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

Soil Report 40

SOIL SURVEY OF BATANES PROVINCE PHILIPPINES

Reconnaissance Soil Survey and Soil Erosion Survey

BY

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Chief of Party

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Member

MANILA
GOVERNMENT PRINTING OFFICE
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SOIL SURVEY OF BATANES PROVINCE [1]

CONTENTS

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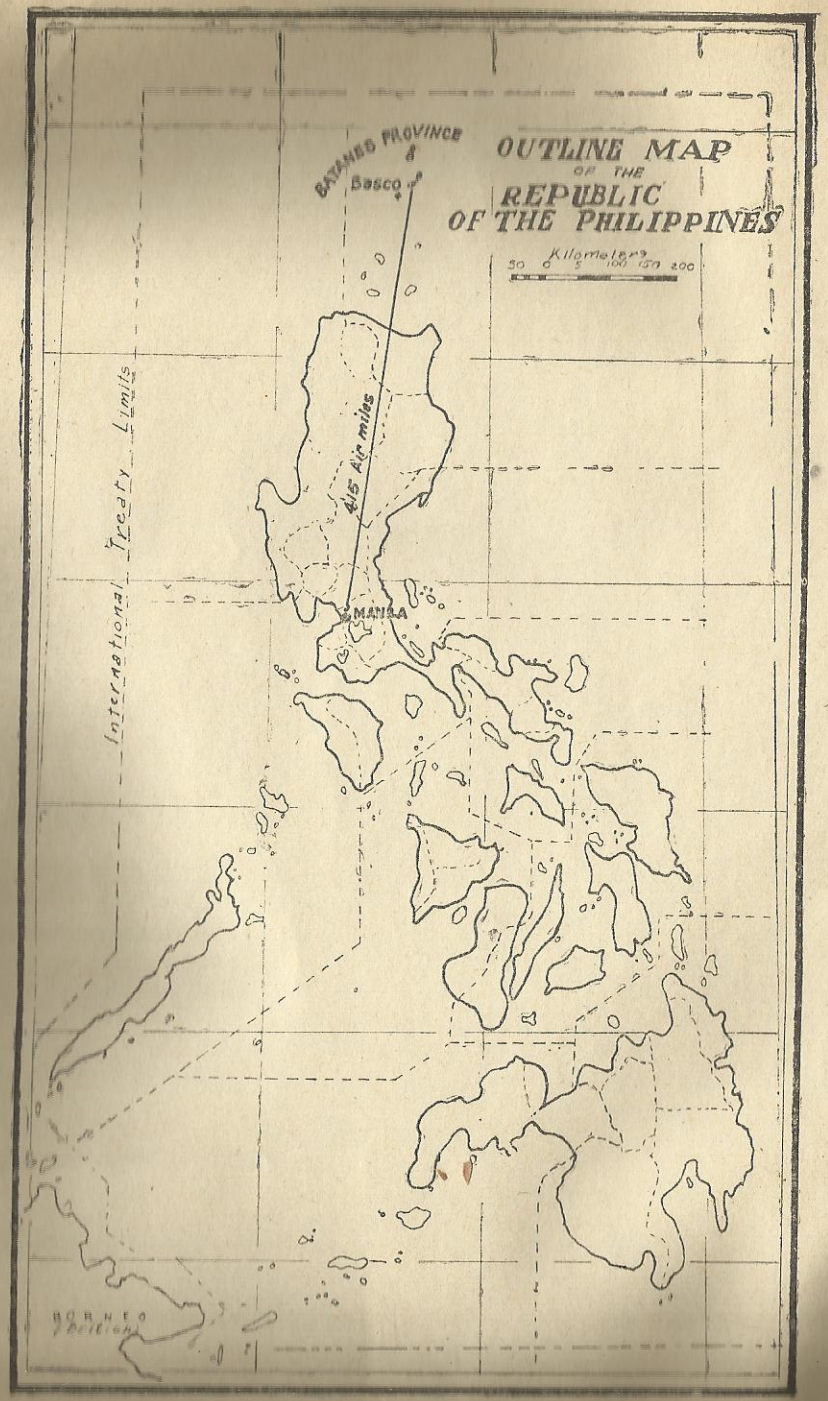

Fig. 1. Outline map of the Republic of the Philippines showing the location of Batanes Province.

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DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES

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Secretary

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Undersecretary

BUREAU OF SOILS

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Director

ACKNOWLEDGMENT

The members of the soil survey party are indebted to the national, provincial, municipal officials and all the people of Batanes for the valuable information and data on agriculture furnished the survey party as well as their hospitality and whole-hearted cooperation in the successful prosecution of the survey.

Special mention is given to the people of Itbayat, particularly to the Municipal Council headed by Mayor Joaquin Labrador, who not only cooperated but also gave moral, spiritual and material aid during the "long wait" of the soil survey party for the Philippine Navy boat, which was requested to fetch the party. The unprecedented kindness and understanding of the Itbayateños made the short sojourn of the party very pleasant and memorable.

Last but not least, to the Editors, who have painstakingly done their best to make this report orderly.

THE AUTHORS

ILLUSTRATIONS

INTRODUCTION

Realizing the need for a change in their antiquated farm practices which were mainly responsible for the depletion of the soil and the consequent lowering of the productivity of their farms, the Batanes Provincial Agricultural Council requested the Bureau of Soils to conduct a soil survey of the province the data from which will be used in the formulation of sound management practices designed to conserve soil and water, increase production, and make agriculture permanent.

In response to the above request, a reconnaissance soil classification and erosion surveys were simultaneously conducted from August 26 to December 20, 1957 by Messrs. A. Simon and F. de Jesus of the Bureau of Soils under the directorship of the late Dr. Marcos M. Alicante and during the incumbency of the Honorable Juan de G. Rodriguez as Secretary of Agriculture and Natural Resources.

SUMMARY

Batanes is the smallest province in the Philippines, having an approximate area of only about 20,928 hectares. Occupying the northernmost part of the Philippine Archipelago, it is often referred to as the "geographical head of the country". It is nearer to Formosa than to the mainland of Luzon. Basco, the capital of the province, is about 415 air miles (664 km.) north of Manila.

Batanes is composed of a number of small islands. The most important are Batan, Itbayat, Sabtang and Ibuhos; and the only ones inhabited in the group. All the islands are generally extremely rugged. The small patches of level lands are sporadically located. The mountains are not so high. Mt. Iraya, the extinct volcano in Batan Island with a height of about 1,008 meters, is the highest so far.

The province is well drained. It has no big river but many small and swift creeks. It has no marsh nor swamp.

Sabtang and the southern part of Batan are of volcanic agglomerates with occasional basic dikes. Northern Batan and the small island to the north are of recent volcanic origin, mostly basalts and andesites; while Itbayat, Ibuhos and Dequey are of coral limestone.

A great portion of the province, about 9,547 hectares or 48.26 per cent of the total area of the province, is under cultivation. Grasslands occupy about 4,312 hectares or 21.80 per cent of the provincial area. The grasslands are used as pastures for cattle and carabao. Commercial forest areas are very limited. The cultivated lands are mostly grown to ubi, camote, sugar cane, corn, rice and tugui.

Batanes is politically old but has not advanced economically. Agriculture is still primitive and most of the foodstuffs are imported. It is the only province in the Philippines without Chinese merchants. There are more people in 1794 (16,000 people) than in 1957 (11,000 only). Migration is the cause of the decrease in population.

Batanes is the most inaccessible province of the Philippines. No boat of any shipping company ever calls at any place in the province except by charter; and there is no boat that plies regularly between the islands.

Only Batan Island has roads passable by motor vehicles. In this island there are 30 kilometers of narrow first class road. But there is no vehicle or public conveyance.

Basco, the capital of the province is visited by PAL planes three times a week if weather conditions permit.

The province falls under the fourth type of climate in the Philippines. This type has no very pronounced maximum rain period and no dry season.

Agriculture is the most important industry in Batanes. Crop raising is handicapped by destructive typhoons. Camote, tugui and ubi are the prime products. Garlic has started to flourish as a cash crop. Rice is not extensively produced.

The low fertility and productivity of the soils of the province are attributed to erosion caused by poor farming practices. The steep areas are cultivated to seasonal crops due to lack of good agricultural lands.

Eight soil types and two soil phases comprising the eight soil series and five miscellaneous land types are delineated and mapped in the province. The soils of Batanes are grouped for convenience, into (a) soils of the lowlands, (b) soil of the uplands and (c) miscellaneous land types. The soils of the lowlands are Mayan clay loam and Umingan loam. The soils of the uplands are Bolinao clay; Bolinao clay loam, deep phase; Faraon clay; Basco loam; Basco loam, steep phase; Sabtang loam; Luisiana clay and Uyugan clay loam. The filled-up soils, beach sand, dune land, rough broken land and rock land are the miscellaneous land types.

The productivity ratings of the soils of Batanes based on the average crop yield in relation to the established national standard, are presented in this report. Likewise, the land capability classification and erosion classes and the recommended conservation measures are included.

A soil map showing the distribution of the different soil types and miscellaneous land types in the province accompanies this report.

I. RECONNAISSANCE SOIL SURVEY

DESCRIPTION OF THE AREA

Location and extent.—Batanes is the northernmost province of the Philippine Archipelago and the most inaccessible. It is bounded on the north by the Bashi Channel; on the east by the Pacific Ocean; on the south by the Balintang Channel, and on the west by the China Sea. It lies approximately between 20° 05′ and 21° 13′ north latitudes or about the same latitude with the southern half of the Hawaiian Island; and between 121° 49′ and 122° 02′ east longitudes. Mavolis (Yami) the northernmost island, is about 270 kilometers from the nearest point of Luzon, Cape Engano; 107 kilometers from the Japanese Island, Little Botel Tabago; and 160 kilometers from the southernmost tip of Formosa. On very clear days the Formosan mountains can be seen from the summits of Mount Sta. Rosa in Itbayat Island and Mount Iraya in Batan.

The province is composed of 10 small islands and 13 islets. It is the smallest province in area and population among the 65 provinces of the Philippines. The total land area is only about 20,928 hectares. The islands worthy of mention, arranged according to their economic importance are: Batan, Itbayat, Sabtang, Ibuhos, Mavolis (Yami), Ditarem (Mavudis), Misanga (North Island), Siayan, San Diego (Dinem) and Dequey. The first four islands are the only ones inhabited.

Batan is the most important island in the province; but second only in area to Itbayat. It is the most thickly populated. Being centrally located, it is the commercial center of the province. It is about 19 kilometers in its longest side running in a northeast-southwest direction. The widest portion, six kilometers, is between the barrios of San Vicente and Imnajbu. The narrowest side (about two kilometers) is between the town of Mahatao and Mananioy Bay. The island has four towns, namely; Basco, Mahatao, Ivana, and Uyugan. Basco is the capital of the province. It is also the seaport, airport and commercial center. Basco is about 415 air miles (664 kilometers) north of Manila.

Itbayat Island is the largest in the group and second to Batan Island in economic importance and in population. It

is about 26 kilometers north-northwest of Batan and lying in a northeast-southwest direction. The longest side is about 18 kilometers and the average width is about five kilometers. It has a regular coastline but has no good seaport. It has only one town, Mayan and five barrios, namely; Raile, San Rafael, Sta. Lucia, Sta. Maria, and Sta. Rosa.

Sabtang Island is about five kilometers away from the southwestern most tip of Batan. The island is shaped like that of a dressed squab with the southern end as the neck and the northern tip as the tail. The longest side is about 11 kilometers and the widest portion is about five kilometers. It is the third largest island in the province and ranks third in economic importance and in population. It has only one town and four barrios. The town is San Vicente and the barrios are Nakanmuan, Sumnanga, Chavayan and Savidug.

The rest of the small islands are not of much economic importance at present. They are not inhabited except Ibuhos which has only about a dozen people at the time of the survey.

Ibuhos and Dequey Islands are located west of Sabtang. The other tiny islands occupy the vast expanse of the sea between Itbayat and Bashi Channel.

Physiography, relief and drainage.—Batan Island is mainly a series of rolling hills with ridges running in all directions and deep cañons. The mountains are not so high. The mountain peaks are Mount Iraya, an extinct volcano in Basco, about 3,306 feet high (1,008 meters) and Mount Matarem in Mahatao, about 1,500 feet high (450 meters). The small level areas are sporadically located along the coastline. They appear like dots and dashes as viewed from an airplane. The plain in Basco is the widest in the province. It stretches from Baluarte Bay to Balugan Bay. The length is about three kilometers and the average width is about two kilometers.

The coastline of Batan is relatively regular. There is no well protected bay and port. Basco port at Baluarte Bay, the best in the province, is under construction during the time of the survey. The wharf constructed before World War II has been washed-out by big waves caused by the terrific typhoons. Landings for small boats are afforded in Mahatao; San Vicente, Ivana; Uyugan and Contracosta during good weather.

There is no big river in Batan. The three small and unnavigable rivers worthy of mention are Mahatao River in Mahatao, San Felix River in Ivana and Itbud River in Uyugan. There are many intermittent creeks. All these rivulets provide a natural drainage for the island. They are all very short but very swift during heavy downpours. At times, they cause much damage to crops and public improvements. The island has no lake, swamp nor marsh.

Itbayat Island is more or less a plateau with the outer fringes generally higher than the interior; save Mounts Sta. Rosa and Ripose. There are several sinks or depressed portions. The sinks or level areas are very small in extent and are sporadically located. Some of them are not mappable. The mountains are not high. Mount Sta. Rosa, about 914 feet high (279 meters) and Mount Ripose, about 759 feet high (231 meters) are the prominent landmarks.

Itbayat has a regular shoreline. It has no beach nor port. The entire shoreline is a perpendicular limestone cliff, generally higher than the interior. Landings can be made in four places during favorable weather. The landing in the east coast is about one and a half kilometers northeast of Mount Ripose. Mauyen landing is at the southwestern extremity of the island, and Chinapuliran and Paganaman landings are in the northwestern coast near the townsite of Mayan. The last two landings have steps cut in the rocks leading up the steep cliffs while the first two have none.

Itbayat is well drained. It has no lake, marsh nor swamp but many streamlets that run in all directions. The three small rivers are Piayuyugan, Kauran and Pittangbaran. All of these rivulets are swift during heavy rains.

Sabtang Island is very rugged. It has numerous high, steep peaks and serrated ridges. Bordering the sea at several places, are steep cliffs that often reach a height of 1,200 feet. Very small, low-lying level lands are found along the coast in some places. They look like tiny stitches and dots in a bird's eye view. At the north central portion of the island is a plateau with an elevation of about 1,000 feet.

Sabtang has a more or less regular coastline. It has no good port. The port at Centro (Sabtang Poblacion) is sheltered only during the southeast monsoon. The island is well drained by many intermittent creeks which are swift and destructive

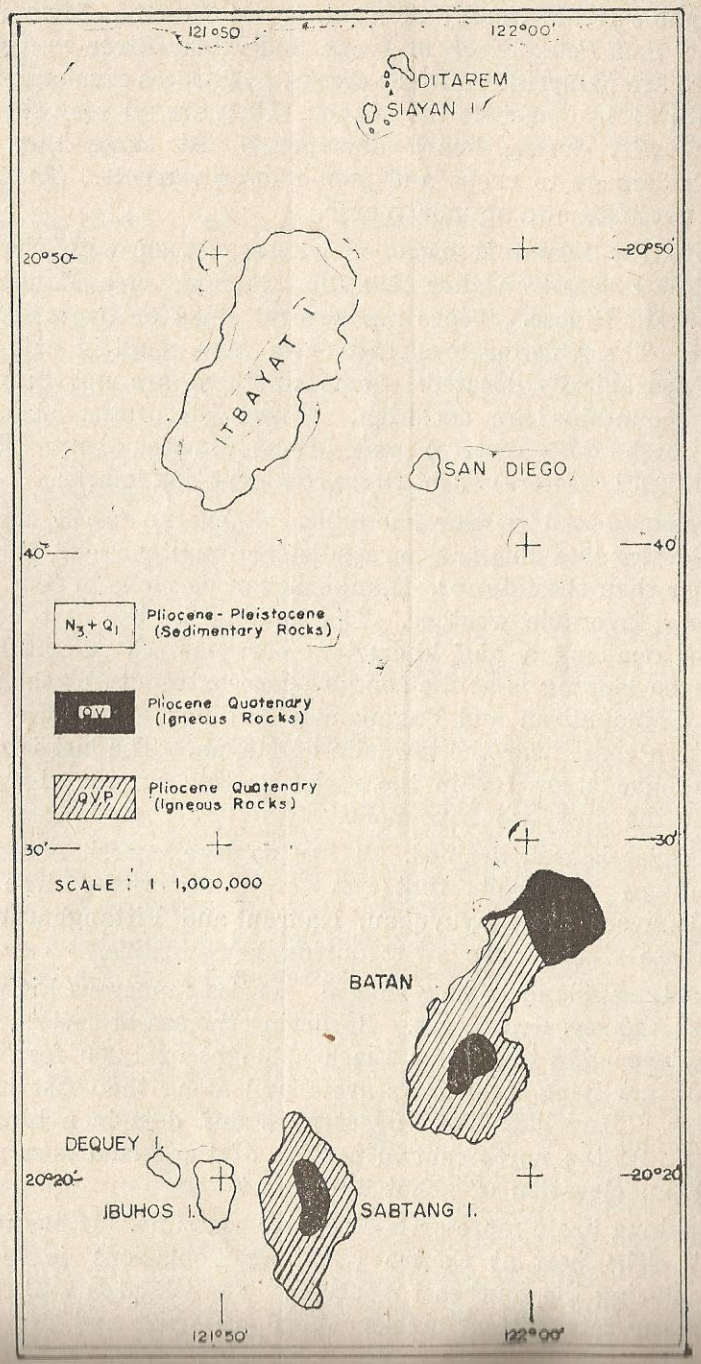

Fig. 2. Geological Map of Batanes Province.

during torrential rains. There is no swamp, marsh, lake nor live stream.

Ibuhos and Dequey Islands have regular coastlines. They are both low set with gently rolling to rolling relief. They are of coral limestone. Cliffs, rising over 100 to 200 feet, surround the islands except in Ibuhos—the eastern side of it where the land rises gently from the fringe of sand dunes. Although there is no stream, all the islands are well drained by underground channels.

San Diego (Dinem) Island is a solitary peak rising from the sea to a height of over 1,800 feet (550 meters). It is an extinct volcano which is steep and serrated.

Mavolis (Yami) Island has a rugged and steep terrain, except in the eastern side. Its elevation is 719 feet or 269 meters above sea level. The Ditarem (Mavudis) Island is another rugged island with an elevation of 754 feet or 230 meters. Siayan Island is also rugged and steep and rises to an elevation of about 543 feet. All of these islands are well-drained. The remaining unnamed islets are all protruding massive rocks.

Geology.—Batanes Islands come into existence during the pre-Miocene and Miocene periods. The Islands are once very much bigger than what they are at present. They have undergone peneplanation and degradation followed by several periods of uplift. The volcanic islands are not formed by a single volcanic eruption but by several effusions. The uplift of Batan and Sabtang has continued almost to the present.

Batanes is roughly divided into three groups, namely; (1) Sabtang and the southern part of Batan which are largely of volcanic agglomerates with occasional basic dikes, particularly in the southern portion of Sabtang, (2) the islands of Mavolis (Yami), Misanga (North Island), Ditarem (Mavudis), Siayan, and the northern portion of Batan which are of recent volcanic origin—the material consists largely of basalts and andesites with subsidiary agglomerate containing volcanic bombs; and (3) Itbayat, Ibuhos, Dequey and Dinem Islands, and the narrow fringe along the coastal portions of Batan Island—from the northern end of Baluarte Bay to Songsong Bay and of Sabtang Island which are of coral limestone.

Vegetation.—A well traveled and experienced man can readily use the stand of vegetation and the kinds or species

found in a certain province or locality as indices in determining the soil fertility, climate, altitude and drainage. Definite species or plant association can be expected under a definite set or combination of the above stated factors. Luxuriantly growing plants indicate that the soil is fertile and the climate is favorable. Dipterocarp forest develops in areas of deep soils while molave trees usually grow on shallow soils. Mangroves grow on poorly drained soils with brackish water while fresh water-loving plants thrive on bottom lands in the presence of fresh water almost the year round. Rain forests grow definitely in a lower elevation than mossy forests.

Some commercial forests are found in Batanes. The commercial forest trees existing in Batanes are different from those found in Luzon, Visayas and Mindanao. The forest trees in Batanes are small, low-set and thick-leaved; whereas the trees in the latter places are big, tall and mostly with thin leaves. Some trees in Batanes are dwarf. This can be attributed to the constant damages caused by the storms or typhoons that frequently pass thru the province. In fact, all types of vegetation in the province are exposed to the frequent and severe typhoons on account of the absence of protective high mountains and the narrowness of the islands.

Batan Island has the biggest commercial forest area in the province. This consists of the whole area of Mount Iraya. The stand of the trees is not as dense as those in the forest areas found in Luzon and in other parts of the Philippines. The western fringes of Mount Matarem are sparsely covered by secondary forest. The remaining areas of the islands are either under grass or cultivated to crops. The cultivated areas are slightly bigger than those covered with grasses. The cultivated lands and grasslands cover the major portion of the island.

The primary forest areas in Itbayat Island are sporadically located. Secondary forests are found in the abandoned *kaingin* clearings. Mount Ripose is totally devoid of trees. Mount Sta. Rosa is almost without forest cover, except the western slope. Grasslands occupy the big portion of the island. The cultivated areas are relatively small in extent.

Sabtang Island is almost entirely denuded of trees. Secondary forest trees are sparsely scattered on the steep slopes of the serrated ridges. A big portion of the island is covered

with grasses. The remainder is cultivated mainly using the *kaingin* system of farming.

Ibuhos and Dequey Islands are devoid of forest. Some pandan and palm trees are found. The major vegetation is grass.

Forest is also found in the islands of San Diego Mavolis, Misanga, Ditarem, and Siayan. The rest of the islets are almost devoid of trees.

The common grasses found in the province are cogon and *samsamong*. While the commercial forest trees are locally called *Aries, Atipujo, Chaye, Kamaya, Niyad, Riwas, Savidug, Uvuy, Vatarao,* (palomaria), *Vatinglao, Vayacvac* and *Vujus.*

Water supply.—The six towns of Batanes have water-work systems that serve only the *poblaciones.* The barrio people get their drinking water from springs, rivers, creeks, and from the rain—collected from the roofs of their houses. The rural folks bathe and wash their clothes in the springs and creeks.

Previously, the town proper of Basco oftentimes faced water scarcity during prolonged dry seasons. Recently, however this problem was solved when the National Water Works and Sewerage Authority (NAWASA) built a reservoir and replaced the small pipes with bigger ones.

The towns of Ivana and Uyugan have a joint waterwork system. However, the volume of water is too small for the two towns. As a consequence, the people suffer the lack of water during prolonged drought. To remedy the situation an artesian well was built in Uyugan to augment the water supply of the town. Nevertheless, Ivana and Uyugan will be faced with a greater insufficiency of water supply in the future if they are not going to reforest the watershed that feeds the stream from which they get their water supply.

The water system in Sabtang has a scanty supply for the town people, especially during the relatively dry months. On this situation, the common practice is to serve the town people by rotation, that is, when one side of the town is supplied with water in the first day, the other side will have its turn the next day. This water problem will become more acute in the near future because the watershed that feeds the spring from which the water supply comes is now devoid of trees. The only recourse for the people is the immediate reforestation

of the watershed in order that they will have abundant and steady supply of water.

Itbayat is more fortunate than Sabtang because the spring that supplies its water requirement has still a big discharge. The town people enjoy a sufficient water supply throughout the year. It is, however, doubtful whether the abundance of water will remain as such for sometime because the watershed that feeds the water system is also almost devoid of trees. It is high time that the Itbayateños start to reforest the watershed.

Organization and population of the area.—In 1687, William Dampier, an English freebooter, discovered and chartered the Batanes group. He named the cluster of islands as Bashi Islands and claimed them as a British territory. The Spaniards were not then very much interested in colonizing the storm-tossed islands. It was only the Dominican fathers who first showed interest in them.

When the Dominican missionaries went to the Bashi Islands, they named the island where they first landed as Batan Island. Since then it is known by that name. The word Batanes is the plural of Batan and it is now used to signify the whole cluster of islands.

When the Dominican priests arrived in Batanes in 1688, the natives were leading a primitive life. They wore G-strings, and lived as tribes. The chieftain of the tribe was called the *datu* and he was usually the strongest father among several families. They had patriarchal form of government. The tribes lived separately from each other along the hills in order to be ready in case enemies attacked them. Tribal wars were very common.

Otto Scheerer asserted that the inhabitants of Batan and Sabtang are of Malay stock, while those of Itbayat are mixed Malayan and Papuan. The people of Batanes possess some of the characteristics of the native of Taiwan. Their peculiar dialects, Ivatan and Itbayat, seemed similar to Taiwanese. This may be due to the fact that intercourse with Taiwan is much easier than with any part of the Philippines.

The early Dominican missionaries (1688–1782) that went to Batanes did wonderful work in spreading the Roman Catholic faith. However, they failed to accomplish as much as they

wanted because they found life hard for them. Food was scarse and the water was unsafe for drinking. Furthermore, the weather was enervating. Most of them met their untimely death in the islands. Those who got sick but did not die had to go to other places. The missionaries had neither Spanish civil authorities nor military man with them.

From 1688 to 1782, Batanes was not of much interest to the Spanish authorities. But in 1783, the attitude changed because of the influence of Governor General Jose Basco y Vargas. It was during this time that the Holy Cross and the Spanish flag were officially enplanted. He sent an expedition to the cluster of islands. In that expedition, he sent not only soldiers and priests, but also alcalde mayors, masons, mechanics, carpenters, and artificers to westernize the ways of life of the Ivatans and Itbayateños. Stone churches were built. The natives were taught to build stone houses and make furniture. They were obliged to live in towns. For the splendid work and deep interest of Governor Basco in colonizing and christianizing the people of Batanes Islands, he received from the King of Spain the title of "Count of the Conquest of the Batanes". The capital of the province, Basco, is named after him.

The Dominican Order was solely responsible in converting the natives to christianity. The priests were very active in their missionary work. The spread of the gospel was very thorough that not a single soul was left unbaptized. It was reported that in 1794, a total of 16,000 natives were baptized which represented the total population of the province at that time. A missionary commenting on the rapid progress said, "I do not know of any place in the Philippines where missionary work has progressed on much and so fast in so short a time". The primitive ways of the natives had totally changed that one commentator said at the close of the Spanish sovereignty in the Philippines, "Batanes had become the oasis of pure Hispanish. The ways, dress, customs, beliefs and mode of life of many of the people are essentially Spanish".

The people had remained faithful to the Catholic faith as the Dominican friars have never left the province. The Dominicans have remained in Batanes up to this day. Nevertheless, some elements of Protestantism had been planted in the province in 1937 and now it has followers in Batan and Itbayat.

From 1783 to 1897, Batanes was a sub-province of Cagayan with Basco as the capital. In September 1897, the province came under the control of the Revolutionary Government. The

Katipuneros remained in power until 1899, then the Americans took possession. When the United States established a civil government, Batanes was made a part of Cagayan. It remained as such until 1909. It was then separated from Cagayan and organized as a special province. It has remained as such up to now.

During World War II, Batanes was the first province of the Philippines that was attacked and occupied by the Japanese Imperial Forces. It was occupied from December 8, 1941 to September 8, 1945. The war caused much economic setback to the geographical head of the country. Livestock, foodstuffs, galvanized roofs of public buildings and woodwork in the schools were looted and brought to Japan by launches. Precious jewels and silver money were taken from the natives by the Japanese soldiers.

TABLE 1.—*Distribution of population in Batanes by Municipality according to the Census of 1903–1960.*

Municipality	1903 March 2	1918 December 31	1939 January 1	1948 October 1	1960 February 15
Basco	2,347	2,338	2,782	3,312	2,868
Itbayat	1,198	1,363	1,625	1,954	2,365
Ivana	672	939	965	1,083	1,039
Mahatao	1,129	1,054	1,238	1,492	1,242
Sabtang	1,763	1,665	1,844	1,656	1,766
Uyugan	1,104	855	1,058	1,208	1,029
Total	8,293	8,214	9,512	10,705	10,309

In 1903, the population of Batanes was 8,293 but in 1918 there were only 8,214 people (Table 1). It is interesting to note that instead of a steady increase in population there was a decline. This can be attributed to the effect of mass education during the American regime wherein the people came to know that there are other places of the country that offer them better opportunities economically. In 1948 the Philippine Census and Statistics indicated that Batanes had only 10,705 people which is 0.05 per cent of the total population of the Philippines. Not long ago, many of the people wanted to go to Mindanao in mass but the local government authorities regulated the outflow in order that the political status of the province will not be lost. According to the Philippine Census of 1960, the population of the province is 10,309 people. The decrease in population could be attributed to the migration of the inhabitants to other places of the Philippines. Migration is still going on up to the present.

Transportation and market.—Batanes is the most isolated province of the Philippines. During the Spanish regime and early American occupation, sailboats were the only means of transportation and communication to the place. The sailboats usually visited the cluster of small islands once in every six months and at times once a year. During the latter part of the American regime and up to the present time, irregular steamship service is maintained between Manila and the town of Basco, and islands of Itbayat and Sabtang. The calls are by arrangement with shipping companies subsidized by the government. The main reasons of the irregular and subsidized trips are the limited exports and imports of the islanders, and the great danger in going there on account of the strong ocean currents and prevalence of severe typhoons.

Radio communications are maintained in Basco, Sabtang and Itbayat. Telegrams from Sabtang and Itbayat to other parts of the Philippines and vice-versa are first relayed to Basco.

Mailing system in the islands of Batan and Sabtang is regular while in Itbayat, it is very irregular. The mails of Itbayat are either carried occasionally by patrolling Philippine Navy boats or by commercial boats. Mails and travelers in Sabtang are carried by sailboats and rowboats, locally called *faluas*. However, the sailboats and *faluas* could not be used in going to Itbayat due to the treacherous sea between Batan and Itbayat. Strong gusts of wind and ocean currents exist in the area. Waves as high as 30 meters sometimes occur. At high tide the currents flow westward into the China Sea from the Pacific and ebb eastward. The currents usually attain a speed of 5.5 knots. Strong tide rips and swirls are found near the shorelines. This is also true in the other islands. Many people who had tried to go to Itbayat by sailboats and *faluas* had lost their lives.

All of the Batanes Islands have no good roads, except Batan which has a narrow first class road of about 30 kilometers. This road traverses from Basco to Bo. Imnajbu, Uyugan and from Basco to Contracosta. Despite the existence of the first class road in Batan, there is no public conveyance in the area. Vehicles of the United States Navy at Loran Station, located between Kilometer Posts 24 and 25, provide free rides every Wednesday and Friday when they get their supplies at Basco airport. Government vehicles are only used by the

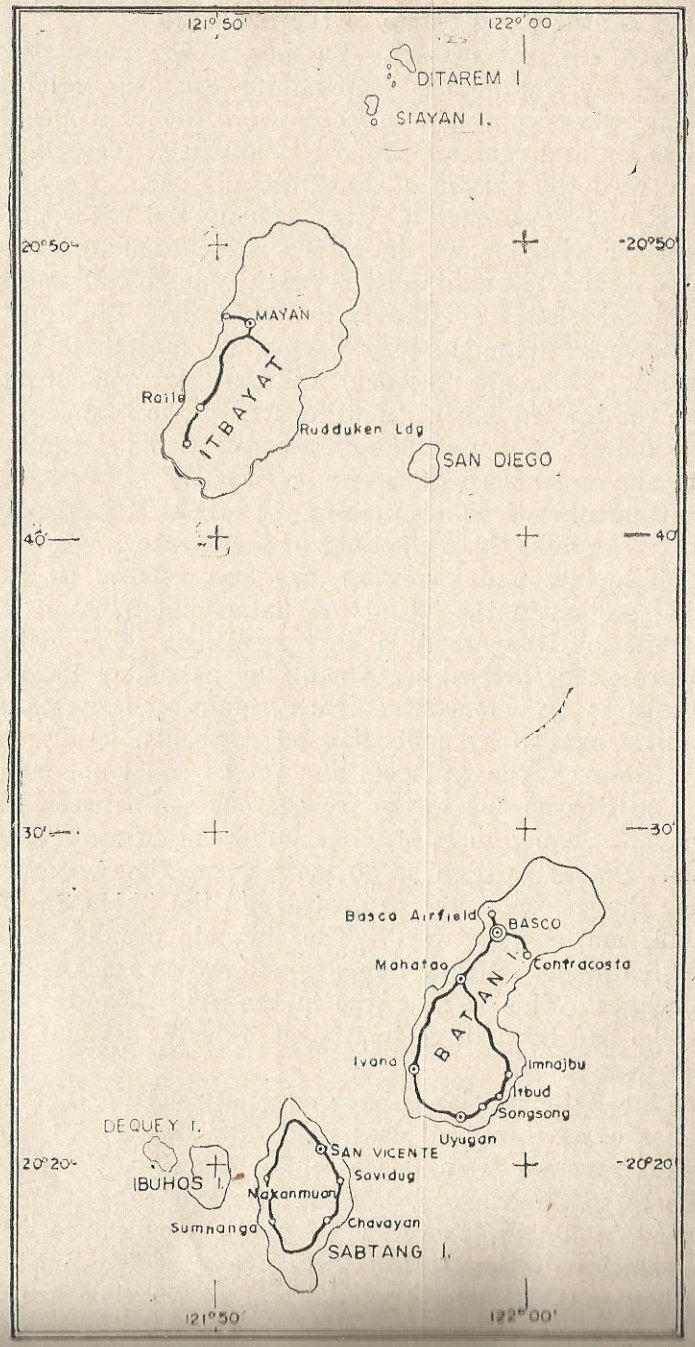

Fig. 3. Road Map of Batanes Province.

Offices of the District Engineer, Health, Philippine Constabulary and Bureau of Agricultural Extension. All other offices including the governor's office are without any vehicle. Sabtang Island has a poorly maintained second class road. The road traverses around the island passing along the coasts. Likewise, there is no vehicle in the island. In Itbayat a muddy road traverses the island from Paganaman Landing, passes thru Mayan, and branches to Mauyen and Ripose Landings. Foot trails cut through the different islands. Men and packed animals in Sabtang, carry the products to the market. Sleds drawn by farm animals are also used.

The establishment of an air line service in Batanes in 1946 is a blessing to the people of these islands. Through it the inhabitants receive news from the outside world. In the beginning planes call twice a week. Now, it is three times a week as conditioned by favorable weather. News seep through the Itbayat via the telecommunications office. An airport is under construction near the barrio site of Raile at the time of the survey.

There is no public market in the province. Only a few stores mostly under the homes are found in the different towns. These stores sell a limited amount of imported products coming directly from the merchants from the commercial boats. The more enterprising farmers and ranchers group themselves together and one or two of them are designated to bring and sell their products directly to Manila.

Cultural development and improvement.—The Spaniards succeeded in the unification of the different tribes in the spread of Christianity, and in civilizing the natives in the sense that they learned to wear clothes and discard the use of G-string. Likewise, the American succeeded in the spread of the democratic way of life through mass education.

Public schools of primary and intermediate grades are found in all *poblaciones* of the six towns. Public primary schools are found in all barrios of the province. A public high school is found in Basco. There is no private elementary, high school, nor college in the province.

The educational attainment of the people of Batanes is shown in Table 2.

The Bureaus of Health and Public Hospitals take care of the health of the people and maintain the sanitary conditions of the province. A provincial hospital is located in Basco.

TABLE 2.—*Educational attainment of the population of Batanes by Municipality in 1960.*[1]

Municipality	Population	Completed	Elementary Grade I to V	Grade VI to High School 3	High school graduate to college graduate
Basco	2,868	947	899	655	937
Itbayat	2,365	787	867	580	131
Ivana	1,039	293	319	291	136
Mahatao	1,242	447	404	309	82
Sabtang	1,766	529	658	485	94
Uyugan	1,029	196	438	302	93
Batanes	10,309	3,199	3,585	2,622	903

[1] Census of the Philippines, 1960, Vol. 1.

Public dispensaries are found in all the municipalities. The Social Welfare Administration maintains a branch in Basco and social workers are distributed in the three main islands, Batan, Itbayat and Sabtang, who are ever ready to give relief to the people in time of catastrophe.

The Ivatans and Itbayateños are not contented with the high school education they acquired from the province and so many bright young men and women come to Manila to find work and study at the same time. Most of the leaders of the province are self-made men.

The types of building in Batanes are unique in the Philippines. The frequent occurrence of destructive typhoons in the province had influenced the islanders to build low houses close to each other. The buildings are mostly made of stones and rocks with thick walls of not less than two feet. Burnt lime is the cementing material. The roofs are triple thatched, made of cogon. Concrete modern buildings with galvanized iron roofing are also built.

Industries.—Agriculture is the major industry of the province. Next in importance is fishing. Fish abounds in the waters surrounding the cluster of islands. Deep sea fishing is not yet tapped in the area. Small-time fishermen operating in the area can only fish during good weather. The best time to fish is from March to June. Milkfish is not raised in the province. Tilapia is raised in ponds and in some of the creeks.

Batanes has no big-time manufacturing industries but only of household industries. The household industries are mat and hat weaving, furniture making and basketry. The mats and hats are sold locally. The pieces of furniture and baskets are sold to other provinces.

CLIMATE

Climate is the average condition of the weather at a particular place over a period of years. Weather is the day by day breakdown of the climate. The primary climatic elements are temperature, precipitation, wind velocity, humidity and air pressure. These elemental forces vary in intensity at different places of the earth at different seasons due to the differences in latitude or distance from the equator, distribution of land masses and bodies of water, altitude, winds, mountain barriers, ocean currents, storms and occurrence of low and high pressure centers.

Climate plays a very important role in the lives of plants and animals including men. It affects (in combination with other factors) the formations of soils and their distributions; alkalinity and acidity; erosion conditions; land forms, particularly surface features; drainage conditions; land utilization; landscape; plant growths and their distributions; the spread and intensity of attacks of pests and diseases; and many other things. Many effects of climate can be cited but in brief we can say this—if the weather is too dry or too wet, most crops fail and the farmers suffer and consequently humanity is adversely affected because the farmers feed the world.

Batanes Province falls under the fourth or Intermediate B type of climate of the Philippines characterized by no very pronounced maximum rain period and no dry season. The rains are more or less evenly distributed throughout the year. Both the cyclonic (summer rains) and northeast rains as well as thunderstorm rains are experienced in this type. Table 3 shows that February, March and April are the months of minimum rains and the other months are with optimum precipitations.

The average annual rainfall of the province is 123.70 inches. It is much higher than the annual average rainfall for the Philippines which is 93.2 inches. The annual number of rainy days in the cluster of islands is 215 days. Table 3 shows that throughout the year, Basco experiences days with partly cloudy and cloudy to overcast. This shows that in a year there are more rainy days than the bright sunny days. This factor makes the grasslands and pastures evergreen, thus cattle raising is favorable.

Temperature is a very important element of climate. It can inhibit or augment the biological activities of plants and animals. Men and animals cannot work efficiently under extreme cold and heat. The chemical as well as the physical processes taking place in plants, solubility of minerals, absorption of water, gases, and mineral nutrients, diffusion, synthesis, growth, and reproduction are affected by temperature. The temperature changes in Batanes do not vary so much to adversely affect plants and animals. The average annual temperature of the province is 25.7 degrees centigrade. Table 3 shows that the coolest months of the year are from December to March.

TABLE 3.—*Monthly average and annual rainfall; number of rainy days; mean, mean maximum and mean minimum temperature; relative humidity and cloudiness in Basco, Batanes.*[1]

Month	Rainfall in Inches	Number of Rainy Days	Temperature (°C)			Relative Humidity %	Cloudiness (0–10)
			Mean	Mean Maximum	Mean Minimum		
January	9.03	20	21.4	24.2	18.6	80	8
February	5.10	15	22.8	25.7	19.8	80	7
March	5.04	14	24.4	27.5	21.4	80	7
April	3.08	11	26.0	29.1	22.8	82	7
May	8.09	14	27.9	31.0	24.8	82	7
June	9.52	16	28.5	31.6	25.3	83	7
July	12.11	19	27.5	30.0	24.9	83	7
August	15.84	21	27.3	30.2	24.4	85	8
September	14.31	20	27.3	30.3	24.3	84	8
October	14.44	21	26.5	29.1	23.8	81	8
November	13.61	21	25.3	28.0	22.6	80	8
December	12.76	23	23.5	25.8	20.7	81	8
Annual	123.70	215	25.7	28.5	22.8	82	8

[1] Data taken from the Philippine Weather Bureau Scientific Papers—*Annual Climatological Review for 1961*, Scientific Paper No. 50, U.D.C. 582.2 (914) pp. 59–60.

Another important element of climate is relative humidity. The term has reference to the quantity of moisture present in the air at all times in the state of invisible vapor. It is usually expressed in percentage.

Humidity controls evaporation and healthfulness of a place. It has much to do with comfort and health of animals and men as do those of temperature, sunshine and wind. A high degree of humidity makes a hot wave of air sensibly hotter, and cold wave colder, which is the case when the amount of moisture in the air is relatively low. High humidity in warm weather makes one uncomfortable because the evaporation of perspiration from the pores of the body is greatly retarded, thus preventing the cooling effect produced by this process.

An atmosphere with a high humidity during cold weather increases the conductive qualities of wearing apparels and permits a more rapid escape of the body's heat thus one feels cool more than when the air is dry. It is more pleasant to live in regions which have low percentage of moisture than in places with damp climates.

Batanes is damp. The dampness is due to: (1) extraordinary evaporation from the seas that surround the cluster of islands, (2) the richness in vegetation, (3) the different prevailing winds in the different seasons, and (4) the abundant rain falling throughout the year.

Batanes lies on the Pacific typhoon belt. Records of the Weather Bureau show that typhoons very frequently strike the province. Twenty-five per cent of the typhoons that strike the Philippines hit the geographical head of the country. The islanders suffer much from the destructive typhoons. From July to October of every year, the north wind comes in fearful gusts often blowing at hurricane speed and raising waves as high as 100 feet.

Despite the destruction brought by typhoons, they are blessings in disguise for Batanes and the Philippines for the following reasons: (1) they bring in beneficial rains; (2) they vary our prevailing winds; (3) they augment cloudiness which reduces the intense heat of the tropical sun; and (4) they greatly lessen the enervating effect of our tropical temperature.

AGRICULTURE

When the Spaniards colonized the Batanes, the islanders had been living as tribes engaged in primitive agriculture. They farmed the hills with the *kaingin* method. *Ubi, tugui* and camote were the common crops planted. Wild animals supplied their meat. Their *kaingin* clearings were in small patches.

Batanes has not progressed economically as fast as the other places of the Philippines. There is not much change in the agricultural practices since Dampier discovered the Islands. Most of the farmers are still engaged in the age-old *kaingin* system of farming. Few farmers use plow. No modern implement has been introduced in the province. The slow progress of farming may be attributed to the following: (1) Frequent visits of destructive typhoons; (2) isola-

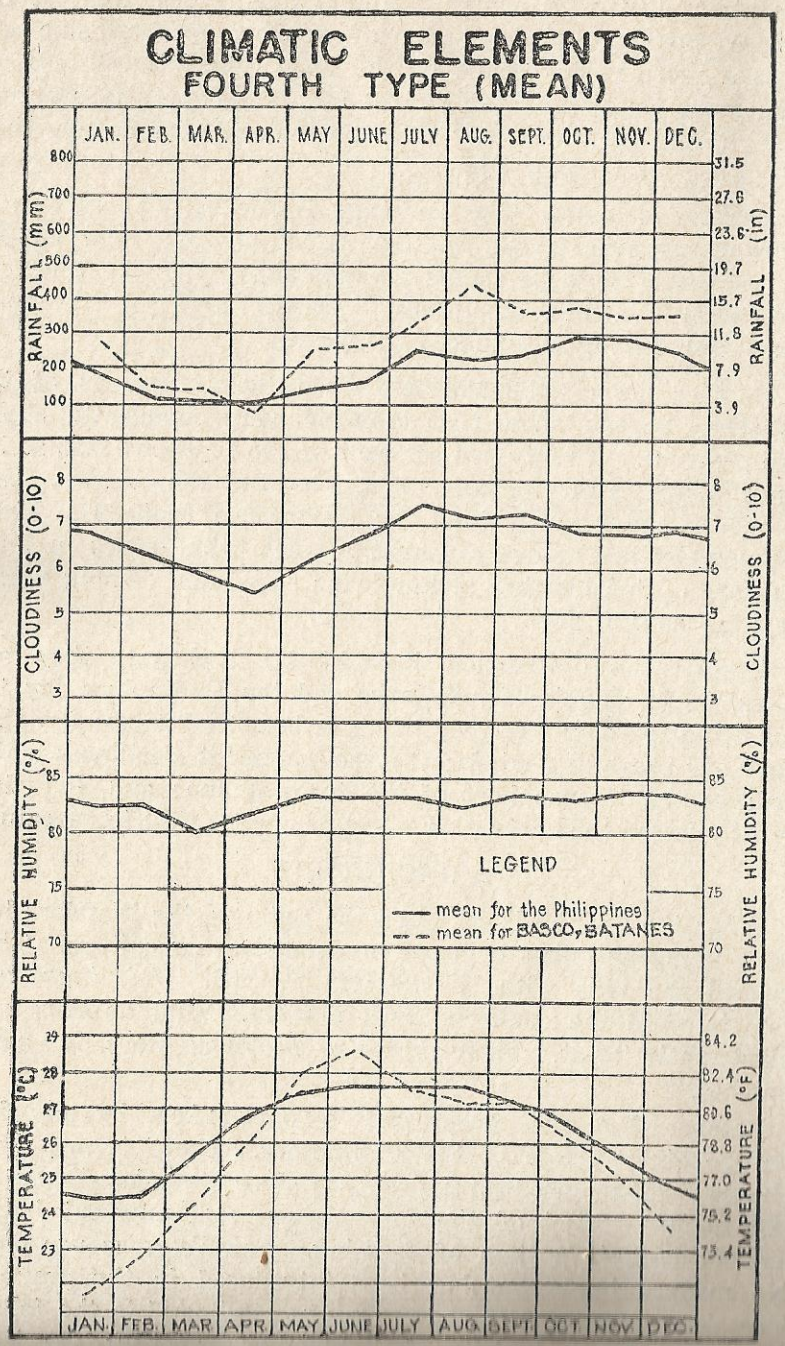

Fig. 4. Graph of the fourth type of climate of the Philippines and of Basco, Batanes.

tion and inaccessibility to good markets; (3) contentment and/or indifference of the people to economic improvements; (4) lack of knowledge and application of scientific methods of agriculture; (5) impoverished condition of the soils; and (6) lack of good areas for expansion.

In the 1960 Census of Agriculture, about 4,372.9 hectares were recorded as farm lands in the province of Batanes, represented as follows:

Kind	*Area in Hectares*	*Per Cent*
Arable land	2,404.3	54.98
Planted to permanent crop	207.8	4.75
Permanent pasture	1,096.7	25.08
Covered with forest	649.2	14.85
All other lands	14.9	0.34
Total	4,372.9	100.00

In 1960, the ten leading crops of the province, in the order of value of produce.[1] are as follows:

Crop	*Area planted in hectares*	*Production*	*Value in pesos*
Garlic	48.7	180,437 kilos	₱285,728
Camote	598.3	2,810,878 kilos	259,206
Ubi	363.3	1,953,227 kilos	243,759
Corn	251.2	4,980 cavans	72,726
Coconut	174.9	341,591 nuts	55,864
Sugar cane	32.4	1,187 tons	33,235
Onion	24.8	52,332 kilos	23,026
Palay	79.3	1,546 cavans	21,644
Banana	64.6	192,412 kilos	19,267
Watermelon	5.7	54,959 kilos	16,488

Among the ten leading crops garlic, sugar cane, onion and watermelon are the less cultivated as indicated above. However, it is interesting to note that garlic, which was produced from 48.7 hectares exceeds the income from camote produced in 598.3 hectares. This indicates that if this crop would be grown extensively it would give a greater income for the farmers of the province.

Ubi.—*Ubi* is one of the most important root crops of Batanes. It ranks next to camote in terms of area planted. In 1960 the area planted to ubi was 363.3 hectares with a total production of 1,953,227 kilograms valued at 243,759 pesos. The average production of one hectare is about 5,376 kilos.

[1] 1960 Census of the Philippines, VOL. I.

Batanes is the only province in the Philippines that uses *ubi* as a staple food. There are many varieties grown in the province. The most common ones are locally called, in Itbayat dialect, *Dalipac, Munas, Hayhawaii, Hayingles, Naypura, Nayvisaya, Romachi, Talapuyo, Tucodi, Uyod,* and *Vahucon.* The tubers of these varieties are generally elongated, oblong, rounded, branched or lobed. The color of the flesh of tubers ranges from white to yellow, orange, and red to deep purple. The approximate fuel value is about 1,360 calories a kilogram which is equivalent to only 2/5 of the value of rice. The tubers have an excellent keeping quality. They can be stored in crates or baskets in an ordinary dry place for a year without any special treatment.

Ubi is propagated from "sets" taken from the tubers. The upper portion of the tuber, nearest the stem, is more suitable for planting than the lower portion. The best suitable soil for *ubi* is one that is deep, friable, fertile and well-drained, regardless of the texture. In planting, the soil has to be plowed or dug deep and pulverized well. The rows have to be spaced three feet apart and the "sets" are to be planted two feet apart in the row. The "sets" are allowed to germinate before planting, or else they are likely to rot in the hill. With the fourth type of climate prevailing in the province, ubi can be planted in any month of the year, but January, February and March seem to be the best months. The common practice of the islanders is to plant ubi in new *kaingin* clearings. The "sets" are planted with the use of either a pick, hoe, crowbar, or mattock. Plows are seldom used. The plants are made to climb trellises. The field is kept clean until the plants are well established and strong enough to check other plants' growths. The crop is harvested after eight to 10 months from the date of planting. The *ubi* crop is ready for harvest when most of the leaves of the plants are turning yellowish brown and the stems begin to shrivel.

All of the six towns of the province grow *ubi.* The towns of Sabtang, Mahatao and Uyugan lead in the production of *ubi* in 1960. While the town of Uyugan, Iyana, and Mahatao lead in hectarage planted in the same period.

Camote.—Camote is the most extensively grown crop in Batanes. The varieties grown are *Ternas, Chivajes, Inamaria, Iso, Bobohan, Palisin, Samurangan,* and *Morado.* The *ternas, Chivajes* and *Inamaria* have the same characteristics. They

differ only in the shape of the leaves. All of them have pinkish red skin and light yellow flesh. These varieties are planted in any month, from September to April and can be grown successfully for more than two years with an unimpaired production. Their first set of tubers are ready for harvest after four to five months from the date of planting. The tubers of these varieties have poor keeping quality as they easily rot.

Iso variety has the same characteristics as *Ternas* except that the former has a pinkish red skin and a white flesh, while the latter has pinkish red skin and light yellow flesh.

Bobohan, Palisin and *Samurangan* varieties have white skin and white flesh. All the other characteristics are similar to *Ternas, Chivajes* and *Inamaria.*

Morado variety has a white skin and a violet flesh. It is usually planted from September to February. Six months after planting, the tubers are ready for harvest. This variety has a fairly good keeping quality.

Sweet potatoes or camote thrive best on deep, fertile, well drained friable and moderately permeable soils regardless of the textural grades. Good yields are usually obtained from rich and deep alluvial soils. Warm temperature with optimum moisture is preferred by camote. The distance of planting is about 75 centimeters between rows and 50 centimeters between hills. Vine cuttings of about 40 centimeters long are used for planting. Tip cuttings are preferred over any other parts of the vine.

It is the practice in Itbayat to plant camote in *kaingin* clearings. Camote is planted in rotation with other crops, such as corn, *ubi, or tugui,* onion or garlic and sugar cane. In the rotation, corn is the first crop being planted. After corn, either *ubi* or *tugui* is planted in the month of February or immediately after corn harvest. This is followed by either garlic or onion which is planted in October. After the crop of garlic or onion, camote comes in. Camote is usually the last crop to be planted in a clearing if sugar cane does not follow camote. The camote crop is usually allowed to grow perennially. The matured tubers are harvested from time to time leaving the small ones to mature. When the camote crop is no longer productive, the field is fallowed and trees are encouraged to grow. Fallowing usually lasts from three to 10 years. If trees are the first to establish in a fallowed field, it

lasts only for three years; but if grasses gain foothold ahead of the trees, it will last for 10 years because they will wait for the trees to dominate the area.

Camote can be planted in Batanes at anytime of the year. However, in Batan the favorable month is February; while in Sabtang planting is done in August. In Itbayat, planting is done in October. The planting in Batan and Sabtang Islands is mostly done with the use of plow, while in Itbayat the planting is done mostly with a pick, hoe or mattock. The camote is usually hilled up or planted in ridges. Weeds are removed from time to time. Intensive care is usually given. Camote seems to be the best adapted crop in the province for it is not much affected by typhoons. This crop is not exported to other provinces but for local consumption only. Farmers of the other towns of Batanes send camote and other crops to Basco for the consumption of their children studying in the high school. This is a must because the lands in Basco can hardly produce sufficient food for its populace.

Corn.—Corn is the most important cereal of the islanders. In 1960, 251.2 hectares were planted to corn with a total production of 4,980 cavans valued at 72,726 pesos. The average production was 19 cavans per hectare. The production is quite low. With good soil and favorable weather together with scientifically approved farming practices, the production can be increased to the optimum. Fertility on corn fields as well as in other croplands can be maintained and enhanced by the application of inorganic and organic fertilizers, and good cropping system like crop rotation with legumes and other deep rooted crops. On the other hand, continuous cropping of corn on the same piece of land exhausts the soil of its plant food nutrients.

On the level and undulating lands in Batan and Sabtang, the fields are plowed and harrowed two or three times before planting. The crops are planted in furrows. The furrows are about 80 centimeters apart and the distance between hills is about 70 centimeters. The corn is usually intercropped with legumes like peanut and beans. The plants are cultivated with a plow when they are about a month old. Hand weeding is usually practiced. The plants are not irrigated, neither manured nor fertilized. After corn and the legumes are harvested, the land is immediately prepared for other crops. The land is utilized throughout the year.

In the southern part of Batan and Itbayat the best time to plant corn is in October. In other parts of Batan and in Sabtang, the best time is in January or February. Usually, only one corn crop is grown in a year.

In the rolling areas and steep portions of Batan, Sabtang, and in the whole island of Itbayat, corn is planted in *kaingin* clearings in rotation with other crops. The first crop planted in a new *kaingin* clearing is corn. It is claimed that Itbayat has a higher corn production per unit area than in the other islands. The order of succession of planting is corn, *ubi*, or *tugui*, camote, garlic or onion and sugar cane. The planting is done with the use of either a sharp pointed pole, mattock or pick. Cultivation and weeding are done with grub hoe, mattock, trowel and pick. Fertilization, irrigation and control of pests and diseases are not usually practiced by the *kaingineros*.

The common varieties planted are the white and yellow flint, and pop corn. This crop is not exported but consumed locally as green corn, corn-rice or for livestock feeds. Production of corn in 1960 is as follows:

Ivana	1,283	cavans
Sabtang	957	"
Itbayat	931	"
Uyugan	654	"
Basco	627	"
Mahatao	528	"
Total	4,980	cavans

Sugar cane.—Sugar cane is the sixth ranking crop in terms of monetary value. According to the Census of the Philippines on Agriculture in 1960, the area planted was 32.4 hectares with a production of 1,187 tons of cane valued at 23,235 pesos including *palek* (local wine).

Sugar cane is planted in small scale and in patches in Batanes. They are grown by the islanders for chewing and for the making of *palek*, *muscovado*, and *panocha*. No refined sugar is made out of it. The canes are milled in native wooden crushers and imported iron crushers drawn by animals. The *muscovado* sugar and *panocha* are processed cane juice; while *palek* is fermented cane juice.

Sugar cane grows in any kind of soil, however, it grows best in newly cleared lands, especially on alluvial soils, that are deep, fertile and well drained with moderate permeability.

The topography of the land may be undulating to rolling. It requires plenty of moisture during its growth.

Generally, the stand of the sugar cane in the province is poor. This is attributed to the varieties grown, land preparation, poor condition of the soil and effects of typhoons. The varieties grown are locally called *Yato, Hilak, Havit, Vaheng* and *Nahivag*. The first four attain a diameter of two centimeters while the last one attains a diameter of four centimeters and sometimes more. These varieties have tough and pliant canes. They can be planted and harvested anytime of the year. The canes are ready for harvest after eight or 12 months from planting. The distance of planting is one meter between rows and one meter between hills. Usually two cane points are planted in a hill.

In Batan and Sabtang Islands, the sugar cane is planted in the level, undulating and sloping areas with the use of animal-drawn plows; while in the hilly areas with steep slopes and in Itbayat the *kaingin* system is being employed. In Batan and Sabtang Islands, the sugar cane crop is usually allowed to ratoon for two to three years in newly cleared areas and in fields that have been fallowed prior to sugar cane planting while in Itbayat, it is practiced for as long as 10 years. Fertilization and the control of pests and diseases are not practiced.

Palay.—Rice or palay is grown throughout the province but in small scale. The ricefields are in small patches. The total area planted in 1960 was 79.3 hectares with a production of 1,546 cavans of palay (rough rice) valued at 21,644 pesos. The average production per hectare is very low. It is only slightly over 10 cavans. The low production is attributed to the varieties grown, the cultural practices, pests and diseases, poor condition of the soils and inclement weather. In terms of production of rice, Basco ranks first followed by Sabtang, Itbayat and Mahatao in that order. The province is not self-sufficient in rice and this cereal is eaten as a supplement to the root crops, the staple food of the people. The greater bulk of the rice used in the province comes from Luzon. When typhoons and other calamities hit the province the Social Welfare Administration rationed the people with government rice.

The rice varieties grown are locally called *Binirhen, Mimis, Cayagca* and *Dico*. In Batanes, the farmers use the dry method

or upland culture of rice because they have not provided dikes in the rice paddies which are necessary in impounding water for the culture of lowland rice. In Batan and Sabtang, the level areas are plowed and harrowed with native implements three times before planting. The seeds are broadcasted after the third plowing and the field is harrowed after broadcasting. The *kaingin* system of farming is practiced in Itbayat and in the rolling and steep areas of Batan and Sabtang. In the *kaingin* clearings the rice seeds are planted with the use of a pointed pole, which at times is reinforced with an iron tip. A dibbler makes the hole of about two inches deep, spaced at 29 centimeters apart. Three to five seeds are dropped in each hole and simultaneously covered with soil, either by hand or feet by a person following the dibbler. Green manuring, liming, and application of organic and inorganic fertilizers are not practiced.

The planting of rice is done in May and June and harvested in October and November, which coincides with the typhoon months, thus exposing the crops to inclement weather. The disastrous effect of the typhoons can be avoided by changing the planting calendar in such a way that the booting and fruiting stage of the rice plants will not fall under the typhoon periods, July to November.

Introduction of new improved rice varieties, will no doubt, boost the production of rice in the province. The lowland rice fields in Itbayat can be expanded to a certain extent by utilizing depressed or sink areas for the growing of lowland rice.

Tugui.—This crop is one of the most important root crops in Batanes. The area planted in 1960 was 25.3 hectares with a total production of 117,415 kilos valued at 11,742 pesos. The average production per hectare was about 4,640 kilos. Almost every farmer has a small field of *tugui*.

Tugui is grown in the same manner and for the same purpose as *ubi*. The tubers, the edible portion of the plant, are smaller in size than the *ubi* but they are more in number. *Tugui* tubers do not grow deep into the soil as those of *ubi*. The islanders claim that *tugui* is more palatable and superior in flavor than the camote. The food value of *tugui, ubi* and camote, however, are almost the same. Their calorific value is 2/5 that of rice.

Coconut.—Coconuts are grown only in the shielded small areas which are sporadically located in the province. The pro-

duction of coconuts in Batanes, in terms of area, number of trees and produce, is like a spoonful of water in a bucket in comparison with other provinces of the Philippines like Quezon, Laguna and Samar, where coconut is extensively grown. The total area planted in 1960 was 174.9 hectares with a production of 341,591 nuts valued at 55,864 pesos. The total number of trees planted was 24,349 of which 19,762 were bearing and 4,587 were non-bearing. The production per tree is very low. The produce is barely enough to meet the demands of the province. They are mostly used for food. Edible oil from coconut are produced by cooking the coconut milk extracted from grated coconut meat. Freshly grated coconut meat is eaten with boiled *ubi*, camote and *tugui*. Some coconut trees are tapped for *tuba*.

Itbayat leads the other towns in the province followed by Basco, Mahatao, Uyugan, Sabtang and Ivana in coconut production. The coconut plantations are poorly managed. Brushes and tall grasses are commonly seen under the trees. In some places, *ubi*, camote, *tugui*, *gabi* and some vegetables are grown underneath.

Tobacco.—Tobacco is one among the many crops introduced by the Spaniards in the province. Since the Spanish regime up to the present, the growing of this crop has not gained much impetus. It has remained as a garden crop and grown in small scale for local consumption. The area planted in 1960 was only 15.1 hectares with a production of 14,768 kilos valued at 12,844 pesos. It is mostly grown in *kaingin* clearings. A seedbed is usually made in one of the corners of the field to be planted. Preparation of seedbed is done by digging and pulverizing the soil with a mattock or grub hoe. A teaspoonful of seeds is mixed with one fourth liter of sieved wood ash before they are sown. The mixture is evenly sown in the bed and covered thinly with finely pulverized soil. The bed is watered regularly with a sprinkler. It is always kept moist until the seedlings are transplanted. But during heavy rains, the seedbeds are protected with roofings. Pricking is seldom practiced. The seedlings are transplanted when three pairs of leaves have already appeared. Transplanting is usually done in the afternoon. The young plants are watered and shaded either with clods or with banana sheaths cut to about 20 centimeters long. Cultivation and weedling are done with a hand tool like a grub hoe or a trowel. Worms are

handpicked every day. When the plants are about to bloom, they are topped or the buds are ripped off with the fingers. Side sprouts and shoots are removed as soon as they appear. This is done to produce bigger and thicker leaves with stronger flavor and aroma. The leaves are picked as they mature. Poling and drying go hand in hand with harvesting. The leaves are dried and cured inside the house, kitchen or barn, in a platform near the roof. Cured tobacco for home use are allowed to remain in the poles until they are consumed, while those for sale are bundled into *manos*—one *mano* is 100 leaves tied together. Mahatao leads the other towns in tobacco production followed by Ivana, Sabtang and Uyugan.

Cabbage.—In 1960, the area planted to cabbage was 10.3 hectares with a production of 28,244 kilos valued at 7,356 pesos. Basco ranks first in cabbage growing followed by Mahatao, Sabtang, Uyugan, Ivana and Itbayat. This crop may turn out to be an important money crop if the farmers will grow it with more zeal, diligence and care. Generally, the present practice is not conducive to good production. In Itbayat, the planting of cabbage is from seedling raised in seedbeds. Seeds are sown without any treatment, in seedbeds prepared by digging the soil with a mattock or grub hoe. Transplanting of seedlings is done after the emergence of the third pair of leaves. Watering of the crop is done twice or thrice only, from planting to harvesting. Weedling and cultivation are seldom done. Worms are handpicked as soon as observed. Fertilizer and manure applications are not practiced. Inspite of the little care given, good-sized heads of cabbage are produced. This can be attributed to the favorable climate condition obtaining in Batanes for the growing of cabbage with the exception of the typhoon months.

Garlic.—In 1960, garlic tops all other crops of the province in terms of value of produce. That year, the area planted was only 48.7 hectares and the production was 180,437 kilos valued at 285,728 pesos. In terms of production, Itbayat leads the other towns followed by Basco, Ivana, Mahatao, Sabtang and Uyugan. Plantings were done in small patches only. Each farmer usually has a small plot planted to garlic for his home use, but during the time of the soil survey (1957) some farmers have planted several hectares each, particularly in Itbayat. The estimated area planted then was no less than 100 hectares. Garlic is fast flourishing as the most important money crop

of the islanders. It is exported to Manila and other parts of the Philippines. The varieties are Taipei and Native. The garlic grown in Batanes, especially the Taipei variety, are bigger than those produced in the Ilocos Provinces and/or Batangas.

Most of the Itbayateños plant the garlic in the new *kaingin* clearings while most of the Ivatans, people of Batan and Sabtang, plant garlic in fallowed fields. It is their experience that they get better crops in these areas than in fields that had been planted continuously. The local farmers do not mulch their garlic unlike those in the Ilocos Provinces. Fields in the level and undulating areas are being plowed, while those in slopping or rolling areas—*kaingin* clearings are not plowed. The cloves of the garlic are individually separated and soaked in water overnight before planting. Planting is done with the use of a pointed pole or a dibbler. The holes are distanced at about 25 centimeters between rows and about 15 centimeters between hills. One clove is inserted in each hole with the posterior end inside and then covered with a thin layer of soil. Weeding and cultivation are done simultaneously as soon as weeds show up. Fertilization, irrigation and control of pests and diseases are not practiced. Planting is done in October and November and the harvesting is in April. Harvesting is done by hand pulling the bulbs individually. Then, dried under the sun for three or more days. After drying they are braided into 100 bulbs each.

Onion.—This crop is fast becoming one of the major crops of the province side by side with garlic. It was reported in the Census of Agriculture of 1960 that the total area planted to this crop was 24.8 hectares and the production was 52,332 kilos valued at 23,026 pesos. Both native and Bermuda onions are grown in the province. The native varieties grown are called Native Small Red, Native Medium-Sized Red and Native Big White. These varieties are bigger and less pungent than the native onions grown in the Ilocos Provinces and Batangas. The Native Big White can be mistaken for a Bermuda onion. These varieties have good keeping quality and they can be preserved for a year or until the next planting season without much care. The people preserve their onions by hanging the bundled onion over their native stoves where they are smoked during the time of cooking. The islanders grow their onions in the same way they grow garlic. They plant them in November and December and are harvested in March and April.

This crop is being exported to Manila and to other parts of the Philippines. Sabtang led the other towns in the production of onion in 1960, followed by Ivana, Itbayat, Basco, Uyugan and Mahatao.

Abaca.—This crop is grown for local use. All of the six towns of the province grow abaca in a very small scale. They are grown in few hills on sinked or depressed areas and on the banks of the small rivers and creeks that are shielded from strong winds and typhoons. This crop is never given attention and care once it is planted. The abaca is stripped into fibers by means of a native instrument called *hagutan*. The fibers are made into ropes for halters and tethering animals, for use in the small bancas (*faluas*), and for making fishing nets.

Vegetables.—The important vegetable crops of the province, aside from cabbage which has been discussed earlier, are eggplant, patola, pechay, tomato, squash, mustard, kondol, ampalaya, chayote and radish. They are mostly grown in home and school gardens.

Legume crops.—The Batanes farmers plant legume crops for food, either as green pods or dried seeds, but not as green manures. They are commonly intercropped with corn or grown in gardens in very limited extent. The legumes grown are peanut, peas, Singapore bean, cowpea, mungo, Bountiful bean and other beans. The area planted to these crops in 1960 was about a hectare with a production of 7,523 kilos valued at 771 pesos.

Legumes prefer soils that are slightly acidic to alkaline in reaction. They are not very exacting in soil type requirements provided the soil is well drained.

Banana and other fruits.—Among the fruit crops grown in the province in 1960, banana gave the highest income. In that year, inspite of the many typhoons that passed the province, banana production was about 192,412 kilos valued at 19,267 pesos. Banana is one of the crops most easily affected by typhoon.

The other important fruit trees grown in the province are breadfruit, jackfruit, lanzones, papaya, pummelo, orange, lemon and *kalamansi*. Few fruit trees are grown in the province, thus scarcity of fruits in the locality is felt. The frequent

visits of storms and typhoons are the deterrent factors in the growing of fruit trees in the province. During typhoons, fruit trees are battered badly, tattered and even uprooted. Fruit and other trees totally devoid of leaves and fruits are a common sight in Batanes after a typhoon.

Other crops.—Other crops worth mentioning are *gabi,* arrowroot, ginger, cassava, *galiang,* potatoes, *yautia,* pineapple, black pepper, and ramie.

The area planted to *gabi* in 1960 was 29.1 hectares giving a total production of 58,280 kilos valued at 5,233 pesos. The pineapples grown in Batanes gave indications that the soil and climate of the province are favorable for this crop. The incumbent governor of Batanes in 1957, Honorable Marcos Malupa, was very enthusiastic on the raising of pineapple in a commercial scale. He claimed that an American Firm is interested to engage in the production of this crop in Batanes, particularly in Itbayat.

Black pepper may be grown in the shielded, well drained sinks or depressions in Itbayat. Ramie seems to be suited also in the province. These three crops, pineapple, black pepper and ramie, appear to have bright prospects in Batanes.

AGRICULTURAL PRACTICES AND LAND-USE CHANGES

The *kaingin* method of farming is still prevalent in Batanes. This practice has caused severe erosion in many areas in Batanes. No other improved or modern farm implement is used except a few animal-drawn native plows and harrows. Plowing and harrowing are mostly done up and down the slopes. The agricultural agencies of the government stationed in the province are trying their best to stop these malpractices by introducing modern methods of farming. However, the farmers seem reluctant to follow the advices of agricultural workers. In such a situation it may take years before the people will adopt the scientifically tested and approved farming practices. Crop rotation and crop diversification are practiced by the people not for the conservation of the soil, but to eke out additional supply of food throughout the year. Legumes are not included in the crop rotation set up. The crop rotation pattern, especially in Itbayat, is corn-*ubi* or *tugui*-camote-garlic or onion-sugar cane. The succession lasts for a period of five years after which the fields are fallowed.

Fallowing ranges from five to 10 years. If cogon gains a foot-hold in the fallowed fields ahead of trees, the idle period lasts for 10 years. After 10 years or more the field is re-cleared for planting. If the trees get ahead of the grasses, the fallowing lasts for five years only. In Batan and Sabtang, fallowing is practiced because the farmers have found out that they get higher yields of *ubi* or *tugui* by allowing the field to rest for one or two years than cropping them continuously. Fallowing in Itbayat takes a longer period than in Batan and Sabtang because the farmers of the former have relatively more areas for cultivation than those of the latter two islands.

In 1957, the use of fertilizers, lime and insecticides are not given any attention by the islanders, except by a lucky few who have benefited from the demonstrations performed in their fields by representatives of the agricultural agencies of the government.

Inter-cropping and catch-cropping, such as planting of corn with peanut; corn with mungo; corn with cowpeas; corn with *tugui* or *ubi; ubi* with *gabi; tugui* with *gabi;* camote with *gabi*; camote with pineapple; coconut with camote; coconut with vegetables; and some other combinations, are practiced to a certain extent. These practices are done to increase production per unit area.

Terracing, a practice done by the Igorots for many centuries and by other tribes of the Philippines, is not popular in Batanes. Throughout Batan and Itbayat, one cannot see any terraced field. It is only in some places in Sabtang where some fields are terraced. The use of dikes in ricefields for impounding water, a must in the culture of lowland rice, is not yet well known to the farmers of Batanes in 1957. Green manuring and incorporation of animal manures and plant residues in the soil are not practiced by the farmers. Plant and animal residues are mostly thrown to the sea or burned. The people should make use of these materials instead of wasting them. These materials, if incorporated in the soil, will improve the physical and chemical conditions of the soil as well as contribute to the maintenance of its productivity.

There is neither a government nor a private irrigation system in the province. The creeks are the only source of irrigation water in the province. The supply is rather inadequate. All farms are totally dependent on rain for water.

Land-use changes in the provinces can be gleaned from the following census figures:

Land According to Use	Area (Hectares)		
	1939	1948	1960
Planted to seasonal or temporary crops	1,340.32	1,553.58	1,263.7
Planted to permanent crops	.....	.....	207.8
Permanent Pastures	2,340.07	891.87	1,096.7
Under forest growth	195.45	213.51	649.2
Idle land	1,333.93	1,686.60	1,140.6
Other lands	169.46	202.40	14.9
Total	5,379.27	4,548.96	4,372.9

The total farm area in the province diminishes. Land area planted to seasonal crops has decreased from 1948 to 1960 but the decrease is rather used for permanent crops. The acreage devoted to permanent pastures has increased substantially from 1948 to 1960. Forested areas likewise increased. These increments may be attributed to the revival of the livestock industry after the war and the practice of the farmers to fallow their farms until forest growth is attained.

LIVESTOCK AND POULTRY INDUSTRY

Cattle raising has been the major source of cash of the people before the outbreak of World War II and even up to the present. This industry, like in other provinces of the Philippines, suffered a great setback during the last world war because many of the animals were commandeered and slaughtered by the Japanese Imperial Forces. In spite of the ravages of war, the people were not discouraged. Immediately after the liberation of the Philippines by the American Forces, the people started to rehabilitate the industry from whatever animals that survived the war. The climate condition, relief and vegetative cover of the province have led the people to the raising of animals. Most of the animals raised are the native breeds and some up-graded ones. The Bureau of Animal Industry, however, has established a breeding station in Basco to improve the animal population in the province and the livestock industry as well.

There is no big cattle ranch in the province. Most of the farmers own a few heads of cattle which are usually tethered in their farms. Few farmers have pasture lands. Some of the more enterprising ones grouped themselves and keep their animals in the "common pastures" to graze. The communal pasture lands are found in Ibuhos and Itbayat. Itbayat has

the most number of cattles in the province, followed by Sabtang, Basco, Mahatao, Uyugan and Ivana. Most of these cattles are being exported to Manila.

Carabaos are also raised but mainly as work animals in addition to some bull cattles which are trained for work. Some female carabaos, cows and goats are raised for milking. The number of work animals in Batanes as reported in the Philippines Census of 1960 was 1,162 carabaos and 1,175 cattles. In that year, there were also 88 milking cattles, 32 milking carabaos and 6 milking goats.

Hogs and chickens are raised in backyards by housewives for local consumption and sometimes for export to Manila through the commercial boats that occasionally visit the province. The town of Itbayat ranks first in hog production followed by Basco, Sabtang, Ivana, Mahatao and Uyugan.

The other animals raised in Batanes are horses, sheeps, ducks, geese, turkeys and pigeons.

The number and value of livestock and poultry in Batanes according to the 1960 census figures are as follows:

Livestock and Poultry	*Number*	*Value in Pesos*
Carabao	1,723	280,958
Cattle	8,952	1,631,450
Horse	348	29,943
Hog	4,530	227,632
Sheep	1,262	12,444
Chicken	101	1,241
Duck	18,201	29,581
Goose	70	116
Turkey	19	68
Pigeon	44	237
	100	150

FARM TENURE

Farm tenure refers to the manner in which a farm is held by its operator. In farm tenure classification, the Bureau of the Census and Statistics during the 1960 census year classified farm operators into five categories; namely, (1) full owners, (2) part owners, (3) tenants, (4) farm managers, and (5) farm operators under other conditions. Tenants are further classified as (a) cash tenants, (b) fixed-amount-of-produce tenants, (c) share-of-produce tenants, (d) cash and fixed-amount-of-produce tenants, (e) cash and share-of-produce tenants, and (f) rent-free tenants.

The total number of farms and the total area of these farms by tenure of farm operator in Batanes according to census figures of 1960 are as follows:

Tenure of Farm Operator	*Number of Farms*	*Area of Farms-ha.*
Full owner	1,650	4,158.7
Part owner	51	112.2
Tenant:		
Cash tenant	.....	.....
Fixed-amount-of-produce tenant	.....	.....
Share-of-produce tenant	51	52.2
Cash and fixed-amount-of-produce tenant	.....	.....
Cash and share-of-produce tenant	.....	.....
Rent-free tenant	3	4.5
Other tenants	.....	.....
Manager	.....	.....
Other forms of tenure	6	45.3
Total	1,761	4,372.9

TYPES OF FARMS

The Bureau of the Census and Statistics during the 1960 census year classified farms into 14 types, 10 of which are grouped as crop farms. The 10 crop farms classified which were based on the first 10 major crops in the country are as follows: (1) palay farm, (2) corn farm, (3) sugar cane farm, (4) abaca farm, (5) tobacco farm, (6) vegetable farm, (7) root crop farm, (8) coconut farm, (9) fruit farm, and (10) coffee farm. The relationship between the physical area planted to a particular crop, on one hand, and the cultivated land in the farm, on the other, is taken into primary consideration. A crop farm is typed according to the particular crop which occupies 50 per cent or more of the cultivated part of the farm.

The four other types of farms are: (11) hog farms with 20 or more hogs regardless of area; (12) livestock farms which satisfy any of these conditions, namely, (a) the area is 10 hectares or more with at least 10 heads of any specific kind of livestock and the cultivated area is less than 20 per cent of the total area of the farm, or (b) the area is less than 10 hectares provided there are more than 20 heads of any specific kind of livestock (except hogs) and the cultivated area of the farm is less than 20 per cent of the total area of the farm; (13) poultry farms are farms which do not qualify as crop farms and satisfy any of these conditions, namely (a) there are more than 300 chickens regardless of area, (b) there are more than 100 laying chickens or ducks regardless of area, or (c) there are more than 200 other specific kinds of poultry other than chickens; and (14) other farms which are those that could not be classified under any of the aforementioned thirteen types of farms, grouped as follows: (a) farms planted to palay, corn, coconut, abaca, tobacco, and/or sugar cane without any of them occupying 50 per cent or more of the cultivated land, or (b) farms planted to other miscellaneous crops such as cotton, cacao, kapok, ramie, bamboo, etc., even if one of them occupied 50 per cent or more of the cultivated land.

The total number of farms and the total area of these farms by type of farm in Batanes according to census figures of 1960 are as follows:

Types of Farms	*Number*	*Area in hectare*
Palay	45	80.4
Corn	135	194.4
Sugar cane	6	9.3
Vegetables	30	81.3
Root crops	1,222	2,032.5
Coconut	63	131.4
Fruit	48	57.3
Hog	4	3.4
Livestock	56	1,259.4
Other farms	152	523.5
Total	1,761	4,372.9

The total number of farms and the total area of these farms by size of farm in Batanes according to census figures of 1960 are as follows:

Size of farm-ha.	*Number*	*Area in hectare*
Under 1.0	546	240.9
1 and under 4	995	1,801.0
4 and under 10	169	940.8
10 and under 20	33	424.5
20 and under 50	10	361.9
50 and under 100	6	398.8
100 and under 200	2	205.0
Total	1,761	4,372.9

FARM INVESTMENT

The investment on a farm usually consists of the land, building, farm equipment and work animals. In Batanes, the bulk of the investment is on farm land and building.

According to the 1960 Census of the Philippines, the total farm value of fully-owned farms was ₱3,092,903.00, ₱3,048,343.00 for the land and ₱44,560.00 for the buildings. The estimated average farm value was ₱1,874.00 and the average value of farmland per hectare was ₱733.00.

Farm equipment in the province consist mainly of plows, harrows, carts and sugar cane crushers. The number of these farm equipment as recorded in the Census of the Philippines of 1960, are as follows:

Plows	1,208
Harrows	744
Sugar cane crushers	4
Carts	697

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 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 collectively called the soil profile. The horizons of the profile, as well as the parent material beneath, are studied in detail and the color, structure, porosity, consistency, texture, and the presence 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 group 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) soil complex. Areas of land that have no true soils, such as river beds, coastal beaches, or bare rocky mountain sides 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 materials. It comprises of 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 Mayan series was first found and classified in the vicinity of the town of Mayan, Batanes.

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 soil. For example, Mayan clay loam is a soil type within the Mayan series. The soil type, therefore, has the same general characteristics as the soil series except for the texture of the surface soil. The soil type is the principal mapping unit. Because of its certain specific characteristics it is usually the unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, differing from the soil type only in some minor features, generally external, that may be of special practical significance. Differences in relief, stoniness, and extent or degree of erosion are shown as phases. A minor difference in relief may cause a change in the 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 differ in fertilizer requirement and cultural management from 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 is usually segregated on the map if the area can be delineated.

A soil complex is a soil association composed of such intimate mixture of series, types, or phases in an intricate pattern 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 Faraon, Sabtang, and Uyugan that are mixed together, the complex bears the names of the dominant series, as the case may be. If there is only one dominant constituent, the complex bears the name of that series, as Sabtang or Uyugan complex.

Surface and subsoil samples for chemical and physical analyses 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 such as trails, railroads, bridges, telephone and telegraph lines; barrios, towns, and cities; rivers and lakes; prominent mountains; and many others, found in the area, are indicated on the soil map.

THE SOILS OF BATANES PROVINCE

Eight soil series and five miscellaneous land types are identified in Batanes. The soil series identified are Basco, Mayan, Sabtang, Uyugan, Bolinao, Faraon, Luisiana and Umingan. The first four are the newly established soil series in Batanes and the other four are established in other places of the Philippines. The area and proportionate extent of each soil type, soil phase and miscellaneous land type are shown in Table 4. Their distribution and location are indicated in the soil map accompanying this report.

The soils of the province are grouped, for convenience, into (1) soils of the lowlands (2) soils of the uplands and (3) miscellaneous land types. The soils under each group are as follows:

		Number
A.	Soils of the lowlands:	
	1. Mayan clay loam	684
	2. Umingan loam	322
B.	Soils of the uplands:	
	I. Calcareous soils	
	1. Bolinao clay	153
	2. Bolinao clay loam, deep phase	683
	3. Faraon clay	183

	II. Non-calcareous soils	
	1. Basco loam	688
	2. Basco loam, steep phase	689
	3. Sabtang loam	690
	4. Luisiana clay	239
	5. Uyugan clay loam	685
C.	Miscellaneous Land Types:	
	1. Filled-up soils	29
	2. Beach sand	118
	3. Dune land	594
	4. Rough broken land	326
	5. Rock land	599

TABLE 4.—*Area and proportionate extent of the soils of Batanes Province.*

Soil Mapping Number	Soil Mapping Unit	Area[1] (Hectare)	Per Cent
684	Mayan clay loam	213.47	1.02
322	Umingan loam	443.67	2.12
688	Basco loam	508.55	2.43
689	Basco loam, deep phase	3,053.40	14.59
153	Bolinao clay	613.19	2.93
683	Bolinao clay loam, deep phase	4,951.57	23.66
183	Faraon clay	1,155.23	5.52
239	Luisiana clay	975.24	4.66
690	Sabtang loam	443.67	2.12
685	Uyugan clay loam	3,363.13	16.07
118	Beach sand	382.98	1.83
594	Dune land	73.25	0.35
29	Filled-up soil	83.71	0.40
599	Rock land	3,407.08	16.28
326	Rough broken land	1,259.87	6.02
	TOTAL	20,928.00	100.00

[1] Area was determined with the use of a planimeter.

SOILS OF THE LOWLANDS

This group consists of soils of recent alluvial deposits. They occupy the level to slightly undulating areas sporadically located along the coast of the islands of Sabtang and Batan, and the inland of Itbayat Island. They are young soils with no well developed profile. Under this group are the Mayan clay loam and Umingan loam.

MAYAN SERIES

Mayan series is established in the island of Itbayat, Batanes. It is developed from local alluvium. The relief is level to gently undulating.

The depth of the surface soil ranges from 30 to 40 centimeters. The subsoil is brown to reddish brown clay columnar

to cloddy in structure. It is very plastic and sticky when wet, and hard when dry. It has a moderately slow permeability and its depth ranges from 40 to 60 centimeters from the surface. The substratum is light reddish brown to light yellowish brown, columnar clay. It is plastic and sticky when wet, and hard when dry, non-calcareous and has no coarse skeleton. This layer reaches to a depth of more than 150 centimeters from the surface. The color of this layer indicates that this soil series is moderately well drained.

The areas covered by Mayan series are devoid of their original vegetation. The present vegetation are mostly *cogon, amorseco, talahib, culape, samsamong* and second-growth forest. The crops grown are camote, *ubi, tugui,* garlic, onion, banana, coconut and fruit trees.

Mayan clay loam (684).—Mayan clay loam is the only soil type under the series mapped in the province. It occupies eight small areas mostly on depressions or "sinks". The relief is nearly level to slightly undulating. The total area covered is about 213.47 hectares or 1.02 per cent of the total area of the province.

The typical profile characteristics of the series as represented by Mayan clay loam are as follows:

Depth (cm.)	Characteristics
0 — 40	Surface soil, reddish brown when moist, brown when dry; clay loam; coarse granular to blocky structure; strongly plastic when wet, hard and brittle when dry. Clods are formed when cultivated. No coarse skeleton. Boundary to next layer is diffuse.
40 — 80	Subsoil, brown to reddish brown, clay; columnar to cloddy structure. Very plastic and sticky when wet, hard when dry. No coarse skeleton and non-calcareous. Boundary to next horizon is diffuse.
80 — 150 and below	Substratum, light reddish brown to light yellowish brown, clay columnar in structure; plastic and sticky when wet, hard when dry. Non-calcareous. No coarse skeleton.

Mayan clay loam is well-drained. The water that accumulates on the surface during flash-floods does not stay long. It passes readily through the crevices of the rocks. Some of the areas under this soil type have been converted into ponds by plugging the crevices with soil or mud. Stored water can be used for raising fresh-water fishes and as drinking water of farm animals. The bigger ponds may even be used for boating, a recreation for the people of Itbayat.

Mayan clay loam is one of the best agricultural lands of Batanes. It is relatively rich in plant nutrients and is not subject to erosion. It is good for lowland rice. It is, however, grown to camote, *ubi tugui,* garlic, onion, banana, coconut, vegetables, and fruit trees. Application of animal manures and compost will improve the tilth of the soil as well as its permeability and the effectiveness of chemical fertilizer.

UMINGAN SERIES

This soil series was first established in Umingan, Pangasinan. It is developed from alluvial deposits coming from the surrounding higher areas. Soils of Umingan series occurs on level, nearly level to gently undulating areas.

The color of Umingan soils is light brown, yellowish brown, brown and dark brown. The surface soil ranges in depth from 20–45 centimeters, while that of the subsoil ranges from 50 to more than 100 centimeters from the surface. The lower layer of the subsoil ranging from 55 to 120 centimeters from the surface, consists mostly of water-worn gravels and stones accumulated in varying thickness. This layer of gravels and stones is the distinguishing characteristic of Umingan soils.

The underlying layer is fine to coarse sand.

Umingan loam (322).—Umingan loam is the only soil type under the series mapped in the province. The surface soil is light brown to brown loam; loose, fine granular structure; fair in organic matter content. Root penetration is easy. Normally, no coarse skeleton. Depth is 30 centimeters. Boundary to the next layer is smooth and diffuse.

The subsoil is dark brown, gravelly silt loam. It varies in depth from 30 to 120 centimeters from the surface. It is granular in structure. The lower portion of the subsoil is mostly of gravels and stones accumulation that varies in thickness from a few centimeters to about a meter, the lower boundary ranges from 55 to 120 centimeters from the surface. The gravels and stones have smooth surfaces and edges. The boundary to the next layer is smooth and clear.

The substratum is brown to dark brown fine to coarse sand.

Umingan loam is found in the municipalities of Basco, Mahatao, Ivana and Uyugan, Batan Island and in San Vicente, Savidug, Sumnanga and Nakanmuan, Sabtang Island. The total area covered is about 443.67 hectares or 2.12 per cent of the total area of the province.

The native vegetation of this soil type has been removed a long time ago. The areas occupied by Umingan loam have been under cultivation for so many years. Herbs, brushes and grasses are growing in fallowed areas.

The crops grown are rice, corn, sugar cane, coconut, banana, *tugui, ubi,* tobacco, garlic, onion, fruit trees and vegetables. This soil is productive and can be mechanized. It is easy to cultivate. The drainage is good to very good. It is not subject to erosion, except those along river banks. But it is endangered by occasional flooding. This flooding, however, can be minimized if not totally prevented by the installation of dikes on critical areas.

SOILS OF THE UPLANDS

Soils under this group are developed in place from the underlying materials. The relief varies from gently sloping to hilly. Native vegetation consists of primary forest, second growth forest and grasses. The parent materials are either calcareous or non-calcareous.

A. CALCAREOUS SOILS

These soils are developed from limestone rocks. The calcareous soils found in Batanes are Bolinao and Faraon series. These two soil series differ from each other in color. Bolinao series has reddish brown to red surface and subsoils; while Faraon has black surface soil and dark yellowsh gray subsoil.

The limestone rocks are found in the islands of Itbayat, Ibuhos and Dequey. The entire shore line of Itbayat is of limestone cliff.

BÔLINAO SERIES

Bolinao series is a residual or formed in place soil, developed from porous coralline limestone. The distinguishing characteristics of this soil are the reddish brown to red and compact clay subsoil. One soil type and one soil phase are identified and mapped in the province. These are Bolinao clay and Bolinao clay loam, deep phase.

Bolinao clay (153).—This soil type is found in the islands of Ibuhos and Dequey. The relief is slightly sloping to rolling with a prevailing slope range of 3 to 15 per cent. It occupies a total area of about 613.19 hectares or 2.93 per cent of the total area of the province.

The surface soil ranges in depth from 20 to 35 centimeters in un-eroded areas, but in eroded places it ranges from 10 to 15 centimeters. The texture is clay but has a clay loam feel when there is plenty of organic matter. It is friable when dry and when at optimum moisture content. It is plastic and stick when wet. Plenty of roots are present. Gravels are found in some places.

The subsoil is reddish brown to red clay; plastic and sticky when wet; hard and brittle when dry; and low in organic matter content. Permeability is rather slow. Gravels of coralline limestone are sometimes present.

The upper substratum is reddish brown gritty clay. The grits consist of coralline sand. Plenty of coralline pebbles are present. The lower substratum is highly weathered limestone rocks, underlain with hard rocks.

The areas covered by this soil type are used mainly as communal pastures in 1957. The common grasses found are cogon and *samsamong.* The areas in Ibuhos are over-grazed and over stocked with animals. About 600 heads of cattle are confined in Ibuhos. Scientific pasture management is not observed. Overgrazing in Ibuhos can be avoided if some of the animals are transferred to Dequey Island where only a few heads are raised.

The islands of Ibuhos and Dequey are suited for pastures. However, scientific pasture management should be employed. The areas should be divided into pasture lots. Grazing should be rotated. Fertilizing and reseeding the pasture areas with improved pasture grasses adapted in the locality should be done.

The area can be devoted also to crops such as corn, rice, coconut, banana, camote, *ubi, tugui,* legumes and vegetables sans the typhoons.

Bolinao clay loam, deep phase (683).—This soil phase is found in Itbayat Island. It differs from the Bolinao clay described above in the texture of the surface soil and depth of the solum.

The Bolinao clay loam, deep phase, identified in Batanes Province, has the following profile characteristics:

Depth (cm.)	Characteristics
0 — 30	Surface soil, grayish brown to dark brown when dry, reddish brown when moist, clay loam, granular structure; plastic when wet, friable at optimum moisture and when dry; fair organic matter content. No coarse skeleton. Boundary to next horizon is diffuse.
30 — 60	Upper subsoil, dark brown to reddish brown when dry, red when moist, clay, coarse granular to blocky structure; plastic when wet, hard when dry. Slow permeability. No coarse skeleton. Boundary to lower layer is diffuse.
60 — 100	Lower subsoil, light brown to yellowish brown, clay, columnar structure; plastic when moist, hard and brittle when dry. Boundary to lower layer is diffuse.
100 — 300	Substratum, pale reddish brown to yellowish brown clay with scattered yellowish white spots. Slightly compact, and blocky structure. Plastic when moist, hard and brittle when dry. Slow permeability. Some coarse skeletons are present. Underlain with massive coralline limestone.

The relief ranges from gently sloping, moderately sloping, strongly sloping to hilly. The most prevalent slope range is from 5 to 25 per cent. The summits of the hills are with limestone outcrops.

Bolinao clay loam, deep phase is well drained. It is devoid of its native vegetation. It is cultivated by *kaingin* system for about 300 years. The crops grown are camote, *ubi, tugui, gabi,* rice, corn, sugar cane, pineapple, tobacco, garlic, onion, coconut, vegetable, and fruit trees. Cogon, *samsamong, talahib, pandan,* shrubs, and secondary forest trees are found growing in the uncultivated areas.

Bolinao clay loam, deep phase is the most extensive soil in Batanes, particularly in Itbayat. It has a total area of about 4,951.57 hectares or 23.66 per cent of the total area of the province.

The soil is deep and relatively fertile. It responds well to good soil management. It is suited for the growing of crops and for the raising of animals. The crops grown are doing well and the pasture grasses like cogon and *samsamong,* are also growing luxuriantly. Nevertheless, it would be wise to reseed the pastures with improved pasture grasses adaptable to the locality and to observe crop rotation and rotation grazing.

It is noted that the soil and climate of the locality is favorable to the raising of livestocks. Establishment of this industry, no doubt, will greatly bolster the deplorable economic condition of the province, especially of Itbayat.

FARAON SERIES

This soil series was first established in the province of Negros Occidental. It is a residual soil from coralline limestone like that of Bolinao series. The main difference between the two series is their color. The soil of Faraon is black while that of Bolinao is reddish brown to red. The relief of Faraon series is rolling to hilly.

The Faraon clay, is the only soil type under the Faraon series identified and mapped in the province.

Faraon clay (132).—This soil type was identified and mapped in the southern parts of the islands of Batan and Itbayat, and in the eastern coast of Sabtang Island. It has a rolling relief. The prevalent slope range is 8 to 25 per cent. Like any other soils developed from limestone, it is marked by the presence of numerous limestone outcrops. It is well-drained. It covers a total area of about 1,155.23 hectares or 5.52 per cent of the total area of the province.

The surface soil is clay but with a clay loam feel due to high organic matter content. The soil has been under grass for more than two hundred (200) years disturbed only by patch cultivation for the growing of seasonal crops, like rice, corn, beans, *ubi,* camote, *tugui* and tomato. It was noted during the survey that the rice plants were not doing well. This soil type is best suited for pasture.

The typical profile characteristics of Faraon clay, as found in the province, are as follows:

Depth (cm.)	Characteristics
0 — 20	Surface soil, grayish black clay, medium granular structure; friable at optimum moisture, plastic when wet, and brittle when dry. Fair in organic matter content. At times, limestone outcrops are found on the surface. Boundary to the subsoil is abrupt and smooth.
20 — 40	Subsoil, dark yellowish gray clay, coarse granular structure; plastic when wet, hard when dry; mixed with partially weathered limestone rock fragments. Boundary to the next layer is clear and smooth.
40 — 70	Substratum, yellowish gray, highly weathered limestone rocks. Underlain with hard and massive coralline limestone rocks.

B. NON-CALCAREOUS SOILS

Soils of this group were developed from rocks other than limestone. These are igneous and sedimentary rocks, the

igneous rocks are andesite and the sedimentary rocks are agglomerates and detritus derived from igneous rocks.

The soil series identified in Batanes that fall under the non-calcareous soils group are Basco, Sabtang, Luisiana and Uyugan series.

BASCO SERIES

Basco series is a new series identified and established in the town of Basco at Batan Island, Batanes Province. It is a residual soil derived from sedimentary rocks (shale, sand and volcanic cinders). This soil series is distinguished from the others by its stratified substratum. It is found in an elevation of about 50 to 1,500 feet above sea level. The relief ranges from nearly level, gently rolling, rolling, hilly to mountainous.

One soil type and a soil phase under this soil series are mapped in the province. They are Basco loam and Basco loam, steep phase.

Basco loam (688).—This soil type is found in the town of Basco at Batan Island. It covers a total area of about 508.55 hectares or 2.43 per cent of the total area of the province. The area delineated as Basco loam includes some small areas having silt loam, gravelly sandy loam surface soil which cannot be mapped separately because of the limitation of the scale used in the mapping of the soil. The silt loam areas are found in the low-lying portion and the gravelly sandy loam are on the eroded areas. Basco loam occurs at an elevation of 50 to 200 feet above sea level. The relief is nearly level to slightly sloping.

The surface soil is loam, granular structure, loose, friable loam with fair organic matter content. The depth ranges from 20 to 30 centimeters.

The upper subsoil is lighter in color than the plow layer, loam to silt loam, granular structure, loose and friable. Downward movement of fine soil particles from the plow layer to this layer is clearly evident. The depth ranges from 35 to 45 centimeters. It is poor in organic matter content. Some gravels are present.

The lower subsoil is gravelly sandy loam, loose, friable; moderate in permeability. Some of the gravels are of volcanic cinders. Some roots penetrate this horizon. It is fair in

organic matter content. Its depth ranges from 60 to 65 centimeters. The boundary to the next layer is clear and wavy.

The fourth horizon is similar to the second layer as to thickness and appearance. Their diffferences are in color and amount of fine materials. The second layer is darker in color and has more fine materials than the fourth.

The characteristics of the fifth layer is similar to the third layer, and the sixth layer is similar to the fourth horizon. It is fine sandy loam with some narrow bands of sand.

The fourth, fifth, sixth and seventh layers make-up the substratum.

The typical profile characteristics of Basco loam, found in the vicinity of Kilometer Post No. 2 between Basco and Contracosta, are as follows:

Depth (cm.)	Characteristics
0– 30	Surface soil, very dark gray to almost black, loam, loose friable, granular structure, with few gravels. Fair amount of organic matter is present. Some gravels are exposed on the surface in eroded areas. Boundary to next layer is diffuse and wavy.
30– 45	Upper subsoil, gray to light grayish brown, loam to silt loam, granular structure, loose, friable, with some gravels. Plenty of roots are present. Moderate amount of organic matter is present. Boundary to next layer is clear and wavy.
45– 65	Lower subsoil, yellowish brown to grayish brown gravelly sandy loam. Some of the gravels are of volcanic cinders. Fair amount of root and organic matter are present. Boundary to next layer is clear and wavy.
65– 85	Yellowish brown fine sandy loam with few gravels. No volcanic cinders. Some roots penetrate this layer. Boundary to next layer is diffuse.
85–100	Light brown to gray, gravelly sandy loam. Some of the gravels are of volcanic cinders. Boundary to next layer is clear and wavy.
100–130	Grayish brown to grayish black sandy loam, loose, and friable; with few gravels. Boundary to next layer is clear and wavy.
130–200	Dark gray to very dark gray, highly weathered shale which when kneaded gives a fine sandy clay loam texture. The underlying layers are stratified alternating layers of compact sand and gravelly sandy loam. The gravelly layers are thinner than the sand layers.

Basco loam is the most intensively cultivated soil in Batan. It has been under cultivation since the time of the Spanish regime or about 400 years ago. It is easy to work on. The gently undulating to rolling areas can be mechanized. It is grown to camote, *tugui, ubi,* sugar cane, corn, rice, fruit trees, and vegetables. *Palomaria* trees are grown in-between the field lots, indicating the boundary lines of individual ownership. These lines of trees appear like giant dikes when viewed in an airplane.

Basco loam, steep phase (689.)—Basco loam, steep phase occurs on areas having an elevation of 200 to 1,500 feet above sea level. The relief of the land ranges from rolling, hilly to mountainous. This soil phase is very similar to Basco loam in all respect except for its topography. It occupies a total area of about 3,053.40 hectares or 14.59 per cent of the total area of the province.

Owing to its relief, Basco loam, steep phase should not be cultivated for seasonal crops, but due to shortage of good agricultural lands in the province it has been used intensively for the growing of such crops. However, some areas are being utilized for grazing of animals. The crops grown are camote, *ubi tugui,* rice, garlic, onions and vegetables.

Basco loam, steep phase is best suited for forest or for growing permanent crops. Nevertheless, areas where the slopes of the land are less than 30 per cent may be utilized for the growing of camote, *ubi* and *tugui* since their vines can provide a thick canopy that will protect the soil from erosion. It will be better if terraces and other appropriate soil conservation measures could be employed for the protection of the soil from erosion. Areas having more than 30 per cent slope should be used for either growing permanent crops or forest trees or for pasture.

SABTANG SERIES

Sabtang series is another new soil series established in Sabtang Island. It is a residual soil derived from agglomerates—rocks made up of angular gravels, cobbles and stones cemented together by a binding material. This is found on a plateau southwest of San Vicente town proper. The relief is gently rolling. This soil series seems the oldest soil in the province. Only one soil type is found in Batanes.

Sabtang loam (690).—This is the only soil type mapped under the series in Batanes. It is found in one place only and in limited extent. It is bounded on the eastern side by a sharp escarpment of agglomerate, on the west by a straight-lined cliffs, and on the north and south by steep hills. The predominating slope range of this soil type is 3 to 15 per cent. The total area covered is about 443.67 hectares or 2.12 per cent of the total area of the province.

The typical profile characteristics of Sabtang loam are as follows:

Depth (cm.)	Characteristics
0– 40	Surface soil, very dark gray to almost black when moist; dark gray to very dark gray when dry; loam, loose, friable, and granular structure. No coarse skeleton. Boundary to subsoil is diffuse and wavy.
40– 90	Subsoil, reddish brown to dark brown when moist, light brown to brown when dry, sandy clay loam, plastic when wet, friable at optimum moisture, hard and brittle when dry; coarse granular to blocky structure. Boundary to lower layer is diffuse and wavy.
90–200	Substratum, light brown sandy loam, loose, friable and coarse granular structure, underlain by highly weathered agglomerates.

Sabtang loam has been under cultivation for more than 300 years. The crops grown are camote, *tugui, ubi,* beans, upland rice, corn, and vegetables. The fallowed areas are covered with shrubs, *talahib, cogon,* and other grasses.

LUISIANA SERIES

Luisiana series is a residual soil derived from igneous rocks. It is an upland soil with rolling to hilly, and mountainous relief. This soil series is characterized by its red color and deep soil, which usually reaches to a depth of more than two meters without any coarse skeleton within the entire profile. This soil series is differentiated from Guimbalaon, Antipolo, and Alaminos soils by its dark red color; very deep solum; absence of coarse skeleton in the profile; and the gradual change of color from the surface down to the substratum.

Luisiana clay (239.—This is the only soil type mapped under Luisiana series in Batanes Province. The surface soil is dark brown to reddish brown, clay. The clay loam feel is due to the presence of organic matter. It is fine to coarse granular

in structure, loose and friable at optimum moisture. The depth ranges from 20 to 30 centimeters. Boundary to the next layer is diffuse and smooth.

The subsoil is dark reddish brown to red clay, medium to coarse granular in structure. It is slightly compact, sticky and plastic when wet, hard and brittle when dry; poor in organic matter content. The depth ranges from 30 to more than 100 centimeters from the surface. No coarse skeleton. Boundary to next layer is diffuse and smooth.

The substratum is yellowish red to red clay, medium to coarse granular in structure slightly compact and hard when dry. Yellowish red splotches are produced when the soil material is cut with a spade at dry condition. Depth is from 100 to 300 centimeters from the surface.

Luisiana clay occupies Mount Sta. Rosa and Mount Ripose. The relief is rolling and steep to hilly. Runoff in the cultivated and overgrazed areas is excessive. Newly formed gullies can be seen on the summit of Mount Sta. Rosa and Mount Ripose. Small level areas are found between hills. These areas are poorly drained. Water collects in these areas.

Luisiana clay covers a total area of about 975.24 hectares or 4.66 per cent of the total area of the province. About one-half of the area is planted to camote, *tugui, ubi, corn, rice,* and vegetables. The other half is used as pasture. The grasses are mostly *samsamong* and *cogon.*

Generally, Luisiana clay is not suited for the cultivation of seasonal or annual crops because of it steep slope. Relatively, only a small portion is suitable for growing seasonal crops. The method of farming employed contributes to soil erosion in the area thereby decreases yield of crops, too.

It is recommended that the area be planted to forest trees, or permanent crops or pasture rather than utilize it for the growing of seasonal crops. However, areas with slopes of not more than 25 per cent may be devoted to seasonal crops provided a combination of two or more of the soil conservation measures namely, contour farming, strip cropping, terracing, cover cropping and green manuring are employed.

UYUGAN SERIES

Uyugan series is a new soil series found and identified in the town of Uyugan, Batan Island. It is a residual soil developed from weathered agglomerates. It occurs on upland with

rolling, hilly and mountainous relief. It is a moderately deep soil.

Uyugan series has similar parent material, relief and vegetation as those of Sabtang series. Their differences are in the color of the surface soil, depth and presence of coarse skeleton in the solum. Uyugan series has reddish brown to brown surface soil, slightly shallower solum and contains weathered fragments in the lower layers. While Sabtang series has dark gray to almost black surface soil, deeper solum and no coarse skeleton.

This series is found in two places, Batan and Sabtang Islands, Batanes. The elevation of these two places ranges from 500 to 1,500 feet above sea level. Runoff is excessive, especially in cultivated and overgrazed areas. Permeability is moderately slow.

Uyugan clay loam (685).—It is the only soil type mapped under this series.

The typical profile characteristics of the series as represented by Uyugan clay loam are as follows:

Depth (cm.)	Characteristics
0– 30	Surface soil, reddish brown to brown clay loam, coarse granular to blocky structure, plastic when wet, hard and brittle when dry. No coarse skeleton. Boundary to next layer is diffuse.
30– 60	Upper subsoil, reddish brown to dark reddish brown clay, columnar to blocky structure, plastic when wet, hard and brittle when dry. No coarse skeleton. Boundary to lower layer is diffuse and wavy.
60– 80	Lower subsoil, light yellowish brown to brown heavy clay, blocky structure, plastic when wet, hard and brittle when dry. Some fragments of very highly weathered agglomerates are sporadically embedded. Fragments can be easily cut and crushed with a spade.
80–150	Substratum, variegated reddish gray, highly weathered agglomerates. Weathered material can be readily cut and crushed with a spade.

Uugan clay loam has rolling to hilly and mountainous relief. The slope ranges from 15 to 100 per cent. It is excessively drained. The cultivated and overgrazed areas are seriously eroded. Gullies are common on this soil type.

Uyugan clay loam covers a total area of about 3,363.13 hectares or about 16.07 per cent of the total area of the province. Almost one fourth of the area is under cultivation. The crops grown are camote, *tugui, ubi,* corn, rice, and vegetables. The rest of the area are idle and under grass or *parang* type of vegetation. The common grasses are *samsamong* and *cogon.* These are used as pastures.

The main problem on Uyugan clay loam is accelerated erosion. The steep slopes do not warrant the growing of seasonal crops. This soil type is best suited for forest or pasture. The areas that are good for pasture should be developed as such by planting improved pasture grasses adapted in the locality. Rotation grazing and other good pasture management should be observed.

The rest of the areas not suited for pasture should be planted to permanent crops and forest trees.

MISCELLANEOUS LAND TYPES

Miscellaneous land types include areas that have little or no natural soil at all; areas that are inaccessible for orderly examination, or where for other reasons, it is not feasible to classify the soils of the area; rough broken lands; and man-made lands. The miscellaneous land types are classified primarily in terms of land form and secondarily in terms of material that compose the land type.

The miscellaneous land types mapped in Batanes are filled-up soils, beach sand, dune land, rough broken land and rock land.

Filled-up soils (29).—Filled-up soils or man-made land is an area that is artificially filled with trashes, stones, gravels, boulders, and/or earth-filling materials. This type of land is found in the vicinity of Basco. It covers an area of about 83.71 hectares or 0.40 per cent of the total area of the province. A big portion of it is being used as an airport of the Philippine Air Lines (PAL). The airport has been in use before the outbreak of World War II up to the present. It was expanded and improved by the Japanese Imperial Forces during the war.

Beach sand (118).—As the name implies; beach sand is sand deposited along the shores. This land type is found in small patches in the islands of Batan, Sabtang and Ibuhos. The aggregate area covered is 382.98 hectares or 1.83 per cent of the total area of the province. The vegetation found are runner grass and vines. No crop is grown in this land type.

This miscellaneous land type is adapted to coconut, however, the growing of such crop is not feasible in Batanes as the areas are exposed to frequent typhoons. It is advisable to utilize this land type for the growing of either maguey or *pandan,* the leaves of which are raw materials for mat weaving.

Dune land (594).—Dune land or sand dune is a land mass consisting of shifting sand. It is found in ridges formed by the blowing action of the wind. The shifting is favored by dry weather and strong currents of wind.

This land type is found in two places in the province—one in the east-central coastline of Sabtang Island and the other in the east side of Ibuhos Island. It has an aggregate area of about 73.25 hectares or 0.35 per cent of the area of Batanes. It has no agricultural value. Only a few camote are grown on this land type during the rainy season.

Rough broken land (326).—This land type occurs on very steep land broken by numerous drainage channels. It is found in Mount Mataram and Mount Iraya—the highest areas in Batanes. Both mountains are located in the island of Batan. The aggregate area of this land type is about 1,259.87 hectares or 6.02 per cent of the province. The two areas are covered with primary forest and grasses. The trees are logged for local consumption. The grasslands are used for grazing animals.

Rock land (599).—This miscellaneous land type consists of areas having frequent rock outcrops and very shallow soils. The rock outcrops usually occupy 25 to 90 per cent of the area. The rock land in the province has 40 per cent rock outcrops.

This land type is found in almost all the islands of Batanes Province. San Diego Island is entirely a rock land. Itbayat Island is fringed by this land type. It is also scattered in several places in the islands—six in Batan Island, four in Sabtang Island, two in Ibuhos Island and one in Dequey Island. The aggregate area covered is about 3,407.08 hectares or 16.28 per cent of the total area of the province.

TABLE 5.—*Key to soils of Batanes Province and their respective vegetative cover and/or present use.*

Soil Mapping Number	Soil Mapping Unit	Parent Material	Relief	Drainage: External	Drainage: Internal	Present Use/Vegetation
684	Mayan clay loam	Alluvium	Level, nearly level to gently undulating.	Good	Fair	Camote, *tugui*, *ubi*, garlic, onion, banana, coconut, vegetables, fruit trees; *cogon*, *talahib*, *cuape*, *samsamong* and secondary forest.
322	Umingan loam					Camote, *tugui*, *ubi*, garlic, onion, banana; grasses, shrubs and brushes.
153	Bolinao clay	Coralline limestone	Slightly sloping to rolling and hilly.		Poor	Pasture grasses.
683	Bolinao clay loam, deep phase					Camote, *tugui*, *ubi*, *gabi*, corn, upland rice, sugar cane, garlic, onion, pineapple, coconut, fruit trees, vegetables; grasses, *pandan*, shrubs, second growth forest
132	Faraon clay		Rolling to hilly	Free to rapid.	Fair	Camote, *tugui*, *ubi*, corn, beans and tomatoes.
688	Basco loam	Shale, sand and volcanic cinders	Nearly level to slightly sloping.		Good	Camote, *tugui*, *ubi*, sugar cane, corn, upland rice, vegetables, fruit trees; *Palomaria.*
689	Basco loam, steep phase		Rolling, hilly and mountainous			Camote, *tugui*, *ubi*, upland rice, onion, garlic, vegetables; pastures
690	Sabtang loam	Agglomerates	Gently rolling	Free	Fair	Camote, *tugui*, *ubi*, corn, upland rice, beans, vegetables; *talahib*, *cogon*, shrubs and other grasses.
239	Luisiana clay	Igneous rocks	Rolling, hilly and mountainous	Excessive	Poor	Camote, *tugui*, *ubi*, corn, upland rice, vegetables, grasses.
685	Uyugan clay loam	Agglomerates				Camote, *tugui*, *ubi*, upland rice, corn, vegetables; grasses; idle land.
[illegible]	Beach sand	Sand deposits	Nearly level	Excellent	Excellent	Idle land; runner grasses and vines
[illegible]	Dune land		Undulating to slightly rolling			Idle land.
[illegible]	Filled-up soils		Level to nearly level	Good	Fair	Airport (PAL)
[illegible]	Rough broken land		Steep and rough	Excessive	Poor	Forest and grasses.
[illegible]	Rock land					Scrubs and grasses.

The areas are sparsely covered with vegetation mostly scrubs and grass. The growth of the grass is very light and thin. The areas are good for wildlife only.

LAND-USE AND SOIL MANAGEMENT

The term "land-use" refers to the general use of the land such as (1) crop land, (2) permanent pasture, and (3) forest. On the other hand, soil management refers to the operations done on the farms such as (1) methods of tillage, (2) choice and rotation of crops, (3) application of soil improving materials like fertilizers, farm manures, organic matter and other soil amendments, and (4) control of erosion and runoff. The primary purpose of good soil management is to promote the optimum condition of the soil for the growth of plants and to protect the soil from wastage as well. It is always the aim of good soil managers to maintain the soil fertility, good tilth, capacity to hold enough water that will not cause waterlogging and to minimize soil erosion.

Farm practices in Batanes Province have not changed much since the turn of the century. Antiquated farm practices handed down from their forefathers are still in use. *Kaingin* system of farming or shifting cultivation is found everywhere in Batanes. This system of farming has promoted denudation of the native vegetative cover as well as soil erosion in the province. The farmers cultivate the sloping lands and steep hills, using the *kaingin* method. The cultivation of the steep hills can be attributed to the limited area of good arable lands in the province. Most of the areas under the upland soils such as Bolinao clay loam, deep phase; Basco loam, steep phase; Luisiana clay and Uyugan clay loam are not suited for the cultivation of seasonal crops. They are best suited to permanent vegetation or pasture and forest. During the survey, it was noticed that most of the arable lands are under continuous cultivation, except for a few areas that are allowed to fallow. The plant nutrients in the soil are not replaced through the use of fertilizer and farm manures or farm refuse. Good farm management practices are wanting.

The need to change from the present land-use and farming method and practices to the scientific way must be given serious consideration. Land-use, good soil management and control of runoff on the land need a lot of special attention, not only from the side of the farmers but also from the government.

Generally, the existing farm practices cannot give satisfactory income for the labor expended nor maintain the productivity of the soil. The *kaingin* system of farming should be discouraged or stopped to prevent further deterioration of the land. The farmers should be made to understand that their present methods of farming are very detrimental to their lands as well as to their economy.

The soils of the plains and valleys like Mayan clay loam and Umingan loam are suited for intensive cultivation with easily applied conservation measures and good farm practices. The farm practices that may be employed are crop rotation with legumes as one of the crops, green manuring and application of farm manures and fertilizers.

The soils of the rolling and steep hills should be devoted to permanent crops like fruit trees. These crops should be planted along the contour. Areas suited for pasture should be seeded to improved grasses adapted in the locality. Application of fertilizers and organic matter is suggested to encourage the growth of the grasses. Limited and controlled grazing should be observed in such pasture lands.

Areas of the upland soils that are suited for cultivation should be managed with the employment of a number or a combination of suitable soil conservation measures, such as contour tillage, strip cropping, contour furrowing, cover cropping, green manuring, terracing with suitable grassed waterways, and application of fertilizers and organic matter or farm manures. Legumes such as mungo, soybean, peanut, etc., in rotation with the main crops should be grown.

WATER CONTROL ON THE LAND

Control of water on the land is one of the phases in soil management, as water is one of the limiting factors in crop production. The success or failure of crops is oftentimes dependent upon water supply. Excess or absence of moisture in the soil is detrimental to the normal growth of plants. Excessive runoff on bare sloping lands leads to the destruction of the soil through erosion unless its volume and velocity are checked. Furthermore, excessive runoff may destroy crops and fields of the plains or may cause floods that might wash away banks of streams during rainy days.

Low yield of crops can be traced to erosion as a result of runoff. Unchecked runoff is a loss of water which might be otherwise useful to plants. Aside from this loss, the surface soil together with its plant nutrients may be lost through excessive runoff.

To check runoff as well as erosion, the bare steep lands should be planted to permanent vegetation such as forest trees or grasses. Excess rain water should lead to grassed waterways, be impounded in small ponds where possible, for source of irrigation water in the fields and for use of the domestic and work animals.

Where grass is grown for pastures, controlled and rotation grazing should be maintained.

Upland soils suited for cultivation should be managed to include conservation measures such as terracing, contour tillage, contour planting, cover cropping, strip cropping, grassed waterways, incorporation of organic matter in the soil and the like. Maintenance of the high fertility of the soil by the incorporation of fertilizers, farm manures or organic matter will encourage vigorous growth of plants, thus a good canopy that will protect the soil from the impact of raindrops is created.

PRODUCTIVITY RATINGS OF THE SOILS OF BATANES

The productivity of a soil is its capability to produce a specified crop or sequence of crops under a specified system of management. In this report, soil productivity rating is based on the average crop yield of a soil type in relation to national standards established. The yield being obtained without the use of fertilizer or soil amendments. Yield predictions are arrived at in two principal ways; namely: (1) through judgments based upon evidence afforded by actual yield data from sample areas of the soil mapping units, and (2) through judgments based on comparisons of the characteristics of soils and basic knowledge of plant requirements.

Table 6 indicates the productivity ratings of the soils of Batanes for the major crops grown in the province. The productivity ratings were developed mainly from estimates based upon observations and interviews with the farmers supplemented by a few records and census data, thus the relia-

TABLE 6.—*Productivity ratings of the major soil types of Batanes Province.*

Soil Types	Crop Productivity Index for[1]									
	Upland rice 100=20 cavans	Corn 100=17 cavans	*Ubi* 100=14 tons	Camote 100=8 tons	Sugar cane 100=80 piculs	*Tugui* 100=6 tons	Coconut 100=3,750 nuts	Tobacco 100=1,475 kilos	Cabbage 100=2,500 kilos	Garlic 100=3,000 kilos
Bolinao clay	60	70	60	70	60	60	60	50	70	70
Dampigan loam	80	80	90	90	70	90	80	70	70	70
Ladiana clay	60	70	60	70	60	60	60	70	70	70
Fungon clay	45	70	60	60	60	60	60	50	70	70
Bolinao clay loam, deep phase	80	80	90	90	80	90	70	50	60	60
Marañ clay loam	80	80	80	80	80	80	80	80	80	90
Uyugan clay loam	70	70	70	75	70	75	70	70	70	90
Basco loam	80	80	90	90	80	90	80	70	70	70
Basco loam, steep phase	80	70	80	80	60	70	70	70	70	70
Sabtang loam	70	70	80	80	60	80	60	70	70	70

[1] The soils of Batanes are given indexes that give the approximate average production of each crop, in per cent, as the standard of reference. The standard represents the approximate yield obtained without the use of fertilizer or amendments on the extensive and better soil types of the Philippines in which the crop is most widely grown.

bility may be only considered fair. The soil productivity rating or index for a given crop is expressed in terms of a standard index of 100. Thus, a productivity rating of 75 for a certain crop means that a soil is about three-fourth as productive in relation to the national standard, or in terms of production the soil could produce 15 cavans of palay of upland rice wherein the national standard is 20 cavans of palay.

TEXTURAL CLASSES OF THE SOILS OF BATANES

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 in 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.

MECHANICAL ANALYSIS

Accuracy in the determination of textural classes of soils delineated during the soil survey is attained through mechanical analysis. Generally, field classifications coincide with the results of the mechanical analyses. However, there are instances when field classification and laboratory classification vary. Some soils exhibit clayey textures in the field. They are sticky and plastic when wet, hard or brittle when dry, but actually when analyzed their clay contents are low. Under these circumstances, the field classifications are maintained except when their clay contents are so low that their final textural classifications are those established by the laboratory.

The soil separates are sand, silt, and clay. Sand includes particles from 2.0 millimeters to 0.05 millimeter in diameter; silt from 0.05 to 0.002 millimeter; and clay, particles smaller than 0.002 millimeter in diameter.[1] Particles larger than 2.0

[1] Previous to 1938, the United States Department of Agriculture used the 0.05 to 0.005 millimeter for the size of silt and smaller than 0.005 millimeter for clay.

millimeters such as gravels, pebbles, and cobbles are considered coarse skeleton. Class names such as sand, silt, silt loam, clay loam, clay, sandy loam, etc., are determined by the proportionate amount of the different separates present in the soil. A soil with an analysis of 30 per cent or more of clay fraction is considered a clay soil. Lately, however, this percentage was changed to 40, so that all soils containing 40 per cent or more of clay are classified as clay soils.

The modified Bouyoucos method was employed in the mechanical analysis wherein the conventional jar, hydrometer, and thermometer were used. Analysis was made without removing the organic matter from the soil.

TABLE 7.—*Mechanical analysis of important soil types in Batanes using the Bouyoucos method.*

Soil Mapping No.	Soil type and/or soil phase	Sand Per cent	Silt Per cent	Clay Per cent
684	Mayan clay loam	25.3	35.3	39.4
322	Umingan loam	32.8	40.6	26.6
153	Bolinao clay	29.8	22.2	48.0
683	Bolinao clay loam, deep phase	27.6	33.2	39.2
132	Faraon clay	25.5	32.3	42.2
688	Basco loam	42.3	32.2	25.5
689	Basco loam, steep phase	44.8	31.1	24.1
239	Luisiana clay	27.2	31.7	41.1
690	Sabtang loam	40.3	41.4	18.3
685	Uyugan clay loam	28.6	32.6	38.8

LAND CAPABILITY CLASSIFICATION AND CONSERVATION GUIDE FOR THE SOILS OF BATANES

Land capability classification is a scheme of grouping soil types for their proper utilization. Utilization, from the standpoint of agricultural as well as economic capabilities implies any of or a combination of four general purposes, namely: (1) cropland, (2) pasture land, (3) forest land, and (4) land for wildlife or recreation. For cropping purposes the crops or set of crops are usually specified and the corresponding necessary soil management practices together with the supporting soil conservation measures are given.

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 consideration of a given soil type, its physical and chemical properties, both of which consist of inherent and acquired characteristics, are fully

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evaluated in the field and in the laboratory. Land capability classes are further subdivided into subclasses by taking into account the different soil problems. In the Philippines, the three major problems on soils are (a) erosion and runoff, (b) wetness and drainage, (3) root zone and tillage limitations, such as shallowness, stoniness, droughtiness salinity or alkalinity. The subclasses are indicated by "e" for erosion and runoff; by "w" for wetness and drainage; and by "s" for root zone and tillage limitations.

The different land capability classes are as follows:

CLASS A ....Very good land; can be cultivated safely; requires only simple but good farm management practices.

CLASS B ....Good land; can be cultivated safely; requires easily applied conservation practices.

CLASS C ....Moderately good land; must be cultivated with caution; requires careful management and intensive conservation practices.

CLASS D ....Fairly good land; must be cultivated with extra caution; requires careful management and complex conservation practices. This land is good for limited cultivation only and best suited for permanent crops.

CLASS L ....Level to nearly level land; too stony or very wet for cultivation. Suited to pasture or forest with good soil management.

CLASS M ..Steep, very severely to excessively eroded or shallow for cultivation. Suited to pasture or forest with careful management.

CLASS N ....Very steep, excessively eroded, shallow, rough, or dry for cultivation. Suited to pasture with very careful management and definite restrictions. Best suited to forest with very careful management.

CLASS X ....Level land, wet most of the time, cannot be economically drained. Suited for farm ponds or for recreation.

CLASS Y ....Very hilly and mountainous; barren and rugged; should be reserved for recreation and wildlife.

LAND CAPABILITY CLASS B, SUBCLASS Bw

Nearly level, occurs in depressions. Occasional overflow is the problem. Requires protection from overflow. Observe easily applied conservation practices.

Mayan clay loam
Umingan loam

Subclass Bw land is nearly level and occurs in depressions near large streams or on low bottom lands. Included under this subclass are wet lands that can be easily drained and those with a high water table. The soil is deep; the subsoil is heavy.

Poor external and internal drainage require some means to drain the excess water. Furthermore the area is subjected to occasional overflow.

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

Protection from occasional overflow of nearby streams maybe needed. Diversion ditches should be constructed for runoff coming from adjoining uplands. When drained and cultivated, lime and the right kind and quantity of fertilizer should be applied. The planting of soil-improving crops and the use of farm manure and compost must be observed.

TABLE 8.—*Land capability classification of the different soils and miscellaneous land types of Batanes.*

Soil Mapping Number	Soil/Miscellaneous Land Type	Possible Soil Unit[1] (Slope-erosion Class)	Land Capability Class/ Subclass
684	Mayan clay loam	a–0	Bw
322	Umingan loam		
688	Basco loam	b–1	Be
683	Bolinao clay loam, steep phase	b–2	
153	Bolinao clay	b–3	Ce
690	Sabtang loam	c–2	
132	Faraon clay	d–2	De
689	Basco loam, steep phase	e–3	M
239	Luisiana clay		N
685	Uyugan clay loam	f–3	
118	Beach sand		Ds
594	Dune land		Y
29	Filled-up soils		
599	Rock land		
326	Rough broken land		

[1] The slope-erosion units are the possible conditions that may exist in each type. Any other unit with a slope or an erosion greater than the one indicated above will accordingly be classified under a lower capability class or subclass.

LAND CAPABILITY CLASS B, SUBCLASS Be

Nearly level to gently sloping, slightly to moderately eroded. Erosion is the main problem. Observe erosion control measures and easily applied conservation practices.

Bolinao clay loam, deep phase
Basco loam
Sabtang loam

Subclass Be is nearly level to gently sloping land and is slightly to moderately eroded. It is deep with rather heavy subsoil.

The slope, which in any place is not more than 8 per cent makes the soil susceptible to moderate erosion.

Crops adapted to the area grown on soils of this subclass respond to good management. However, erosion control measures such as contour plowing, terracing, and strip cropping should be practiced. Excess water on the area and runoff from the adjoining uplands must be channeled into grassed waterways or diversion ditches.

In addition to erosion control measures, the proper kind and quantity of fertilizer and lime should be applied. Crop rotation should be observed wherein a legume is included in the sequence at least once in every three or four years for soil building purposes. For all legumes, the soil should be well supplied with lime and a phospate-carrying fertilizer; if the soil does not contain the right kind of bacteria it should be inoculated accordingly. The use of farm manure or compost is recommended.

Land Capability Class C, Subclass Ce

Moderately sloping, moderately to severely eroded. Erosion and fertility are the main problems. Observe erosion control measures, careful management and intensive conservation practices.

Bolinao clay
Bolinao clay loam, deep phase
Basco loam
Sabtang loam
Faraon clay

Subclass Ce land is moderately sloping and is moderately to severely eroded. Its effective depth may extend to 90 centimeters or more.

The slope which ranges from 8 to 15 per cent accelerates erosion. In turn erosion depletes fertility.

Primarily, for the this subclass, a good cropping system should be planned. The crops grown and tillage methods affect soil conditions, and consequently runoff and soil erosion. Different combinations of erosion-prevention and water-control practices should be chosen with the crops to be grown. In general, crops common in the area as well as fruit trees

could be cultivated. Close-growing crops with a legume in the rotation should be supported by practices that control runoff and minimize erosion the most important of which are contour tillage, strip cropping, cover cropping, grassed waterways, and terracing. In addition lime and fertilizer according to needs, should be applied; compost and farm manure should be incorporated into the soil; and green manuring must be observed regularly.

Land Capability Class D, Subclass De

Strongly sloping, severely to very severely eroded. Erosion and fertility are the main problems and the number of years for cultivation limited. Observe erosion control measures; very careful soil management specially good crop rotation, and complex conservation practices if land is to be cultivated. This land is good for limited cultivation only and best suited for permanent crops.

Faraon clay
Bolinao clay loam, deep phase

Subclass De is strongly sloping and is severely to very severely eroded land. The topsoil is generally thin; the subsoil is usually heavy and slowly permeable.

The slope, which ranges from 15 to 25 per cent, and the heavy and slowly permeable subsoil induce moderate to excessive runoff. Consequently, the danger of soil erosion is increased. The topsoil being thin, accelerated erosion on this land will be very critical both on the standpoint of effective soil depth and fertility. The lack of soil depth for good root penetration and water intake and storage are added problems to cope with.

To farm this land safely very careful and good soil management practices should be observed. Subclass De land has definite restrictions and the choice of use is reduced. Planting of row crops is not advisable. When close growing crops are planted a well planned rotation should be followed, planting should be along the contour, and before full growth is attained by the plants mulching is necessary. On the higher slopes a system of properly laid out terraces should be constructed with suitable outlets installed in the absence of natural outlets. Terrace outlets must have vegetative cover, preferably grass, at all times. If grass is not well established,

reseeding and fertilizing should be done. All hazards induced by tillage and runoff should be properly appraised and supporting conservation practices instituted accordingly.

When used for orchards contour planting should be observed and a good stand of leguminous cover crop should be maintained. Deep-rooted legumes improve subsoil structure. They keep the subsoil porous for water, roots, and air to get through readily.

When erosion on a moderately deep soil is not severe, gullies should be smoothened and then seeded to grass or legumes. The soil should be limed and fertilized to give the grass or legume a good start; the legume seeds will need inoculation.

It is best suited to pasture or forest.

Land Capability Class D, Subclass Ds

Nearly level to gently sloping, slightly eroded. Very low fertility, very rapid permeability and low moisture holding capacity, strongly alkaline or high salt content, formation of dunes is/are the problem/s. Adopt special soil management practices and observe complex conservation practices if land is to be cultivated.

Beach sand

Subclass Ds is nearly level to gently sloping land and is slightly eroded. The surface soil is shallow with sandy to loamy texture; the subsoil is highly permeable.

Relatively, subclass Ds land may be less sloping than subclass Cs land, but for root zone and tillage limitations, the former has more acute problems than the latter. Thus, Ds land is comparatively of lower fertility, or has a more rapid permeability and lower moisture holding capacity, or has a higher salt content than Cs land. Moreover, the formation of dunes through wind action is more likely to happen on land under subclass Ds.

If planted to clean culture crops soils under this subclass require intensive conservation measures. This subclass may be devoted to vegetables or to truck farming and to root crops provided water supply is adequate and additional measures are taken to increase the water holding capacity of the soil.

Increasing the organic matter content of the soil by the application of compost and farm manure and the observance

of green manuring are necessary. Other vegetative soil conservation measures to be instituted in conjunction with clean culture cultivation are contour and buffer strip cropping, cover cropping and mulching. Where sand dunes are likely to form vegetative and mechanical means to stabilize the shifting sand must be adopted.

It is not likely that soils under this subclass will need any lime but should it be deemed necessary, lime may be added only after the soil is analyzed. Commercial fertilizers needed would be more of nitrogenous fertilizer for leafy vegetables and ammonium phosphate or complete fertilizers, as soil analysis may show, for the fruiting vegetables.

Land Capability Class M

Steep, very severely to excessively eroded or shallow for cultivation. Suited to pasture or forest with careful management.

Holinao clay loam, deep phase
Hasco loam, steep phase
Luisiana clay
Uyugan clay loam

Class M is steep and is very severely to excessively eroded, or shallow land. Stones or gravels may be present.

The slope, which ranges from 25 to 40 per cent, and the generally shallow soil make this land unfit for seasonal cultivation. Where climatic conditions are favorable orchards of citrus, coffee, etc., may be developed provided the trees are planted along the contour and a good cover crop is raised to prevent soil erosion.

Land under this capability class is best suited to pasture or forest. When devoted to pasture careful management should be observed. To grow legumes or grass for grazing the soil should be well prepared. Lime and fertilizers, as needed, should be applied to give the young legumes or grass a good start. Newly developed pastures should not be grazed heavily; the use of those already established should be controlled and rotated. Stock ponds should be constructed wherever possible. Diversion terraces around the heads of active gullies should be installed. Gullies that are about to develop should be smoothened and sodded.

For forest purposes, trees should be protected from fires; *kaingin* cultivation must be prevented; bare spaces should be planted to trees like *ipil-ipil.*

Land Capability Class N

Very steep, excessively eroded, shallow, rough or dry for cultivation. Suited to pasture with very careful management and restrictions. Best suited to forest with very careful management and restrictions.

Basco loam, steep phase
Luisiana clay
Uyugan clay loam

Class N is very steep and is excessively eroded land. The soil is very shallow and dry; the land is rugged and broken by many large gullies.

The slope, which is 40 per cent or over, and excessive erosion make this land not suitable for cultivation.

Land under this capability class could be utilized for pasture provided very careful management is observed and definite restrictions imposed. Where grasses grow, grazing must be controlled or restricted to a few heads of animals per hectare and grazing areas rotated regularly. The pasture will need liberal application of fertilizers and lime; reseeding is necessary.

This land is best suited to forest. However, very careful management and restrictions must be observed. The establishment of permanent vegetation, like *ipil-ipil,* is recommended especially in gullied places. *Kaingin* farming must be stopped by all means.

Land Capability Class Y

Very hilly or mountainous, barren and rugged. Should be reserved for recreation and wildlife.

Rough broken land
Dune land
Rock land
Filled-up soils

Class Y is extremely arid or very steep; rough and stony land with very thin or no soil cover at all. It includes such areas as rocky foot-hills, rough mountainous land; large areas dotted with rock outcrops or strewn with boulders; and extremely eroded places with exposed substrata.

Land under this capability class is recommended for wildlife and recreation. By all means, existing forests should be preserved; as much as possible, where non-existent, permanent forest vegetation should be established.

II. SOIL EROSION SURVEY

The erosion survey of Batanes was conducted simultaneously with the soil survey of the province. The objective of the survey was to determine the degree and extent of soil erosion to which the different soils of the province have been subjected.

SOIL EROSION DEFINED

Soil erosion is defined as the process of soil detachment and transportation by either wind or water. There are two kinds of erosion: namely, normal or geologic and accelerated erosion.

Normal or geologic erosion.—Normal or geologic erosion takes place in a natural or undisturbed condition under the canopy of forest, grass, ground litter, and in underground network of binding roots. Geologic erosion is a slow process; the removal of the soil by either water or wind is balanced by the formation of soil from the parent material underneath.

This kind of erosion is beneficial in the sense that there is a constant renewal of the fertility of the soil.

Accelerated erosion.—Accelerated erosion is the process brought about by man's activities on the land, thereby disturbing the equilibrium between soil building and soil removal. This kind of erosion is destructive as it removes soil particle very much faster than the formation of soils from the material underneath. The loss of the surface soil which contains most of the fertility means also the decline in crop yields. Soil erosion in the Philippines is caused mainly by water. The different kinds of accelerated soil erosion are: sheet, rill, gully, and stream bank erosion.

Sheet erosion.—This is the washing away in a more or less uniform depth, of the upper part of the soil in the croplands. It occurs when farmers cultivate their sloping lands without employing any means of controlling the flow of the surface water or runoff. At the beginning, this kind of erosion is slow and is not noticeable, but it is treacherously destructive.

Rill erosion.—This kind of erosion is the washing off of the soil by the formation of tiny incisions of a few inches depth and width which run down the slope of an unprotected cultivated land. This is attributed to the method of planning and arranging the furrows along the slope of the land. Such rills may be erased by ordinary plowing. This type of erosion marks the beginning of the formation of more serious kinds of erosion.

Gully erosion.—This erosion occurs on paths of concentrated flow down a slope and is the cutting of deep narrow strips or gullies on the face thereof. Gullies occur both on alluvial plains as well as on uplands. On a plain where drainage outlets are not protected, the edges of the plain are gradually eroded which consequently form into deep vertical cuts. These gullies if not checked, gradually destroy the plain. On uplands, gullying occurs mostly where runoff continually drain. This happens when farmers plow their fields up and down the slopes. Some gullies are small, but others are so big that farm animals cannot cross. Gullies grow bigger each year.

Stream bank erosion.—This kind of erosion occurs along the banks of streams and rivers. It is very destructive particularly on such lands where the substrata are of coarse or medium-textured soils. The flowing water undermines the lower part of the river or stream bank particularly along its outer curve thus causing the upper part to fall by its own weight.

FACTORS AFFECTING SOIL EROSION

Soil erosion occurs when water runs over the surface of a sloping land. This water running over the surface is called runoff. The rate of soil erosion will depend upon the speed of surface runoff. The volume of runoff as well as its speed depends upon the soil, slope, vegetation, and intensity of rainfall in the area.

SOIL

The soil possesses certain physical characteristics which influence its erodibility. Under similar conditions of climate, relief and vegetative cover, there are marked differences in the erodibility of different soils. In some cases sandy loam

soils are more susceptible to erosion than clay loam soils.

Porosity and permeability are important factors in the formation of runoff. The higher the absorbing quality of the soil or infiltration of water into the soil the less runoff will be formed. Different soil types differ in porosity and permeability. Also soils rich in organic matter are porous and will absorb more water readily than those poor in it.

SLOPE

Slope has a great influence on erosion. Runoff flows faster on a steeper slope than on one with a lesser grade. Taking other erosion factors equal, soil loss is greatest where runoff is fastest. Furthermore, on farm lands with the same grades of slopes, one with a longer slope will erode more than one with a shorter slope. This is so because as runoff acquires momentum its cutting power as well as the soil carrying capacity is increased considerably. A slope unprotected by vegetation or some mechanical devices to decrease the velocity of runoff suffers heavily during a heavy rainfall.

VEGETATION

The density of the vegetative cover of an area contributes a great deal to its resistance to erosion. In the heavily wooded portions of our forests the rate of soil loss is balanced by the formation of soil underneath. On cultivated farms the crops offer very little protection for the soil. Crops that can cover the ground well will give some protection for the soil but clean tilled row crops are conducive to erosion. Land on slopes exposed or bare of vegetative cover suffers heavy soil losses.

In the open areas where cogon predominates very little erosion takes place. The thick growth of cogon is quite adequate protection for the land. Even on steep slopes the grass cover if preserved and improved will give good protection.

INTENSITY OF RAINFALL

Rainfall intensity is a factor in erosion. A region with rainfall distributed throughout the year will have less soil erosion than another area where the same amount of rain occurs but only within a period of six months. In the latter area the intensity of rainfall is much bigger and hence the amount of runoff is correspondingly greater. In the former case, the intensity of rainfall is less giving more time for the water to infiltrate into the soil, hence, less runoff.

How much of the rain that falls run off the surface is shown by investigations conducted by the United States Department of Agriculture. At the Yazoo River Watershed, 27 inches of rain caused a disastrous flood, where 62 per cent of the rain water immediately run off cultivated fields and carried soil at the rate of 34 tons per acre. Runoff from plots on barren abandoned fields was 54 per cent of the total rainfall. Surface runoff during the most intense rains increased from 75 to 95 per cent of the total precipitation. On undisturbed oak forest only 0.5 per cent of the 27 inches of rain ran off the experimental plots while soil removed was only 75 pounds per acre.

FACTORS PROMOTING SOIL EROSION

System of farming lands.—In the province, most of the farm lands are rolling and hilly. These are planted to upland rice, corn, and tobacco which are erosion promoting crops. No means of protection is employed in farming these sloping lands. Erosion is aggravated by the common farm practice of plowing up and down the hill and laying the furrows along the slopes.

Crop rotation in the province is practiced but legume is not included in the sequence. Corn, *ubi, tugui,* onion, garlic and camote are planted from year to year. Sometimes the field is fallowed after camote crop. A good rotation of crops which includes a soil building legume helps conserve the soil.

The pasture lands are overgrazed. As a result, hillsides have very scant grass cover and erosion is very much in evidence.

Kaingin.—This is another contributing factor to the destruction of soil and forest. Very often *kaingin* clearings are made on steep slopes. The trees and other vegetation are burned, leaving the area cleared and entirely bare. When it rains runoff rushes downhill and generates quite a tremendous cutting power that detaches and carries a great deal of surface soil. Rills and sometimes gullies often result after one heavy rain.

SOIL EROSION SURVEY METHODS

The primary purpose of the soil erosion survey is to determine the degree of erosion in the different soils of the province, that is, the extent to which removal of the surface or subsoil

has progressed as well as the amount of gullying with special reference to its effect on the cultivation of the land.

The present depths of the different soil types under cultivation in the province were compared to the depths of the virgin soils or soils with normal profiles. The depths of different soil under normal profiles were established after various determinations over a wide area by boring with the soil auger, studying road cuts, pits, open wells, and stream banks.

Variations in the depth of soil as caused by erosion together with the presence of gullies are considered in mapping the different erosion classes. The depth and frequency of occurrence of gullies are noted as these affect the cultivation of the land. The classification of the different degrees of soil erosion used in this survey are as follows:

Erosion Class	*Degree of Erosion*	*Description*
0	No apparent erosion; no gullies.	No apparent erosion; no gullies.
1	Slight erosion	Less than 1/4 of original surface soil eroded; occasional crossable gullies present.
2	Moderate erosion	From 1/4 to 3/4 of original surface soil eroded.
3	Severe erosion	From 3/4 of original surface soil to 1/4 of subsoil eroded.
4	Very severe erosion	All of the surface soil to 3/4 of subsoil eroded.
5	Excessive erosion	All of the surface soil and over 3/4 of subsoil eroded.
W	Normal erosion	Balance between soil erosion and soil formation is maintained.
Q	Erosion, undifferentiated.	Erosion conditions change as often as floods occur.

The extent as well as the degree of soil erosion will increase each year unless control measures are instituted and practiced.

SOIL EROSION IN THE DIFFERENT AREAS

Mayan clay loam (684).—Mayan clay loam occupies the lowlands in Itbayat. All these areas have no apparent

erosion. Any erosion that might had taken place is very negligible, except in places immediately adjacent to the crevices that drain the area. This can be easily controlled by lining the openings with concrete walls.

Umingan loam (322).—This soil type is found in the islands of Batan and Sabtang which occurs as small patches in the municipalities of Basco, Mahatao, Ivana, Uyugan and San Vicente. It has no apparent erosion. Due to its nearly level relief coupled with a moderately rapid permeability, sheet erosion has not set in the area. Most of the rain water are readily absorbed in the soil, leaving only a small fraction to move out from the area in non-erosive velocity.

Stream bank erosion is the form of erosion that damages the Umingan loam. Valuable slices of land along the creeks are being lost yearly. This form of erosion maybe minimized, if not prevented, either by or a combination of the following: (1) sloping the banks of the streams and then planting them to deep-rooted grasses and trees, or (2) providing a concrete wall or wood piles driven along-side the banks.

Basco loam (688).—Basco loam is found in the town of Basco, Batan Island. It occupies only one place. It is moderately eroded or about one-fourth to three-fourths of its surface soil has been eroded. The soil type could not have reached this stage of erosion had the farmers employed conservation measures to hold the soil at its place.

Basco loam can be improved by the application of organic matter and employment of several or a combination of a number of soil conservation measures or practices, such as green manuring, crop rotation, contour plowing, terracing and strip cropping. Diversion channels should be employed to protect the area from runoff coming from higher surrounding areas.

Basco loam, steep phase (689).—This soil phase is found in the towns of Basco, Mahatao and Uyugan. It is severely eroded, or about 3/4 of its original surface soil to 1/4 of its subsoil have been washed away.

Basco loam, steep phase, is best suited to pasture and woodland, but the people have been using it continuously for the cultivation of seasonal crops since time immemorial. The erroneous practice is may be due to pressing economic needs and lack of good agricultural lands. The people do not know that this land would give them better economic returns if

they use it for pasture rather than for the growing of seasonal crops.

Bolinao clay (153).—This soil type is found in the islands of Ibuhos and Dequey. Some of the areas are good for cultivation and the rest are suited for pasture. They are at present used for pastures but not properly managed. As a consequence, severe erosion has set in.

Bolinao clay loam, deep phase (683).—Part of the area has slight erosion or less than one-fourth of the surface soil is lost. It is found on the gently and moderately sloping areas that are covered with cogon and *samsamong* grass. The areas are used as pasture lands.

The other portion has moderate erosion or one-fourth to three-fourths of the surface soil have been lost. It covers the strongly sloping, steep, hilly, and mountainous areas from the northern portion down to the south central portion of the island of Itbayat. It constitutes the bigger portion of the soil phase.

Faraon clay (132).—This soil type is found in the southwestern part of Itbayat and in the southwestern tip of Batan Island. The one found in Itbayat Island has gentler slopes than that found in Batan Island. The predominating slope is 8 to 25 per cent.

The area found in Itbayat Island has severe erosion or three-fourths of the surface soil to about one-fourth of the subsoil have been lost. Such erosion has set in the area because it has been continuously used for the cultivation of seasonal crops without the employment of any soil conservation measure.

The one located in Batan Island is moderately eroded or one-fourth to about three-fourths of its surface soil have been washed away. This is so, because the area is under grass cover most of the time and only occasionally cultivated to seasonal crops.

Sabtang loam (690).—Sabtang loam is located at about 2 kilometers southwest of the town proper of San Vicente, Sabtang Island. Class 2 or moderate erosion has set in the area.

Luisiana clay (239).—Luisiana clay is found in Mount Sta. Rosa and Mount Ripose, Itbayat Island. It is utilized for the cultivation of seasonal crops. As a result, severe erosion has set in the area. Worst erosion may come in this area if the

land-use will not be changed. The area is suited for pasture land and woodland or for permanent crops.

Uyugan clay loam (685).—This soil type is found in the uplands in Batan and Sabtang Islands with rolling, steep, hilly and mountainous relief. It is utilized for the cultivation of seasonal crops using the *kaingin* system or shifting cultivation from time immemorial so much so that severe erosion has set in. Shifting cultivation must be discouraged and the area should be grassed or reforested to prevent further destruction of the land.

Beach sand (118).—The beach sand occupies a limited area in the province. It is found in small patches along the seashores in the islands of Batan, Sabtang and Ibuhos. There is no apparent erosion. Apparent erosion has not set in this land type because of the very rapid permeability of the soil.

Dune land (594).—Dune land is formed by shifting sands. The dune land in the province is found in two small patches—one in Sabtang and other in Ibuhos Islands. It occupies a very small area as compared to that found in Ilocos Norte. The shifting of the sand dunes caused by the action of the wind takes place during the dry months during which the sands are very dry and when there are strong wind currents. The movement of the sand dunes does not present a big danger in Batanes as they are only in small patches. However, by any means, the movement should be checked for the protection of the crops in the surrounding areas. This can be done by maintaining a good vegetative cover on the sand dunes and irrigating them during dry weather. Bare areas should be planted to suitable grasses, trees, shrubs or vines such as that one called *marcomote* in Ilocano; and vegetative litters should be piled all over the area. Stakes or boards should be driven into the ground in staggered formation to protect the young plants against the blowing of the wind and permit them to get started. Erosion is classified as normal.

Filled-up soils (Made Land) (29).—This miscellaneous land type is found in Basco, the capital of the province. It is used as an airport of the Philippine Air Lines. The runway has not suffered any apparent erosion but the other portions of the airport is slightly eroded, losing less than 1/4 of the top fillings. To prevent the soil from being washed away during

heavy rains, the grass cover should be maintained throughout the year and diversion channels should be constructed to take care of the runoff coming from the adjoining uplands. Another suggestion is to fence the whole compound of the airport so that no animal maybe allowed to graze in the area.

Rough broken land (326).—The rough broken land in Batanes occupies the steep slopes of Mount Iraya located in the northern part of Batan Island. The area is under primary forest and no apparent accelerated erosion has been noticed. The erosion that might have taken place is a normal or geologic erosion where any soil removed is counterbalanced by the amount of soil formed.

Rock land (599).—This land type is found in the islands of Dequey, Itbayat, Batan, Sabtang, Ibuhos, and San Diego. The rock land areas are of no agricultural value. The grasses are very scanty and the trees are sparse and scrubby. These areas are good for wildlife preservation. As such, the natural vegetation should be encouraged to grow and no burning and cutting should be allowed. In this way soil formation may later take place. Erosion is classified as normal.

EFFECTS OF SOIL EROSION

Soil erosion has an exhausting influence on agriculture. Previously, most of us have had so little concern about its adverse effects; it was only recently that we became aware of the fact that erosion if left uncontrolled will eventually deplete the nation's economic stability and prosperity.

PHYSICAL EFFECTS

Where erosion exists, the first to suffer is the land which is gradually robbed of its surface soil or furrow slice. This means that not only the inherent fertility of the soil is lost but costly commercial fertilizers added are wasted as well, Much more, if the furrow slice shall be comprised less of the surface soil and more of the subsoil which is usually less fertile, there will be greater difficulty in maintaining a satisfactory physical condition of the soil. Moreover, eroded soil materials, such as sand and gravel, have at times covered entire fields of newly cultivated crops causing so much loss in seeding and interference in subsequent cultivation. The objectives of any scheme of soil management, however good, is therefore seriously interfered with. One appreciable effect of soil erosion is the silting up of reservoirs which reduces their storage capacity and adding greatly to the expense of their

upkeep. Gullying and stream bank cutting of agricultural lands seriously impair the productive capacity of the farm and the farmer's income suffers an appreciable loss. Likewise, highways near or parallel to stream or river courses suffer from stream bank cutting and those along the hills and mountains suffer from landslides thereby the means of transportation is seriously impeded.

ECONOMIC AND CULTURAL EFFECTS

The adverse effects of accelerated or man-made soil erosion are much too obvious that they need not be over emphasized. Unfortunately, however, most people take the existence of soil for granted, in the manner that almost everyone always indifferently regards the existence of the air we breathe. Whereas our supply of the latter has never been doubted, the certainty of our enjoying the bounty of the former cannot last forever unless we recognize the imminent dangers of soil erosion.

Soil conditions have much to do to shape the pattern of a nation's existence. While we begin by trying to analyze their effects from an agricultural point of view, we ultimately arrive at their economic and social effects as well. This is so because agricultural, economic and social conditions are closely interrelated so much so that it is quite difficult to separate them too sharply. Erodibility being one of the many soil conditions, should ever be borne in mind as much as fertility.

We know that food, shelter, and clothing, man's basic needs, all emanate from the soil. Soil lost to us if taken in terms of the economic value of production of these basic needs surely would amount to enormous figures. The high cost of living may then be partially understood.

We know that while soil loss mounts, there is no sign that population also declines. The tendency is when population increases, people tend to overwork the soil. Overworking the soil inevitably results in the decline of productivity. Soil erosion then commences and if unchecked, the people simply abandon the affected area and move to other places. This may happen once or more than once within a generation. What has started as an agricultural problem also becomes an economic and social problem.

We know that industry, especially the manufacture of consumer goods, is dependent on the supply of various raw materials. By and large, these raw materials are produced from

the soil. Industry, therefore, directly and indirectly is affected by soil erosion. In turn when factories shut down or curtail operations, men lose their jobs and another social problem is added.

Soil erosion, therefore, is not the individual farmer's problem alone. While it affects his capacity to provide for his family's wants and meet his social obligations, erosion eventually becomes a community's, a province's and finally a nation's agricultural, economic, and social concern.

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 or 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 accumulates such as in strip cropped 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 rainfalls 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 seep 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 assists 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 maintains if not improves 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 minimizes or helps 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 on 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 BATANES PROVINCE

Common Name	*Scientific Name*	*Family*
Abaca	*Musa textilis* Nee	Musaceae
Alibangbang	*Bauhinia malabarica* Roxb.	Leguminosae
Alugbate	*Basella rubra* Linn.	Basellaceae
Amorseco	*Andropogon aciculatus* Retz.	Gramineae
Ampalaya	*Momordica charantia* Linn.	Cucurbitaceae
Anabiong	*Trema orientalis* (Linn.) Blm.	Ulmaceae
Antipolo (Chipohu-Ivatan)	*Artocarpus blancoi* (Elm.) Merr.	Moraceae
Arrowroot (Bai-Ivatan)	*Maranta arundinacea* Linn.	Marantaceae
Atis	*Anona squamosa* Linn.	Anonaceae
Avocado	*Persea americana* Mill.	Lauraceae
Balanti (Tanugtug-Ivatan)	*Homolanthus fastnosus* (Linden) F. Vill.	Euphorbiaceae
Balete	*Ficus benjamina* Linn.	Moraceae
Bamboo	*Bambusa spinosa* Roxb.	Gramineae
Banana	*Musa sapientum* Linn.	Musaceae
Bermuda grass	*Cynodon dactylon* (Linn.) Pers.	Gramineae
Betel nut	*Areca catechu* Linn.	Palmae
Biga	*Alocasia macrorrhiza* (Linn.) Schott.	Araceae
Bignai	*Antidesma bunius* (Linn.) Spreng.	Euphorbiaceae
Bitaog	*Calophyllum inophyllum* Linn.	Guttiferae
Boho	*Schizostachyum lumampao* (Blanco) Merr.	Gramineae
Boling-uali (Anai-Ivatan)	*Flogellaria indica* Linn.	Flogellariaceae
Breadfruit	*Artocarpus communis* Forst.	Moraceae
Bulala	*Nephuelium mutabile* Blume.	Sapindaceae
Buri	*Corypha elata* Roxb.	Palmae
Buyo	*Piper betle* Linn.	Piperaceae
Cabbage	*Brassica oleracea* Linn. var. *capitata* Linn.	Cruciferae
Cacao	*Theobroma cacao* Linn.	Sterculiaceae
Cadios	*Cajanus cajan* (Linn.) Milsp.	Leguminosae
Camote (Wakay-Ivatan)	*Ipomoea batatas* Linn.	Convolvulaceae
Cassava	*Manihot esculenta* Crantz	Euphorbiaceae
Castor oil plant (Katana-Ivatan)	*Ricinus communis* Linn.	Euphorbiaceae
Cauliflower	*Brassica oleracea* Var. *botrytis* Linn.	Cruciferae

Common Name	*Scientific Name*	*Family*
Citrus	*Citrus medica* Linn.	Rutaceae
Coconut	*Cocos nucifera* Linn.	Palmae
Coffee	*Coffea arabica* Linn.	Rubiaceae
Cogon (Buchid-Ivatan)	*Imperata cylindrica* (Linn.) Beauv.	Gramineae
Corn	*Zea mays* Linn.	Gramineae
Cotton	*Gossypium hirsutum* Linn.	Malvaceae
Cowpea	*Vigna sinensis* (Linn.) Sav.	Leguminosae
Croton oil plant	*Croton tiglium* Linn.	Euphorbiaceae
Cucumber	*Cucumis sativus* Linn.	Cucurbitaceae
Dangla	*Vitex trifolia* Linn.	Verbenaceae
Dayap	*Citrus aurantifolia* (Christm.) Swingle	Rutaceae
Derris	*Derris eliptica* (Roxb.) Benth.	Leguminosae
Eggplant	*Solanum melongena* Linn.	Solanaceae
Gabi	*Colacasia esculenta* (Linn.) Schott & Endl.	Araceae
Garlic	*Allium sativum* Linn.	Liliaceae
Ginger	*Zingiber officinale* Rosc.	Zingiberaceae
Gogo	*Entada phaseoloides* (Linn.) Merr.	Leguminosae
Guava	*Psidium guajava* Linn.	Myrtaceae
Guayabano	*Anona muricata* Linn.	Anonaceae
Indigo (Tagum)	*Indigofera suffructicosa* Mill.	Leguminosae
Ipil-ipil	*Leucaena glauca* (Linn.) Benth.	Leguminosae
Kabuyan	*Citrus macroptera* Montr.	Rutaceae
Kakauati	*Gliricidia sepium* (Jacq.) Steud.	Leguminosae
Kalamansi	*Citrus microcarpa* Bunge	Rutaceae
Kamuning (Vanali-Ivatan)	*Muraya paniculata* (Linn.) Jack	Rutaceae
Kapok	*Ceiba pentandra* (Linn.) Gaertn.	Bombacaceae
Karmai	*Cicca acida* (Linn.) Merr.	Euphorbiaceae
Kauayan-killing	*Bambusa vulgaris* Schrad	Gramineae
Kolobot	*Citrus hystrix* (Blanco) Wester	Rutaceae
Kondol	*Benincasa hispida* (Thunb.) Cogn.	Cucurbitaceae
Kulot-kulotan	*Triumfetta bartramia* L.	Tilliaceae
Labayo (Hanut-nu-dah-dah-Ivatan)	*Melochia umbelleta* (Houtt.) Stapf.	Sterculiaceae
Lasona (Native)	*Allium ascalonicum*	Liliaceae
Lemon	*Citrus limon* Burm.	Rutaceae
Lettuce	*Lactuca sativa* Linn.	Compositae

Common Name	*Scientific Name*	*Family*
Mabolo (Kamaya-Ivatan)	*Diospyrus discolor* Willd.	Ebenaceae
Macopa	*Eugenia mallacensis* Linn.	Myrtaceae
Maguey	*Agave cantala* Roxb.	Amaryllidaceae
Malabuho (Jantak-Ivatan)	*Sterculia oblongata* R. Br.	Sterculiaceae
Malubago (Hanot-Ivatan)	*Habiscus tillacens* Linn.	Malvaceae
Malungay	*Moringa oleifera* Lam.	Moringaceae
Mango	*Mangifera indica* Linn.	Anacardiaceae
Marasiksik (Piknik-Ivatan)	*Okalis repens*	Oxalidaceae
Millet	*Panicum miliaceum* Linn.	Gramineae
Mulberry (Tanyud-Ivatan)	*Morus alba* Linn.	Moraceae
Mungo	*Phaseolus aureus* Roxb.	Leguminosae
Mustard	*Brassica integrifolia* (West) O. E. Schulz	Cruciferae
Nangka	*Artocarpus heterophylus* Lam.	Moraceae
Nito	*Lygidyum spp.*	Schizaeaceae
Onion	*Allium cepa* Linn.	Liliaceae
Orange	*Citrus aurantium* Linn.	Rutaceae
Pandan	*Pandanus tectorius* Sol.	Pandanaceae
Papaya	*Carica papaya* Linn.	Caricaceae
Patola	*Lufa cylindrica* (Linn.) M. Roem.	Cucurbitaceae
Peanut	*Arachis hypogaea* Linn.	Moraceae
Petchay	*Brassica chinensis* Linn.	Cruciferae
Pineapple	*Ananas comosus* (Linn.) Merr.	Bromeliaceae
Pummelo	*Citrus maxima* (Burm.) Merr.	Rutaceae
Radish	*Raphanus sativus* Linn.	Cruciferae
Ramie	*Boehmeria nivera* (Linn.) Guadish	Urtricaceae
Rattan	*Calamus ornatus* Blm.	Palmae
Rice	*Oryza sativa* Linn.	Gramineae
Samsamong	*Themeda arianda*	Gramineae
Sandalaitan (Kapan-Ivatan)	*Saphora tomentosa* Linn.	Leguminosae
Santol	*Sandoricum koetjape* (Burn.) Merr.	Meliaceae
Seguidilla	*Psophocarpus tetragonolobus* (Linn.) DC.	Leguminosae
Sincamas	*Pachyrrhizus erosus* (Linn.) Brb.	Leguminosae
Sitao	*Vigna sesquipedalis* Fruw.	Leguminosae
Sorghum	*Andropogon sorghum* (Linn.) Brot.	Gramineae
Squash	*Cucurbita maxima* Dusheane	Cucurbitaceae
Sugar cane	*Saccharum officinarum* Linn.	Gramineae
Sweet basil (Valan-	*Ocimum basilicum* Linn.	Labiatae

Common Name	*Scientific Name*	*Family*
Tagum (Panai- Ivatan) (Indigo)	*Indigofera suffructicosa* Mill.	Leguminosae
Talahib	*Saccharum spontaneum* Linn.	Gramineae
Tayumtayuman (Taium-Ivatan)	*Indigofera tinctoria* Linn.	Leguminosae
Tobacco	*Nicotiana tabacum* Linn.	Solanaceae
Tomato	*Lycopersicum esculentum* Mill.	Solanaceae
Tugui (Dukai-Ivatan)	*Dioscorea esculenta* (Lour.) Burkill	Dioscoreaceae
Ubi	*Dioscorea alata* Linn.	Dioscoreaceae
Upo	*Lagenaria leucantha* (Duch.) Rusby	Cucurbitaceae
Voyayai (Ivatan)	*Phoenix hanceana* Naud. var. *philippinensis*	Palmae
Watermelon	*Citrullus vulgaris* Schrad.	Cucurbitaceae

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