bare causing it to be detached by rainfall and surface runoff, transported and deposited on other cultivated lands or to the sea.

Soil loss occurs through the action of surface runoff or unabsorbed water running down the slope scouring the surface of the soil. The rate of loss depends on the soil, slope, vegetation, and climate.

Soil.—The soil possesses certain physical characteristics which influence its erodibility. Under similar conditions of climate, topography, and plant cover, there are marked differences in the erodibility of different soil types. In some cases soils with a sandy loam surface soil may be more susceptible to erosion than those with clay loam surface soils.

Porosity enhances a soil's resistance to washing. Its absorbing quality permits water to soak through. An attribute of all soils, it differs greatly among the different soil types and even within the same type. Due to increased infiltration, better resistance to erosion may be created by the addition of organic matter.

Slope.—Slope, although not affecting the amount of runoff or infiltration, has a great influence on the effect of runoff. Because of the velocity acquired in the steep slopes the cutting power of the water flowing downhill is tremendous. Its carrying capacity is likewise increased. A slope unprotected by vegetation or man-made devices suffers most during a heavy rain. In Antique the farm lands are subject to heavy and prolonged rains during certain months of the year. Soil loss through erosion during certain months is heavy on the upland and hilly areas of the province.

Vegetation.—Plant cover has a great deal to do with the resistance of the soil to erosion. It was estimated that it will take 3,500 years to erode 7 inches of soil under grass cover while the same amount of soil, if the land is grown continuously to corn, will be eroded in only 56 years. In the wooded portions of the forest the rate of soil loss is balanced by the formation of soil underneath. On farms where the natural cover is gone, the crops offer the only protection to the soil. If vegetation is thick and covers the land well the soil is well protected. Soil losses are heavy if crops planted do not cover the land well. The latter condition generally prevails in the rolling and hilly areas of Antique. Very little protection is given the soil. Row crop instead of preventing erosion promotes it. This is especially true if the rows run up and down the slope.

In the open areas where cogon and other grasses grow very little erosion may take place. The thick growth of the grass retards the flow of surface runoff. Besides, roots bind the soil protecting it from washing.

Climate.—The intensity of rainfall presents one of the problems in erosion control. In Antique where torrential rains are frequent, especially during July, August, and September, a

great volume of water collects and runs down hill carrying with it a great deal of suspended soil material. Because infiltration rate is very much slower than precipitation, a large volume of water runs out of the fields instead of sinking into the soil. Hence, the soil suffers much during the months of heavy precipitation.

FACTORS RESPONSIBLE FOR SOIL EROSION IN ANTIQUE

The soils of Antique have been under cultivation for a considerable length of time. From the beginning farming practices were not conducive to the retention of the soil. Heavy rains have washed away tons of earth from the farms. Old time practices handed down from generation to generation caused the land to waste away (depletion through cropping and erosion processes).

In Antique, most farm practices are against the principles of soil conservation. Leaving the soil of vegetation is a common practice throughout the dry season. After the first rains at the start of the wet season, the land is stirred preparatory for planting rice, corn, and other crops. Corn as a row crop promotes erosion especially if rows run up and down the slope. Other row crops enhance erosion in the same way.

Kaiñgin contributes to the erosion problems in Antique. *Kaiñgins* are made by cutting the larger trees after which whatever left are burned until only the stumps of trees remain. Upland rice and corn are usually planted. During the first rains when the plants have just sprouted the land becomes badly scarred by numerous incisions. In some cases, sections of the topmost layer of the soil are washed away.

Kaiñgins are cropped for two to three years and then abandoned. The land in time becomes covered by brush and second growth timber. After ten to fifteen years it is again turned into *kaiñgin*. If grass like cogon and *talahib* become the vegetation, the land is left idle or used as pasture.

Established practices known to benefit the soil are seldom observed in the province. One crop farming prevails. Rice is planted year after year, or corn follows rice, a rotation that is detrimental to the soil rather than beneficial. Legumes are planted as need arises and not as a part of a planned rotation.

In countries more advanced agriculturally than the Philippines, rotation of crops is planned over a number of years. Legumes form part of the rotation. Crop rotation, however, cannot be carried on in farms with the size most Antique farmers operate (one to two hectares, table 11). It will also be noted in table 13 that rice and corn are the crops commonly planted on practically all the soil types. They are the major crops of the province and are oftentimes grown exclusively in some of the farms. The size of the farm a farmer cultivated has something to do with the way he manages it. A farmer with a limited area is forced to cultivate every inch of it in order to produce enough for his needs. Crop rotation that involves the planting of crops other than food crops, say legumes, are not considered. If the family is large he has to look elsewhere to fill the family's needs.

In the province, owing to the lack of available level land, most of the hill and mountain sides are cultivated. The steady increase of population has caused the cultivation of these lands. Consequently, erosion losses are high especially if the plowing is done up and down slope and the furrows laid in the same manner. After a heavy rain it is not uncommon to see hillsides planted to rice and corn severely eroded due to runoff.

Antique is an agricultural area whose erosions range from no apparent erosion to severe erosion. Paddy rice fields, hydrosol areas, and mountains covered by virgin forests are the only places where no apparent erosion and normal erosion occur.

Soil types such as Umingan sandy loam, Umingan clay loam, Sta. Rita clay, Sta. Rita sandy loam, Magcalon sandy loam, Patnongon sandy clay loam, and San Manuel loam whose relief ranges from level to nearly level have less than ¼ of their original surface soils eroded.

Umingan sandy loam with relief ranging from nearly level to gently sloping is moderately eroded.

Alimodian sandy clay, Alimodian–Bolinao complex, and *kaiñgin* areas classified under mountain soils undifferentiated which are rolling to undulating are seriously eroded. Alimodian sandy clay which is intensively cultivated is further damaged with gully formations.

Soils of the hills and mountains, particularly Alimodian sandy clay, with steep slopes which are under regular or occasional cultivation are severely eroded.

In table 22 are listed the different soil types with their corresponding erosion classification, while an accompanying soil erosion map indicates their distribution. Table 23 tabulates the estimated soil lost through the different types of erosion.

TABLE 22.—*Different soil types in different erosion groups, area, and per cent of each group*[1]

Erosion group	Erosion class	Average amount of original surface soil eroded	Soil type	Area in hectares	Per cent
No apparent erosion	0	No sheet erosion	Hydrosol Beach sand Umingan sandy loam San Manuel loam	16,809.90	6.28
Slight sheet erosion	1	Less than ¼ of original surface soil eroded.	Umingan sandy loam Umingan clay loam Sta. Rita clay Sta. Rita sandy loam Magcalon sandy loam Patnongon sandy clay loam San Manuel loam	33,251.65	12.42
Moderate sheet erosion	2	¼ to less than ¾ of original surface soil eroded.	Umingan sandy loam	786.05	0.30
Serious sheet erosion	3	¾ of original surface soil to ¼ of subsoil eroded.	Alimodian sandy clay Alimodian–Bolinao complex Mountain soils, undifferentiated	118,262.40	44.14
Serious sheet erosion with frequent gullies	38	¾ of original surface soil to ¼ of subsoil eroded.	Alimodian sandy clay	2,877.40	1.08
Severe sheet erosion	4	All surface soil and ¼ to ¾ of subsoil eroded.	Alimodian sandy clay	5,615.45	2.10
Normal erosion	W	No sheet erosion	Mountain soils, undifferentiated	85,969.15	32.05
Unclassified areas				4,355.00	1.63
Total				267,927.00	100.00

[1] The areas of the different erosion classes were determined by the use of planimeter.

TABLE 23.—*Extent of soil erosion in Antique*

Types of erosion	Erosion class	Area (hectares)	Average amount of soil eroded[1] (Depth in centimeters)	Tons of earth lost[2]
No apparent erosion	0	16,809.90		
Slight sheet erosion	1	33,251.65	5	23,076,645.12
Moderate sheet erosion	2	786.05	13	1,418,348.68
Serious sheet erosion	3	118,262.40	19	311,881,601.20
Serious sheet erosion (gullies present)	38	2,877.40	20	7,897,662.40
Severe sheet erosion	4	5,615.45	48[3]	37,412,237.08
Normal erosion	W	85,969.15		
Unclassified areas		4,355.00		
Total		267,927.00		381,776,494.48

[1] Average depth of Antique surface soils is approximately 26 centimeters. The subsoil is 78 centimeters.

[2] Based from Gustafson, A. F. Using and Managing Soil: 1000 tons per acre, 7 inches deep. One hectare is equal to 2.471 acres.

[3] This represents all surface soil plus part of the subsoil.

EFFECTS OF SOIL EROSION

Man depends upon the land for his sustenance. His material well-being depends on the income he gets from it. For centuries he has toiled with varying degrees of success, dependent on the care the land received. Bountiful harvests marked the opening of the land to agriculture. Nature gave lavishly so the land may be fruitful. But Nature has also intended that man should care for the land which bears so heavily.

Man's increasing demands led to abuse. Past civilizations which flourished in Africa, Central Asia, and parts of South America declined due to the deterioration of the land resulting from abuse and neglect. In the Philippines where the population depends mainly on agriculture, the more progressive communities are found in the rich agricultural districts. Where the soil is poor and unproductive, the farmers barely get a living out of the land. The soil in the later case has either been depleted of its fertility through centuries of cultivation or has rapidly deteriorated through the loss of the fertile topsoil.

PHYSICAL EFFECT

The capacity of the soil to produce is associated with certain characteristics of composition and structure that have developed with the soil and may be injured or improved when man uses it. Unwise use of the land in the main is responsible for declining yields. Cropping, erosion and leaching are followed by loss of productivity and may adversely affect the physical condition or chemical composition of the soil or both.

Owing to its high degree of friability the granular condition of the soil is highly desirable. Loss of the topsoil leaving the less friable subsoil through constant washing may alter the friability of the soil. Grasslands severely overgrazed deteriorates. Its highly permeable condition is lost through erosion.

Structure of the soil largely determines its permeability to water and plant roots, its capacity to retain moisture, for use of growing plants, and its resistance to erosion. Such conditions are fundamental to continued productivity. It is generally more difficult to recover a favorable structure than it is to recover losses of the various plant nutrients. Nitrogen, potassium, phosphorus, and other plant nutrients can be replaced through the application of commercial fertilizers. Close growing

crops like grasses and legumes included in the rotation is conducive to the production of a favorable soil structure.

The loss of the surface soil may be noted in the changing color of the soil; the dark color gradually fades into the lighter color of the subsoil. This is accompanied by sharp decline in yields. Another change readily noted on the land is the appearance of gullies. Excess rain scours the soil. After a heavy rain small shallow incisions may be seen, especially on the plowed fields. These incisions, if neglected, widen and deepen into gullies.

Soil materials washed away are carried by water and deposited on other farms, stream channels, reservoirs, and harbors. Elevation of stream channels and the consequent lessening of the volume of water which the channels can hold, cause higher flood levels resulting in greater destruction from floods.

Reservoir silting causes the loss of valuable irrigation water which is so important during months of low rainfall. The San Jose–Sibalom irrigation reservoir has taken in a lot of erosion debris so that its capacity is greatly reduced.

ECONOMIC EFFECT

Erosion losses often cause the destruction of farms. Many farms have become unproductive. Such a condition creates poverty and the lowering of living standards. Although floods and typhoons are beyond human control, they pass away; their effects are only temporary in nature. But erosion, which is within human power to counteract, is more enduring and more keenly felt. Its effects are far reaching. Crops destroyed can easily be replaced. Even the plant nutrients removed by cropping are not hard to replace. Soil lost is irreplaceable. What may be lost in an hour of heavy rain cannot be replaced in a lifetime. Soil formation goes on very slowly to make imperative conservation of the soil for continuous land productivity. Although productivity levels may be maintained through the application of fertilizers, the loss not only of the fertile surface but also the subsurface will eventually make it uneconomical to continue farming the land. It is also uneconomical to farm a land very much scarred by gullies.

Erosion has a profound effect on the economic life of the people. Declining yields as a result of the loss of the fertile portion of the soil, lower farm incomes and create poverty among the rural population followed by economic and social disorders. In extreme cases the peace and order situation is disturbed. Quoting Bennet and Lowdermilk: (1) "There is a definite relationship between erosion and economic and social ills . . . the level of prices and income has a definite relationship to erosion and to the undesirable economic and social disorders which usually come about where there are serious and damaging soil losses."

The low yields of farms in Antique are not only the results of long occupancy, but also the destruction erosion has caused. Washing away part or all of the surface soil have reduced the land into unfruitful fields. Barely getting anything out of the land, the rural population lives in poverty taking anything in the way of adding something to fill their needs. With limited agricultural lands the people have to find means to keep themselves alive. Too often they have to abandon their farms for more productive fields. Migrations to Mindanao and other places are impelled by hunger. The yearly exodus of labor from Antique to Negros Occidental is not done merely to obtain additional pesos to their income. Insufficiency of produce and farm incomes very much below living costs, forced the rural population to yearly migrations into the more productive sugar lands. Low wages are not spurned but are taken as a necessary part of their existence. Men, women, and children share the discomfort and insanitary conditions of travel. As early as September recruiting is done. Labor is hired during the milling season from October to March. Willing hands are not wanting in the province, ready to take on a job for a minimum pay. The little amount they get from the land must be supplemented with earnings from other sources. And the sugar cane fields offer the only avenue in sight. But whatever is offered in Negros in the way of ameliorating the miserable conditions of these people is only temporary. These farm folks return to Antique in the same miserable condition they were at the start.

The passage and implementation of the Minimum Wage Law appears to solve the problem of the Antique rural population. Low farm incomes supplemented by higher wages during the milling season assure better living conditions. But unless conservation of the soil is done in Antique farmlands the ultimate result is poverty and widespread misery of these farm population.

METHODS OF EROSION CONTROL

There are two general ways of erosion control in croplands; namely, (1) vegetative measures, and (2) mechanical means. Vegetative measures are simpler and easier to apply, while mechanical means usually require engineering aids, tools, and machinery. The former is usually employed on land that are nearly level to gently rolling, while the latter is adapted to rolling and undulating land. Sometimes both means are employed simultaneously, or one in support of the other depending upon attendant circumstances.

VEGETATIVE MEASURES

Control of erosion by vegetative means deals with the use of plants following the normal farm operations and use of ordinary implements and machinery.

Cover cropping.—Vegetative cover is the first protection against runoff and erosion. Cover crops are usually planted after the harvest of row tilled or seasonal crops. There are also permanent cover crops which are mostly planted in orchards. When planting cover crops mulches of dead stems, leaves, or straw are necessary since cover crops offer protection only after they have attained considerable growth.

Strip cropping.—This vegetative method of erosion control is the alternate cultivation of clean tilled crops on one strip and dense close growing crops on the next strip. These alternate strips break up a relatively large sloping field into small narrow bands lying across the slope. They serve to check the momentum of runoff and to filter out the soil particles. The subsequent loss of the speed of runoff allows rain water to seep into the soil rather than readily flow down the slope. Soil and water are thus conserved.

Buffer strip cropping.—Buffer strips are established bands usually on the contour, two to three meters wide, planted to perennial grass or other erosion-resisting vegetation. They are arranged in regular alternation with relatively wider strips of row tilled crops. Buffer strips are adapted to land with slopes up to eight per cent. When the slope is long, a combination of vegetative and some mechanical means may be necessary. Grasses such as Guinea grass, Napier, Brown-top, Bermuda grass, and *Ipil-ipil* (periodically trimmed to about a foot high) are recommended.

Grassed waterways.—Waterways in soils work are either natural or man-made depressions on sloping areas which serve as passageways for water that goes through a farm from adjacent land or accumulating on it due to rain. They are important in any scheme of soil and water conservation. Naturally located depressions serve the purpose best. Man-made canals strategically laid are also necessary for more efficient discharge of runoff. The establishment of a dense vegetative cover over all waterways is imperative. Grasses readily adaptable to the area should be used, but whenever practicable those species which form a dense turf are preferable. Inasmuch as waterways are supposed to carry heavy flows during certain periods they should be designed to handle maximum runoff from the heaviest rainfall occurring in the locality once in about eight to ten years. Grassed waterways are essential whenever excess runoff accumulate such as in stripcropped fields.

MECHANICAL MEASURES

On steep slopes vegetative measures offer inadequate protection for the soil. Mechanical means of erosion control are therefore essential in conjunction with the vegetative phase.

Contour tillage.—Contour tillage is plowing and planting on the contour. This is an erosion control measure which is most effective on two to eight per cent slopes and less than 100 meters long. Ridges formed by the tillage implements retard the downhill flow of water. These ridges serve adequately when rainfall is even and light but their effectiveness is reduced when rains are intense or heavy. Contouring is not enough protection especially when slopes are not uniform and above eight per cent, when the fields are already eroded, or when subsoils are clayey and compact. In these cases excess runoff may break through the ridges thus necessitating the adoption of other mechanical conservation measures like terracing.

Terracing.—Terraces are mechanical measures of soil conservation and are differentiated into three types; namely, (1) absorptive, (2) bench, and (3) drainage.

Absorptive terrace or ridge type is designed for moisture conservation. It is adapted to gentler slopes and absorptive soils.

Bench terrace is constructed on the contour. It has a steep drop and adapted to steeper slopes.

Drainage terrace or broad channel type is designed to conduct

water from a field at low velocity.

As used in this text, terrace may denote a ridge type or a combination of ridge and channel type.

Terraces are built across a slope. They are either level or graded depending upon the purpose for which they are made. Graded terraces lead runoff from the field at nonerosive velocities. Level terraces impound most of the water giving it time to soak into the soil. Where the average annual rainfall is less than 30 inches, level terraces are recommended. Dimensions of terraces are also of utmost importance. They should be large enough to avoid overtopping. Usually the runoff which may be expected from the heaviest rain occurring on an average of once in 10 years is used as a basis. Their shape is generally based on the farming equipment used.

Terrace construction requires technical skill, financing, and special implements and machinery. Aside from these considerations, one must realize that all slopes and all soils cannot be successfully or economically terraced. Sandy, stony, and shallow soils, fields dotted by humps or mounds, or slopes that change planes and steepness every 30 meters are impractical to build terraces on.

Diversion ditches.—Diversion ditches or diversion terraces are built to intercept the runoff from drainage areas. They are usually larger than field terraces. They are designed to protect cultivated fields from hillside runoff by providing for a passageway of the water away from the fields to other nearby areas where it is spread or dispersed. Where adjacent slopes generate runoff towards a terraced area, diversion ditches carry the water away from the terrace system, or if towards a gully diverting the water assist in controlling its further enlargement.

OTHER ASPECTS OF EROSION CONTROL

Whereas erosion depletes the soil of its inherent fertility, low fertility also brings about soil erosion. Infertile soils invariably mean poor vegetation, thus more surface soil is exposed to direct rain and wind action. Therefore, soils of low fertility when tilled are highly erodible. In this case proper and adequate fertilization can minimize erosion.

The regular application of farm manures and the practice of green manuring increase the soil's organic matter content. Organic matter, aside from enhancing soil fertility, also improves tilth and maintain if not improve soil structure. Stable and favorable soil structure means higher porosity and better permeability. When soils are porous and permeable plant root penetration is improved. All of these favorable physical conditions when attained promote the soil's water absorbing and water holding capacities, or in other words surface runoff is minimized.

Crop rotation should essentially be a part of every farm program. A well planned scheme of crop rotation, aside from providing a practical means of utilizing green manures and fertilizers, counteracting possible development of toxic substances, and improving crop quality and increasing yields, also minimize or help control erosion. This farm practice keeps the soil in suitable physical condition, helps maintain the supply of organic matter and nitrogen in the soil, provides vegetative cover, and changes the location of the feeding ranges of roots.

The physical effects of liming such as the promotion of soil granulation of fine-textured soils and the modification and improvement of the structure of coarse-textured soils thus making them lighter to work subsequently contribute much to erosion control.

An efficient system of soil management in support to vegetative and mechanical measures is, indeed, necessary to combat soil erosion. The different practices followed or adopted should form a farm program that as a unit could fit the kind of soil or kinds of soils within a farm so that the end attained is the combined beneficial effects of the many interacting processes involved. Each farmer, therefore, should first appraise the erosion hazards of his farm, then plan a cropping system and supporting conservation practices to reduce or offset the erosion hazards.

GLOSSARY OF COMMON ECONOMIC PLANTS FOUND IN ANTIQUE PROVINCE

Common Name	Scientific Name	Family Name
Abaca	*Musa textilis* Nee.	Musaceæ
Achuete	*Bixa orellana* Linn.	Bixaceæ
Agiñgai	*Rottboellia exaltata* Linn.	Gramineæ
Alibangbang	*Bauhinia malabarica* Roxb.	Leguminosæ
Ampalaya	*Momordica charantia* Linn.	Cucurbitaceæ
Anonas	*Anona reticulata* Linn.	Anonaceæ
Api-api	*Avicennia officinalis* Linn.	Verbenaceæ
Arrowroot	*Maranta arundinacea* Linn.	Marantaceæ
Atis	*Anona squamosa* Linn.	Anonaceæ
Avocado	*Persea americana* Mill.	Lauraceæ
Bakauan-babae	*Rhizophora mucronata* Lam.	Rhizophoraceæ
Bakauan-lalake	*Rhizophora candelaria* DC.	Rhizophoraceæ
Bamboo	*Bambusa spinosa* Roxb.	Gramineæ
Banana	*Musa sapientum* Linn.	Musaceæ
Bangkal	*Nauclea orientalis* Linn.	Rubiaceæ
Batao	*Dolichos lablab* Linn.	Leguminosæ
Bermuda grass	*Cynodon dactylon* (Linn.) Pers.	Gramineæ
Binayoyo	*Antidesma ghaesembilla* Gaertn.	Euphorbiaceæ
Breadfruit	*Artocarpus communis* Forst.	Moraceæ
Buri	*Corypha elata* Roxb.	Palmæ
Cabbage	*Brassica oleracea* Linn.	Cruciferæ
Cacao	*Theobroma cacao* Linn.	Sterculiaceæ
Cadios	*Cajanus cajan* (Linn.) Millsp.	Leguminosæ
Caimito	*Chrysophyllum cainito* Linn.	Sapotaceæ
Cashew	*Anacardium occidentale* Linn.	Anacardiaceæ
Cassava	*Manihot esculenta* Crantz.	Euphorbiaceæ
Chico	*Achras sapota* Linn.	Sapotaceæ
Coconut	*Cocos nucifera* Linn.	Palmæ
Coffee	*Coffea sp.* Linn.	Rubiaceæ
Cogon	*Imperata cylindrica* (Linn.) Beauv.	Gramineæ
Corn	*Zea mays* Linn.	Gramineæ
Cotton	*Gossypium hirsutum* Linn.	Malvaceæ
Cowpea	*Vigna sinensis* (Linn.) Savi.	Leguminosæ
Cucumber	*Cucumis sativus* Linn.	Cucurbitaceæ
Derris	*Derris elliptica* (Roxb.) Benth.	Leguminosæ
Duhat	*Eugenia cumini* (Linn.) Druce	Myrtaceæ
Dungon-late	*Heritiera littoralis* Dryand	Sterculiaceæ
Eggplant	*Solanum melongena* Linn.	Solanaceæ
Gabi	*Colocasia esculenta* (Linn.) Schott. and Endl.	Araceæ
Garlic	*Allium sativum* Linn.	Liliaceæ
Ginger	*Zingiber officinale* Rose.	Zingiberaceæ

Ipil	*Intsia bijuga* (Colebr.) O. Kuntze	Leguminosæ
Ipil-ipil	*Leucaena glauca* (Linn.) Benth.	Leguminosæ
Kalumpit	*Terminalia edulis* Blanco	Combretaceæ
Kamachile	*Pithecolobium dulce* (Roxb.) Benth.	Leguminosæ
Kapok	*Ceiba pentandra* (Linn.) Gaertn.	Bombacaceæ
Kondol	*Benincasa hispida* (Thunb.) Cogn.	Cucurbitaceæ
Lañgarai	*Bruguiera parviflora* (Roxb.) W. and A.	Rhizophoraceæ
Lettuce	*Lactuca sativa* Linn.	Compositæ
Lumbayau	*Tarrietia javanica* Blume Bijdr.	Sterculiaceæ
Maguey	*Agave cantala* Roxb.	Amaryllidaceæ
Mandarin (Narangita)	*Citrus nobilis* Lour.	Rutaceæ
Mango	*Mangifera indica* Linn.	Anacardiaceæ
Molave	*Vitex parviflora* Juss.	Verbenaceæ
Mungo	*Phaseolus aureus* Roxb.	Leguminosæ
Nangka	*Artocarpus heterophyllus* Lam.	Moraceæ
Nipa	*Nypa fruticans* Wurmb.	Palmæ
Onion	*Allium cepa* Linn.	Liliaceæ
Orange	*Citrus aurantium* Linn.	Rutaceæ
Palosapis or lauan-puti	*Anisoptera thurifera* (Blanco) Blume	Dipterocarpaceæ
Pandan	*Pandanus tectorius* Solander	Pandanaceæ
Papaya	*Carica papaya* Linn.	Caricaceæ
Patani	*Phaseolus lunatus* Linn.	Leguminosæ
Patola	*Luffa acutangula* (Linn.) Roxb.	Cucurbitaceæ
Patolang-bilog	*Luffa cylindrica* (Linn.) M. Roem.	Cucurbitaceæ
Peanut	*Arachis hypogaea* Linn.	Leguminosæ
Pechay	*Brassica chinensis* Linn.	Cruciferæ
Pineapple	*Ananas comosus* (Linn.) Merr.	Bromeliaceæ
Potato	*Solanum tuberosum* Linn.	Solanaceæ
Pummelo	*Citrus maxima* (Burm.) Merr.	Rutaceæ
Radish	*Raphanus sativus* Linn.	Cruciferæ
Rice	*Oryza sativa* Linn.	Gramineæ
Santol	*Sandoricum koetjape* (Burm. f.) Merr.	Meliaceæ
Sincamas	*Pachyrrhizus erosus* (Linn.) Urb.	Leguminosæ
Sitao	*Vigna sesquipedalis* Fruw.	Leguminosæ
Soybean	*Glycine max* (Linn.) Merr.	Leguminosæ
Squash	*Cucurbita maxima* Duchesne	Cucurbitaceæ
Sugar cane	*Saccharum officinarum* Linn.	Gramineæ
Sweet potato	*Ipomoea batatas* Linn.	Convolvulaceæ
Talahib	*Saccharum spontaneum* Linn.	Gramineæ
Tobacco	*Nicotiana tabacum* Linn.	Solanaceæ
Tomato	*Lycopersicum esculentum* Mill.	Solanaceæ
Tugui or yam	*Dioscorea esculenta* (Lour.) Burkill	Dioscoreaceæ
Ubi	*Dioscorea alata* Linn.	Dioscoreaceæ
Upo	*Lagenaria leucantha* (Duch.) Rusby	Cucurbitaceæ
Watermelon	*Citrullus vulgaris* Schrad.	Cucurbitaceæ

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