

THE SOILS OF HAITI

By A. T. Sweet
U. S. Bureau of Soils

Early in September 1924 a call came to Washington for two men to do soil survey work in the Republic of Haiti. In answer to this A. W. Koeber and I accepted a temporary appointment from the Service Technique of the Haitian Government and sailed from New York November 1.

For the soil surveyor who visits the West Indies for the first time Haiti has many surprises. Situated 1300 miles south of New York, 1200 southeast from New Orleans and but 600 from the Florida coast it differs so widely in climate, vegetation and people from any part of the United States that it seems a part of another world.

Sailing time from New York to Port-Au-Prince is six days. We took a freighter and after stopping for the discharge of cargo at Cap. Haitien, Port de Paix, Gonaives and St. Marc arrived in ten.

Reaching Port-Au-Prince we learned that we were to make a detailed soil survey of the Lower Artibonite Valley, the work to be done from camp. The purpose of the work was to determine how much of the valley is suitable for irrigation.

Our outfit which had not been assembled was to be elaborate. It provided for two assistants and interpreters, a cook, camp attendants, saddle horses and men armed with murderous looking machetes for cutting out lines of traverse. The thing most needed, however, a dependable Ford, was supplied under protest.

After numerous delays we succeeded in getting into the field early in December. During this time we had been frequently reminded that in the Tropics things are not done as they are in the States. We soon learned however that if a soil survey was to be made it must be largely thru our own efforts. We therefore proceeded to construct our own base map, made foot traverses, bored holes, repaired bridges and drove Henry hundreds of miles over roads that had never before been traveled by an automobile. We undoubtedly lost caste with the natives who regard all work as degrading but in return gave them many lessons in industry.

Topographers had been at work for some time before our arrival and received us courteously. When after working for a few weeks we one day drove into their camp and showed them a well constructed base

map of a large part of the valley they expressed real interest. Upon completion of our work we were highly complimented by the director of Public Works for the rapidity and accuracy with which the survey had been made and copies of our maps were requested for immediate use of the topographers in the field.

The island of Haiti, situated between Cuba and Porto Rico, is the second largest in the West Indies. The Republic of Haiti occupies approximately the west third of the island, and is French while the Dominican Republic occupies the eastern two thirds and is Spanish. There is but little intercourse between the two republics.

Haiti is extremely mountainous, high steep mountains in many places rising abruptly from the sea. These have a volcanic core and a maximum elevation of over 9,000 feet. The slopes are of limestone. The chains have a general east and west trend and between them are low belts or plains with an elevation ranging from sea level to about 200 feet. The principal low plains are the Artibonite, the Cul de Sac, Du Nord, Fort Liberte, Archaï, Leogane, Aux Cayes and Torbec. There are also a number of small intermountain valleys.

The total area of the Republic is 10,200 square miles, only about one tenth of which is occupied by the low plains and valleys. There is also a Central high plain but which, with the exception of a few hundred acres, has never been under cultivation.

Precipitation in different parts of the island is quite variable ranging from more than 80 inches where conditions are favorable for condensing the moisture from the trade winds to less than 20 where they are not favorable. Many of the rains are torrential and evaporation on account of high temperature is rapid. We were surprised to learn that the deserts in Haiti probably receive a greater rainfall than is required for successful dry farming in Middle West. There are, however, two well defined rainy seasons one extending from about the middle of March to the last of May and the other from the last of August to about the middle of November, permitting of two growing seasons for a number of the food crops.

The winter temperature of Haiti is warm and strikingly equable. At our camp, in the shade and with good air circulation, the temperature day after day rose steadily from 70 degrees at daylight to 100 or a little higher at one o'clock. After three o'clock it again slowly dropped to about 70 degrees. The coolest period of the 24 hours seems to be a short time before daylight. During five months winter residence on the island there was no time so far as I remember when between seven in the morning and nine at night even the lightest of

clothing for warmth was necessary.

From our camp in the upper part of the Artibonite Valley we were able to drive in less than an hour from a region of luxuriant subtropical vegetation to one as arid as any to be found in Southern California or Arizona. Like conditions are to be found in parts of the other low plains. In these arid regions especially where occurring near the sea, the soil carries a high concentration of soluble salts. In the Artibonite Valley about half the area carries alkali in sufficient quantities either to make the land entirely unsuited for agricultural purposes or to seriously influence crop production. The percentage of alkali lands in the other low plains is not known but in some, especially in the region north and west of Port-Au-Prince and in that near Gonaives, it is high. Considering the Republic as a whole it is doubtful if more than five per cent is suitable for intensive cultivation as we understand it. The high valleys and mountain slopes, however, are quite productive supporting a considerable population.

When Haiti was discovered in 1492 the Indian population was estimated as high as 2,000,000. Within a quarter of a century this had by Spanish cruelty and probably by diseases been reduced to only a few thousand and no Indians have survived.

Settlements were first established by the Buccaneers but control gradually passed to the French whose rights to the west part of the island were recognized by Spain in 1697. The French established sugar plantations which required much labor and large numbers of slaves were brought over from Africa. In time Haiti became the richest colonial possession in the world. French warehouses were filled with sugar, coffee, cotton and cacao. Plains and valleys were highly developed. Broad straight roads, some surfaced with stone, were built. Extensive irrigation systems were in use. Power for large mills was developed from streams brought from the mountains over flumes of wonderful construction. Many of these yet stand, a monument to French energy and engineering ability. Large mansions of stone set well back from the roads were approached thru broad gateways and avenues of tamarind trees. Haiti at that time was a veritable garden spot and the white owners loved a life of ease, luxury and refinement probably never surpassed in any other part of the world.

At the time of the French Revolution the population had increased to 30,000 whites, 25,000 mulattos and free negroes and 480,000 slaves. The white proprietors in 1791 owned all the land and ninety per cent of the population. Thirteen years later thru the rebellion

of the slaves and the inability of the French to cope with them at that time every acre was owned by former slaves and is now owned by their descendants. These were entirely unprepared for self rule and the result has been a succession of rebellions, revolutions, rapine and bloodshed. The common people are ignorant and superstitious and for more than a hundred years have been the dupes of ambitious leaders and scheming politicians.

With the overthrow of the French the large estates were broken up and the head of each former slave family received a small portion of land. This was to be held by them and their descendants tax free, and is so held at the present time. The Haitian peasant regards his little farm of two or three carros his most valuable possession for it is his only means of maintaining life for himself and family.

It is an interesting fact that the names of the former French owners have survived in the names of the estates. A peasant is said to live on the Bocazelle or on the Petite des Dunes estate and the village of Dessalines which was made the capitol by an early Haitian leader is commonly spoken of by the peasants as Marshall its old French name.

The mansions have long since been torn down by the seekers for hidden treasure and groups of caillies now occupy many of the sites. The flumes and mills are no longer in use unless it be to furnish shade for a cock fight or a place in which to pen goats. The roads are grown up in Bayahonde until only donkey trails or foot paths remain.

In recent years debts which they could not pay were contracted with various nations and almost constant internal strife prevailed. That the obligations might be settled and for the maintenance of peace the United States in 1915 intervened and put the country under military rule acting as receiver for finances. Under American occupation peace has been established, a native army under American officers organized and trained, sanitary conditions greatly improved, roads built and schools established. What the final outcome will be no one knows.

The present population of more than 2,000,000 is largely rural. Well watered fertile regions swarm with natives. Steep mountain slopes are inhabited. Groups of caillies are strung along the streams far out into the deserts. Wherever water is available there are native villages. Every where are roads, burrow trails or foot paths along which moves a continuous stream of black humanity. Young bare-foot women in short skirts and bright turbans with baskets on their heads, old women in long loose dresses and broad brimmed straw hats ride sideways on little donkeys already overloaded, pack animals

carrying cotton, coffee, logwood, pigs and chickens, men in white linen, wearing machetes and carrying canes. All move swiftly with the swinging stride of the soil surveyor for Haiti is the land of foot travelers and distance is measured not in miles but in hours.

Native houses or cailles are built of sticks, daubed with mud and thatched with palm or palmetto. They are usually built in groups, the owners farming the surrounding lands. Cultivation is of the crudest kind being done almost entirely with heavy long handled hoes of home manufacture. In the Artibonite Valley more than 50,000 acres are under cultivation without the use of a farm animal of any kind. Rice and petit mil are picked by hand, threshed on the ground by trampling and cleaned by winnowing in shallow trays and pounding in large wooden mortars. These mortars are also used for grinding corn, hulling coffee and preparing other foods. Throughout Haiti the dull "Chug! Chug! Chug!" of the hand mortar is heard from morning 'til night. The expenditure of human effort for the bare necessities of life is enormous.

The important food crops are sugar cane, beans, rice, maize, petit mil, sweet potatoes, bananas, plantain, manyoke, Congo peas, tobacco, many kinds of garden vegetables, melons and squashes.

Cane is ground in antiquated mills with wooden rollers and the juice evaporated in large shallow kettles left by the French. A small yellow flinty maize is grown extensively and used for human consumption only, being too valuable to feed to animals. Petit mil is a rank growing non saccharine cane, the grain of which is eaten like rice or ground into flour. Plantain resembles large green bananas, but is cooked before being eaten. The manyoke plant resembles that of the castor bean but has large tuberous roots from which is made the casava bread, one of staple articles of diet. Of tropical fruits there is an abundance, mangoes, avocados, oranges, limes, guavas, custard apples and others. Coconuts are abundant but used for the milk only.

The principal exports are coffee, logwood, cotton and cacao. Sugar for export is made by the Hasco Company at Port-Au-Prince. The United Fruit Company has several small banana plantations in the western and southern parts of the island. The West Indian Company is growing tobacco for domestic manufacture in the Central Plain and a pineapple plantation has recently been established near Cap. Haitien.

Cotton is of the tree variety which grows from year to year and must be cut back to keep the bolls within reach. Plants from

twelve to fifteen feet in height are often seen. The yields from the native fields are small, probably not more than 300 to 400 pounds of seed cotton per acre. Coffee is produced from small trees in the high valleys or on the mountain slopes, planted among the bananas or allowed to grow wild. Logwood, introduced by the French, has spread to nearly all parts of the island and is an important article of export being rafted down the rivers and carried out on pack animals.

There are rather large numbers of cattle and goats and a few sheep. There are many hogs of poor type and poorer flesh. Small donkeys are the principal beasts of burden but there are also many ponies and small saddle horses. Chickens are every where. Cock fighting is the national sport for the men and industriously indulged in. The markets are the community centers for the women.

The natural vegetation is of interest. In the well watered regions are an abundance of royal and cocconut palms, beautiful mangoes, immense mapou, regarded by the natives as the abode of Zombe the Devil, the silk cotton tree which yields the kapok of commerce, the Hatian oak, the campeche or logwood, the bois d' erme or native mulberry, mahoganv, rose wood, satin wood, the figuier, the immortal, royal ponciana, the bois casse and many others. Where the soil is shallow or the rainfall is less the predominating growth is bayahonde, the mesquite of the Southwest, Bois cabreit or goat wood, the tamarind, many varieties of acacia, the gïao or lignum bitae, bois june from which are made Khaki dies, and the Senegal. In the lower arid and alkali regions are scrubby bayahonde, casti of many varieties, pickle weed and mangrove.

The lower Artibonite Valley is V-shaped opening toward the sea at the northwest. At the sides are low mountain ranges with fairly steep slopes covered by scant forest growth. The Artibonite enters the valley near its apex, follows a meandering course along the southwest side and empties at Grand Saline. Its upper course is partly protected by levees but the lower part overflows during one or both rainy seasons. The Esterre River enters this valley thru a gap in the mountains on the right side, and follows an almost direct course thru broad marsh lands, said to have been the indigo fields of the French, and empties north of Grand Saline. This stream has built up a low natural levee which for miles is occupied by an almost continuous string of native villages.

Near the point of a sharp ridge which extends into the upper part of the valley Christoph, one of the early Hatian rulers, built a massive palace and in the well preserved ruins of this we pitched

our camp. From it we could look down into the town of Petite Riviere with its large church, its market square, gendarm post, white cemetery and hundreds of thatched roofs. We could see far out over the valley with its pathetic ruins. Mole St. Nicholas, at which Columbus made his first landing on the island, is just around the point which we can see in the distance. In plain sight on the steep mountain slope to the right are three strong fortresses built by Desselaines. On the crest of the ridge half a mile above our camp is another old fortress in the ruins of which are many antiquated cannons. One of these bears the insignia and monogram of George Third of England for the English at one time held parts of Haiti.

The soils of the Artibonite Valley range from light yellowish brown thru various shades of brown, grayish brown and dark brown to black. They are predominantly heavy in texture ranging from clay loam to clay, silty clay loam and silty clay predominating. They are highly calcareous, soils from all parts of the valley effervesce: ing freely upon the application of hydrochloric acid. Considerable areas, especially in the lower parts, carry high percentages of alkali and other areas farther inland carry alkali in varying amounts. During our work no laboratory examinations were made to determine the character of the salts but they are believed to be largely sodium chloride. No field indications of sodium carbonate or black alkali were noted.

The alluvial soils of the valley were grouped into four principal series and additional minor ones which were given local names, attempt being made to correlate them with the soils of the United States.

Of these the most important on account of high agricultural value is the Artibonite series. These are light brown to slightly yellowish brown this color predominating thru soil and subsoil section. In deep sections as shown along the river bank they are irregularly stratified to a depth of fifteen or more feet, heavy slightly darker colored layers alternating with those slightly lighter both in color and texture. The predominating type is a silty clay loam, slightly lighter and more friable to a depth of eight or ten inches. Where exposed to weathering the heavy subsoil shows a slight columnar structure. The lighter types are found adjacent to the river and in places in a low narrow first bottom. The heavier types predominate at some distance from the river and in places in old abandoned channels and cut-offs. Under proper moisture conditions these soils are fairly friable and easy to cultivate, take up and hold moisture well, are free from alkali and are the most productive and highly developed soils of the valley.

They extend as a belt along the Artibonite River being widest in the upper part but narrowing to a point where the river empties.

The soils of the Desselaines Series are very dark brown to black, heavy in texture and high in organic matter. The subsoil is a gray clay high in lime. Soils of this series occupy a considerable area of marsh land along the northeast side of the main valley near Desselaines and predominates in the small adjacent valleys. On account of their heavy texture these soils are difficult to handle but are free from alkali and are productive. As soon as overflowed these soils are covered by a rank growth of a water-loving plant the tlagce, which reaches a height of five or six feet. As soon as the water subsided this is chopped off and burned and the larger part of the land planted to maize.

The soils of the Esterre Series are dark gray heavy and plastic and low in organic matter. The subsoil is a mottled gray, yellow and rusty brown tenaceous clay. They are flat and poorly drained and carry in most places high percentages of alkali. They occupy the lower central part of the valley, between the Artibonite and Esterre Rivers and are subject to overflow from both streams. The surface in places has the loose granular structure of alkali soils in the West. Only limited areas are under cultivation and these as a rule are not very productive. Large areas are covered by pickle weed, scrubby bayahonde and cacti. Adjacent to these but extending up the central part of the valley is a considerable body of soils closely resembling those of the Esterre Series but slightly higher and better drained. They are dull brown to grayish brown in color, heavy in texture but with less pronounced mottling in the subsoil. They are comparatively free from alkali and considerable areas are under cultivation. The yields are poor.

The soils of the Verrette Series are light gray in color and the subsoil a light gray highly calcareous clay. Considerable areas are gravelly carrying in places large quantities of partly rounded limestone fragments. These soils have been carried into the valley by the small streams which head in the mountains to the south. They are for the most part irrigated and productive.

On the lower hill slopes bordering the Artibonite Valley the underlying material is a soft cream colored ~~marly~~ limestone or chalk. Where this is exposed to the weather a hard layer resembling the caliche of the western plains develops at the surface. Along foot-paths and roads this wears thru and the soft underlying material weathers rapidly. In places it is dug out and used for lime and for surfacing the roads. Under the ordinary processes of weather-

ing it forms a black clay soil quite granular at the surface but a short distance below the surface breaking into small fragments with sharp irregular fracture. At a depth of eight or ten inches the sub-soil becomes grayish and is underlain by the light colored lime material at an average depth of about fifteen inches. The series name of Petite Riviere was given to these black residual soils. Soils of this kind were noted on the lower slopes south of Port-Au-Prince, near St. Michell in the Central Plain and in many other places.

A few small areas of soils derived from igneous rocks were noted. These are dull brown to reddish brown, heavy in texture gravelly and shallow. They support a scant growth of short grass, cacti and a few hardy shrubs.

Our work was confined entirely to the Artibonite Valley of which 259 square miles were surveyed in detail. A very large number of alkali determinations were made and the surveyed area divided into three grades as regards alkali. The first or alkali free area covers about 40 to 45 per cent of the valley including the upper portion and narrow strips along the lower courses of the rivers. The second area in which there is an appreciable amount of alkali but not enough to seriously interfere with crop production covers from 15 to 20 per cent. The third area in which alkali is present in sufficient quantities to make the land practically useless for agricultural purposes covers the remainder, about 40 per cent. Observations in other parts of the island were made hastily as we had opportunity.

In places on the slopes above the dark brown and black soils are areas of reddish brown to deep red rocky soils. Many of these areas were noted on the slopes bordering the Artibonite Valley which have much the appearance of the Crawford stony loam. High on the slopes south of Port-Au-Prince is a deep or dark red stony clay resembling the Decatur soils. The stone is a hard limestone exposed in large irregular masses with clay between. These steep slopes are sparsely settled and the soil where possible planted to Guinea grass, Congo peas and bananas. Red soils are said to be developed in many places in the high mountains.

On the holdings of the Hasco Sugar Company in the Cul de Sac Plain north of Port-Au-Prince the soil is a grayish brown to dark or nearly black silty clay or clay. Along ditches being dug for drainage purposes the soil is distinctly stratified to a depth of ten or twelve feet, dark colored very heavy soil twelve to eighteen inches in depth alternating with layers of about the same thickness slightly lighter in both color and texture. The darker colored soil when exposed to

weathering breaks with a sharp fracture into irregular masses one-half to three-fourths inch through. Where it is exposed at the surface or has but a shallow covering is quite unproductive and is said to have been so in French times. Attempts are now being made to reclaim these unproductive areas by drainage, assuming the trouble to be due to alkali. The watertable, however, is not high. There are no surface indications of alkali and the bridge indicates a high resistance. The trouble seems to be purely one of soil texture and structure.

On the Bon Repos cotton plantation in the same plain the soil is a brown heavy clay loam, loose and friable at the surface but with a heavy subsoil. In the lower lying areas are unproductive alkali spots.

The tillable soils in the western part of the island, used extensively for bananas, seem to consist principally of loamy and gravelly soils deposited as alluvial fans by the small streams or as valley filling material at the foot of mountain slopes. Valley filling material also occupies the upper parts of the small valleys extending high into the mountains. Here much of it is used for bananas and coffee the two crops being planted together.

I did not see the soils near Cap Haitien being used for growing pineapples. Of these Kocher gives the following description, "The pineapple soils that I saw are of coastal plain formation rather recent in origin varying from a heavy sandy loam to heavy loam in texture. The surface color is brown to dark brown and the soils are mellow and easily cultivated. The subsoil is irregularly stratified to a depth of six or more feet and consists of brown to light brown loams, the lower horizons somewhat mottled with rusty brown. There is but little evidence of advanced weathering, the subsoil being open, mellow and easily penetrated by both water and roots. It is said the pineapples are better on the lighter textured soils. It is reported that the average pineapple grown on this plantation weighs about seven pounds while the average weight of the Hawaiian pineapple is said to be about three and one half pounds."

Kocher also gives the following description of the red soils on the mountain slopes south of Cap. Haitien which he says seem to be old valley filling material, "The surface is a deep red silty clay loam resting on a compact clay loam of the same color at about 18 inches. Below this the color remains about the same but the structure is more open and friable. It appears somewhat stratified but is not strikingly different to a depth of ten feet or more. The depth of this soil is unusual the greater part of the hill lands being very shallow. The

type was producing excellent coffee and bananas although both are in a wild state".

The Central Plain which is about 50 miles in length and has an average width of about 15 miles lies on the north central part of the Republic. The soils considering them as a whole are heavy and refractory and show upon weathering an adobe structure. The soils of flat areas where drainage is poor are uniformly very dark brown to black. Where surface drainage and probably under drainage is better they are brown, reddish brown or yellowish brown. Light gray to cream colored calcareous material is exposed in all deep subsoil sections and abundant lime concretions are found in places favorable for their accumulation.

The only indication of advanced soil development noted on the island is to be found in this plain in a flat area of considerable extent about midway between St. Michell and Maisserie. The predominating soil of that region is a very dark brown silty clay. In this at intervals of 25 to 50 yards are light gray irregular spots ten to twenty feet across reminding one of the alkali spots of the western plains. Where a recently graded road crosses this area these spots give the adjacent slopes a streaked appearance. In places the light colored material was being dug out and used in surfacing the road. A sample taken from one of the spots shows a shallow layer of gray clay loam slightly granular. Below this and extending to a depth of twenty inches is a light ash gray soil of single cell structure with numerous small iron concretions. This is abruptly underlain by dark brown heavy clay with small reddish brown specks and a few iron concretions. Upon exposure it breaks into irregular cubical masses one to two inches through. At about thirty five inches this grades into a reddish brown and yellow mottled, plastic clay. Below forty five inches is yellowish and gray sandy clay and soft lime material.

In conclusion,--The area of Haiti suitable for intensive cultivation is small. Economic conditions are bad. Labor is cheap. Hundreds of men at an hours notice can be hired for thirty cents a day and board themselves. A house servant costs ten dollars a month. A good caille can be built for twelve dollars. Oranges sell for one-fifth a cent each, chickens for twenty cents and a full grown turkey for half a dollar. Among the working people many of the children are naked. Grown people are in rags, many under nourished and hungry.

On the other hand there is an opportunity for very greatly increased production through the establishment of irrigation systems and

improved agricultural methods. It would seem that exports, especially bananas, coffee and cotton might be very greatly increased. To these might be added oranges, limes, grapefruit, avacadoes, pineapples and doubtless others. The hevia rubber plant is said to have been grown successfully on the island and it is possible that small rubber plantations might be successfully established.

Although the opportunities offered by a productive soil, a tropical climate, cheap labor and good markets are important they are far surpassed by the opportunities of the island as a tourist winter resort. As such Haiti has much to offer, the beautiful blue Caribbean with its bathing beaches, bays, inlets and promontories, rugged mountains, tropical vegetation, primitive people and historical associations. With a stable government, good roads, and modern hotels Haiti would have more to offer within one day's travel than Southern California, Florida or even the Ozarks of Missouri.