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

## SOIL REPORT 43

# SOIL SURVEY OF ABRA PROVINCE PHILIPPINES

**Reconnaissance Soil Survey**

by

NARCISO M. NATIVIDAD
*Chief of Party*

JESUS AYSON AND CAMILO GALAMAY
*Members*

MANILA
GOVERNMENT PRINTING OFFICE
1974

# SOIL SURVEY OF ABRA PROVINCE[1]

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[1] Report updated and edited by Mr. Timoteo P. Demen, Supervising Soil Tech. and Mrs. Magdalena Q. Favis, Soil Tech. II, Technical Specialist Section, Bureau of Soils, Manila.

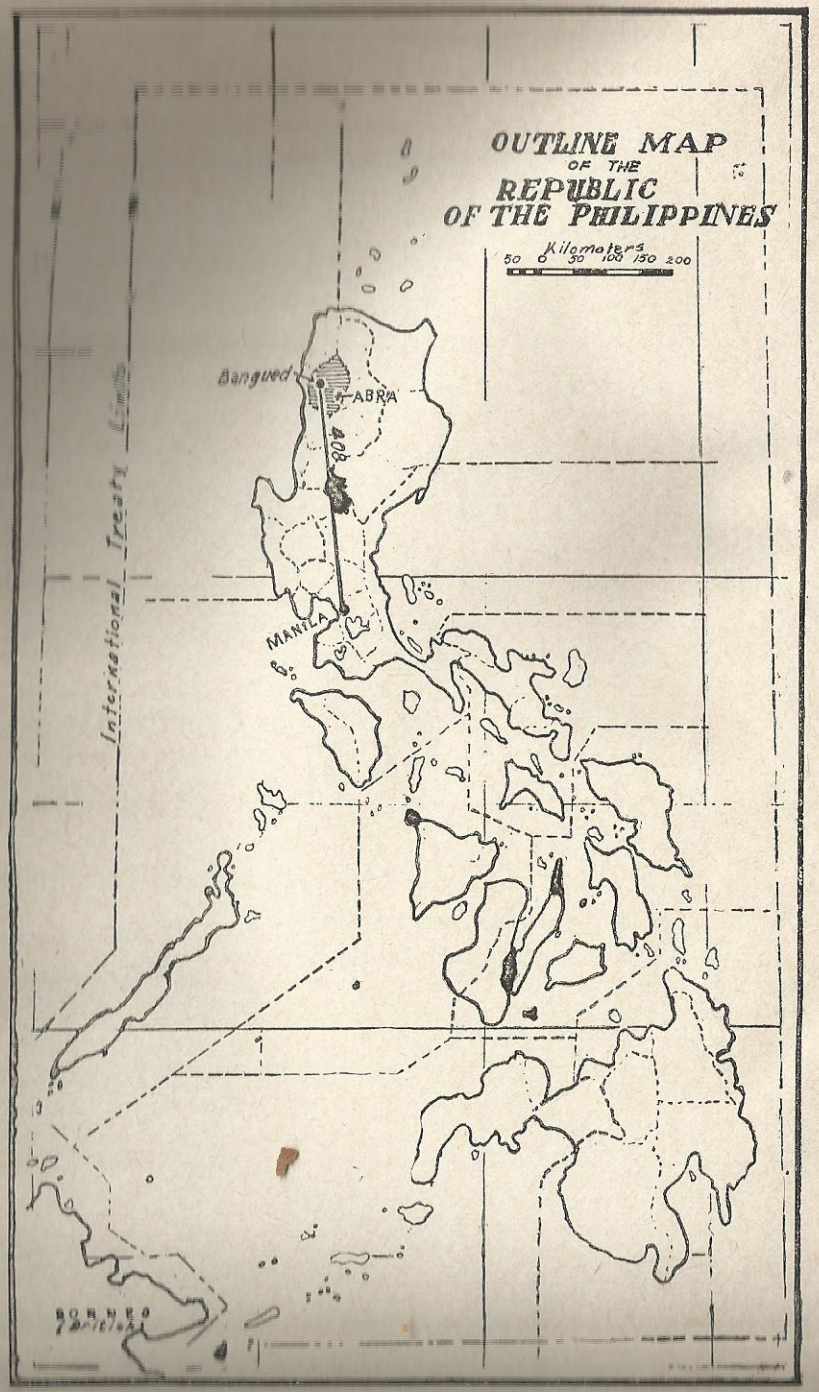


Figure 1. Outline map of the Philippines showing the location of Abra Province.

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DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES

HON. ARTURO R. TANCO, JR.
*Secretary*

HON. JOSE D. DRILON, JR.
*Undersecretary*

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**BUREAU OF SOILS**

JUAN A. MARIANO
*Director*

## ACKNOWLEDGMENT

The members of the soil survey party acknowledge with gratitude the assistance and wholehearted cooperation of Governor Jose Valera of the Province of Abra and the members of the Provincial Board during the survey and classification of the soils of the province.

To the staff of the Provincial Agricultural Agency we are indebted for the valuable information and data furnished us.

We also extend our appreciation to the various provincial and municipal officials, as well as to the private citizens of the province, who in one way or another, contributed to the success of the survey.

Our sincere thanks are due the soil survey staff also for editing and finalizing this report.

THE AUTHORS

## ILLUSTRATIONS

# INTRODUCTION

The prevailing low crop yields in many areas of the Philippines is basically due to improper soil management. Constant cropping without attempting to replenish what had been taken from the soil by the crops and the lack of understanding of the importance of the topsoil and in the conservation of its valuable properties, among other factors, have set back farm income to a minimum, or in other words have caused once productive soils to become sub-marginal land.

The Bureau of Soils (formerly the Bureau of Soil Conservation), the foremost government agency relegated with the task of conserving the soil resources of the country, undertook the soil survey and classification of the Province of Abra, not only to assess soil losses in the province but also to gather soil data, specifically their physical and chemical characteristics and study these characteristics so that the necessary soil management practices can be instituted thereby sustained economic crop production can be ultimately attained.

The survey was conducted from July 27 to December 17, 1955, inclusive, by Messrs. Narciso M. Natividad, Jesus Ayson and Camilo Galamay of the Bureau of Soils (formerly Bureau of Soil Conservation), under the directorship of the late Dr. Marcos M. Alicante and during the incumbency of Honorable Juan de G. Rodriguez as Secretary of Agriculture and Natural Resources.

## SUMMARY

The province of Abra is located in the central-eastern part of the Ilocos Region. It has an area of approximately 397,555 hectares with 32,544.8 hectares as farm lands. Bangued, the capital of the province, is approximately 408 kilometers by road from Manila.

Abra is largely hilly and mountainous with small valleys and small level plains, and strips of narrow level areas along rivers. The prominent mountain peaks are Bulagao, Banti, Sagang, Bosoy, Balutictic, Ticmo, Buagan, Madocay, Tumalpac, and Manago. The Abra Valley is considered the biggest plain in the province.

The numerous rivers and streams provide the good natural drainage system for the province. Aside from Abra River, the other important streams in the province are Malapao, Boot, Palsaguan, Timog, Baoy, Manisbal, Bocloc, Ilam, Masinio, Malanas and Utep.

The province has inadequate supply of potable vater. Only Bangued and Bucay towns have water system.

The vegetative cover of the province consists of primary forests, second-growth trees, grasses and cultivated crops. The primary forests are found in the northwestern and in the northeastern portions extending to the southern side of the province.

The grasslands occupy the middle northern portion of the province extending to the southeastern side down to the southern part.

The development of the province of Abra started way-back in the early days of the Spanish regime. Bangued was founded in 1598 by the Augustinian missionary. Revolutionary Government was established in Abra in 1899 by Don Blas Villamor. On August 19, 1901, a civil government was established by the Americans. In February 1905, Abra was annexed to Ilocos Sur and remained as such until March 1917. By virtue of Act 2683, Abra became a separate province.

Abra is densely populated. In 1960, the total population of Abra was 115,193 people.

The regular municipalities in Abra are linked by a network of first, second and third class roads. In the fiscal year 1964–1965, the existing kilometerages of roads in the province were as follows: (a) municipal highway—117.44 kilometers; (b) provincial highway—283.77 kilometers.

Abra is a fourth class province having 19 municipalities and 19 municipal districts. Almost all regular towns and barrios, are provided with elementary schools. Municipal districts are also provided as occasion demands and funds are available.

The province falls under the first type of climate of the Philippines, i.e., two distinct seasons, dry and wet. Wet in the months of May to September and dry from October to April.

The basic industry of the province is agriculture. The important crops grown are rice, corn, sugar cane, tobacco and vegetables. The livestock and poultry industry are flourishing. Majority of the farms are operated by their owners. The average land holding in 1960 is 2.05 hectares.

Twenty soil types and three miscellaneous land types were identified and delineated in the province. These soil types and miscellaneous land types are grouped, for convenience, into (1) soils of the plains and valleys; (2) soils of the intermediate uplands; (3) soils of the hills and mountains; and (4) miscellaneous land types. Seven soil types fall under the first group; six soil types under the second group; seven soil types under the third group; and three land types under the fourth group.

The soils of the province are also grouped into land capability classes. Included in this report is the productivity rating of the different soil types and land types of the province.

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

# I RECONNAISSANCE SOIL SURVEY

## DESCRIPTION OF THE AREA

*Location and extent.*—The province of Abra is located in the central-eastern part of the Ilocos Region. It lies approximately within 120° 28′ and 121° 07′ east longitudes, and between 17° 06′ and 17° 58′ north latitudes. It is bounded on the northwest by Ilocos Norte Province; on the west and south by Ilocos Sur and Ilocos Norte Provinces; and on the east by Benguet and Kalinga-Apayao Provinces. It is more or less oblong-shaped with irregular boundary. The major axis, measuring from the northern tip to the southern point, is approximately 74 kilometers; while the minor axis, from the eastern side to the western part, is 54 kilometers. Bangued, the capital of the province, is 408 kilometers by road from Manila.

The approximate area is about 397,555 hectares or 3,809 square kilometers. The Agricultural Census of 1960 has indicated that the total farm area of Abra is about 32,544.8 hectares. This farm area is classified as follows:

| *Kind* | *Area* | *Per cent* |
|---|---|---|
| Arable land: | | |
| Planted to temporary crops | 22,431.2 | 69.2 |
| Lying idle | 5,155.7 | 15.8 |
| Planted to permanent crop | 951.4 | 2.8 |
| Permanent pasture | 1,340.2 | 4.1 |
| Area covered with forest | 2,327.7 | 7.1 |
| All other lands | 338.6 | 1.0 |
| TOTAL | 32,544.8 | 100.0 |

*Relief and drainage.*—Abra is generally rugged and is traversed on all sides by hills, towering mountains and rivers that make up the rough relief of the province (Fig. 2). The prominent mountain peaks are Bulagao (1121 ft.), Banti (799 ft.), Sagang (1240 ft.), Bosoy (1540 ft.), Balutictic (1860 ft.), Ticmo (1826 ft.), Buagan (1771 ft.), Madocay (1443 ft.), Tumalpac (1589 ft.), and Mt. Manago (1575 ft.). These mountain peaks constitute that Central Cordillera that runs

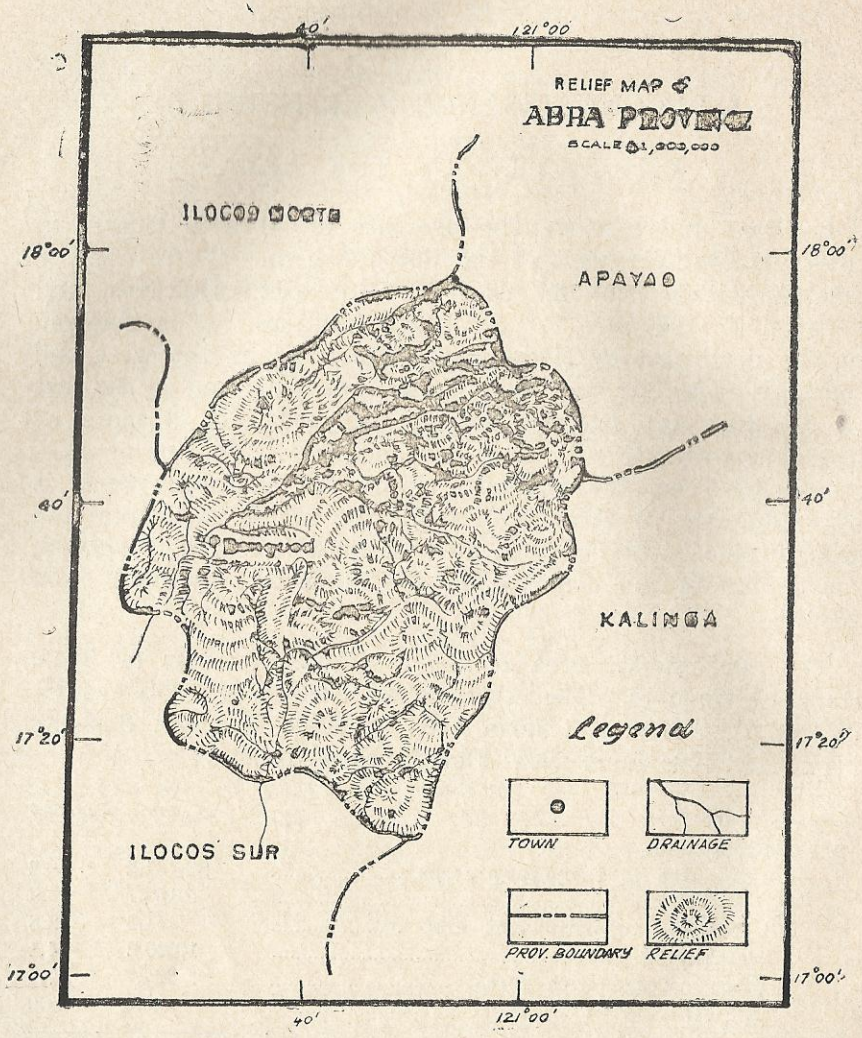



**Fig. 2. Relief map and drainage pattern of Abra Province.**



from the southeastern to northeastern part of the province. The few plains are generally small and narrow, fringing along the rivers, mountains and hills. The Abra Valley is considered the biggest plain in the province. It is composed of the western part of Bangued and the northern portion of Peñarrubia to the eastern part of Tayum. Other small but important plains are those found in Lagangilang, Tayum, Manabat, Pidigan, and Danglas. All of these areas, although situated in the lower portion are drained by the surrounding rivers and their branching creeks.

The Province of Abra, as a whole, is well drained. This condition is made possible by the natural configuration of the province and the presence of several rivers and creeks. Aside from the Abra River, the other important rivers found in Abra are Malapaao, Soot, Palsaguan, Tineg, Anayan, Binongan, Baay, Manicbel, Bucloc, Ikumin, Masisio, Malanas and Utep. All of these rivers empty into the Abra River which drains to the China Sea through the Banauang Gap in Ilocos Sur. Abra River is considered one of the biggest rivers not only in Abra Province but also in other Ilocos Provinces. It rises from Mount Data in Benguet and passes through Vigan in the northern part of Ilocos Sur to the central part of Abra. The estimated maximum discharge of Abra River amounts to about 408,000 cubic feet per second.

*Water supply.*—The Province of Abra has inadequate supply of potable water. Only two towns have water supply of the gravity type. One of which is in Bangued, the provincial capital, with a capacity of 180,000 gallons a day and serving 6,600 people. The other one is in Bucay with a discharge of 158,400 gallons a day and serving 700 people. Surface water is plentiful at the central part of the province with moderate supply of ground water at a depth of 50 to 300 feet. These water resources, both surface and ground water, may not be safe for drinking thus require treatment for potability. The water supply for other localities come from perennial springs and drilled wells (Fig. 3 and 4.).

*Vegetation.*—The vegetation of Abra Province consists of primary forests, second-growth forests, grasses and cultivated crops.

The primary forests are found on the rocky mountainous areas in the north-western portion bordering Ilocos Norte,

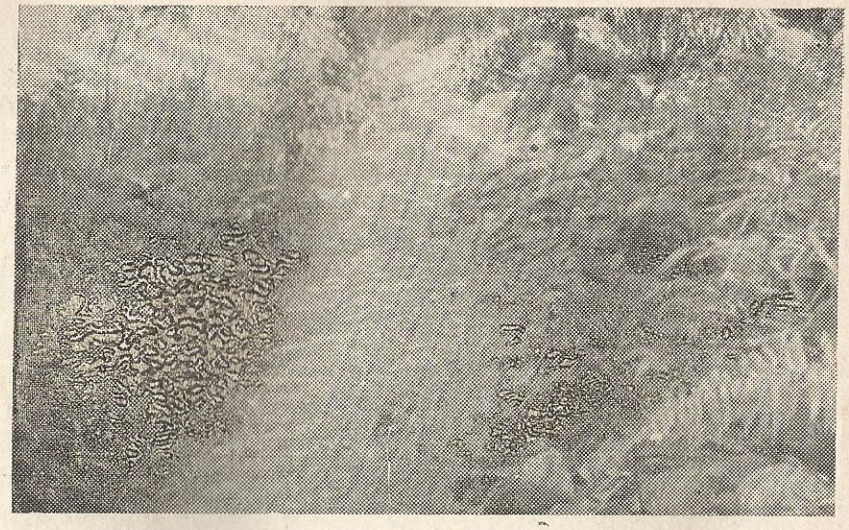


Fig. 3. Spring water, serves not only as source of water for drinking, but for irrigation water as well.

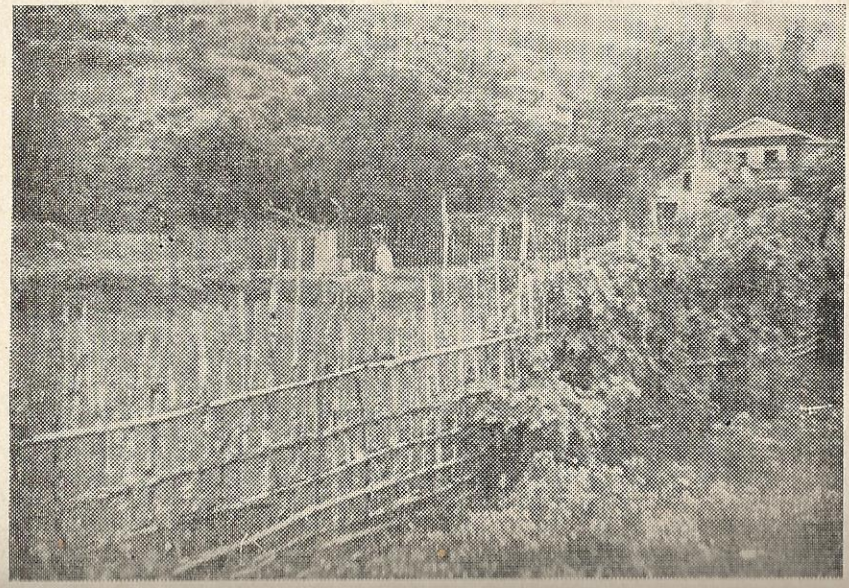


Fig. 4. Drilled wells with force-pumps are found in some sections of the province.



and in the northeastern to southeastern side fringing Apayao-Kalinga Province. The type of vegetation found in the areas bordering Apayao–Kalinga Province is entirely different from those found in other parts of the Province. The species of trees found consist of Benguet pine and others in association with sunflower, cogon, talahib, *aguingay, culape,* and others.

The important species of trees found in the forest areas at the northern side to the northwestern side of the province bordering Ilocos Norte are given below.

| *Common Name* | *Scientific Name* |
|---|---|
| Apitong | *Dipterocarpus grandiflora,* Blanco |
| Molave | *Vitex parviflora,* Juss. |
| Tanguile | *Shorea polysperma* (Blanco) Merr. |
| Dungon | *Tarieta sylvatica* (Vidal) Merr. |
| Tindalo | *Pahudia rhomboidea* (Blanco) Prain. |
| White lauan | *Pentacme contorta* (Vidal) Merr. & Rolfe |
| Narra | *Pterocarpus indicus* Willd. |

The secondary forests are found on the low-lying hills in the central portion of the province. The species consist of soft-wood trees, shrubs, and vines.

The grasses are the predominant soil cover of Abra. These are commonly the results after cultivated areas are abandoned. They are found in the undulating to hilly and mountainous areas in the central northern portion extending to the south-eastern side down to the southern part of the province. In some of the forested areas grasses are also found. The common grasses are *samsamong,* cogon, *talahib, aguingay.* They have thin, narrow, and short leaves, an indication of poor soil in the area. The distribution of the vegetative cover of Abra Province is shown in figure 5.

*Organization and population.*—The early history of Abra denotes nothing in the way of exploration. Missionary work, however, seems to have been undertaken among the mountain people of the province since the early days of the Spanish occupation. This particular work is done by the Agustinian Friars, who, as early as 1598, founded the town of Bangued, Abra's present capital.

In the latter half of the eighteenth century, the uprising, known as Silang Rebellion, had its effects upon Abra. Like

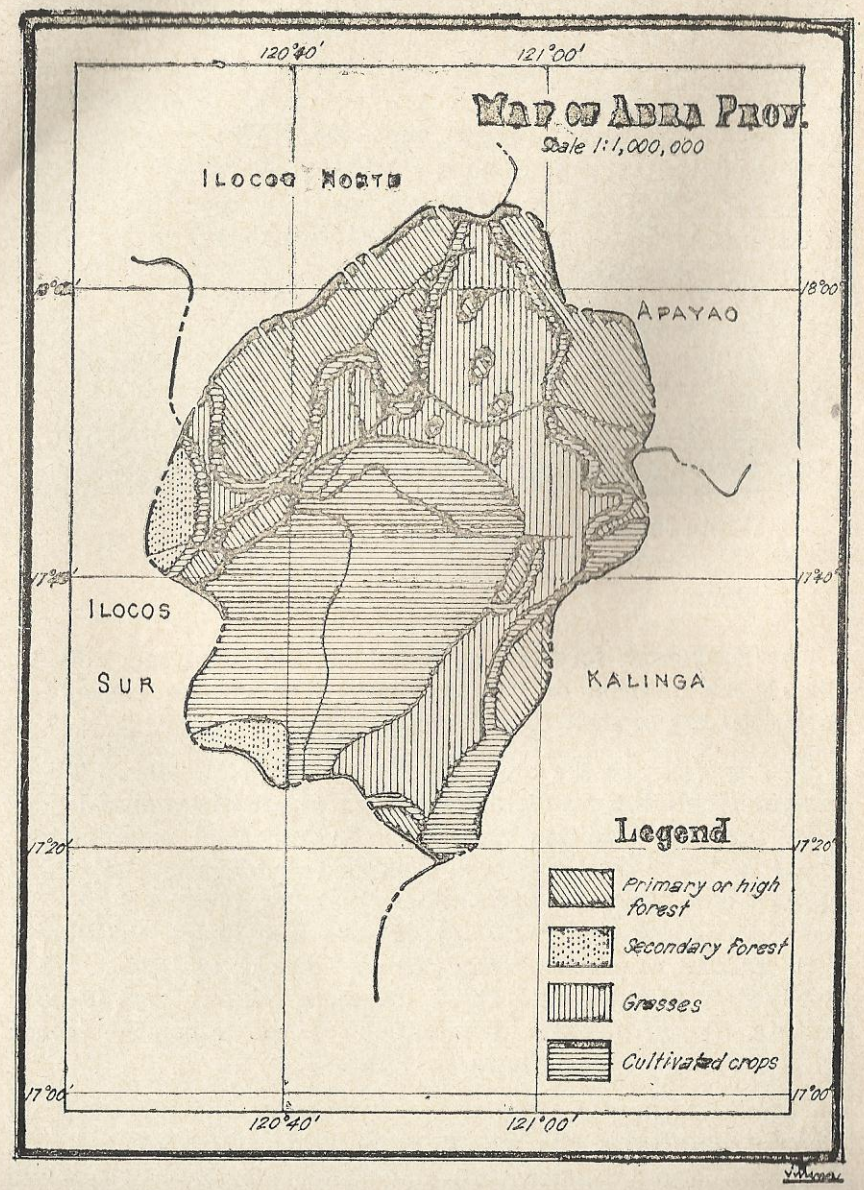



**Fig. 5. Map of Abra Province showing general vegetation.**



in most provinces of the Philippines, the people of Abra put their whole hearts and souls behind the revolutionary movement which started in the eighteenth century. About the middle part of 1899, through the whole initiative of Don Blas Villamor, a revolutionary government was set-up in Abra. Leocadio Valera became the provincial governor until Abra fell into the hands of the American forces in the latter part of that same year. It was in this short period that the people of Abra have enjoyed more privileges which were denied them during the Spanish period.

On August 19, 1901, in the early part of the American regime, civil government was established in the province. In February 1905, Abra was annexed to Ilocos Sur and remained as such until March 1917 when Abra was again made into a separate province by virtue of Act 2683.

The province of Abra has progressed slowly up to the present time. It is oftentimes referred to as "one-town province." The municipal districts and regular municipalities, except Bangued, are comparatively small and underdeveloped. They are like mere barrios in comparison with other towns in Central Luzon.

In the Second World War, when the Philippines fell under the Japanese Imperial Army, the subversive organization composed of Guerillas, was formed in Abra to resist the Japanese Occupation Army. This period of occupation, April 1942 to April 1945, has adversely affected the industries and properties of the people. They recovered only after the country has been liberated by the American forces in the latter part of 1945.

The inhabitants of the regular municipalities, with the exception of Manabo, Villaviciosa and La Paz, are almost hundred per cent Ilocanos. The municipal districts are generally inhabited by *Tinguians* with some Ilocanos. Like the Ilocanos, the *Tinguians* speak the Ilocano dialect; and they are resourceful, thrifty, hard workers and industrious. Some of the *Tinguians* lived in semi-civilized ways farther up in the mountains.

Abra is densely populated, as compared to some provinces of the Philippines based on the area of the province. Among the municipalities, Bangued, the capital of the province, is the most thickly populated. However, some of the inhabitants of the province are migrating to nearby provinces. This movement of

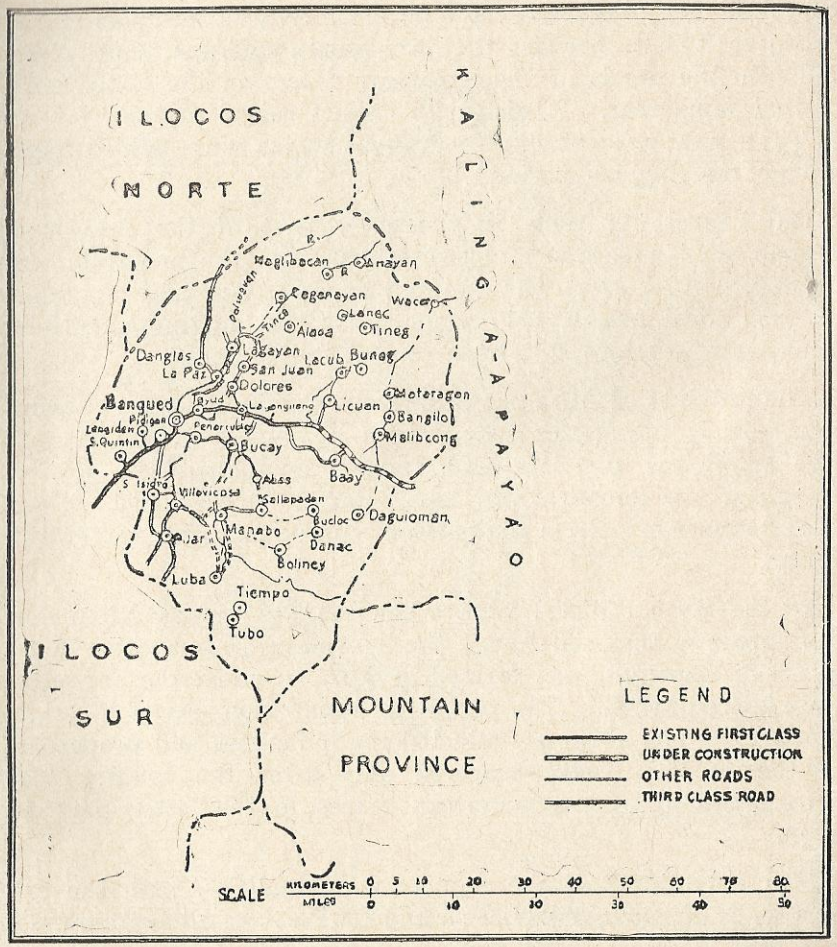



**Fig. 6. Road map of Abra Province.**



the people maybe attributed to the limited good agricultural areas in the province and to the fast deterioration of the soils as a result of improper farm practices in Abra.

According to the Yearbook of Philippine Statistics of 1966, published by the Bureau of the Census and Statistics, the population of Abra in 1939 was 87,780; 86,600 in 1948; and in 1960 it became 115,193. It can be noted that in 1948 there was a decrease in population of 1,180 people. This can be attributed to casualties during the Second World War and migration of some of the inhabitants. However, from 1948 to 1960 there was an increase in population of 28,593. This shows that the yearly increase in population was about 2,300 people.

*Transportation and market.*—The regular municipalities of Abra are linked by a net-work of first, second and third class roads. In 1955, the Office of the Provincial Engineer of Abra has recorded these net-work of roads as follows:

| *Class* | *National* | *Provincial* | *Municipal* | *Total* |
|---|---|---|---|---|
| | Kms. | Kms. | Kms. | Kms. |
| First | 70.96 | 86.91 | 8.29 | 116.16 |
| Second | 40.80 | 51.98 | 21.60 | 120.38 |
| Third | 9.51 | 88.28 | 88.38 | 186.17 |
| Total | 121.27 | 227.17 | 118.27 | 483.71 |

The 1966 Yearbook of Philippine Statistics published by the Bureau of the Census and Statistics, has listed the existing kilometerages of highways in Abra in the fiscal year 1964–1965 as follows: (1) municipal highway—117.44 kilometers, and (2) provincial highway—283.77 kilometers.

Difficulty in traveling to Danglas, La Paz, Lagayan, San Juan, Dolores, Lagangilang and Manabo is sometimes encountered. The difficulty is in crossing the Abra River which become uncrossable during and after heavy rains. Crossing this river is by means of a bamboo raft. During the old days when there was no road yet, Abra River is the main route from Bangued to Vigan, Ilocos Sur.

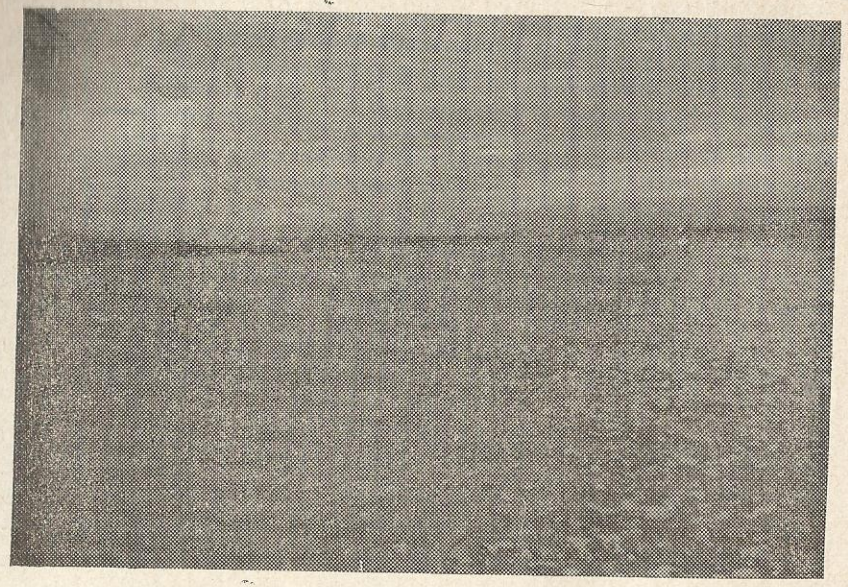


Fig. 7. Abra River, the biggest in the province, traverses the central portion of the province and serves as the main route to other parts of the province.

Fig. 8. People cross the Abra River on bamboo raft. Vehicles bound for Danglas, La Paz, Lagayan, San Juan, Dolores, Lagangilang and Manabo are also ferried across the river.



During the survey in 1955, the municipal districts of Abra are not accessible by road. They can be reached only by horseback and by foot on mountain trails. However, more roads and highways are proposed and some are under construction. These roads are Quirsodan-Baay, Bituin-Lacub, Lagayan-San Juan, Bucat-Sallapadan, Manabo-Tiempo, and feeder roads of Villaviciosa and Pilar.

All of these roads mentioned traverse some important barrios in the province. The highways under construction are the Abra-Ilocos Norte Road and Abra-Kalinga Road. During the survey about 27 kilometers of the Abra-Ilocos Norte Road have been completed and 67 kilometers of the Abra-Kalinga Road are already finished.

In 1955, at the time of the survey, the province has no airport. Bangued, the capital of the province, can be reached by first class road from Manila. The transportation companies operating within the province and neighboring provinces are the Philippine Rabbit, Benguet Auto Line, Volca, and Northern Bus Line. Jeepneys, weapon carriers and cargo trucks are the means of transportation in some of the towns and barrios in the province. Horses and bull-carts are used to transport farm products from farms to homes and to markets in places that are not accessible to motor vehicles.

Since Abra is still in her stage of recovery from her abandoned industries caused by the Second World War, products which include farm crops, livestock and poultry are generally consumed in the province. To a certain extent, traders from nearby provinces and Baguio City come to Bangued to purchase swine, cattle, chicken and other farm products. Before the World Conflict, it is claimed that Abra is supplying some of the provinces in Central Luzon with horses and cattle.

Bangued has the busiest market, especially during market days. People from the different places of the province come to Bangued to sell their farm products and buy their needs.

*Cultural development and improvements.*—The educational system of the province is shared by the public and private institutions. The public and private schools offer primary and intermediate education. Almost all barrios are provided with primary schools and in some cases with intermediate schools.

Municipal districts are also provided with educational facilities by the government as occasion demands and funds are available.

According to the Yearbook of Statistics of 1966, published by the Bureau of the Census and Statistics, the enrollment in Abra in the school year 1963–1964 in all school levels were as follows:

| *School Level* | *Public School* | *Private School* |
|---|---|---|
| Primary | 15,885 | 1,673 |
| Intermediate | 4,628 | 613 |
| Secondary | ..... | 3,054 |
| Collegiate | ..... | 530 |

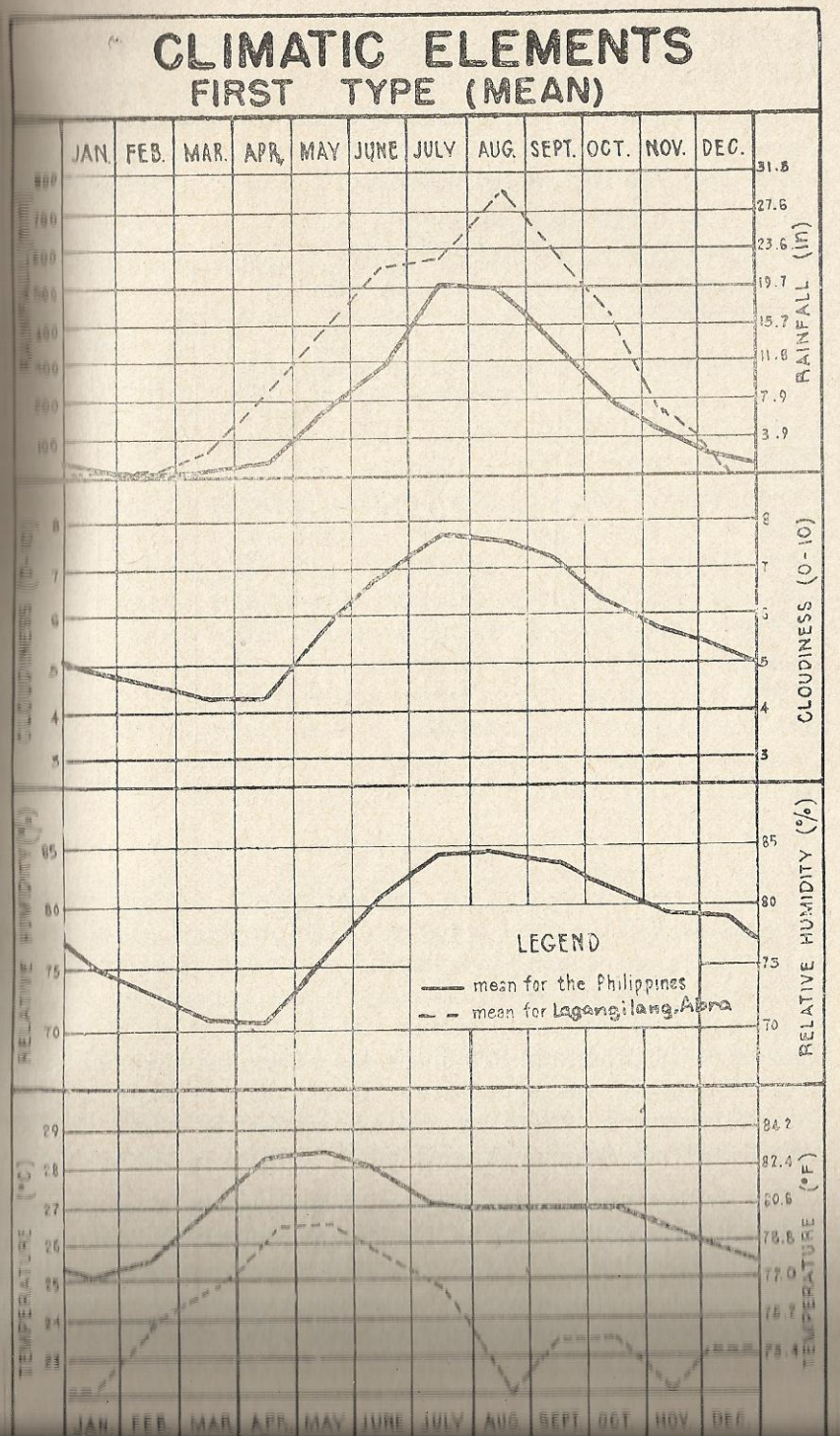
The Colegio del Sagrada Corazon in Bangued, operated by the Society of the Divine World, a Catholic organization, offers collegiate, secondary, intermediate and primary courses. Its branches at Bo. San Jose in Manabo, and in the towns of Dolores, La Paz and Pilar offer secondary courses. The Abra Mountain High School, a vocational secondary school in the municipal district of Bucloc, is also operated by the Society of Divine World. The Abra College, an institution operated by a private corporation in Bangued, also offers collegiate, secondary and elementary courses. The Saint John Memorial Institute in San Jose and La Paz Vocational High School in La Paz are the two other secondary schools in Abra operated by private persons.

The secondary public schools in Abra are the Lagangilang Agricultural High School in Lagangilang, Bucay High School in Bucay, and the Abra High School in Bangued.

## CLIMATE

The climate prevailing in Abra is similar to that of Ilocos Norte, Ilocos Sur, La Union, Pangasinan, Rizal, northwest and southwestern part of Mindoro, and northern and southwestern part of Palawan. It falls under the first type of climate, which is characterized by two pronounced seasons—dry and wet. The wet season is during the months of May, June, July, August, and September; while the dry period commences in October and ends in April. Rainfall is most abundant in July and August and the driest months are January and February. Table 1 shows the monthly average rainfall and the average number





of rainy days in Abra as recorded in the weather station at Lagangilang.

The variation of temperature in the province is shown in Table 1. The months of March, April and May are slightly hotter than the rest of the months of the year in the province.

TABLE 1.—*Average monthly rainfall, monthly average number of rainy days; mean, mean maximum and mean minimum temperature in Lagangilang Reforestation Project, Abra.*[1]

| Month | Rainfall in inches | Number of rainy days | 1961 temperature °C | | |
|---|---|---|---|---|---|
| | Years of record—13 years | | Mean | Mean maximum | Mean minimum |
| January | 0.30 | 1 | 21.6 | 26.8 | 16.3 |
| February | 0.66 | 1 | 24.0 | 29.8 | 18.3 |
| March | 2.13 | 4 | 25.4 | 30.9 | 19.1 |
| April | 6.67 | 10 | 26.5 | 32.6 | 20.8 |
| May | 12.06 | 17 | 25.7 | 30.4 | 20.9 |
| June | 19.50 | 21 | 24.8 | 29.0 | 20.5 |
| July | 21.00 | 25 | 22.6 | 25.6 | 19.6 |
| August | 28.18 | 26 | 23.2 | 26.3 | 20.1 |
| September | 20.98 | 22 | 23.5 | 26.8 | 20.2 |
| October | 8.93 | 12 | 23.5 | 27.3 | 19.6 |
| November | 5.47 | 6 | 20.5 | 22.7 | 16.3 |
| December | 1.22 | 3 | 23.4 | 25.5 | 19.2 |
| Annual | 127.10 | 148 | 23.7 | 28.0 | 19.4 |

[1] Weather Bureau, *Annual Climatological Review: 1961.* (Manila: Weather Bureau, 1961.) p. 49.

## AGRICULTURE

Like in most provinces of the *Philippines*, agriculture has been and is still the chief industry of the people of Abra. It is the industry on which they depend or derive their means of livelihood. The natives (*Tinguians*) are believed to be the forerunners of early agriculture in this province. Like the Igorots of the Mountain Provinces, the *Tinguians* have exhibited artistic ingenuity in agriculture evidently seen in their wonderful rice terraces. Rice terraces are commonly found in municipal districts than in regular municipalities of the province.

The limited areas suited for regular cultivation of crops have induced the inhabitants to be industrious, thrifty, and to engage in diversified farming. Rice, corn, and tobacco are the principal crops grown in the province; while sugar cane, beans, peanut, eggplant, camote, mungo, cassava and other vegetables make



up the secondary crops. In some towns and municipal districts, some fruit trees and perennial crops, like coffee and citrus, are grown in backyards.

### CROPS

The Census of Agriculture of 1960 recorded 32,544.8 hectares as farm area in Abra, of which 22,431.2 hectares or 68.92 per cent were under cultivation for temporary crops and 951.4 hectares or 2.92 per cent were planted to permanent crops.

*Rice.*—Rice is the staple crop of Abra and is the most important crop grown in the province. It is grown throughout the plains and in some upland areas of the province. The total area devoted to rice, as recorded in the 1960 Census of Agriculture, is 22,436.2 hectares with a total production of 513,562 cavans. The leading rice-growing towns are Tubo, Bangued, Tineg, Manabo, Sal-lapadan, Tayum and Dolores. Rice is commonly planted in the other municipalities and municipal districts of the province but not as extensive as in the towns mentioned above. In the municipal districts of Boliney, Bucloc and Sal-lapadan rice is grown twice a year. The people of nearby towns that produce insufficient rice for consumption come to these places to buy rice. The rice grown in these places are the bearded variety of the aromatic type.

The most important early maturing varieties of lowland rice grown in Abra are *Besar, San Fabian, Bandera, Macapuno, Sa-ong, Binaay, Paniola, Latiko, Granates, Ipon, Cocimay,* and *Dikit.* These varieties are planted in July and harvested in October to December. The average yield per hectare of these rice varieties ranges from 20 to 25 cavans per hectare.

The medium-late maturing varieties grown in Bucay, San Isidro and Luba are *Camaal, Lasuna, Uliog, Putik* and *Buntayog.* They are planted in July and harvested in November and December. They yield varies from 28 to 32 cavans per hectare.

The late maturing varieties are *Malloc, Quezon, Malaba, Buokan, Manteca* and *Mismis.* These varieties are planted in early part of July and harvested in the later part of December. The average yield per hectare varies from 29 to 32 cavans. These varieties are commonly grown in the northern part of the province and in some parts of Abra Valley.

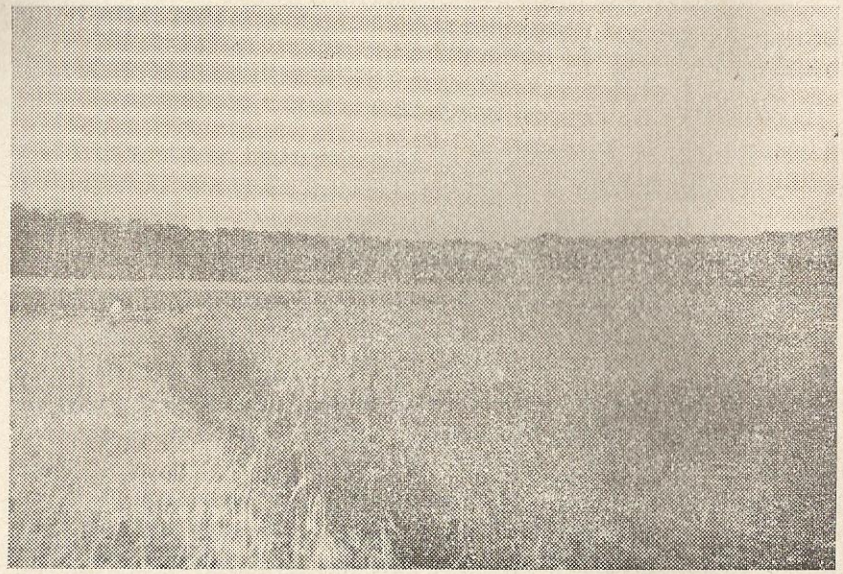


**Fig. 10. Rice is planted in the plains of Abra Province in July and harvested in November to December.**

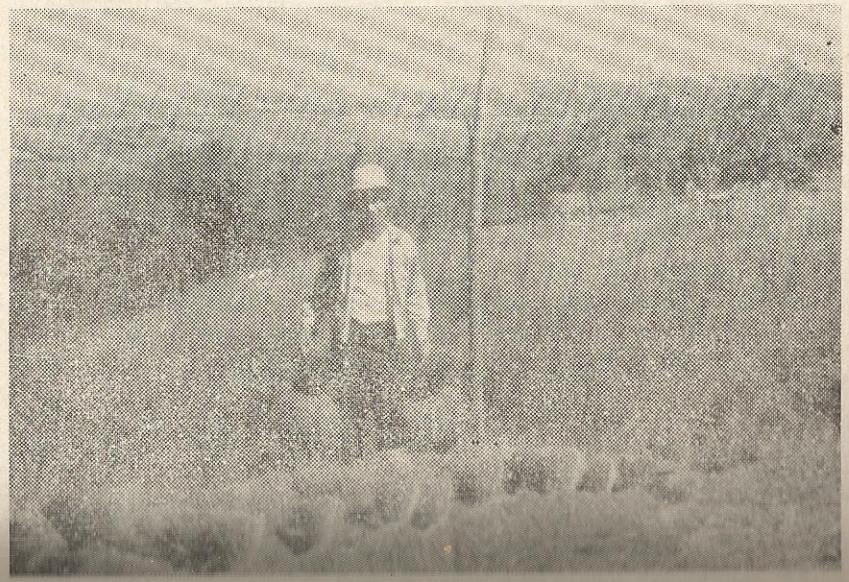


**Fig. 11. Upland rice (bearded variety) is bundled and dried under the sun after harvest.**



The existence of irrigation system in some of the farms in the province has enabled the farmers to raise a second crop of rice or *palagad*. The *palagad* rice is planted during the dry season or in the months of February and March and harvested in April and May. In places where there is no irrigation system, crop failures are being experienced when there is prolonged dry period. In almost all the towns of Abra, except in Sal-lapadan and Tayum, gravity system of irrigation is found. In 1960, the total irrigated area in Abra was about 16,115.6 hectares.

The manner of sowing lowland rice seeds in the province of Abra differs from those of the provinces in Central and Southern Luzon. In Abra, the seeds are sown on seed beds on elevated dry places.

Harvesting rice is by means of *yatab* by which the rice panicles are cut and then bundled, as shown in figure 11. Newly harvested rice in bundles are dried first under the sun and then stored in native rice granaries.

*Corn.*—Corn is second to rice in importance as a stable crop of Abra. In some places in the province, three crops a year including green corn, are produced. The first crop is planted during the months of April and May and harvested in August; the second crop is planted in October and harvested in January and February; while the third crop is planted in February to March and harvested in April to May.

The three corn varieties being grown are the Yellow flint, White glutinous and ordinary White. The greater bulk of the corn in the province is produced in some sections of Abra Valley, particularly in the northwestern to the southern part of Bangued town proper. The other places which produce large quantities of corn are Pidigan, Bucay, La Paz, Dolores, San Quintin, San Juan; Langiden and Lagangilang.

In Abra, corn is generally grown in nearly level to flat areas with good to excellent external and internal drainage. These areas are usually of alluvial soils ranging from loamy sand to silt loam. Only in rare cases corn is grown on hilly areas. The usual practice in the preparation of the land for corn planting consists of plowing once and harrowing of the field 2 to 3 times. Seeds are sown on hills with a distance of 70 to 80 centimeters between hills in a row. Thinning is

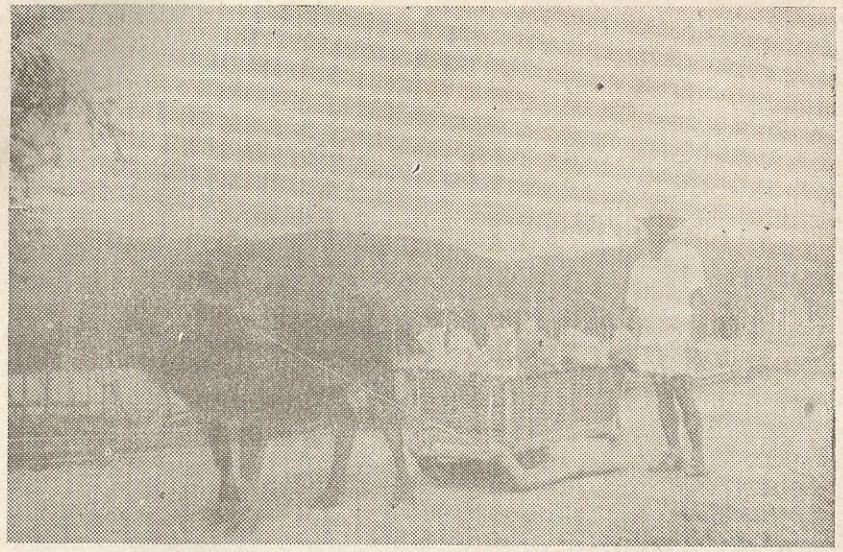


**Fig. 12. Sleds pulled by a carabao or a cow is the common means of transporting farm products in Abra Province. Note the bundles of rice in the sled.**

**Fig. 13. Rice granaries are common sights in Abra Province.**



employed by allowing only 2 or 3 healthy plants in a hill. Cultivation is done when the plants are about one foot high.

Corn plants are sometimes inter-cropped with peanuts or cowpeas, but more often, rotated with mungo, peanut, camote, cassava and rice.

Unhusked corn in cobs are usually stored by *halayhay* (hanging) method, either over stoves or anywhere around the house. This method of keeping corn in cobs is believed to be safe from attack of weevils. Corn for seed purposes are also kept this way.

Shelled corn are sold in the open market, but when the yearly production of palay in the province is insufficient, the farmers are forced to mill their corn to supplement their rice supply. Because of this only a small amount is left for the poultry and livestock in most cases.

*Tobacco.*—Tobacco is grown in the province for home consumption and for commercial purposes. As recorded in the Census of Agriculture in 1948, the area planted to tobacco was 470 hectares and in 1960, it was 2,994.4 hectares. The towns of Tubo and Pilar lead in the production of this crop. It was in 1955 that the people of Abra became conscious of the growing of Virginia tobacco. This was brought about by the National Government ban on the importation of Virginia leaf tobacco. However, native variety is likewise planted.

Virginia tobacco is said to be exacting in soil requirements. However, it has been reported that it thrives with varying success in almost all types of soil from light sandy to heavy clay loam. Soils rich in barnyard manure and other organic matter produce a lusty growth; while those grown on heavy, dark and poorly drained soils produce thick and coarse tobacco leaves. Light porous and friable soils produce light colored tobacco leaves. Rich, loamy sand and sandy loam soils that are usually warm, porous and friable are known to be best for tobacco growing.

In Abra, the tobacco is grown from seedlings raised in seedbeds measuring 1 meter wide and to any desired length. Tobacco seeds are mixed with wood ash, in 1:1 ratio, before sowing them in seedbeds. Sowing is done in the months of August to October. Seedbeds are shaded to encourage the growth and development of the seedlings. Thinning is done

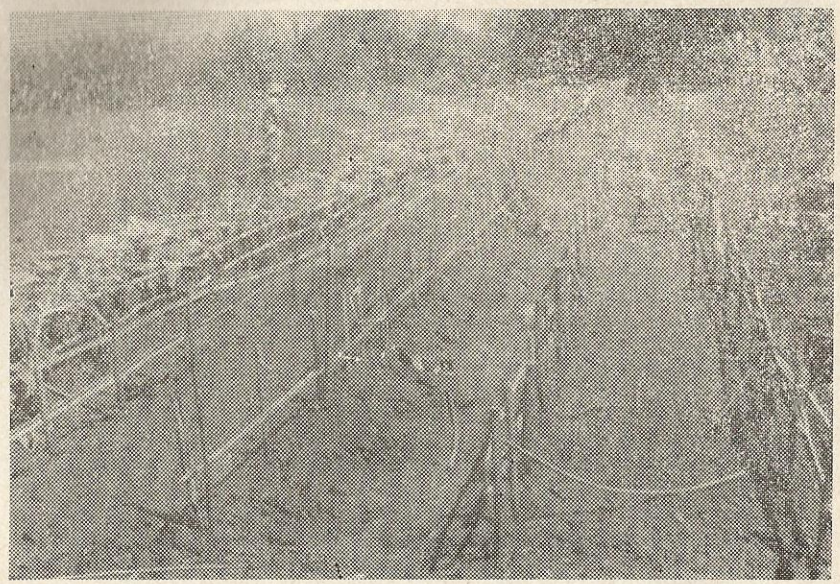


Fig. 14. Virginia tobacco seeds are first sown in nursery seedbeds to afford close attention and care for the young plants. Sowing is done in August to October.

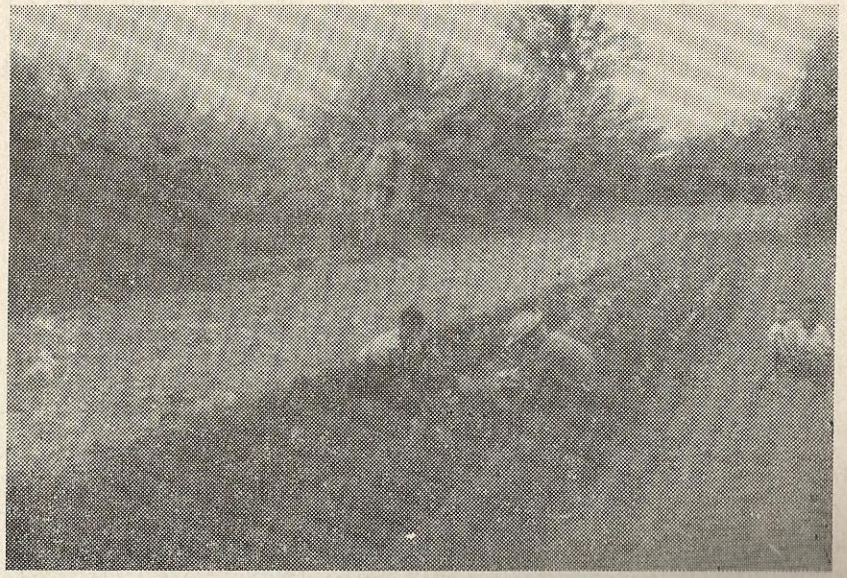


Fig. 15. Transplanting of healthy tobacco seedlings at 40 to 45 days old in well prepared fields is usually done late in the afternoon.



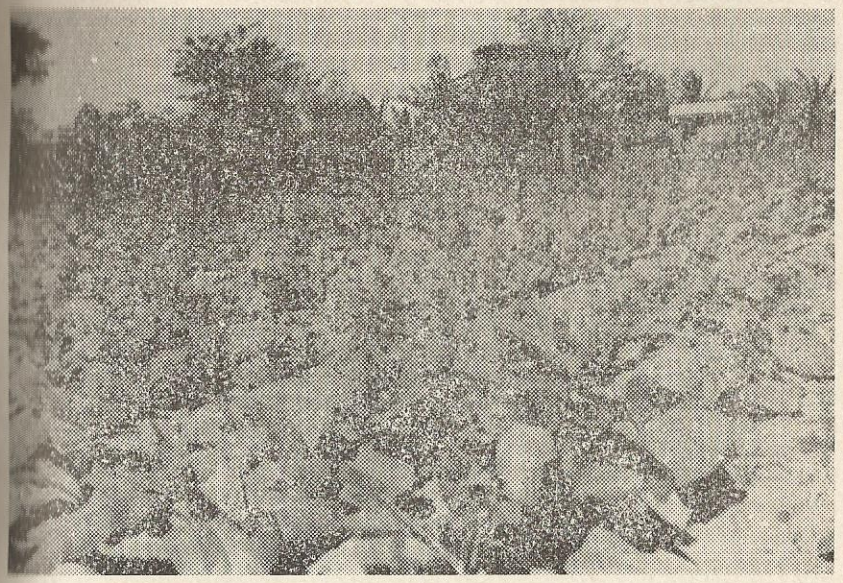


Fig. 16. A tobacco plantation in the plains of Abra Province.

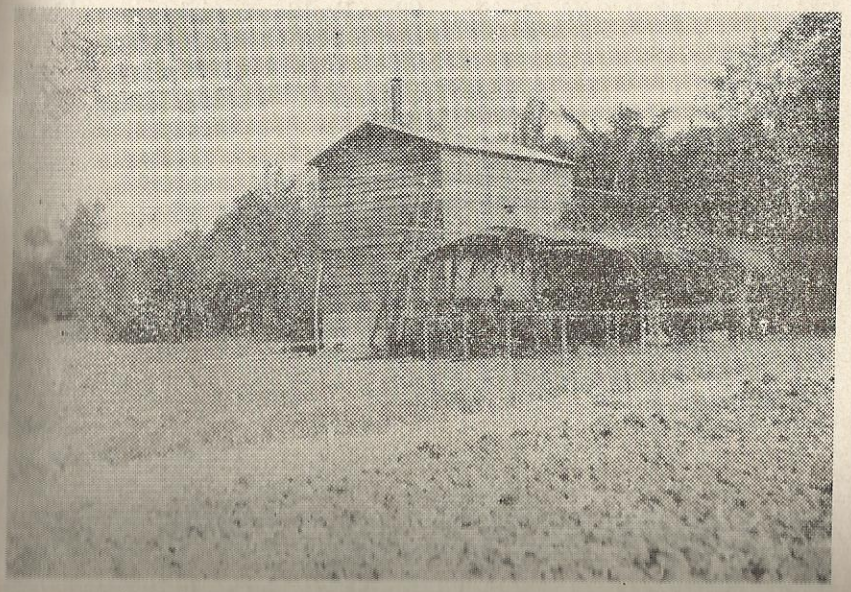


Fig. 17. A native flue-curing barn. Newly harvested tobacco leaves are brought to the shed annex the barn where women workers prepare them for curing.

to safeguard the seedlings from damping-off. Worm picking is also practiced in the care of the seedlings.

Healthy tobacco seedlings are transplanted at 40 to 50 days old in well-prepared fields. Distance of planting is 1 meter each way. Newly transplanted seedlings are watered daily until they are fully rooted. Picking of worms is also made daily during the growth of the tobacco plants. Cultivation and weeding are often done. Application of fertilizers is also done, but without prior soil analysis, thus, tobacco growers do not produce good quality tobacco leaves.

*Coconut.*—Planting of coconut in Abra is being encouraged by the personnel of the Agricultural Productivity Commission. Young seedlings are being sold to the farmers at nominal price. It was reported that several hectares of land are now planted to coconut of the San Ramon and Laguna types. The Census of Agriculture of 1960 has reported that about 91.4 hectares in Abra have been planted to coconut.

*Sugar cane.*—Sugar cane is commonly grown in Abra mainly for local consumption. The sugar cane varieties grown are the P.O.J. 2878 and Badila. The Badila variety is sold in the market for chewing.

The juice of the sugar cane is extracted by means of a carabao-drawn wooden sugar cane crusher. The extracted juice is mostly manufactured into a native wine called *basi*. Some is also processed into *panocha* or muscovado sugar.

Sugar cane crop, like any other farm crops, grows on a wide range of soils and topography. But it grows best on deep, fertile, well drained alluvial soils. The cultural practices, such as land preparation, furrowing and other soil management for sugar cane, are similar to those of corn, except in the distance of planting. Cane points are planted closer in the furrow, about 40 to 50 centimeters apart. In Abra, cultivation and weeding of sugar cane fields are similar to those employed in cornfield, that is, with the use of native plow pulled by a carabao which requires more time and labor. Few farmers apply fertilizers in their sugar cane fields, and good soil management is entirely neglected, thus, very low yield per unit area results.



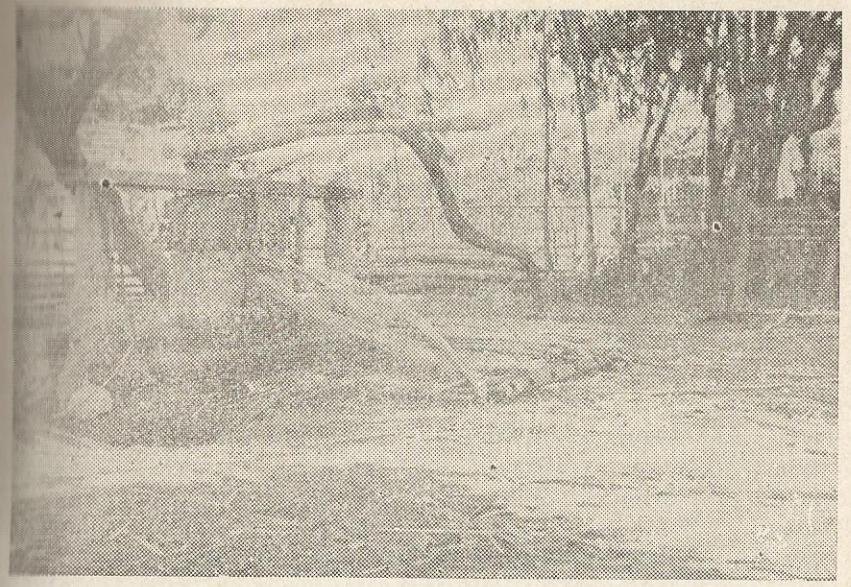


**Fig. 18. A native sugar cane crusher drawn by a carabao in Abra Province.**

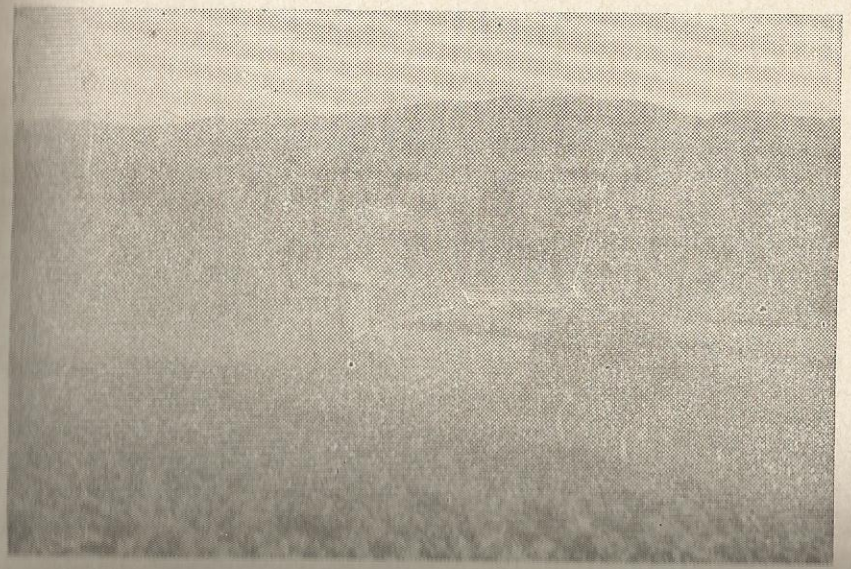


**Fig. 19. The carabao-drawn native plow is the common farm implement in most farms in Abra Province.**

*Fruits and other bearing trees.*—The fruit trees most commonly grown are banana, papaya, mango, caimito, pummelo, nangka, santol, and oranges. Small scale coffee plantations are also found in some elevated places in Luba, Pilar, Boliney and in the eastern part of the province, particularly in Boay, Licuan and Danac.

*Root crops.*—The root crops raised in the province are cassava, camote, tugui, gabi, ubi, and peanut. They are grown in almost every locality of the province. Root crops are raised for home consumption to supplement the staple food. These crops prefer to grow on deep, fertile, friable, loose and well drained soils.

*Other crops.*—The people of Abra is known to be vegetarian, hence, the growing of vegetables is never neglected in every farm within the province. The vegetables are generally grown either by inter-cropping or in rotation with rice, corn and tobacco. However, some farmers grow them in backyards and along the dikes of ricefields. The vegetables commonly grown are eggplant, squash, beans, tomato, upo and ampalaya. Due to the inadequacy of transportation facilities, perishable vegetables are raised for home consumption only.

Fiber crops like *kapok* and maguey, which are growing wild, are found in the eastern part of the province.

## AGRICULTURAL PRACTICES

Some of the old farming methods are still used in Abra. The native plow and harrow are the two farm implements mostly used in tilling the fields. Though bullocks are sometimes used in tilling upland areas, the carabao is still the main source of power for almost all farm operations in the province. Some good farm practices, like weeding, crop rotation and inter-cropping which have been employed since the early agriculture of the province, are still practiced although not regularly observed. The use of commercial fertilizers is a recent introduction in the province. During the time of the survey (in 1955) it was noticed that the application of fertilizers is by hit-and-miss method where not much benefits are derived. The improved methods of lowland rice culture introduced by the Bureau of Agricultural Extension are being adopted gradually in the province.



Fig. 20. Straight planting of lowland rice is practiced in Abra Province.

Fig. 21. Lowland rice is grown in bench terraces.

Bench terracing which is believed to have been in existence in the country long before the Spanish regime, is considered as one of the most essential agricultural practices in Abra. This was introduced in the province to enable the farmers to utilize the hillsides for the culture of lowland rice due to the limited areas of the plains. The presence of springs in the hillsides, which supply irrigation water has made possible the adoption of bench terracing for the growing of lowland rice. However, terraces are not employed on the sloping areas of the province that are cultivated to tobacco, corn, upland rice, root crops and vegetables.

In 1955, there is no government-operated irrigation system in Abra. It is the clamor of the farmers of Abra Valley for the government to provide irrigation system in order to solve the problem of lack of water for the growing of lowland rice. The existing irrigation systems in the province are the communal irrigation systems, i.e., water from creeks is diverted and impounded by means of dams constructed by the farmers themselves. Examples of these dams can be found in Abuguid, La Paz and in Banoy, Pidigan. The presence of three communal irrigation systems in some of the towns of Abra have enabled the farmers to plant rice twice a year. The Census of Agriculture of 1960 has recorded 16,115.6 hectares of land in Abra that are under irrigation.

Crop rotation is another important farm practice for maintaining the fertility of the soils. In Abra, the system of crop rotation employed is not in conformity with the principle of a good cropping system that would contribute to the maintenance of the fertility of the soil, that is, planting shallow-rooted crops first, followed by deep-rooted crops, and finally with leguminous crops for green manuring at least once in 3 years. In Abra, the sequence of crop rotation is corn-rice-tobacco or corn-rice-vegetables such as eggplant and tomato. In some instances, the sequence is, rice-corn-tobacco throughout the year in the same field. This system of crop rotation being followed in Abra causes rapid exhaustion of the soil fertility.

Inter-cropping and planting of catch crops are sometimes practiced in the province. A good farm practice in Abra is the planting of corn with peanut or cowpeas or upland rice. Some advantages can be derived from this practice. Two



crops—main crop and catch crop or inter-crops can be produced which mean additional income per unit area. The inter-crops, which are planted in the spaces between the rows of the main crop, serve as cover crop, thus, protecting the soil from the raindrops. These also check the growth of weeds, thereby weeding expenses are reduced.

*Kaingin* system of farming, which had been employed since the early days of agriculture in the province, is still practiced in the cultivation of food crops such as rice, root crops, corn and vegetables. This system is considered the most destructive way of farming. It had led to the destruction of the original vegetations in the mountains and hillsides of the province which resulted to the existence of vast open grasslands and *parang*. The removal of the forest trees had caused floods which resulted to the annual destruction of crops in the lowland areas. It is, however, being reforested now. In fact, a forest station was established in Bo. Bituin at Lagangilang. In 1955, this station had reported that about 500 hectares had been reforested with Benguet Pines.

## LIVESTOCK AND POULTRY INDUSTRY

The livestock and poultry of the province are still on their recovery stage from the ravage of World War II. Before the Second World War, it was said, Abra was supplying cattle, horses, swine, and chicken to the nearby provinces, Central Luzon, and even Manila throughout the year. According to the 1960 Census of Agriculture, 1,340.2 hectares or 4.11 per cent of the total farm lands of the province (32,544.8 hectares) are under pasture land. On this pasture land, carabao, cattle, horse, swine, goat, and sheep are raised.

During the Japanese occupation, the province of Abra, like the other provinces of the Philippines, had suffered tremendous losses, particularly in her livestock industry. The farm animals were abandoned, some were commandeered and others were slaughtered for home consumption. The farm animals which survived during this period became the foundation stock of the livestock and poultry industry in Abra Province. After liberation, efforts had been made by the Bureau of Animal Industry to rehabilitate the livestock industry of the province. A breeding station with foreign breed animals had been introduced. Later, the Bureau of Animal Industry

carried out the "Livestock Operation Dispersal", a program launched and aimed at distributing breeding stock to the deserving farmers or 4–H Club members of the province.

The kind, number and value of livestock and poultry in Abra province in 1960 as recorded in the Agricultural Census, are as follows:

| *Kind of livestock* | *Number* | *Value (Pesos)* |
|---|---|---|
| Carabaos | 45,886 | 8,236,704 |
| Cattle | 26,125 | 4,534,806 |
| Hogs | 55,018 | 2,572,860 |
| Horses | 6,376 | 825,449 |
| Goats | 6,661 | 84,195 |
| Sheep | 402 | 5,040 |
| Chicken | 191,518 | 258,726 |
| Ducks | 2,833 | 5,108 |
| Geese and turkeys | 18 | 69 |
| Pigeons | 922 | 916 |
| TOTAL | 259,659 | 16,523,883 |

*Carabao.*—The carabao plays an important role in the farm. As previously mentioned, carabao is one of the sources of power in the farm. Each farm unit maintains an average of 1 to 2 heads for use in tilling the soil and hauling farm produce. These work-animals are reared in the farm mainly for this purpose. So far, there is no organization or corporation in the province engaged in raising carabao in big scale.

In 1960 Census, 45,866 heads of carabao, of all ages and sexes, had been recorded. Out of this total number of carabaos, 41,889 heads were reported as farm household animals and 3,977 heads as non-farm household animals. Of the 41,889 heads of farm household animals, 21,983 heads are being utilized as work-animals in the farms.

*Cattle.*—Beef cattle raising has some commercial importance. Most of the cattle being raised are sold to traders. A few cattle are raised in the farms, usually the males, for work-animals. Like the carabaos, the cattles are used in the farms for tilling and pulling carts.

It has been observed during the survey that proper care—protection and feeding, and other good animal managements are not properly implemented as shown by the appearance of the animals themselves. They are small and thin.



*Horses.*—Horses are not raised in big scale. They are raised in the farms for traveling and hauling farm produce. The horses in this province are well known for their poise and indurance. They are commonly used in pulling calesas, and some are used for hauling farm produce from the farm to the markets, especially in places inaccessible to any other means of transportation. The horse population of the province, as recorded in the Agricultural Census of 1960 is 6,376 heads.

*Goat.*—The raising of goats in the province is of local importance. A herd of 4 to 10 is common in every farm. Like in cattle raising, goats are set free to roam around to forage throughout the year without protection and additional feeding. Goats are not particular to feeds and they are known for their voraciousness, but they prefer to graze on areas where there are plenty of shrubs. The common breed of goats is the native. Only a few are of foreign breed. Most of the goats in the province are raised for local consumption.

*Swine.*—Swine is another farm animal raised in Abra which is of local importance. In 1960, a total of 55,018 heads of swine had been recorded in the Agricultural Census as existing in the province. Of this number 82.8 per cent are raised in the farms and 17.2 per cent in other areas. The animals are allowed to subsist on kitchen refuse and farm products, such as rice bran, vegetables, and root crops. The feeds are supplemented by forage as the swine are set free to stray around in the farm and backyards. Generally, the swines are raised for local consumption, however, some are sold to traders from other provinces. The common breeds being raised are the native and a few hybrids.

*Poultry.*—The poultry being raised in Abra are chickens and ducks. Poultry, like swine, are reared both in farms and in backyards of community centers. The poultry feeds consist primarily of rice and corn supplemented with fresh green grasses obtainable in the farms and backyards. Before the Second World War, it was claimed that Abra was supplying nearby provinces and Manila with poultry and eggs.

## FARM TENURE

Farm tenure refers to the manner in which farm is held by its operator. The farm lands in Abra are operated by five classes of operator—full-owners, part-owners, tenants, managers

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and other forms of tenure. Full–owners are farm operators who own all the land in which they work; part-owners are farm operators who own part and rent or lease other parts of the land in which they work; tenants are farm operators who rent or lease from others all the land they work on, and farm managers are operators who supervise the operation of the farm for the landowner, receiving wages or salaries for their services. The tenants are in six categories; namely, (1) cash tenants, (2) fixed–amount–of–produce tenants, (3) share–of–produce tenants, (4) cash–and–share–of–produce tenants, (5) rent–free tenants, and (6) other types of tenants.

In 1960, based from the record in the Agricultural Census, the total number of farm, total farm area and the percentage of farms under the different farm tenures are as follows:

| Tenure of Farm Operator | *Total number of Farms* | *Total farm Area (Ha.)* | *Percentage of farm* |
|---|---|---|---|
| Full owner | 8,927 | 19,866.6 | 56.35 |
| Part owner | 4,514 | 9,251.3 | 28.48 |
| Tenants: | 2,383 | 3,313.0 | 15.05 |
| Cash tenants | (12) | (15.0) | (0.08) |
| Fixed-amount- of- produce tenant | (22) | (13.0) | (0.14) |
| Share-of-produce tenant | (2,259) | (3,158.7) | (14.26) |
| Cash-and-share-of-produce tenant | (18) | (21.6) | (0.12) |
| Rent-free tenant | (21) | (28.8) | (0.13) |
| Other tenants | (51) | (75.9) | (0.32) |
| Manager | 3 | 55.1 | 0.02 |
| Other forms of tenure | 15 | 58.8 | 0.10 |
| Total | 15,842 | 32,544.6 | 100.00 |

In Abra, there is little problem in tenancy. The major portion of the farms is equally distributed among the people. The average landholding in the province in 1960 was 2.05 hectares. Of the total number of farms about 56 per cent are operated by full owners and only about 15 per cent are operated by tenants. While 28.48 per ccent are operated by part–owners. The tenants are the landless farmers who came from the neighboring provinces. Every farmer, except a few who are either tenants or farm managers, cultivates his own farm.

Crop sharing between the tenants and the landlords varies with the type of crops grown, productivity of the land and location of the farms. In Bangued, Manabo and Bucay, where the bulk of the rice is produced, the tenants get one–half of the produce if they supply everything. But if the landlord furnishes the work–animals, seeds, and farm implements, the tenants get only one–third of the produce. Expenses for seeds are deducted first before sharing.



In the case of upland rice, the tenants get two-thirds of the harvest if they provide work-animals, farm implements and seeds.

Most of the works in the farms are done by cooperative venture among farmers to catch up with the planting periods and the availability of water during the planting of lowland rice.

## Types of Farm

In 1960, the Bureau of the Census and Statistics classified farms in the Philippines into 14 types, ten of which are grouped as crop farm. The relationship between the area planted to a particular crop to the area of cultivated land in each farm is the basis for classification. A crop farm is classified according to the particular crop which occupies 50 per cent or more of the cultivated part of the farm.

The 10 crop farms classified based on the first ten major crops in the country are; (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 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 Abra according to census figures of 1960 are as follows:

| *Types of Farm* | *Total number* | *Total Area (Has.)* |
|---|---|---|
| Palay | 14,122 | 28,970.4 |
| Corn | 1,241 | 1,895.7 |
| Tobacco | 137 | 185.7 |
| Root crop | 18 | 28.5 |
| Coconut | 2 | 96.9 |
| Fruit | 44 | 225.7 |
| Livestock | 83 | 764.0 |
| Poultry | 46 | 41.3 |
| Others | 149 | 336.6 |
| | 15,842 | 32,544.8 |

## FARM INVESTMENT

Farm investments consist of the land, building, implements and work animals. The implements of the average farmer consist of a plow, harrow, sled or bull cart. Work-animals are carabaos or cattle bulls. Tractors and accessories, threshing machines, harvester and motor vehicles can be found in larger farms.

The numbers of selected farm equipment which corresponds to farm investment in Abra Province according to the Census of 1960 are as follows:

| *Equipment* | *Number* |
|---|---|
| Plows | 23,145 |
| Harrows | 20,583 |
| Tractors | 12 |
| Harvesting machine | 1 |
| Thresher | 33 |
| Carts | 7,369 |
| Motor vehicles | 54 |
| Sugar cane crusher | 25 |
| Sprayers | 833 |
| Incubators | 4 |



The farm value of fully-owned farms in Abra Province in 1960, as recorded in the Census of Agriculture, were as follows:

| | *Total Value (Pesos)* | *Average Farm Value (Pesos)* | *Average Value of Farmland/ha. (Pesos)* |
|---|---|---|---|
| Land | 29,519,353 | 3,343 | 1,486 |
| Building | 322,951 | | |
| | 29,842,304 | | |

## SOIL SURVEY METHODS AND DEFINITION

Soil surveying consists of (1) the determination of the morphological characteristics of soils; (2) the grouping and classification of soils into units according to their characteristics; (3) their delineation on maps; and (4) the description of their characteristics in relation to agriculture and other activities of man.

Soils, their landscapes and underlying formation, are examined in as many sites as possible. Borings with the soil auger are made, test pits are dug, and exposures such as road and railroad cuts are studied. An excavation or road cut exposes a series of layers 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 grouped into classification units, of which the three principal ones are (1) soil series, (2) soil type, and (3) soil phase. When two or more of these mapping units are in such intimate or mixed pattern that they cannot be clearly shown on a small-scale map, they are mapped or grouped into a (4) 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 material. 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 Bituin series was first found and classified in Barrio Bituin, Abra.

A soil series has one or more soil types defined according to the texture of the upper part of the soil, or the surface soil. The class name such as sand, loamy sand, sandy loam, silty clay loam, clay loam or clay is added to the series name to give the complete name of the soil. For example, Bituin clay is a soil type within the Bituin 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 soil type due mainly to degree of erosion, degree of slope and amount of gravel and stone in the surface soil is usually segregated on the map if the area can be delineated.

A soil complex is a soil association composed of such intimate mixture of series, types, or phases that cannot be indicated separately on a small-scale map. This is mapped as a unit and is called a soil complex. If, in an area, there are



several series such as Alimodian, Bauang and Cervantes that are mixed together, the complex must bear the names of the two dominant series, as the case may be. If there is only one dominant constituent, the complex bears the name of that series, as Alimodian or Cervantes complex.

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

The soil survey party, composed of two or three technical men, maps the area and delineates the various soil types, phases, complexes and miscellaneous land types. All natural and cultural features found in the area are indicated on the soil map, such as trails, railroads, bridges, telephones and telegraph lines; barrios, towns, and cities; rivers and lakes; prominent mountains, and many others.

## THE SOILS OF ABRA

The soils of Abra were derived from a variety of rocks that are found in the hills and mountains of the province. In the southeastern part of the province, comprising the hills and foot-hills, are gently folded sandstone, shale and conglomerates. In some of the hills and gently undulating areas, limestone or gravels are sometimes embedded with shale and sandstone.

These varied kinds of rock, as acted upon by the different forces of soil forming factors—climate, relief and biological activities, have produced different kinds of soils—differing in chemical as well as in physical characteristics.

Likewise, the varying degrees of resistance of the different rocks to the forces of weathering give rise to varying relief which ranges from gently sloping to rugged, irregular and accentuated. The harder rocks, such as diorite, basalt, andesite and other igneous rocks, and limestone, are responsible for the formation of rugged mountains; and the softer rocks like sandstone and shale give rise to a more gentle hills and mountains.

Moreover, the more gently sloping hills and foot-hills have deeper soils, while areas of steeper slope have shallower soils and in most intances there are outcrops. The plains and valleys have also deeper soils which were derived from alluvial deposits brought down from the hills and mountains.

Twenty soil types and three land types were identified and classified in Abra. Seven soil types are secondary soils and thirteen are primary soils. The area and proportionate extent of each soil mapping unit are shown in Table 2. The location and distribution of the different soil types and land types are indicated in the accompanying soil map.

TABLE 2.—*Area and proportionate extent of each soil mapping unit in Abra.*

| Soil mapping number | Soil mapping unit | Area[1] (Ha.) | Per cent |
|---|---|---|---|
| 192 | Bigaa clay | 1,629.97 | 0.41 |
| 646 | Bigaa sandy clay loam | 3,220.19 | 0.81 |
| 546 | Bigaa silty clay loam | 516.82 | 0.13 |
| 220 | Maligaya clay | 993.89 | 0.25 |
| 378 | Maligaya sandy clay loam | 3,180.44 | 0.80 |
| 596 | San Manuel sandy clay loam | 4,532.12 | 1.14 |
| 96 | San Manuel sandy loam | 795.11 | 0.20 |
| 327 | Alimodian clay | 3,100.93 | 0.78 |
| 126 | Alimodian clay loam | 675.84 | 0.17 |
| 651 | Alimodian sandy clay loam | 3,100.93 | 0.78 |
| 928 | Bantay sandy loam | 1,669.73 | 0.42 |
| 121 | Bauang clay | 15,146.85 | 3.81 |
| 647 | Bauang clay loam | 13,556.63 | 3.41 |
| 648 | Bauang silty clay loam | 993.89 | 0.25 |
| 574 | Bituin clay | 40,590.37 | 10.21 |
| 24 | Binangonan clay | 3,180.44 | 0.80 |
| 153 | Bolinao clay | 2,663.62 | 0.67 |
| 649 | Cervantes sandy clay loam | 25,801.32 | 6.49 |
| 174 | Sevilla clay | 3,538.24 | 0.89 |
| 650 | Sevilla sandy clay loam | 5,605.53 | 1.41 |
| 45 | Mt. soils, undifferentiated | 207,324.93 | 52.15 |
| 152 | Riverwash | 7,871.59 | 1.98 |
| 171 | Rough stony land | 47,865.62 | 12.04 |
| | Total | 397,555.00 | 100.00 |

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

The soils of Abra are grouped conveniently into four general categories; namely, (1) soils of the plains and valleys, (2) soils of the intermediate uplands, (3) soils of the hills and mountains, and (4) miscellaneous land types.



| Soil and Miscellaneous Land Types | Number |
|---|---|
| A. Soils of the Plains and Valleys: | |
| 1. Bigaa clay | 192 |
| 2. Bigaa sandy clay loam | 646 |
| 3. Bigaa silty clay loam | 546 |
| 4. Maligaya clay | 220 |
| 5. Maligaya sandy clay loam | 378 |
| 6. San Manuel sandy clay loam | 596 |
| 7. San Manuel sandy loam | 96 |
| B. Soils of the Intermediate Uplands: | |
| 1. Bantay sandy loam | 928 |
| 2. Bauang clay | 121 |
| 3. Bauang clay loam | 647 |
| 4. Bauang silty clay loam | 648 |
| 5. Sevilla clay | 174 |
| 6. Sevilla sandy clay loam | 650 |
| C. Soils of the Hills and Mountains: | |
| 1. Alimodian clay | 327 |
| 2. Alimodian clay loam | 126 |
| 3. Alimodian sandy clay loam | 651 |
| 4. Binangonan clay | 24 |
| 5. Bituin clay | 574 |
| 6. Bolinao clay | 153 |
| 7. Cervantes sandy clay loam | 649 |
| D. Miscellaneous Land Types: | |
| 1. Mt. soils, undifferentiated | 45 |
| 2. Riverwash | 152 |
| 3. Rough stony land | 171 |

The soils of the plains and valleys are composed of seven soil types with an area of 14,868.54 hectares or 3.74 per cent of the total area of the province; soils of the intermediate upland are represented by six soil types with a total area of 40,510.87 hectares or 10.19 per cent; soils of the hills and mountains is composed of seven soil types with a total area of 79,113.45 hectares or 19.90 per cent, and three of the miscellaneous land types with a total area of 263,062.14 hectares or 66.17 per cent of the total area of the province.

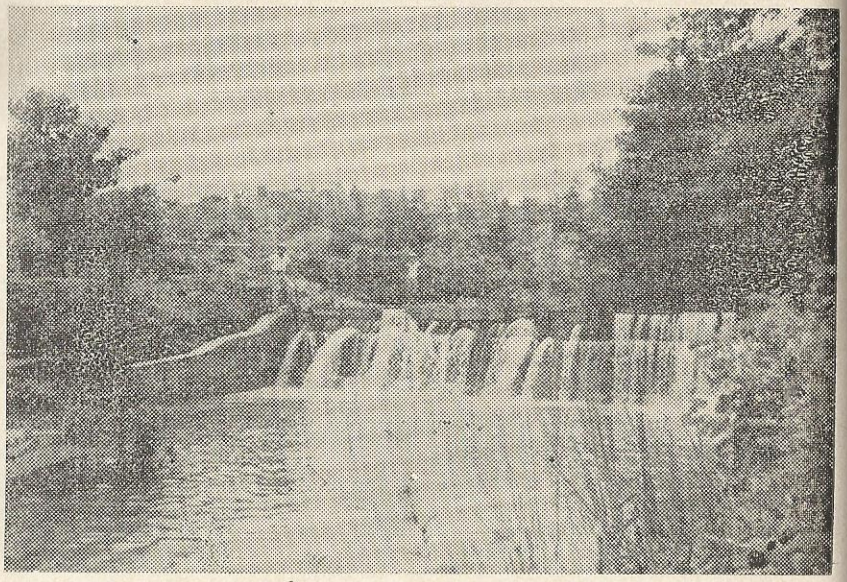

**Fig. 22. This irrigation system enables the farmers to raise two rice crops a year.**

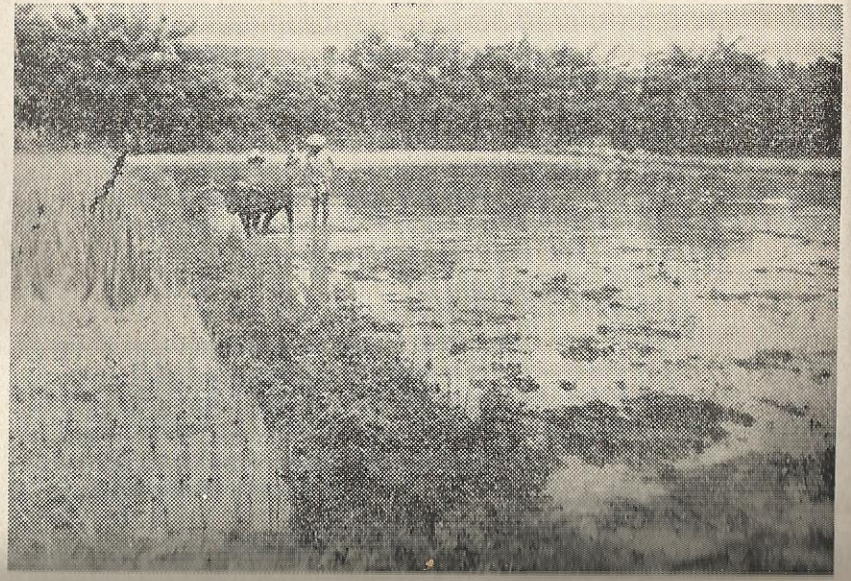

**Fig. 23. Landscape of Bigaa series found in Angad, Bangued, Abra.**



## Soils of the Plains and Valleys

The soil materials brought down from the higher lands and those deposited by rivers along their courses constitute the soils of the plain. These are the alluvial soils, the most productive and widely used soils in the province. The crops grown are rice (lowland and upland), corn, sugar cane, cassava, camote, eggplant, mungo, peanut, tobacco, tomato and cowpea.

The soils are usually deep, well drained and of light to heavy textures, ranging from sandy loam to clay.

The soils of the light textures are the San Manuel series while the Bigaa and Maligaya series are the medium to heavy soils.

### BIGAA SERIES

Bigaa series is derived from recent alluvial deposits. It has level to nearly flat relief. This soil series is characterized by a deep, moderately developed profile with moderately dense subsoil underlain by an unconsolidated material.

Lowland rice is the principal crop grown on this soil series. Other crops grown are corn, tobacco, sugar cane, and cassava. Three soil types under this soil series were delineated and mapped in the province.

The profile characteritics of the series are represented by Bigaa clay are as follows:

| Depth (Cm.) | Characteristics |
|---|---|
| 0–25 | Surface soil, brown to dark brown clay with brick-red streaks; fine granular structure; sticky and plastic when wet; firm when moist and very hard when dry; iron concretions are present; texture becomes heavier as it goes deeper; the pH is 5.5–6.0. |
| 25–60 | Upper subsoil, heavy clay to clay; light brown to dark gray with brick-red streaks; iron concretions are present; plastic and sticky when wet; very hard when dry and firm when moist. |
| 60–120 | Lower subsoil, light gray to yellowish brown compact clay; very sticky and plastic, iron concretions are present. |
| 120 and below | Substratum, light gray; plastic and sticky clay; iron concretions are present. |

*Bigaa clay* (192).—Bigaa clay occupies the level areas in the barrios of Pidipid, Kanan and San Gregorio of La Paz town, and in the barrios of Abaguid, Tuday, Damday and Manganip of the town of Danglas. The aggregate area is about 1,629.97 hectares or 0.41 per cent of the total area of the province.

Lowland rice is the principal crop in this soil type. The area occupied by this soil type is partly irrigated by the Abaguid [area occupied by this soil type is partly irrigated by the Abaguid] Communal Irrigation Project, which makes possible the production of two rice crops a year. The usual planting season is in July and harvesting is in October to December. Harvesting date depends upon the variety of rice planted. The average yield is comparatively higher than those in non-irrigated areas. Corn, tobacco, eggplant, and legume crops are being planted on the non-irrigated areas after harvest of the regular rice crop.

The presence of irrigation water in some of the areas enables the farmers to control weeds and use fertilizers effectively.

Continuous cropping of this soil type without application of soil amendments or fertilizers may soon deplete the soil of its fertility. The return of plant residues into the soil and application of animal manure and fertilizer will help maintain the fertility level of the soil. Crop rotation with green manuring is also a good practice in maintaining the fertility of the soil.

*Bigaa sandy clay loam* (646).—This soil type occupies the nearly level to flat areas in the barrios of San Jose, Bantaoa, San Juan, Dalimono, San Ramon and Cabaroan, Manabo; the level areas in Bos. Pias, Kasili, Angad, Patucanay, Bangued and Tayum. The area covered is about 3,220.19 hectares or 0.81 per cent of the total area of the province.

The surface soil is sandy clay loam with moderate fine granular structure. Mixed with the sandy materials are iron concretions, and streaks of brick-red color. The depth ranges from 20 to 25 centimeters. The soil becomes compact at lower depth. It is slightly sticky and plastic when wet, firm when moist, hard and cracks when dry. Roots are abundant in this layer. The pH is 5.5 to 6.0

This soil type makes Manabo one of the leading rice producing municipalities of Abra. The rice produced constitute



**Fig. 24. Lowland rice on Bigaa soils. Background is a partial view of Bauang series.**

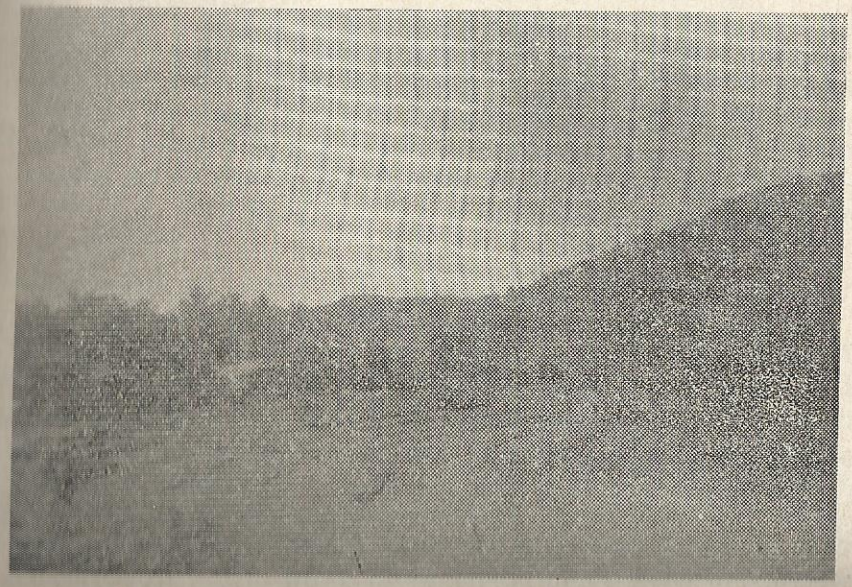

**Fig. 25. Landscape of Maligaya series. The hilly area at the background is Alimodian series.**

the greater bulk of the farm products of the municipality of Manabo, and is considered a money crop of the municipality. In 1955, the local varieties grown are *Macarramiay, Cocimay* and *Dikit.* Planting starts in July and ends in September. Harvesting of the rice crop begins in November until the month of January. The average yield ranges from 25 to 30 cavans of palay per hectare.

Rice is grown continuously in some areas, while tobacco, corn, eggplant, cowpea and peanut are raised in some portions. Good soil management for the maintenance of soil fertility is not practiced. It is assumed, therefore, that sooner or later the rice yield will become very low due to the depletion of plant nutrients in the soil. To correct this situation, crop rotation, and application of farm manure and fertilizers are suggested.

*Bigaa silty clay loam* (546).—This soil type covers an area of about 516.82 hectares or 0.13 per cent of the total area of the province. It occupies the level areas in the barrios of Suyo, Mildanao and Banay, Pidigan.

The profile characteristics of this soil type are similar to those of Bigaa clay except the texture of the surface soil. Lowland rice is the principal crop grown. Other crops like legumes, corn, tobacco, and vegetables, especially when rain water is not available for the growing of lowland rice, are grown as secondary crops. Rice is planted in July and harvested in October to December. Early maturing rice varieties such as *Besar, San Fabian, Bandera, Macapuno,* and *Sar-ong* are commonly grown. The average yield is 25 to 30 cavans of palay per hectare.

### MALIGAYA SERIES

The Maligaya series was first identified and established in Maligaya, Nueva Ecija during the survey of the province. Like Bigaa series, this soil series was developed from alluvial deposits. It has a moderately developed profile with moderately dense subsoil underlain by unconsolidated materials. It differs from the Bigaa series in relief. Generally, Maligaya series is nearly level to slightly sloping or gently undulating. This soil series occurs mostly near the foot of sloping areas where rain water from higher areas drain in it. However, it could be drained easily as desired due to its relief. The internal drainage is rather slow because of its compact subsoil.



This soil series is represented by Maligaya clay, with the following characteristics:

| Depth (Cm.) | Characteristics |
|---|---|
| 0–25 | Surface layer, reddish brown to dark brown clay; moderate, medium granular in structure; slightly compact, sticky and plastic when wet, friable when moist and slightly hard when dry; reddish brown streaks and iron concretions are present; boundary to lower layer is smooth and gradual; pH is 5.0 to 5.5. |
| 25–60 | Upper subsoil, brown to pale reddish brown, heavy clay; columnar and compact; slightly hard to hard and cloddy when dry; friable when moist; sticky and plastic when wet; boundary to lower layer is smooth and gradual. |
| 60–100 | Lower subsoil, heavy compact clay to silty clay; light brown to grayish brown; mottled reddish brown and dark gray; fine gravels present. |
| 100–150 | Substratum, silty clay; light brown to light reddish brown; compact, coarse and gritty. |

*Maligaya clay* (220).—This soil type occupies the narrow strip of level land along Malanas River from Bo. Dapilo to Abualan in San Juan municipality and the nearly level and terraced lands in the town of Bucay on both sides of the La Paz-Lagayan Road. It covers an aggregate area of about 993.89 hectares or 0.25 per cent of the total area of the province. This soil type is devoted to lowland rice. The rice yield varies from 8 to 15 cavans of palay per hectare. The low yield can be attributed to the lack of water and low fertility of the soil.

*Maligaya sandy clay loam* (378).—This soil type covers the major portion of the nearly level to moderately undulating areas in the municipality of Lagangilang, which include the areas in the barrios of Crumpal, Dalaguisen, Longbao, Nagtupacan, Laang and Prelentar; in the municipalities of Lagayan and La Paz and the nearly level areas in the northern part of Bangued. The total area covered is about 3,180.44 hectares or 0.80 per cent of the total area of the province.

Lowland rice is the principal crop grown. Coconut is also grown. The early maturing lowland rice varieties such as

*Binaay, Sawali, Daniola, Letiko, Ganates* and *Ipon* are being planted. The yield of these varieties is rather low—ranging from 8 to 15 cavans of palay per hectare.

This soil type has similar profile characteristics as those of Maligaya clay, except for the texture and color range of the surface layer. The surface soil is characterized by a reddish brown to dark reddish brown sandy clay loam with moderate medium granular structure. The depth varies from 20 to 25 centimeters. Reddish brown streaks and iron concretions are found in this layer. The soil is slightly sticky and slightly plastic when wet; friable in moist condition and slightly hard when dry. The pH is 5.0 to 5.5. Roots are abundant in this layer.

## SAN MANUEL SERIES

Soils of San Manuel series were developed from alluvial deposits. They are moderately fertile or can be made fertile through good soil management. The relief is nearly level to level. The drainage, both internal and external, is fair to good.

The vegetation in the uncultivated areas consist predominantly of grasses, such as *talahib, cogon,* and *amorseco.* Some *kamachiie* trees and *agoho* are found in some areas.

Two soil types under the soil series were identified and mapped in the province. The typical profile characteristics of this series as represented by San Manuel sandy loam are as follows:

| Depth (Cm.) | Characteristics |
|---|---|
| 0– 35 | Surface soil, sandy loam; grayish brown to pale brown, structureless; non-sticky, non-plastic when wet; friable when moist and soft when dry; no coarse skeleton; roots penetrate easily through this layer; pH is 6.0 to 6.5; boundary to lower layer is gradual and smooth. |
| 35–110 | Subsoil, silt loam; brownish gray to light brown with yellowish brown streaks; friable, weak; fine granular; boundary to lower layer is gradual and smooth. |
| 100 and below | Substratum, fine sand to medium sand; yellowish brown to light reddish brown; gritty. |



*San Manuel sandy loam* (96).—San Manuel sandy loam is found along the courses of the rivers. It occupies the western side of Bangued poblacion which extends to Bo. Palao; from the road junction to Pidigan and Peñarrubia it stretches in a narrow strip along the road to Peñarrubia and to Bo. Pau. The total area covered is about 795.11 hectares or 0.20 per cent of the total area of the province. The relief is nearly level to flat. It is moderately drained.

This soil type is intensively grown to various crops or diversified farming is being practiced here. The crops being grown are corn, rice, sugar cane, cassava, tobacco, camote, squash and cowpea. The planting period for these crops, except corn and rice, is not definite—the planting depends upon the occurrence of rain. In the case of rice and first-crop of corn, planting is in May and June. The second-crop of corn is planted in December. Crops grown in this soil type, although the soil is intensively cultivated, do not show any decrease in yield. However, it is suggested that some good soil management practices, such as crop rotation, green manuring and application of organic matter and manures should be observed.

*San Manuel sandy clay loam* (596).—This soil type is found along the tributaries of Malapao River from Bo. Nagpanaoan, Tayum to Pidigan and along Abra River from Lagangilang to to Bo. Patok, Bucay. The total area is about 4,532 hectares or 1.14 per cent of the total provincial area.

The area covered by this soil type is considered the corn belt of the province. The yield of the corn crops throughout the year is excellent. Two crops are being raised annually. The first-crop is planted in May and harvested in August; while the second-crop is planted in December and harvested in February. Green corn or semi-matured corn is harvested after about one hundred days from planting. The varieties of corn grown are the glutinous type and the Abra Yellow Flint. The Abra Yellow Flint is noted for its high quality and resistance to pest and diseases while the glutinous type for its high quality and high yield. The yield varies from 8 to 10 cavans of shelled corn to a hectare. Aside from corn, other crops like peanut, cowpea, eggplant, tomato, cassava, tobacco, camote and mungo, and some fruit trees, such as banana, pummelo, and papaya are also grown on this soil type.

**Fig. 26. Landscape of San Manuel series found in Bo. Layugan, Bucay.**

**Fig. 27. Landscape of Bantay series.**



## The Soils of the Intermediate Uplands

The soils under this group occur on a gently sloping to moderately sloping relief. The surface soil varies from clay loam to clay and the color ranges from light brown to brown. The soil series under this group are Bantay, Bauang, and Sevilla series.

### BANTAY SERIES

Bantay series was first identified and established in Bantay, Ilocos Sur. The soils of this series were developed from calcareous shale. The relief is undulating to rolling. The elevation ranges from 120 to 150 feet above sea level. The typical profile descriptions as represented by Bantay loam are as follows:

| Depth (Cm.) | Characteristics |
|---|---|
| 0– 25 | Surface soil, loam, light brown, brown to grayish brown; medium, fine granular structure; slightly sticky and plastic when wet, friable when moist, and slightly hard when dry; roots are plentiful; with fair amount of organic matter; pH is 5.5 to 6.0; boundary to lower layer is smooth and diffuse. |
| 25– 35 | Subsoil, clay loam; yellowish brown; weak very coarse granular structure, slightly sticky and plastic when wet, friable when moist and slightly hard when dry; boundary to lower layer is clear and wavy. |
| 35– 60 | Substratum, weathered shale that breaks into cubes of one-half to one centimeter in diameter; some lime precipitates are present. |
| 60–150 | Massive layer of whitish shale; gravels are present in some places. |

Only one soil type, Bantay sandy loam, under this series was identified and mapped in the province.

*Bantay sandy loam* (928).—This soil type occupies the low hills in the barrios of Sulay and Malinta, Bangued. It covers an area of about 1,669.73 hectares or 0.42 per cent of the total area of the province. The relief is gently sloping to strongly sloping.

*Madre de cacao, ipil-ipil* and *bamboos* with some species of grass, such as *cogon, talahib, aguingay, culape, kawad-kawad* underneath, are the types of vegetation found in the uncultiv-

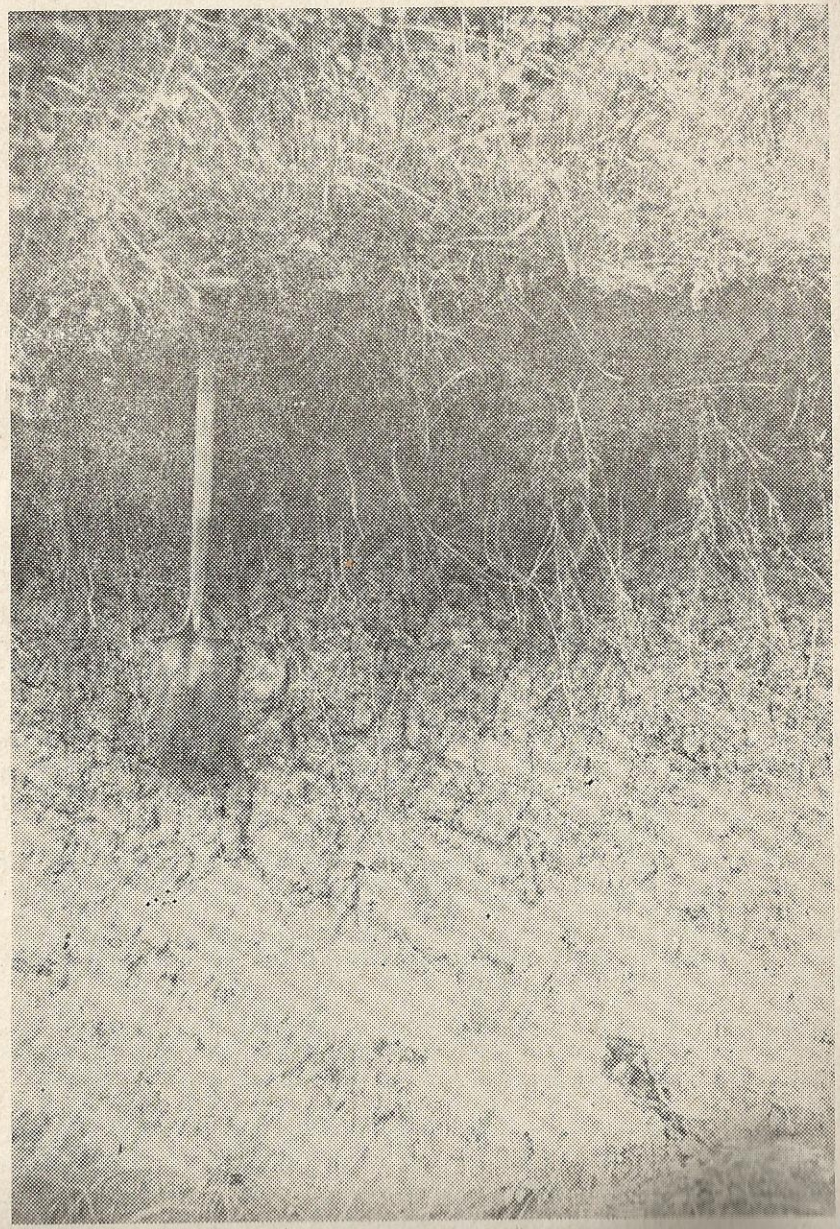

Fig. 28. A typical profile of Bantay series.



ated areas. The crops grown are upland rice, corn, sugar cane, cassava, camote, banana and vegetables. The yields of the crops are rather low.

Bantay sandy loam, like the Bauang soils to which it is related, is susceptible to soil erosion because of its relief and soil characteristics. Some portions are suitable for cultivation, however, soil conservation measures should be provided. Areas with slopes greater than 15 per cent should be utilized for pasture or for permanent crops.

### BAUANG SERIES

Bauang series was first identified and established in the province of La Union. The Bauang series mapped and delineated in Abra Province is an extension of the same series in Narvacan, Ilocos Sur. The soils of the series were developed from weathered stratified shales and sandstones.

The typical profile descriptions are as follows:

| Depth (Cm.) | Characteristics |
|---|---|
| 0– 30 | Surface soil, clay loam; light brown to brown; moderate, coarse granular structure; slightly sticky and slightly plastic when wet, friable to very friable when moist and slightly hard when dry; tends to be sandy in texture in eroded areas; roots are plentiful; boundary to lower layer is gradual and irregular. |
| 30— 60 | Upper subsoil, highly weathered stratified shale; very distinct cubical shaped granules; becomes floury when pulverized; few roots are present. |
| 60— 95 | Lower subsoil, similar to upper layer but less weathered and loose; very few roots are present; boundary to lower layer is abrupt and smooth. |
| 95—150 | Unweathered stratified shale and sandstone in alternating layers. |

Three soil types under the series—Bauang clay loam, Bauang clay and Bauang silty clay loam were delineated and mapped in the province.

*Bauang clay* (121).—This soil type occupies the undulating and hilly to mountainous areas in the municipalities of Pilar and part of San Isidro and Villaviciosa. The area covered is approximately 15,146 hectares which represent 3.81 per cent of the total area of the province. The internal drainage is fair and the external is good to excessive. This soil is droughty and favors the growth of drought resistant plants and grasses.

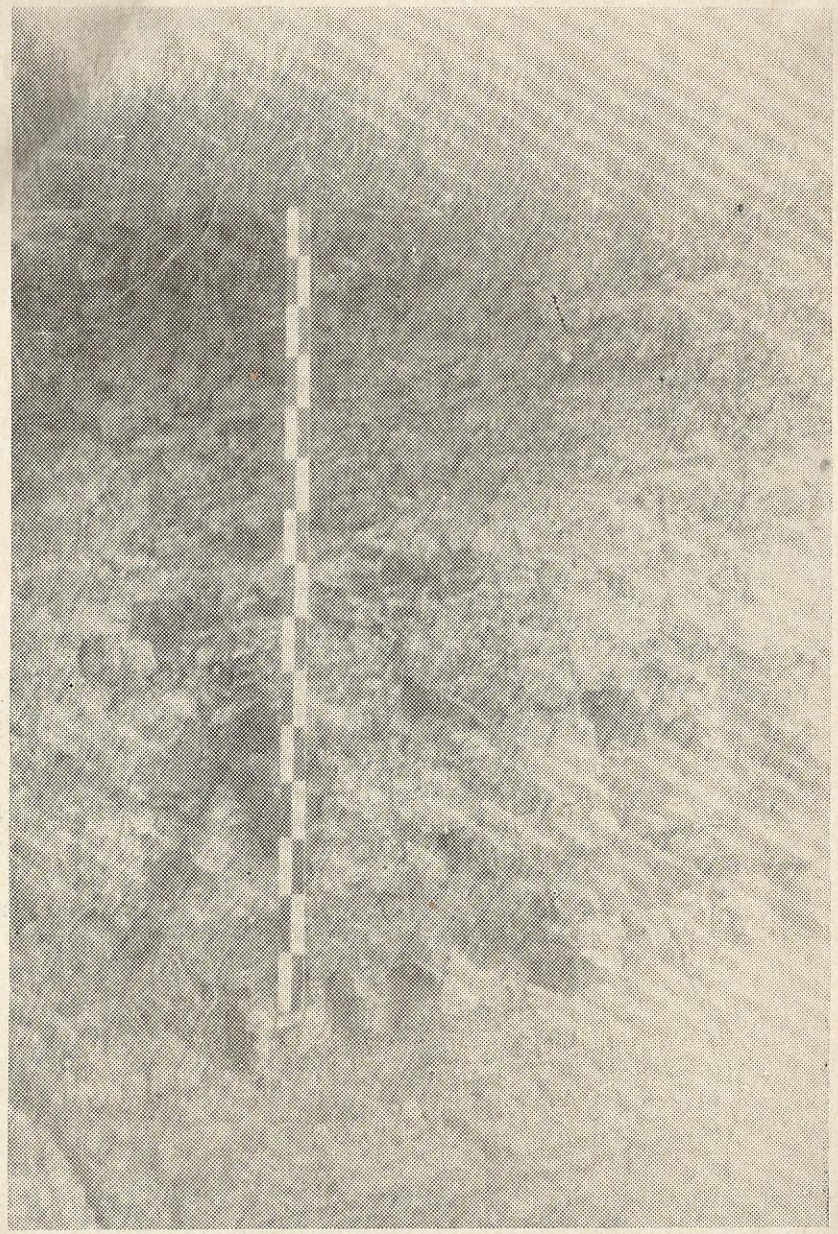

**Fig. 29. A typical profile of Bauang series.**



These plants include *maguey, samsamong, cogon, talahib, shrubs* and *brushes.*

The cultivated areas mostly on the undulating pockets of lands between the hills and mountains are grown to upland rice, tobacco, banana, vegetables and fruit trees. The tobacco grown in the municipalities of Pilar, San Isidro and Villaviciosa are said to be the best tobacco in the province, both in quality and yield. Lowland rice are raised in bench-terraces along rivers and creeks where spring water is available for irrigation purposes. Stones and boulders, fitted together, are used to retain or maintain the dikes or risers of terraces permanently.

Like any other hilly and mountainous soils of the province, the greater portion of this soil type needs to be reforested with fast-growing and soil-building trees. Such vegetation, in one way or another, will help in the protection against soil erosion and in the retention of the soil moisture. Soil conservation measures such as cover-cropping and contour farming should be employed in all the areas suited for cultivation.

*Bauang clay loam* (647).—This soil type occupies the gently rolling to hilly and mountainous areas in the southern part of San Quintin and Pidigan; in the northern part of Bangued to the western part of Tayum; in the southeastern part of Bangued to the northern part of Bucay; and, western part of Lagangilang. The area covered is about 13,556.63 hectares or 3.41 per cent of the total area of the province. The elevation of the area ranges from 240 to 1,200 feet above sea level.

The greater portion of the soil type is uncultivated due to the unfavorable topography and low fertility status of the soil. This portion is either under grasses or second-growth forest. In the grassland, the species of grass found are *cogon, talahib, aguingay, kawad-kawad* and *samsamong;* while in the area under the second-growth forest, shrubs and other soft wood trees are found. Maguey are oftentimes found growing wild in the area.

The crops grown in the cultivated areas are tobacco, upland rice, eggplant, tomato, beans and banana. Lowland rice are grown in the pockets of land or valleys between the hills and mountains. The yield ranges from 12 to 16 cavans of palay per hectare.

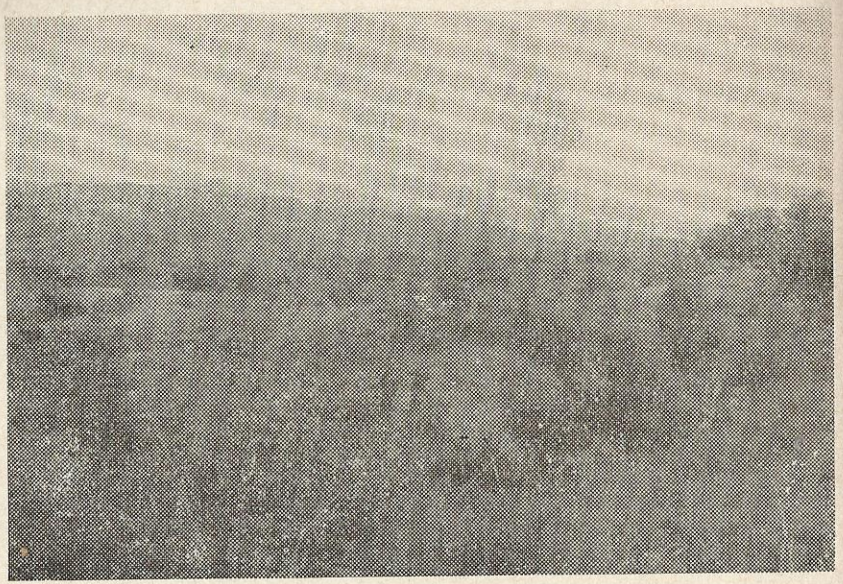

**Fig. 30. Landscape of Bauang series.**

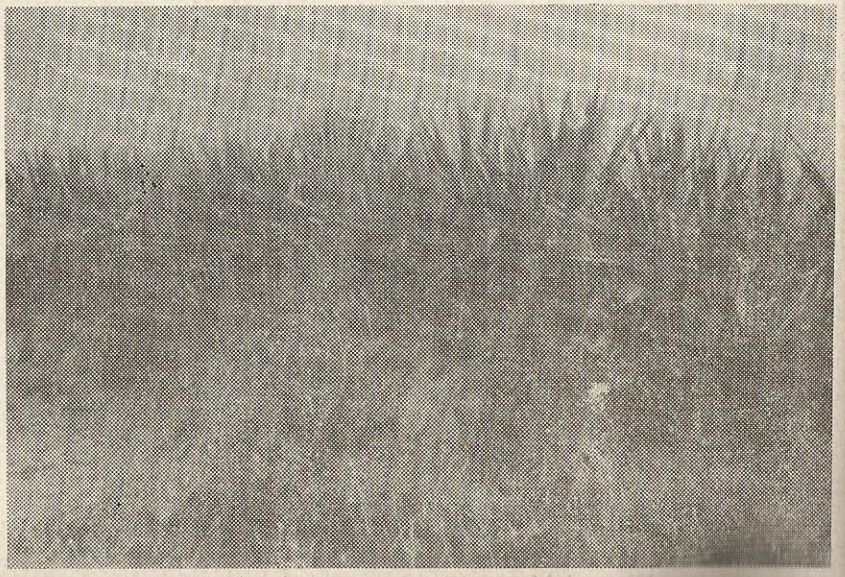

**Fig. 31. Maguey growing wild on Bauang soils.**



*Bauang silty clay loam* (648).—This soil type occupies the areas on the northern part of Danglas from Bo. Damolay towards the vicinity of Bo. San Gregorio. The area is about 993 hectares or 0.25 per cent of the total area of the province. The relief is gently sloping, hilly and mountainous. Small level areas on plateau and between hills are also found within the areas covered by this soil type. External drainage is rapid to excessive and the internal drainage is fair. The soil is very low in fertility and is droughty.

The crops grown are lowland and upland rice, corn, tobacco, sugar cane, banana and vegetables. The major portion of the area is under second growth forest and grasses. The species of grass found are *cogon, talahib, aguingay* and *samsamong* while those under the second-growth forest consist of bamboo grooves, shrubs and soft wood trees.

## SEVILLA SERIES

This soil series is a residual soil derived from calcareous shales and sandstones. The relief is rolling to hilly and steep with undulating areas in between hills. The external drainage is rapid to excessive and the internal drainage is fair to good. The vegetation is generally of the *parang* type. In some places, species of hard wood are found.

The descriptions of the typical profile of Sevilla series as represented by Sevilla clay are given below.

| Depth (Cm.) | Characteristics |
|---|---|
| 0— 55 | Surface soil, dark brown to black clay; moderately fine to medium granular structure; slightly sticky and plastic when wet, friable when moist; and slightly hard when dry; Gravels and cobblestone of calcareous material are occasionally present in small amount; fairly penetrated by roots; boundary to next layer is smooth and diffuse; pH is 7.0. |
| 55—100 | Subsoil, yellowish brown to brown clay, moderate medium granular structure; sticky and plastic when wet, firm when moist, and hard when dry; some limestone gravels are present in some places; few roots present; boundary to next layer is diffuse. |
| 100—150 | Substratum, yellowish brown; sticky and compact clay mixed with a considerable amount of limestone gravels and fragments of shale and sandstone. |

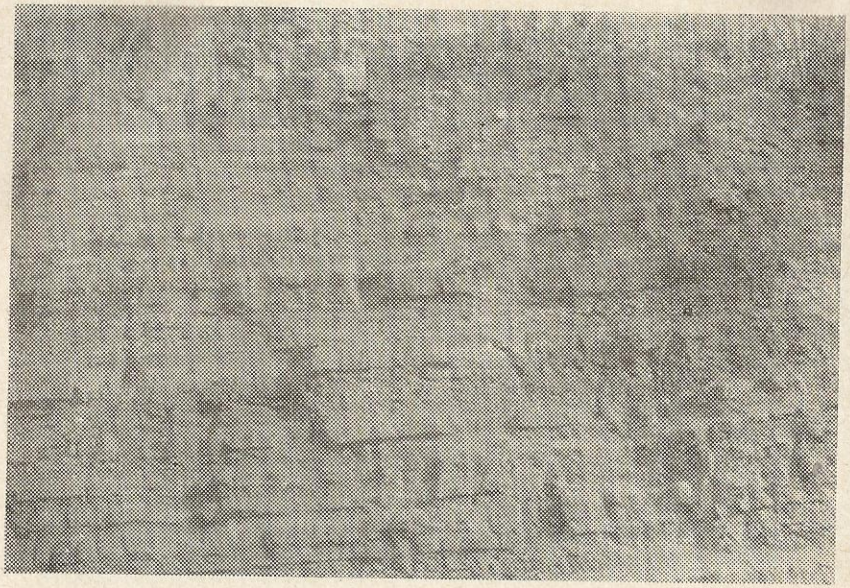

Fig. 32. A profile of an eroded Bauang soil.

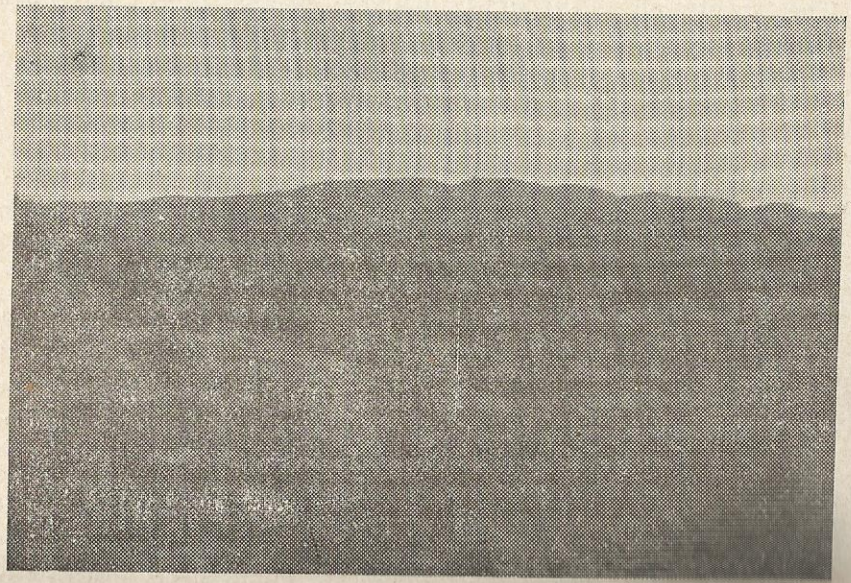

Fig. 33. Landscape of Sevilla series.



Two soil types under the series, Sevilla clay and Sevilla sandy clay loam, were identified and mapped in the province.

*Sevilla clay* (174).—Sevilla clay is found in the municipal district of Luba. It occupies the hills west of Abra River. The total area is about 3,538 hectares or 0.89 per cent of the total area of the province.

The relief is generally rolling to hilly and mountainous. External drainage is rapid to exessive while internal drainage is fair.

The vegetation of the major portion of the area is of the *parang* type which consists of brushes, shrubs, *cogon, talahib, samsamong* and *aguingay*. Few trees and thick brushes are found along the banks of creeks and rivers. The present vegetation seems to be the result of *kaingin* farming in the past. Cultivation is confined to the small areas between hills and mountains. The crops grown are upland rice, corn, cassava, tobacco, camote and banana.

The areas covered by this soil type need a careful management and proper land use. Areas having steep slopes should be placed under forest cover and those with moderate slopes maybe utilized for pasture or for permanent crops. Good soil management practices should be observed in the cultivated areas. Limited and controlled grazing should also be observed in the pasture lands. Contour planting of permanent crops is suggested.

*Sevilla sandy clay loam* (650).—This soil type occupies the rolling to hilly and steep areas in Peñarrubia, extending southward to Villaviciosa in the vicinity of the Sinalong River. The area covered is about 5,605 hectares or 1.41 per cent of the total area of the province.

Majority of the vegetation found in the area is of the *parang* type. Second-growth forest and some hardwood trees are found in some places. The cultivated areas are planted to upland rice, corn, cassava, camote, coconut and banana.

This soil type is subject to severe erosion. To protect this soil from erosion, the land should be used properly and the necessary conservation measures should be provided especially in the cultivated portions. Areas with steep slopes should be

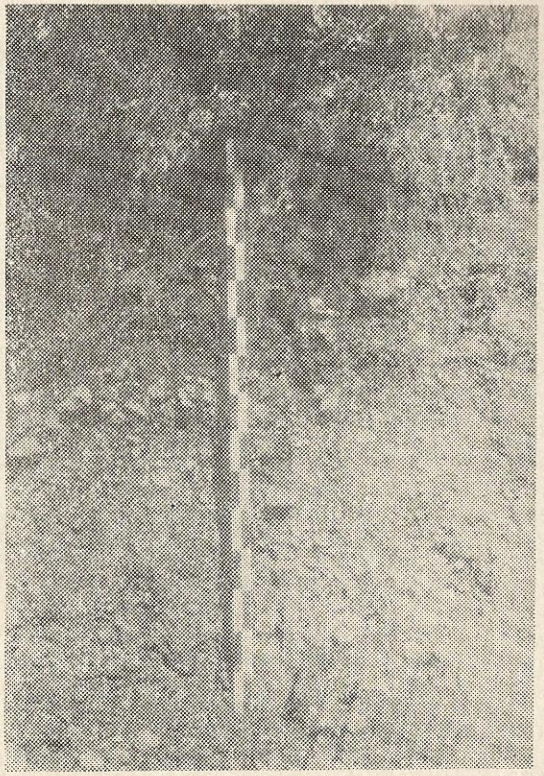

**Fig. 34. A typical profile of Sevilla series.**

**Fig. 35. A landscape of Bituin series taken at the municipal district of Licuan, Abra.**



left as forest or should be planted to permanent trees. Pasture lands should be properly managed and grazing should be controlled.

## Soils of the Hills and Mountains

This group of soils constitutes about 19.90 per cent of the total area of the province or about 79,113 hectares. This is composed of the Alimodian, Bituin, Binangonan, Bolinao and Cervantes series. The relief is rolling to hilly and mountainous. External drainage is good to excessive while internal drainage is fair to poor.

### ALIMODIAN SERIES

Alimodian series is a residual soil developed from weathered products of shale and sandstone. The relief is rolling to hilly and mountainous. External drainage is good to excessive while internal drainage is fair.

The uncultivated portions are covered with second-growth forest and grasses while the cultivated sections are planted to upland rice, cassava, and camote.

The typical profile characteristics of the series as represented by Alimodian clay loam are given below.

| Depth (Cm.) | Characteristics |
|---|---|
| 0— 30 | Surface soil, light brown to reddish brown clay loam; moderate, medium granular structure; slightly sticky and slightly plastic when wet, friable when moist and loose when dry; fair in organic matter content; some rounded gravels and stones are present; Roots are abundant; Boundary to the next layer is diffuse and wavy; pH is 5.0 to 5.5. |
| 30— 60 | Subsoil, light brown clay loam; weak to moderate medium columnar structure; slightly sticky and slightly plastic when wet, friable when moist and soft when dry; few roots are present; boundary to lower layer is gradual and wavy. |
| 60—150 | Substratum, gray to grayish brown; highly weathered shale and sandstone; slightly compact and weak coarse platy in structure. |

Three soil types, Alimodian clay, Alimodian clay loam and Alimodian sandy clay loam, under this soil series were mapped in the province.

*Alimodian clay loam* (126).—This soil type is found in the rolling and hilly areas at the western portion to the northern part of the municipality of La Paz. It covers a total area of about 675 hectares or 0.17 per cent of the total area of the province.

The common vegetation found are *cogon, talahib,* shrubs and soft wood trees.

This soil type is best suited to forest and pasture. Some areas may be used for growing permanent crops, however, proper soil conservation measures should be instituted.

*Alimodian clay* (327).—This soil type occupies the rolling and hilly areas at the northern portion of San Juan. The area is about 3,100 hectares or 0.78 per cent of the total area of the province.

Like the other upland soils found in the province, such as Bauang, Bolinao and Cervantes soils, this soil type has a limited agricultural area. The major portion of the area is covered with second-growth forest and grasses. The hillsides and the small nearly level areas between the hills and mountains are cultivated to annual crops. The crops grown are upland rice, cassava and camote.

Generally, the area is best suited for forest and pasture or permanent crops. However, proper land-use program should be adopted to safeguard the further depletion of soil. Areas with steep slopes should not be utilized for clean cultivation but should be used for forest. Areas with moderate slopes maybe used for pasture or permanent crops. Permanent crops should be planted along the contour and cover crops should be planted to minimize soil erosion.

*Alimodian sandy clay loam* (651).—This soil type occupies the northern portion of Lagangilang extending to the south-eastern portion of San Juan. The total area is about 3,100 hectares or 0.78 per cent of the total area of the province.

The relief is rolling to hilly and mountainous. Generally, the whole area is devoid of its original vegetation. Presently, it is covered with second-growth forest and grasses. Areas between hills and along foot-hills, where the relief is nearly level to undulating, are cultivated to annual crops. In 1955, during the time of the survey, the whole area was utilized



for cattle grazing. It was over-grazed and some degrees of erosion have taken place.

The area may be best utilized for forest and some portions may be used as pasture or could be planted to permanent crops. Proper management of the land should be adopted. Grazing on pasture lands should be limited and controlled. Areas with steep slopes and devoid of trees must be reforested with fast growing trees, like *ipil-ipil* and *madre de cacao.*

### BITUIN SERIES

Bituin series is a new soil series identified and established in Bo. Bituin, Lagangilang, Abra. It is a primary soil developed from a variety of rocks—igneous, shale and sandstone. It occurs on gently sloping to strongly rolling relief. It is a well-drained soil. The external drainage is rapid to excessive.

The vegetation is more of a *parang* type. Grasses predominate over shrubs and trees. The grasses commonly growing are *cogon, samsamong, talahib* and *aguingay.* However, the areas under the Reforestation Project are being planted to Benguet Pine trees.

The distinguishing characteristics of this soil series are its color, ranging from brown to dark brown, yellowish red to reddish yellow, and the presence of granules of various igneous rocks from the lower portion of the surface layer down to the substratum. Another distinguishing characteristics of this soil series is the presence of basalts and andesite rock outcrops in some areas. The degrees of exposure of the outcrops depend upon the slope and nature of vegetation. In gently sloping areas with thick growth of vegetation the exposure is from 1/5 to 2/5, while in areas with steeper slopes and scanty vegetation exposure is almost 3/5.

The soil of this series cracks easily on drying. When wet it is slightly sticky and plastic, but friable when moist. When dry it is hard so that borings with the soil auger are difficult to make.

The profile characteristics of this soil series as represented by Bituin clay, the only soil type delineated and mapped in the province, are given below.

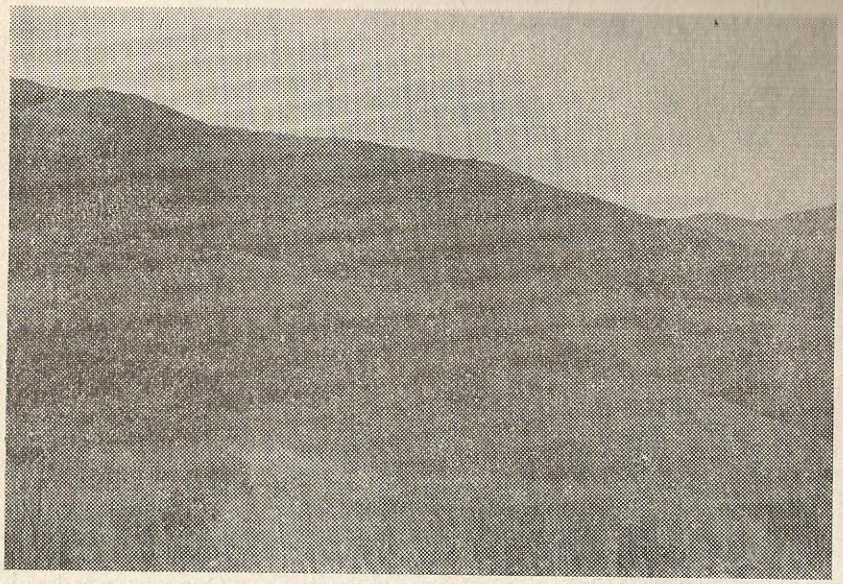

Fig. 36. A reforested area of the Bituin series.

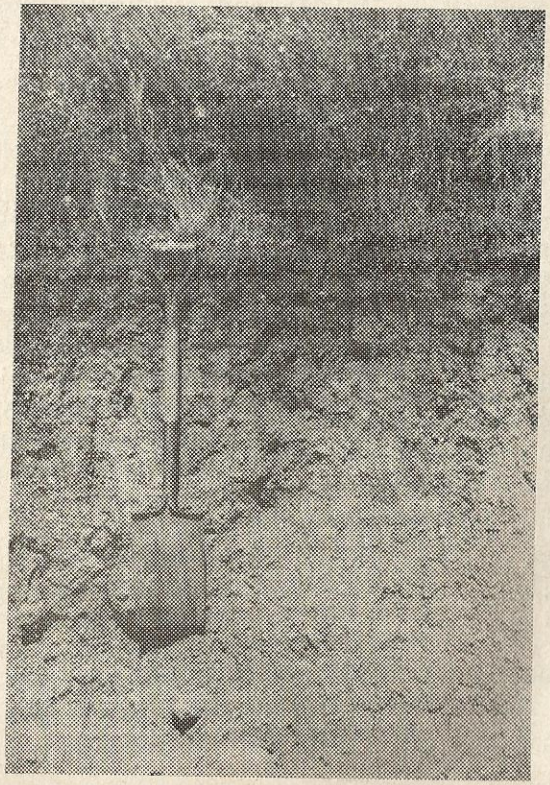

Fig. 37. A typical profile of Bituin series taken at Bituin, Lagangilang, Abra.

| Depth (cm.) | Characteristics |
|---|---|
| 0 – 20 | Surface soil, brown to dark brown clay; moderate, fine granular structure; slightly sticky and slightly plastic when wet, friable when moist and hard when dry; roots are abundant; low in organic matter content; pH is 4.5 to 5.0. Some gravels are present in eroded areas; boundary to lower layer is clear and wavy. |
| 20 – 45 | Upper subsoil, reddish yellow to yellowish red, gravelly clay; dark red to brownish red when wet; moderately weak columnar structure; slightly plastic and slightly sticky when wet, slightly hard when dry and friable when moist; low in organic matter content; roots are abundant; boundary to next layer is smooth and diffuse. |
| 45 – 130 | Lower subsoil, reddish yellow to dark red when dry, yellowish red to brownish red when wet, clay loam; strong medium columnar structure; slightly sticky and slightly plastic when wet and slightly hard when dry; low in organic matter content; fewer gravels than the above layer; few roots of trees present; depth sometimes exceeds 130 cm. from the surface; boundary to lower layer is smooth and diffuse. |
| 130 – 150 | Substratum, reddish yellow to yellowish red, mixture of highly weathered shale, sandstone and igneous rocks; medium coarse granular in structure. |

*Bituin clay* (574).—This soil type occupies the northeasternmost part of Lagangilang, extending to the municipal districts of Licuan, Malibcong and Baay; the easternmost portion of Bucay, after the Abra River; portion of the municipal district of Sallapadan; part of Boliney and Danac Districts; the southern portion of Luba and northern part of Tiempo. The area is about 40,590 hectares or 10.21 per cent of the total area of the province.

Only a small portion of the area is utilized for the production of crops. This consists mainly of the nearly level areas along creeks and rivers, and areas between hills. In areas where spring water is available, lowland rice is grown.

Due to its relief this soil type is not suited for the cultivation of annual crops. However, permanent crops, like fruit trees, maybe planted on areas with gentler slopes. Areas

covered by grasses maybe developed as pastures for livestock. Areas with excessive slopes should be reforested with fast-growing trees.

### BINANGONAN SERIES

This soil series was first established in Binangonan, Rizal during the survey of the province. It is a residual soil derived from limestone. It occurs on rolling to mountainous relief. External drainage is rapid to excessive while internal drainage is rather slow.

Binangonan clay is the only soil type identified and mapped in Abra Province.

The profile characteristics as represented by this soil type are given below.

| Depth (Cm.) | Characteristics |
|---|---|
| 0 – 25 | Surface soil, dark brown to black clay; moderate coarse granular structure; sticky and plastic when wet, firm when moist and hard when dry; fair in organic matter content; roots are abundant; pH is 6.5 to 7.0; boundary to lower layer is gradual and wavy. |
| 25 – 50 | Subsoil, light brownish black clay; lighter in color at lower layer; sticky and plastic when wet, firm when moist and hard when dry; whitish calcareous materials present; roots are plentiful; boundary to lower layer is diffuse and wavy. |
| 50 – 150 | Substratum; massive layer of calcareous rock, nearly white in color. Upper portion is highly weathered limestone. |

*Binangonan clay* (24).—This soil type is found on the mountainous areas that extend from the southeastern portion of San Juan down to the eastern part of Lagangilang. It covers a total area of about 3,180 hectares or 0.80 per cent of the total area of the province.

The relief is rolling to mountainous. The elevation is 250 feet above sea level. The vegetation consists of clusters of *bamboo, shrubs, cogon, talahib* and many other species of grass. It appears that the area had been cultivated to crops through the *kaingin* system of farming. The area is now



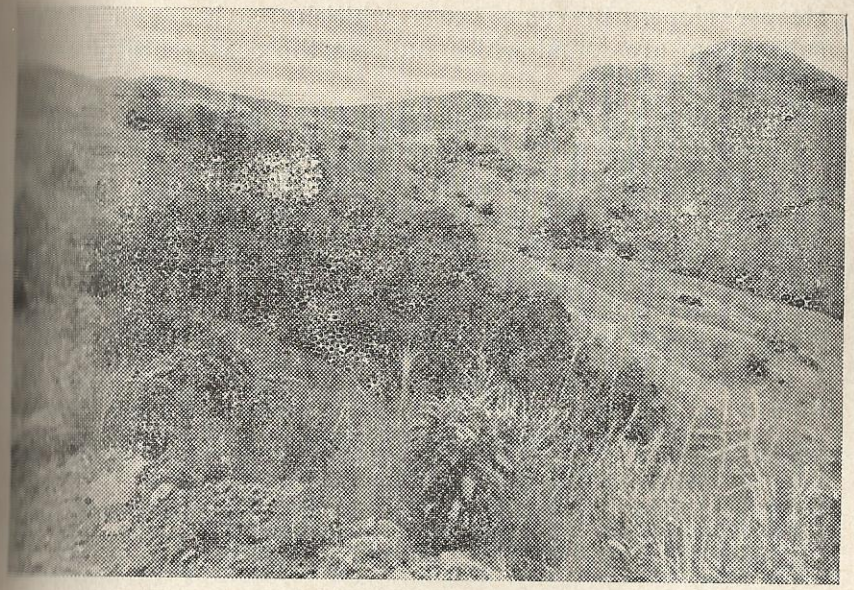

**Fig. 38. A landscape of Bituin series at Lagangilang, Abra.**

Fig. 39. A landscape of Binangonan series.

eroded and depleted of its fertility especially the portion with steeper slope. In some areas whitish patches and exposed substratum are found which indicate the occurrence of severe erosion.

The area covered by this soil type is definitely not fit for cultivation. It is best suited for forest. Some areas may be used for pasture or permanent crops. If used for pasture, grazing should be controlled and rotated. The areas with steep slopes should be reforested with fast-growing trees.

### BOLINAO SERIES

Bolinao series is a residual soil developed from coralline limestone. It occurs on upland areas with moderately rolling and hilly to mountainous relief. It is characterized by a reddish brown to drak brown surface soil. The surface soil varies in depth—from moderately deep to shallow. In some cases, partially weathered coralline limestone fragments are mixed with the soil in the surface layer. Outcrops of limestone rocks are commonly found on the surface.

Bolinao clay is the only soil type under this soil series mapped in the province. The profile characteristics of this soil series as represented by Bolinao clay are as follows:

| Depth (Cm.) | Characteristics |
|---|---|
| | Surface soil, reddish brown to dark brown clay; compact sticky and plastic when wet, firm when moist and hard when dry; moderate, fine granular; roots are abundant; the pH is 6.5 to 7.0; boundary to next layer is clear and wavy. |
| 25–85 | Subsoil, reddish brown clay; moderate, fine to coarse granular; sticky and plastic when wet; partially weathered fragments of coralline limestone are mixed with the soil; roots are very few; boundary to lower layer is smooth and gradual. |
| 85 – 150 | Substratum, upper layer slightly weathered limestone; lower portion unweathered massive limestone; yellowish gray to brownish gray in color. |

*Bolinao clay* (153).—This soil type occupies a narrow strip of rolling to mountainous area that stretches on the west of Abra River, just after the plain on the southern



part of Bucay down to the northern portion of Luba where it expands into a wider area. It is bounded on the west by rough stony land. The total area covered is about 2,663 hectares or 0.67 per cent of the total area of the province.

The vegetation consists of second-growth trees and grasses, such as *madre de cacao, ipil-ipil, culape, kawad-kawad, cogon, talahib, swab, kabage, makahiya, aguingay,* etc. The small trees are growing sporadically in the area. The hardwood species of trees are found in the hilly portions.

The cultivated areas are planted to upland rice, corn and sugar cane. These constitute the principal crops. While the secondary crops are banana, vegetables, papaya, pineapple and maguey.

### CERVANTES SERIES

Cervantes series is developed from a wide variety of igneous rocks. It belongs to the red soils group identified in the Philippines to which the Luisiana, Antipolo and Alaminos soils belong. It occurs on rolling to mountainous relief.

Luisiana soils have purple streaks, splotches of gray, red and yellow colors in the profile while Cervantes has none. It also differs from Antipolo series in the absence of concretions.

A description of the typical profile of Cervantes series is given below.

| Depth (Cm.) | Characteristics |
|---|---|
| 0 – 10 | Surface soil, reddish brown to red; very friable; coarse granular loam to sandy clay loam. |
| 10 – 120 | Subsoil, bright red to red; friable, columnar clay loam to clay; few gravels present. |
| 120 and below | Substratum, whitish gray to brownish gray; loose sandy material; powdery when dry. |

This soil series occurs on a rough terrain, from hilly to mountainous. The external drainage is rapid to excessive owing to its relief, while the internal drainage is fair to good. Second growth forest and grasses are the common vegetation.

One soil type, Cervantes sandy clay loam, under the soil series was delineated and mapped in the province.

*Cervantes sandy clay loam* (649).—This soil type occupies the southern portion of Abra along the eastern side of Abra River, from Manabo down to Tubo. The total area is about

25,801 hectares or 6.49 per cent of the total area of the province.

In the suvey of Ilocos Sur, the portions in Tiempo were classified as Cervantes clay loam, while in the survey of Abra these portions were established as Cervantes sandy clay loam as per mechanical analyses of the soil samples.

The native vegetation is composed of second-growth trees interspersed with grasses. Pine trees, bamboo, *binayoyo* and other softwood trees are common. Shrubs and softwood trees in patches are grown in some areas. Thick growths of vegetation are common along banks of streams and creeks.

Lowland rice is grown on bench-terraces. These terraces are found along the courses of streams and creeks and in places where these are live springs.

Generally, this soil type is not fit for the cultivation of seasonal crops. Except the few places where rice is grown, they should be planted to permanent crops like fruit trees or utilized as pasture. If used as pasture, grazing should be controlled and rotated. Areas with steep slopes that cannot be used as pastures should be reforested.

## Miscellaneous Land Types

Under this group are areas that have little or no natural soil at all, and/or areas having no agricultural value for the present or inaccessible. Included under this group are non-agricultural areas, such as riverwash, rough stony land, swamp, and undifferentiated mountain soils.

*Mountain soils, undifferentiated* (45).—This land type is the biggest unit of land mapped in the province. It includes all the mountainous areas and stony lands that are inaccessible. It is found in the eastern part of the province, extending along the provincial boundary from the northeastern tip to the southern part. The total area covered is about 207,324 hectares or 52.15 per cent of the total area of the province. The terrain of this land type is rough and broken.

*Riverwash* (152).—This land type consists of areas of land with no profile development. It is usually found along courses of rivers and streams.

In Abra, this land type is prominently found along the course of Abra River. It occurs in strips ranging from 50 to 500 meters in width. The widest area is found in the municipality of La Paz. The total area covered by this land type is about 7,871 hectares or 1.98 per cent of the total area of the province.



**Fig. 40. A riverwash area with sparse vegetation composed mainly of *talahib* and cogon-like grass and some *agoho* trees in the background.**

**Fig. 41. A close-up of a riverwash area along Abra River. Note the gravels and stones and sparse growth of grass in the foreground while *kamachile* trees are in the background.**

TABLE 3.—*Key to the soils of Abra and their present vegetation*

| Soil Mapping number | Soil mapping unit | Parent material | Relief | Drainage | | Present vegetation |
|---|---|---|---|---|---|---|
| | | | | External | Internal | |
| 192 | Bigaa clay | | | | | Lowland rice, corn, tobacco, eggplant and legumes. |
| 646 | Bigaa sandy clay loam | | Nearly level | | | Lowland rice, corn, tobacco, eggplant, cowpea and peanut. |
| 546 | Bigaa silty clay loam | Alluvial deposits | | Fair | Poor | Lowland rice, corn, tobacco, and legumes. |
| 220 | Maligaya clay | | Nearly level to undulating | | | Lowland rice. |
| 378 | Maligaya sandy clay loam | | | | | Lowland rice and coconut. |
| 596 | San Manuel sandy clay loam. | | Level | Good | Good | Corn, peanut, cowpea, eggplant, tomato, cassava, tobacco, camote mongo; fruit trees. |
| 96 | San Manuel sandy loam | | | | | Rice, corn, sugar cane, cassava, tobacco, camote, squash and cowpea. |
| 327 | Alimodian clay | | | | | Upland rice, cassava, camote; second-growth trees and grasses. |
| 126 | Alimodian clay loam | Shale and sandstone | Rolling to hilly | Rapid to excessive | Fair | Second-growth trees and grasses. |
| 651 | Alimodian sandy clay loam | | | | | Rice, cassava, camote; second-growth trees and grasses. |
| 928 | Bantay sandy loam | Calcareous shale | sloping to strongly sloping | Rapid | Fair | Upland rice, corn, sugar cane, cassava, camote, banana, vegetables; *ipil-ipil*, *kakauati*, bamboo and grasses |
| 121 | Bauang clay | | | | | Lowland and upland rice, tobacco, banana, vegetables; fruit trees, grasses, brushes and maguey. |
| 647 | Bauang clay loam | Shale and sandstone | Sloping to mountainous | Rapid to excessive | Fair | Lowland and upland rice, tobacco, eggplant, tomato, beans, banana; maguey, second-growth trees and grasses. |
| 648 | Bauang silty clay loam | | | | | Lowland and upland rice, corn, tobacco, sugar cane, banana, vegetables second-growth trees and grasses. |
| 574 | Bituin clay | Igneous rocks, shale and sandstone | Sloping to rolling | | | Lowland rice, second-growth trees and grasses. |
| 24 | Binangonan clay | Limestone | Rolling to mountainous | Excessive | | Second-growth trees, grasses, shrubs, and bamboos. |
| 153 | Bolinao clay | Coralline limestone | Rolling to hilly | Rapid | Poor | Upland rice, corn, banana, vegetables, sugar cane, papaya, pineapple; second-growth trees, grasses and maguey. |
| 649 | Cervantes sandy clay loam | Igneous rocks | Rolling to mountainous | | | Rice, second-growth trees, grasses bamboo, *binayoyo*. |
| 174 | Sevilla clay | Calcareous shale and sandstone | Rolling to hilly | Excessive | Fair | Upland rice, corn, cassava, camote, banana; second-growth trees and grasses. |
| 650 | Sevilla sandy clay loam | | | | | Upland rice, corn, cassava, camote, coconut, banana; second-growth trees and grasses. |
| 45 | Mountain soils, undifferentiated | | Mountainous | Rapid | | Forest and grasses. |
| 152 | Riverwash | | Nearly level | | Rapid | Few grasses, shrubs, *agoho* and *kamachile*. Idle land. |
| 171 | Rough stony land | | Mountainous | Excessive | Poor | Shrubs and few grasses. Idle land. |

The need to change the present system of farming in the province to the modern method should be given serious thought and consideration. The farmers should be made to understand the disastrous effects of the *kaingin* system of farming to their economy as well as the province's. They should be convinced that cultivation of sloping areas needs the employment of conservation measures as part of a good soil management program. They should be taught to utilize the land according to its capability and to treat it according to its needs. Conservation measures like, contour plowing, strip cropping, terracing, and other good soil management practices such as crop rotation, green manuring, application of manures and/or fertilizers, should be practiced. Lands not suited for cultivation but good for pasture or permanent crops must be managed properly.

The problems of excessive runoff and flood in the province can be minimized by immediate reforestation of the denuded areas. The existing vegetative cover of the hills and mountains should be protected from further destruction. The banks of rivers and streams must be protected by planting fast growing trees. Regulations on cutting of existing trees should be fully enforced.

## PRODUCTIVITY RATINGS OF THE SOILS OF ABRA

The productivity of a soil is its capability to produce a specified crop or sequence of crops under a specified system of management. 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 plants requirements. In this report, the soil productivity rating is based on the average crop yield of a soil type in relation to the established national standard yields obtained without the use of fertilizer or soil amendments.

Table 4 indicates the productivity ratings of the soils of Abra for the major crops grown in the province. The productivity ratings presented here were developed mainly from estimates based upon observations and interviews supplemented by a few records and census data; thus, their



TABLE 4.—*Productivity ratings of the soils of Abra.*

| Soil type | Crop productivity index | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lowland rice irrigated 100=60 cav./ha | Lowland rice non-irrigated 100=40 cav./ha | Upland rice 100=20 cav./ha. | Corn 100=17 cav./ha. | Tobacco 100=1475 kg./ha. | Sugarcane 100=80 piculs | Cassava 100=15 tons/ha. | Camote 100=8 tons/ha. | Peanut 100=25 cav./ha. | Mungo 100=5 cav./ha. |
| Almodian clay | x | x | 60 | x | x | x | 70 | x | x | x |
| Almodian clay loam | x | x | 72 | x | x | x | x | 70 | x | x |
| Almodian sandy clay loam | x | x | x | x | x | x | x | x | x | x |
| Bigaa clay | 58 | 62 | x | x | x | x | x | x | x | x |
| Bigaa clay loam | 50 | 55 | x | 53 | 81 | x | x | x | 60 | x |
| Bigaa sandy clay loam | 50 | 55 | x | x | x | x | x | x | x | x |
| Bigaa silty clay | x | 67 | x | 52 | 69 | x | x | x | 52 | x |
| Bantay loam | x | x | 60 | 66 | x | 50 | 75 | x | x | x |
| Bauang clay | x | x | 80 | x | 82 | x | x | x | x | x |
| Bauang clay loam | 27 | x | 72 | x | 74 | x | x | x | x | x |
| Bauang silty clay loam | x | x | 75 | 50 | 75 | 50 | x | x | x | x |
| Binangonan clay | x | x | x | x | x | x | x | x | x | x |
| Bituin clay | 100 | x | x | x | x | x | x | x | x | x |
| Bolinao clay | x | x | 59 | 50 | 72 | x | x | x | x | x |
| Cervantes loam | 50 | x | x | x | x | x | x | x | x | x |
| Cervantes sandy clay loam | x | x | 37 | x | x | x | x | x | x | x |
| Maligaya clay | x | x | 37 | x | x | x | x | x | x | x |
| Maligaya clay loam | x | x | 37 | x | x | x | x | x | x | x |
| Maligaya sandy clay loam | x | x | 76 | x | 53 | x | x | 60 | x | x |
| San Manuel clay loam | x | x | 55 | 58 | 83 | 62 | 73 | 75 | 66 | x |
| San Manuel sandy loam | x | x | x | 59 | 80 | 65 | 80 | x | x | x |
| San Manuel silt loam | x | x | 59 | 50 | 72 | x | 52 | x | x | x |
| Sevilla clay | x | x | 60 | 50 | 72 | x | 54 | x | x | x |
| Sevilla clay loam | x | x | 60 | 50 | 72 | x | 54 | x | x | x |

1 Soils are given indexes that give the approximate average production of each crop in per cent of the standard of reference. The standard represents the approximate average yield obtained without the use of amendments or fertilizers on the more extensive soils of the Philippines on which the crop is most widely grown.

* Indicates that the crop is not grown on the soil type or the crop is grown in small scale.

reliability 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-fourths as productive relative to the national standard, or in terms of production, the soil could produce 45 cavans of palay of lowland rice where the national standard is 60 cavans.

## TEXTURAL CLASSES OF THE SOILS OF ABRA PROVINCE

### FIELD DETERMINATION OF SOIL TEXTURAL CLASS

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

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

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

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

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

*Silt loam.*—Silt loam contains a moderate amount of the fine grades of sand and only a small amount of clay over half of the particles being of the soil separate called "silt". When dry it may appear cloddy but the lumps can be readily broken, and when pulverized it feels soft and floury. When



wet the soil readily runs together and puddles. Either dry or moist, the soil particles will form into a cast which can be freely handled without breaking. When moistened and squeezed between the fingers, it will not "ribbon" but will give a broken appearance.

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

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

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

### 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 analysis. However, there are instances when field classification and laboratory classification differs. 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 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 millimeters such as gravels, pebbles, and cobbles are considered coarse skeleton. Class names such as sand, 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 5.—*Average mechanical analyses of the surface soils of the different soil types of Abra Province using the modified Bouyoucos method.*

| Soil type number | Soil type | Sand (2.00–0.05 mm. Per cent | Silt (0.05–0.002 mm. Per cent | Clay (0.002 mm below Per cent |
|---|---|---|---|---|
| 327 | Alimodian clay | 20.6 | 26.2 | 53.2 |
| 126 | Alimodian clay loam | 44.2 | 27.8 | 28.0 |
| 651 | Alimodian sandy clay loam | 49.1 | 18.9 | 33.0 |
| 192 | Bigaa clay | 22.7 | 24.5 | 53.8 |
| 646 | Bigaa sandy clay loam | 46.2 | 25.0 | 28.8 |
| 546 | Bigaa silty clay loam | 19.2 | 48.0 | 32.8 |
| 928 | Bantay sandy loam | 59.0 | 20.4 | 20.6 |
| 121 | Bauang clay | 19.8 | 32.0 | 48.2 |
| 647 | Bauang clay loam | 45.2 | 21.7 | 33.1 |
| 648 | Bauang silty clay loam | 20.2 | 47.0 | 32.8 |
| 24 | Binangonan clay | 17.7 | 32.6 | 49.7 |
| 574 | Bituin clay | 21.0 | 21.9 | 57.1 |
| 153 | Bolinao clay | 18.3 | 30.1 | 51.6 |
| 649 | Cervantes sandy clay loam | 48.0 | 26.2 | 25.8 |
| 220 | Maligaya clay | 18.2 | 35.7 | 46.1 |
| 378 | Maligaya sandy clay loam | 47.3 | 25.1 | 27.6 |
| 596 | San Manuel sandy clay loam | 53.9 | 16.1 | 30.0 |
| 96 | San Manuel sandy loam | 55.8 | 22.4 | 16.2 |
| 174 | Sevilla clay | 17.8 | 32.1 | 50.1 |
| 650 | Sevilla sandy clay loam | 46.6 | 22.4 | 31.0 |

[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.



## LAND CAPABILITY CLASSIFICATION AND CONSERVATION GUIDE FOR THE SOILS OF ABRA

Land capability classification is a scheme of grouping soil types together 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 crop or set of crops are usually specified and the corresponding necessary soil magagement 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 evaluated in the field and in the laboratory . Land capability classes are further subdivided into subclasses by taking into account different soil problems. In the Philippines, the three major problems on soils are (a) erosion and runoff, (b) wetness and drainage, and (c) root zone and tillage limitations, such as shallowness, stoniness, droughtiness, and salinity. 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. Best suited to pasture or forest.

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 A

Very good land. Can be cultivated safely. Requires only simple but good farm management practices.

San Manuel sandy loam
San Manuel sandy clay loam

Class A is level to nearly level land. The soil is deep, fertile or well supplied with plant nutrient elements, well drained, and easy to cultivate.

Erosion is not much of a problem. The land is rarely flooded.

This class is suited for intensive cultivation and all crops common in the area can be grown. Since soils under this class have good permeability, if lowland rice is to be grown, puddling the soil is usually necessary to minimize seepage.

Good farm management practices are required specially the judicious application of agricultural lime and fertilizers and the observance of crop rotation which should include a legume or soil improving crop in the sequence for sustained production. In consonance with lime and fertilizer application, greater benefits could be derived thereof if green manuring or the plowing under of young green plants, preferably leguminous crops, and the application of farm manure or compost are observed regularly.



TABLE 6.—*Land capability classification of the different soil types and miscellaneous land types of Abra.*

| Soil type number | Soil/miscellaneous land type | Possible soil unit[1] (Slope-erosion) | Land capability class/subclass |
|---|---|---|---|
| 96 | San Manuel sandy loam | a-0 | A |
| 596 | San Manuel sandy clay loam | | |
| 192 | Bigaa clay | a-0 | Bw |
| 646 | Bigaa sandy clay loam | | |
| 546 | Bigaa silty clay loam | | |
| 220 | Maligaya clay | | |
| 378 | Maligaya sandy clay loam | | |
| 928 | Bantay sandy loam | d-1 | De |
| 651 | Alimodian sandy clay loam | d-1, d-2 | De |
| 126 | Alimodian clay loam | | |
| 327 | Alimodan clay | | |
| 648 | Bauang silty clay loam | | |
| 647 | Bauang clay loam | | |
| 649 | Cervantes sandy clay loam | e-2, f-2 | M |
| 174 | Sevilla clay | | |
| 650 | Sevilla sandy clay loam | | |
| 121 | Bauang clay | d-2, d-3, e-2, e-3 | N |
| 24 | Binangonan clay | | |
| 574 | Bituin clay | | |
| 153 | Bolinao clay | | |
| 45 | Mountain soils, undifferentiated | ——— | N |
| 152 | Riverwash | ——— | Y |
| 171 | Rough stony and- | | |

[1] The slope-erosion units are the possible conditions that may exist for each soil type Any other unit with an erosion class more than the one specified above will be classed under the next capability class. Thus, Bauang silty clay loam with a d-3 slope-erosion class will have a land capability class N.

## 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.

Bigaa clay
Bigaa sandy clay loam
Bigaa silty clay loam
Maligaya clay
Maligaya sandy clay 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.

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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.

### 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. Suited for pasture or forest.

| | |
|---|---|
| Alimodian clay | Bauang clay loam |
| Alimodian clay loam | Bauang silty clay loam |
| Alimodian sandy clay loam | Cervantes sandy clay loam |
| Bantay sandy loam | Sevilla clay |
| | Sevilla sandy clay loam |

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.

Where 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 M

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

| | |
|---|---|
| Alimodian clay | Bauang silty clay loam |
| Alimodian clay loam | Cervantes sandy clay loam |
| Alimodian sandy clay loam | Sevilla clay |
| Bauang clay loam | Sevilla sandy 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 definite restrictions. Best suited to forest with very careful management and restrictions.

Bauang clay
Binangonan clay
Bituin clay
Bolinao clay
Moutain soils, undifferentiated

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.

Riverwash
Rough stony land

Class Y is extremely arid or very steep, rough and stony land with 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.

# GLOSSARY OF COMMON ECONOMIC PLANTS FOUND IN ABRA

| *Common Name* | *Scientific Name* | *Family* |
|---|---|---|
| Aguingay | *Rottboellia exaltata* Linn. f. | Gramineae |
| Ampalaya | *Momordica charantia* Linn. | Cucurbitaceae |
| Apitong | *Dipterocarpus grandiflora* Blanco. | Dipterocarpaceae |
| Arrowroot | *Maranta arundinaceae* Linn. | Marantaceae |
| Atis | *Anona squamosa* Linn. | Anonaceae |
| Avocado | *Persea americana* Mill. | Laureaceae |
| Bamboo | *Bambusa spinosa* Roxb. | Gramineae |
| Banana | *Musa sapientum* Linn. | Musaceae |
| Batao | *Dolichos lablab* Linn. | Leguminosae |
| Benguet pine | *Pinus insularis* Endl. | Euphorbiaceae |
| Bermuda grass | *Cynodon dactylon* (Linn.) Pers. | Gramineae |
| Boho | *Schizostachyum lumampao* (Blanco) Merr. | Gramineae |
| Buri | *Corypha elata* Roxb. | Palmae |
| Cabbage | *Brassica oleracea* var. *capitata* Linn. | Cruciferae |
| Cacao | *Theobroma cacao* Linn. | Sterculiaceae |
| Cadios | *Cajanus cajan* (Linn.) Millsp. | Leguminosae |
| Caimito | *Chrysophyllum cainito* Linn. | Sapotaceae |
| Cashew | *Anacardium occidentale* Linn. | Anacardiaceae |
| Cassava | *Manihot esculenta* Crantz | Euphorbiaceae |
| Chico | *Achras sapota* Linn. | Sapotaceae |
| Coconut | *Cocos nucifera* Linn. | Palmae |
| Coffee | *Coffea arabica* Linn. | Rubiaceae |
| Cogon | *Imperata cylindrica* (Linn.) Beauv. | Gramineae |
| Corn | *Zea mays* Linn. | Gramineae |
| Cowpea | *Vigna sinensis* (Linn.) Savi. | Leguminosae |
| Duhat | *Eugenia cumini* (Linn.) Druce. | Myrtaceae |
| Eggplant | *Solanum melongena* Linn. | Solanaceae |
| Gabi | *Colocasia esculenta* (Linn.) Schott & Endl. | Araceae |
| Garlic | *Allium sativum* Linn. | Liliaceae |
| Ginger | *Zingiber officinale* Rosc. | Zingiberaceae |
| Guava | *Psidium guajava* Linn. | Myrtaceae |
| Guayabano | *Anona muricata* Linn. | Anonaceae |
| Ipil-ipil | *Leucaena glauca* (Linn.) Benth. | Leguminosae |
| Jute | *Corchorus capsularis* Linn. | Tiliaceae |
| Kakauati | *Gliricidia sepium* (Jacq.) Steud. | Leguminosae |
| Kamachile | *Pithecolobium dulce* (Roxb.) Benth. | Leguminosae |
| Kapok | *Ceiba pentandra* (Linn.) Gaertn. | Bombacaceae |

| | | |
|---|---|---|
| Kamias | *Averrhoa bilimbi* Linn. | Oxalidaceae |
| Katuray | *Sesbania grandiflora* (Linn.) Pers. | Leguminosae |
| Kondol | *Benincasa hispida* (Thumb.) Gogn. | Cucurbitaceae |
| Lettuce | *Lactuca sativa* Linn. | Compositae |
| Mabolo | *Diospyrus discolor* Wild. | Ebernaceae |
| Maguey | *Agave cantala* Roxb. | Amaryllidaceae |
| Malungay | *Coringa oleifera* Linn. | Moringaceae |
| Mango | *Mangifera indica* Linn. | Anacardiaceae |
| Molave | *Vitex parviflora* Juss. | Verbenaceae |
| Mungo | *Phaseolus aureus* Roxb. | Leguminosae |
| Mustard | *Brassica integrifolia* (West) Schulz | Cruciferae |
| Nangka | *Artocarpus heterophyllus* Lam. | Moraceae |
| Narra | *Pterocarpus indicus* Willd. | Leguminosae |
| Onion | *Allium cepa* Linn. | Liliaceae |
| Orange | *Citrus aurantium* Linn. | Rutaceae |
| Papaya | *Carica papaya* Linn. | Caricaceae |
| Patani | *Phaseolus lunatus* Linn. | Leguminosae |
| Patola | *Luffa cylindrica* (Linn.) M. Roem. | Cucurbitaceae |
| Peanut | *Arachis hypogaea* Linn. | Leguminosae |
| Pechay | *Brassica chinensis* Linn. | Cruciferae |
| Pineapple | *Ananas comosus* (Linn.) Merr. | Bromeliaceae |
| Pummelo | *Citrus maxima* (Burm.) Merr. | Rutaceae |
| Radish | *Raphanus sativus* Linn. | Cruciferae |
| Rice | *Oryza sativa* Linn. | Gramineae |
| Santol | *Sandoricum koetjape* (Burm.F.) Merr. | Myrtaceae |
| Sincamas | *Pachyrrhizus erosus* (Linn.) Urb. | Leguminosae |
| Sineguelas | *Spondias purpurea* Linn. | Anacardiaceae |
| Sitao | *Vigna sesquipedalis* Fruw. | Leguminosae |
| Squash | *Cucurbita maxima* Duchesne | Cucurbitaceae |
| Sugar cane | *Saccharum officinarum* Linn. | Gramineae |
| Sweet potato | *Ipomoea batatas* Linn. | Convolvulaceae |
| Talahib | *Saccharum spontaneum* Linn. | Gramineae |
| Tamarind | *Tamarindus indicus* Linn. | Leguminosae |
| Tanguile | *Shorea polysperma* (Blanco) Merr. | Dipterocarpaceae |
| Tindalo | *Pahudia rhomboidea* (Blanco) Prain. | Leguminosae |
| Tobacco | *Nicotiana tabacum* Linn. | Solanaceae |
| Tomato | *Lycopersicum esculentum* Mill. | Solanaceae |
| Tugui | *Dioscorea esculenta* (Lour.) Burkill. | Dioscoreaceae |
| Ubi | *Dioscorea alata* Linn. | Dioscoreaceae |
| Upo | *Lagenaria leucantha* (Duch.) Rusby | Cucurbitaceae |
| White lauan | *Pentacme contorta* (Vid.) Merr. & Rolfe | Dipterocarpaceae |

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