ATLANTIC ZONE PROGRAMME

Field reports No. 10

A DETAILED SOIL SURVEY OF THE RIO JIMENEZ AREA IN THE ATLANTIC ZONE OF COSTA RICA

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PREFACE

The multidisciplinary research carried out in the context of the Atlantic Zone Programme in Costa Rica started with a diagnostic study of the Zone so as to enable the selection of relevant development oriented research themes. A study of the soils and their potential is part of it.

The present detailed soil survey was carried out in the period March-May 1987 in an area covering part of the subarea Rio Jimenez of the baseline study. The report is not final. Additional soil studies in the area are required to be able to correlate soil units and to establish definite names so that the nomenclature used in this report is likely to change. Furthermore, the chemical analyses of the soil samples taken from the profile pits had not been completed when the report was prepared. The results presented are therefore of a preliminary nature. The data will eventually be incorporated in a comprehensive report on the soils of the Zone and their potential that is to be prepared in due course.

The report was presented in partial fulfillment of the requirements for the degree in Soil Science of the Agricultural University Wageningen, the Netherlands.

The work was supervised by Dr. W.G. Wielemaker.

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Jan F. Wienk
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INTRODUCTION

This report and adjoining maps give the results of a detailed soil survey in the Rió Jiménez area in the Atlantic Zone of Costa Rica. (See Figures 1, 2 and 3 for the exact location).
Main goal of the survey is to make an inventarisation of the soils occurring in the area. This has resulted in a soil map on a scale 1: 20.000 and appropriate map legend (see Appendix IV).
A further characterization of the soils can be found in this report, together with a short comment on the relations between respective soils and soil genesis
Important in this context is the relation between soils, and their different stages of development on one hand,and the physiography of the area on the other hand.
A better understanding of this relation makes fieldwork more efficient and results in a better soil map.

The report starts with a general introduction of the area.
Chapter 1 discusses subjects as geology and geomorphology, climate, hydrology and drainage, and natural vegetation and landuse. Survey methods are given in Chapter 2.
In Chapter 3 a legend system is introduced by means of which the different soil types (suelos) can be classified and grouped.
A concise description of the soils encountered in the survey area and their range in characteristics is given.
Finally some remarks are made concerning soil genesis and relations between soils (Figure 5).
Chapter 4 contains an explanation of the mapping units applied on the soil map; a second paragraph of this chapter gives an analytical description of the soil map image.
Also relations between soils and physiography and parent material, are discussed.Some conclusive remarks are added.
In Chapter 5 a soil capability evaluation for agricultural use is presented, according to the system of the "Manual para la determinacion de la capacidad de uso de las tierras de Costa Rica", and according to the FAO system.
The report is completed with a number of appendices.

CHAPTER 1

GENERAL DESCRIPTION OF THE RIO JIMENEZ AREA

1.1 Location

The Rió Jiménez area is located in the lowland on the Caribbean (Atlantic) coast of Costa Rica, the so-called Atlantic Zone (see Figure 1). The altitude of the area varies from 40 m to about 15 m above sea level. The size of the area is aproximately 1200 hectares.
For the exact location of the area and its boundaries is referred to Figures 2 and 3.

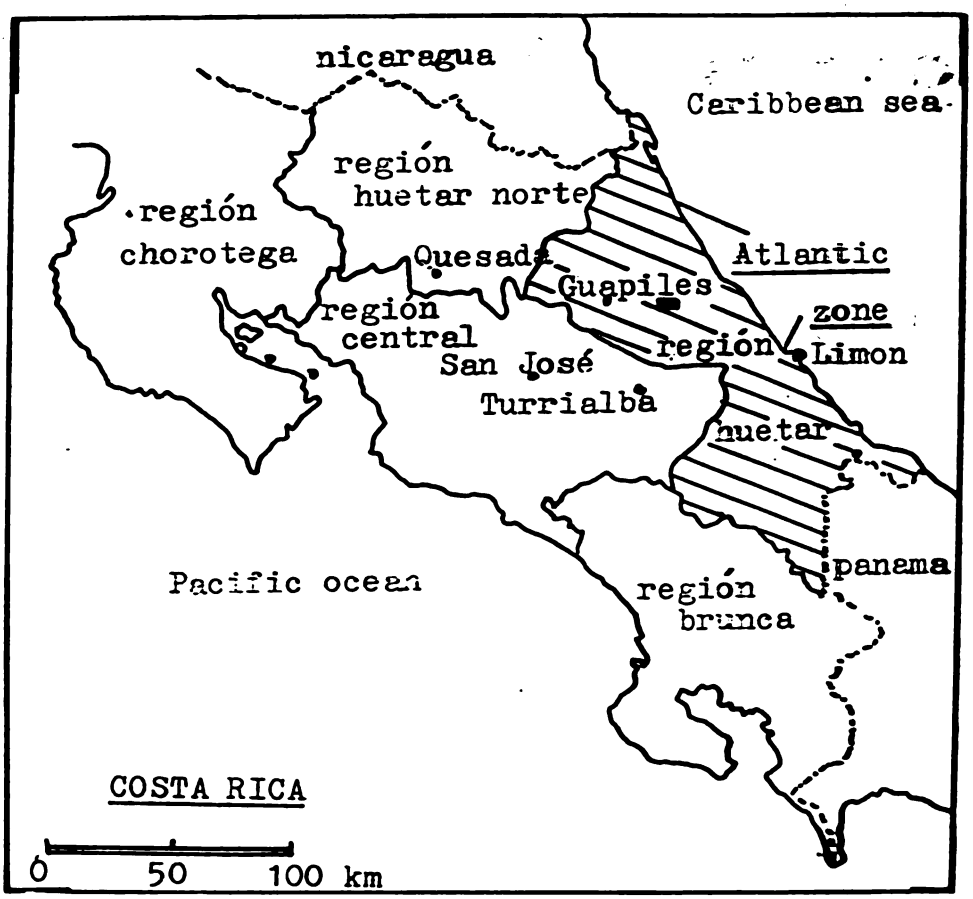


Figure 1: The Atlantic Zone of Costa Rica.

1.2 Climate

There are no exact climatical data available for sites within the survey area. Only precipitation data are given on a 1:1.000.000 scale map: " Precipitacion Promedio Anual en Costa Rica, periodo 1961-1980", (MAG, IMN, 1982); with an average annual precipitation between 3,500 and 4,500 mm.

The most representative data are from "Estacion Meteorologica El Carmen", which is situated about 12 km east of the survey area, at an altitude of 14 m above mean sea level (see Figure 2).
The following data can be given:
The average daily temperature is about 24.7 degrees Celsius.
The difference between average daily maxima and minima is about 8 to 10 degrees C.
The difference in temperature between the coldest and the hottest month is about 2 degrees C.
The average annual temperature of the soil is higher then 24 degrees C. This implies that the soil temperature regime, according to the Soil Taxonomy (Soil Survey Staff, 1975), is isophyperthermic.
The average annual sunshine per day is 4,9 hours,varying from an average 5,8 hours in the sunniest month to an average 4,0 in the cloudiest month.
In general the wind velocity is very low.
Most of the rain falls during the so-called "Temporales", when a cold front or exhausted hurricane reaches the coastal area.
The average relative humidity is above 80 % during the whole year.Occasionnally it can be lower in relatively dry months in dry periods.
Resulting soil moisture regime, according to the Soil Taxonomy (Soil Survey Staff,1975), is Udic.

The following meteorological data are from El Carmen and cover the period 1972-1980. (IMN. 1981).

Month.	Temperature (C)			Sunshine	Relative	Precipitation
	max.	min.	average	(hours)	humidity %	(mm)
January	29.1	19.1	23.5	159.9	86.8	290.4
February	29.9	19.6	23.6	149.1	86.9	211.4
March	30.0	20.2	24.6	180.0	84.8	119.1
April	30.2	20.7	25.1	166.6	85.9	249.0
May	31.1	21.8	25.9	166.0	87.7	231.1
June	30.3	21.8	25.4	125.5	88.3	367.3
July	29.9	21.6	25.1	120.7	90.4	498.3
August	30.5	21.6	25.2	133.5	89.8	363.2
September	30.8	21.4	25.3	146.9	88.2	275.4
October	30.9	21.2	25.1	157.5	87.9	223.8
November	30.3	20.8	24.6	130.1	89.8	440.2
December	29,7	19.6	23.7	150.5	89.2	476.9
Annual	30.1 (average)	20.8	24.7	1786.3 (total)	88.0 (average)	3746.2 (total)

1.3 Geology and Geomorphology

The Atlantic Zone of Costa Rica is a part of the coastal lowland overlying the depression of Nicaragua, which extends from Nicaragua, along the Caribbean coast, into Costa Rica. The region mainly consists of alluvial coastal plains, with locally some low hills, composed of old Quaternary and Tertiairy volcanic materials.
The survey area is located in the Llanura de Santa Clara (llanura = plain), which lies at the foot of the Turrialba volcano (see Figure 2). This volcano is composed of andesitic lavas, lahars, tuffs and other pyroclastic material, (Mapa Geologico de Costa Rica, scale 1:200.000, IGN, 1982).
The adjoining part of the coastal lowland is built up mainly of Quaternary alluvial sediments, alternating with laharic volcanic deposits.

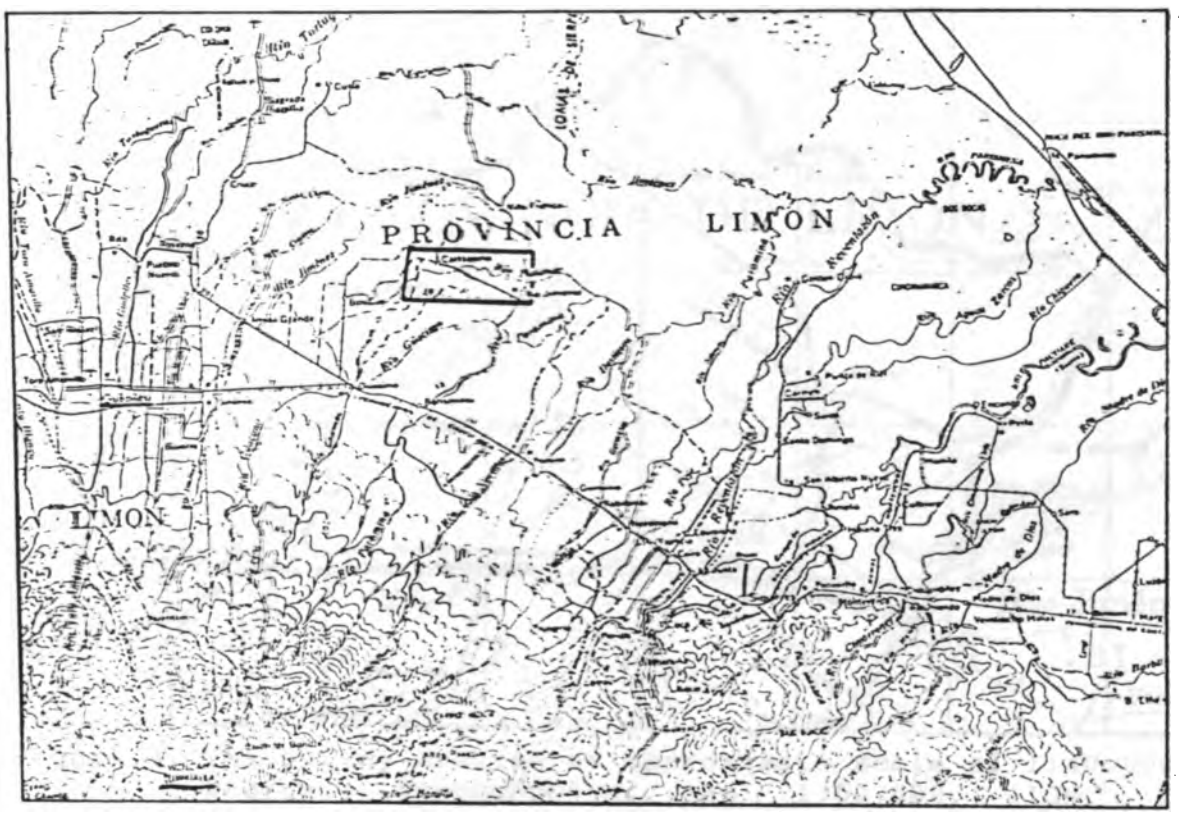


Figure 2: Location of the survey area in the Atlantic zone, with the Turrialba volcano in the southwest, the volcano slope, the alluvial fan and plain, and the coastline. Also indicated meteorological station El Carmen in the east, and Guapiles, west of the survey area.
(source: Topographical map 1:200.000 IGN, 1971).

These two types of deposits form the main parent material for soils in the survey area. Alluvial materials range from humic clay, silty clay and clay loam to sandy loam and sand.
Most of the volcanic material consists of fluviatile redeposited coarse sandy material (locally gravelly) and in situ coarse laharic deposits. Except for one soil type (Suelo Milano, see Chapter 3), all material is relatively recently deposited.

Most of the area has a flat to slightly undulating topography (slope class: 0 - 2 %), with a range in altitude from approximately 40 m in the southwest to approximately 15 m above mean sea level in the northeast (see Figure 3).
The only forms of relief are steep-sided river incisions of 2 to 6 m deep. Along major river courses often river terraces are present with clearly visible edges.
As a result of little variations in geology and landform, the physiography of the area is also relatively homogeneous.
For use as indication for the occurrence of different soil types it is hardly or not suitable.

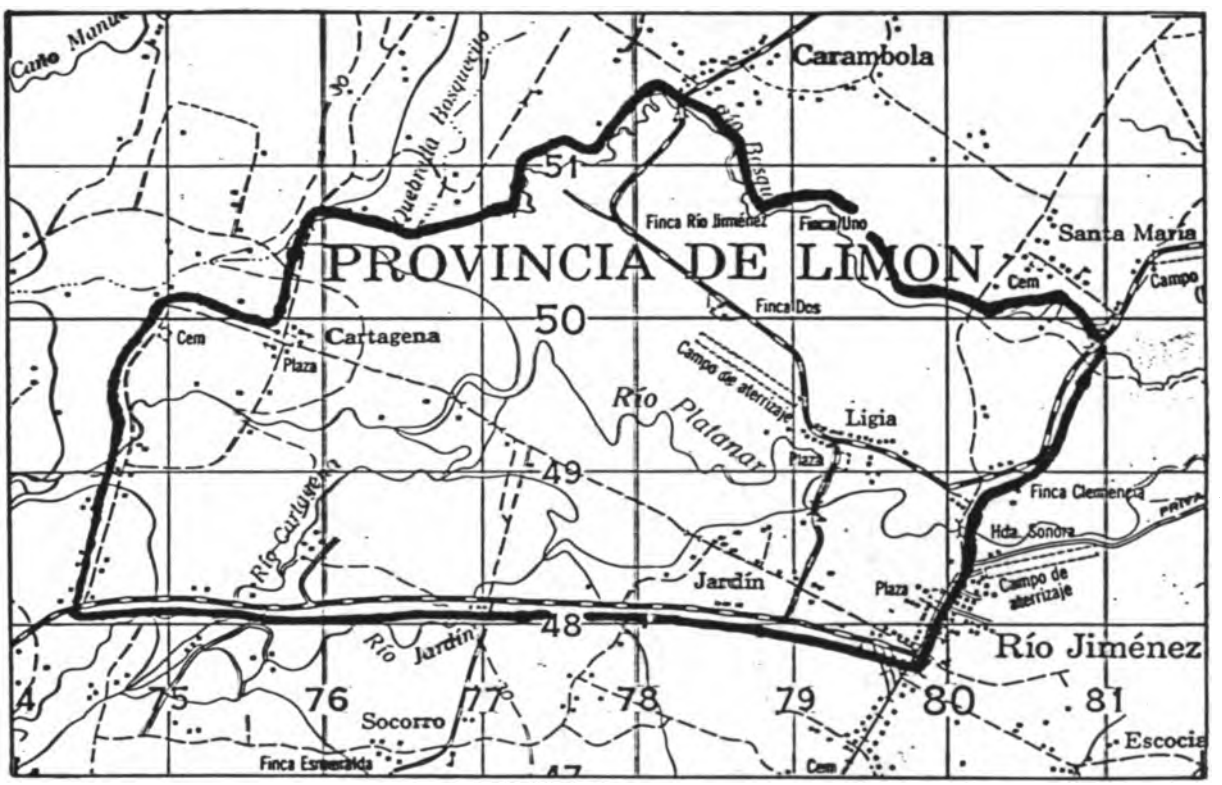


Figure 3: The survey area on an approximate scale of 1:40.000. Source: Topographical map 1:50.000, IGN, Costa Rica,1971.

1.4 Hydrology and drainage

The survey area is drained by numerous small rivers and creeks, of which the Rió Platanar, Rió Bosque and Rió Jardin are the most important ones (Figure 3).
Consequently, most of the area is dissected by a dendritic pattern of active, or temporarily active, small creeks and gullies

Effective drainage in these creeks is often impeded by abundant vegetation and plant debris.
Together with the bad internal drainage of some soils (see Chapter 3) and the low position of parts of the area, this results in imperfectly to poorly drained soils.
Also the presence of artesian water may be important with regard to the bad drainage in some areas.
Stream flow in rivers and creeks varies considerably; high discharge rates are reached in the rainy seasons, (although not observed it has to be considered that this can cause local flooding), while in dryer periods discharge is moderate to low.
Artificial drainage is noticed in esp. areas under regular and continuous cultivation.

1.5 Natural vegetation and land use

The natural vegetation of the survey area is Premontane wet forest, basal belt transition, according to the world life-zone classification of Holdridge.(Source: Mapa Ecologico, scale 1:750,000, C.C.T. 1969).

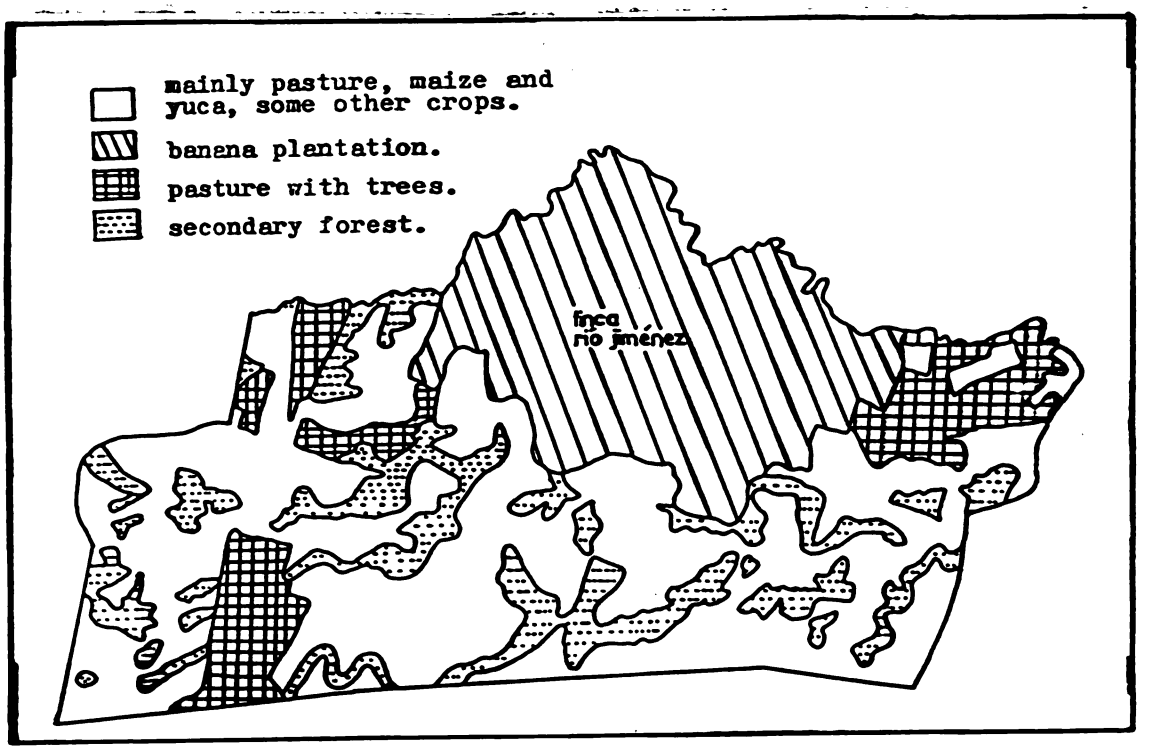


Figure 4: Land use in the survey area, based on aerial photograph interpretation (IGN, 1981, scale 1:35.000), and field observations (Dam, 1987).

Since the area has been under cultivation for over 100 years (which can be considered relatively long in the Atlantic Zone), most of the natural vegetation has disappeared, except for some narrow strips along the river banks and in some poorly drained parts. Presently most of the area seems to be cultivated although some parts very extensively.
Approximately one third of the area is being used as banana plantation (Figure 4).
Pasture and maize are the main types of land use in the remaining parts.
Besides these, a large variety of other crops can be found, like yuca/cassave, cacao (not under active cultivation), vegetables and ornamental plants and flowers.

CHAPTER 2

SURVEY METHODS

In March 1987 a start was made with the fieldwork in the Rió Jiménez area.
Preceeding the actual fieldwork an introductory instruction was given (Fieldwork Instruction Manual,Wielemaker,1986), covering the major goals and methods of the soil survey.
Some recommended literature, ie. the Soil Survey Manual (1951) was studied.
The fieldwork started with an excursion through the area to get an insight in the geology, geomorphology and pedology.
Study and interpretation of aerial photographs took place in this phase of the survey and also continuously during the actual mapping. It proved to be valuable to recognize topographical features and drainage pattern and it gave a possibility to locate field observations more precisely.
The following aerial photographs were available:
-Nrs. 24873,24874 and 24875 Run 177, series L 248, scale 1:35,000. (IGN,17-3-1981).
-nrs. 23 and 24, Run 3, series L 17E, scale 1:80.000, infrared, (IGN, 1985).

The second phase of the survey included the examination of the soil by means of hand augerings in order to determine the different soil types (suelos) in the area.
Soils and soil material were examined on all relevant characteristics, ie. landform, landuse, drainage, texture, colour etc.. For a complete listing of all characteristics is referred to Appendix I, which gives the used soil description form.
Applying the registered characteristics and soil properties as differentiating criteria, it proved to be possible to distinguish a limited number of different soil types (suelos) and soil phases (See Chapters 3 and 4).

For the selection of the final soil types a correlation with other soil surveys in the surrounding area has been made, (Semi-detailed soil survey of cantons Pococi and Guácimo, Van Leeuwen, Spaans and Stoorvogel,1987, and the Detailed soil survey of Neguev and eastern Rió Jiménez areas, Hazeu and Nobbe,1987).

In the third phase of the survey, soil types and soil phases (the major mapping unit, see Chapter 4) were mapped, mainly by means of numerous shallow (1.20 m deep) hand augerings.
Aerial photographs were used to distinguish areas with a distinctive physiography and land use, indicative for a certain soil type. Sometimes it also proved possible to use grey toning as indication.
The boundaries of each mapped soil phase are thus based on hand augerings, physiography, local vegetation and landuse and the pattern of certain grey toning on the aerial photographs.
Aerial photographs enlarged to a scale 1:17,500 formed the base map on which the geographical extent of each soil phase was drawn.

In the last phase of the survey soil types had to be described in soil profile pits, on carefully selected sites, reflecting the central concept of each soil type distinguished. Pits were dug deep enough, if possible, to also examine soil parent material. The soil horizons were examined in detail and all relevent characteristics were registered on special forms (see Appendix I).
Description of the given profiles is based on the FAO guidelines for soil profile description (FAO, 1977).
The complete description of the soil profile pits is given for all soil types as Appendix III.
Finally, each soil horizon was sampled in duplo for textural and chemical analysis.

CHAPTER 3

SOILS AND SOIL MAP LEGEND

In the first paragraph of this chapter a soil map legend is presented for the soils occurring in the Rió Jiménez area. Paragraph 2 contains a concise description of the soil types that have been distinguished in the survey area, mentioning major properties, range of variations and types of land use. For a detailed description of a representative profile of each of the "suelos",(specific soil types), is referred to Appendix III. Relevant background information concerning type of parent material, physiography*, soil genesis and relations between soils is given in paragraph 3.

3.1 The soil map legend

Before starting the detailed soil survey in the Rió Jiménez area it was decided that the lowest category in the final soil legend should be composed of suelos.
Suelos have a range in characteristics equivalent to the Soil Series of the Soil Taxonomy (1975). This unit is uniform concerning horizon sequence, horizon characteristics and has developed on the same type of parent material (Soil Survey Staff,1962).
The suelo is preferred here because its range in characteristics is established in accordance with the local physiography, making it physiographically mappable. (this implies that the suelo does not always fit in the established categories of a taxonomical system like the Soil Taxonomy or FAO world soil map legend).

Based on specific properties of the suelos and other relevant information (see below), grouping of the suelos is possible, resulting in a soil map legend with defined groups of comparable soils. The following compilation gives the soil groups and their major characteristics, as they occur in the survey area; classification criteria are further explained below.

*Since no clear relation exists between the occurrence of soils and local physiography (simply because there is hardly such thing as a varying physiography in the area) more attention is given to the type of parent material.

LEGEND FOR THE 1:20.000 SOIL MAP OF THE RIO JIMENEZ AREA

FINE TEXTURED SOILS WITH CLAY ILLUVIATION (ULTISOLS/ALFISOLS)

Soils developed on laharic deposits

A moderately deep to deep, well drained fine, textured soil with a clayey, dark brown to brown A-horizon and clay illuviation in the B-horizon. Without thixotropic properties im A and B-horizons, but with thixotropy in the C-horizon due to weathering of very coarse lahar deposits (volcanic).

Suelo Milano

Soils developed on fluvial deposits

A moderately deep, moderately drained loamy to clayey soil, with a clayey loam to clayey A-horizon and with clay illuviation and some Fe/Mn concretions in the B-horizon. This soil has no thixotropic properties.

Suelo Aluvial

SOILS WITH CLEAR ANDIC PROPERTIES (ANDISOLS)

Soils developed on laharic deposits

A shallow to moderately deep, well drained soil, with a well developed, humic, very thixotropic A-horizon, overlying unaltered parent material composed of coarse to very coarse sand, gravel and stones.
Stones can occur high in the profile.

Suelo Unión, phase $\frac{\text{Un-3P2}}{\text{A}}$

Soils developed on laharic-fluvial deposits

A shallow to moderately deep. well drained soil with a well developed, sandy loam to sandy, very humic and thixotropic A-horizon, overlying coarse sandy, slightly gravelly parent material. No stones occur in the profile.

Suelo Unión, phase $\frac{\text{Un-3}}{\text{A}}$

A moderately deep, moderately well drained soil, with a silty/sandy clay loam, humic, very thixotropic A-horizon, overlying a slightly cemented, massive, very thixotropic, cambic B-horizon, developed in coarse sandy parent material.

Suelo Chirripó

A well drained, moderately deep soil with a sandy loam to clay loam, humic, very thixotropic A-horizon, overlying a well developed cambic B-horizon, also very thixotropic. Parent material consists of coarse sand.

Suelo Christina

A moderately well drained, moderately deep soil with a moderately well developed, loamy, humic A-horizon, overlying a weakly developed B-horizon, often showing grey mottling in the lower part.
The soil material, sandy loam to clay loam, is thixotropic.

Suelo Ligia

SOILS WITH LITTLE OR NO DISTINCT MARKS OF PEDOGENETIC PROCESSES BUT WITH ONE OR MORE HORIZONS WHICH SHOW ALTERATION OR CONCENTRATION (INCEPTISOLS)

Soils developed on laharic-fluvial deposits

A moderately to very poorly drained, shallow soil with little profile development, on coarse sandy fluvial deposits with distinct thixotropic properties.In most augerings an A-C profile is observed.
Locally this soil contains stones and gravels,(phase $\frac{\text{Ta-3P2}}{\text{A}}$)

Suelo Toro Amarillo

Soils developed on fluvial deposits

A moderately to very poorly drained, shallow, loamy to sandy clay soil, with Ah, Ag and C horizons, without thixotropic properties.

Suelo Jardin

In the given context of the survey area, and the purpose of the produced soil map (agricultural use in the Atlantic zone of Costa Rica) a classification of the soils in the map legend should be based on those soil properties which reflect best management and use potential of the soils.
This has resulted in the application of the following

classification criteria:

On the first level soil orders are distinguished, according to the Soil Taxonomy (Soil Survey Staff, 1975),using the given differentiating taxonomic characteristics,("presence or absence of diagnostic horizons,or features that are marks in the soil of the differences in the degree and kind of the dominant sets of soil forming processes that have gone on", Soil Taxonomy,1975).
Classification of the different suelos in the area, in the category of Soil Taxonomy soil orders, separates those soil types which have clearly different properties.
It is based on the most complete combination of profile characteristics, thus giving the most justifiable subdivision, leaving the possibility open to classify according to a specific, important property, on a lower level in the legend

This is done on the second level of the soil map legend;
It is the impression that, in addition to the general type of soil and soil development (type of soil order), the most typical soil characteristics, (thixotropy,texture,structure, soil depth and in some cases drainage) are directly related to the type of parent material in which the soil is developed.
It is therefore suggested to group those soils together which have comparable parent material.
Three groups can be distinguished, based on this criterium, for the Rió Jiménez area.

-Soils developed in material with a volcanic origin and deposited by lahars.
-Soils developed in material deposited by interacting laharic-fluvial processes, or developed in material deposited by fluvial processes, but with properties, related to the volcanic origin of the parent material.
-Soils developed in material deposited by fluvial processes, without special properties indicating a typical volcanic origin.

Criteria used to characterize the type of parent material are: texture, thixotropic character, occurrence of the deposits and physiography of the area where the soil occurs.

Since parent material is often related to the physiography, and thus physiography also to the soil group,a combination of the criteria type of parent material-physiography can be used to differentiate between soil types on this second level of the soil legend.

On a third and final level soil types are further distinguished, based on their complete range of properties.
When Soil Taxonomy guidelines are applied the final single soil

type is the soil series. As was explained in the beginning of this paragraph the soil series can be compared with the lowest category of the soil legend, the suelo.

Variation in slope, presence of gravel or stones in the profile, presence of stones at the surface and soil depth are not reflected in the suelo.
These variations are expressed as phases of suelos,(see Chapter 4).

3.2 The soil types or Suelos

The following suelos of which a concise description is given below have been distinguished in the Rió Jiménez area.
For a complete description of a representative profile of each suelo is referred to Appendix III.
A schematical compilation of the major characteristics of the suelos is given as Appendix V.

SUELO MILANO (RJZ 2)

Suelo Milano can be described, and is described previously*, as a moderately deep to deep, thoroughly weathered, well drained fine textured soil. Over the whole profile the soil has a high to very high porosity, while biologic activity (ants) is concentrated in the upper part.
The soil has a 30-60 cm thick dark reddish brown A horizon (with a 10-20 cm thick Ap at the surface) with a strong, fine-subangular blocky structure, and is composed of clayey non-tixotropic material.
The B horizon can be 80 to 140 cm thick, is also composed of clayey, non-tixotropic material and has a brown to reddish brown colour.The structure is moderately developed fine-subangular blocky to crumb. In some parts of the B-horizon clay cutans can be observed.
More or less weathered stones encountered ususally at a depth of 100 to 150 cm, present the parent material and determine the effective soil depth.
The C horizon is composed of approximately 90 % rounded stones and 10 % soil material comparable with that in the B horizon, but here it is tixotropic.
The stones, with a high amount of andesites, might be fluvial, but probably laharic deposits.
The Suelo Milano occurs mainly (see references) in areas with a flat to gently undulating topography.

According to the same sources (see below), land use is variable, with mainly maize and pasture.

*Since this soil type was only encountered in a small area in the Rió Jiménez survey, data are used from other surveys where already the same soil type had been distinguished and described. (Hazeu, Nobbe, 1987; Van Leeuwen, Spaans and Stoorvogel,1987; Beks and Van Olst, 1986).

SUELO ALUVIAL (RJZ 21)

Suelo Aluvial is a shallow to moderately deep, moderately well drained clayey to clay loam soil. The soil has a moderately developed brown to dark brown A horizon, humic, with usually a thin dark brown to black Ap horizon at the surface.
The A horizon, composed of clay to clay loam, often has a blocky subangular structure and can be 15 to 40 cm thick.
The B horizon, usually clay loam, sometimes more sandy, is more yellowish brown and shows grey (reduction) mottling in the lower part;it can be 30 to 70 cm thick.
The B horizon often contains a weak Bt horizon, with illuviated clay, as is indicated by the local presence of cutans (argillic). Soft, sferoidal iron and manganese concretions are usually observed. Structure is blocky subangular to angular and consistence (moist) is firm to friable.
Subsoil C material varies from sandy loam, loam to clay loam and clay and is observed in most cases below the groundwaterlevel.
Local drainage conditions are highly influential on profile development which causes some variations in profile characteristics (thickness of the A horizon, total soil depth).

Land use on this soil type is highly variable; mainly pasture but also bananas, maize and other forms of use are observed.
Suelo Aluvial occurs especially in the southeastern part of the survey area, where it is developed most typical. This soil type is also observed throughout the survey area, in narrow strips bordering rivers and creeks (not always mappable).

SUELO UNION (RJZ 22)

Suelo Union is a soil with a well developed, deep A horizon, with andic properties, directly overlying original parent material.
The A horizon consists of very dark brown to black, very thixotropic (greasy) sandy loam, and is rich in humus over its total depth (50 - 90 cm). Structure is fine, subangular blocky, weakly developed and consistence (moist) is loose.
Small pores are observed in large amounts.
The transition to the C horizon is sharp; the slightly cemented sand contains a moderate amount of small gravels. Somewhat deeper the C material is usually loose and contains very few gravels.
The sand, usually medium coarse to coarse, is poorly sorted, it has a dark grey-brown colour and a very heterogeneous (volcanic) composition. Drainage is well throughout the whole profile.
It can be noticed that the soil material is light in weight, ie. it has a low bulk density.

In some parts of the survey area this soil type contains gravels and stones high in the profile. This soil property is mapped as a separate soil phase, in a separate mapping unit (see Chapter 4).

The appearance of this suelo is very consistent throughout the survey area. Locally the thickness of the A horizon can be less. Sometimes the top of the C horizon indicates that a thin Bw horizon is developing. Drainage seems to be important in this

context (see paragraph 3.3).

Main crops on Suelo Unión in the survey area are yuca/cassave and maize.

This soil type is developed most typical in the central-southern part of the survey area, it is observed also in minor amounts throughout most of the area but developed less typical.

The area is mainly flat with very little noticeable slopes; the Suelo Unión is found together with the Suelo Christina, on mainly the higher parts.

SUELO CHIRRIPO (RJZ 25)

Suelo Chirripó is a moderately deep, moderately well drained, medium textured soil with a well developed profile and andic properties. The profile and especially the drainage conditions in the soil are often influenced by the presence of a lithologic discontinuity in the subsoil.

Whereas the soil is developed in a deposit of volcanic derived sandy material, the subsoil is often composed of silty clay and clay loam, (fine textured fluvial deposits).

The profile is characterized by the presence of a well developed dark brown and humic A horizon, with a thickness ranging from 25 to 60 cm, depending on the total depth of the profile (total thickness of the layer of parent material).

The silty or sandy clay loam of the A horizon is thixotropic, structure in the Ap horizon can be strong, just as porosity throughout the whole A horizon.

A massive, structureless, slightly cemented Bw horizon is typical for this soil type. The sandy loam material has a low porosity, a firm consistence when moist and is very thixotropic. Thickness of the B horizon varies between 20 and 50 cm.

In some locations the actual parent material can be observed; coarse, unsorted dark grayish brown sand forms the 1C horizon. In most observations a fine textured alluvial deposit, varying from sandy clay loam to even clay, is encountered in the subsoil at a depth varying from 80 to 120 cm.

The result of the subsoil lithology is a low permeability and consequently a bad internal drainage of the soil, expressed by reduction colours and mottling in the deeper part of the profile.

Variations in profile properties are mainly related to presence of the complete or partly eroded A horizon, drainage and total profile depth, in combination with the different subsoil texture.

The most common land use on this soil type is maize and pasture.

The Suelo Chirripó occurs in a small area in the southwest of the survey area only. It has a flat topography, numerous small creeks and gullies are present due to the bad subsoil drainage.

SUELO CHRISTINA (RJZ 23)

Suelo Christina is a well drained soil with a well developed profile and andic properties.

The brown to very dark brown humic A horizon is composed of very

thixotropic sandy loam to clay loam; it can be 30 - 60 cm thick. Structure is moderately fine, subangular blocky, with a loose to very friable consistence and a high porosity.
Locally the A horizon is thinner and less pronounced due to erosion of topsoil material.
This occurs often in combination with the presence of grey (reduction) mottling, due to poor drainage, lower in the profile.
The B horizon is a cambic horizon (Soil Taxonomy, 1975).
Soil material is weathered in situ, resulting in a yellowish-brown (10 YR 5/6, 10 YR 4/6) very thixotropic clay loam horizon with a moderate to weak blocky subangular structure.
Thickness of the B horizon varies betweem 25 and 50 cm.
A transition usually occurs between this, and underlying C horizon; it is composed of partly weathered, slightly cemented clayey sand. Parent material, clearly present in the C horizon is composed of coarse, (sand, slightly gravelly) volcanic derived deposits.

A local low position of the soil, or a lithologic discontinuity in the subsoil (presence of silty clay layers with low permeability) can impede drainage, which causes the profile to be developed less typical.
Erosion of part of the topsoil material has the same effect.

The land use on this soil type in the survey area is mainly maize and yuca/cassave, but also pasture is found.
The occurrence of Suelo Christina is comparable to that of Suelo Unión; it is mapped as a complex mapping unit.

SUELO LIGIA (RJZ 24)

Suelo Ligia is a moderately developed, moderately well drained soil, with a total effective depth of 70 - 100 cm.
The Ah horizon, 5-15 cm thick is composed of a dark brown clay loam, with a strong blocky subangular structure.
The less humic Au horizon is more sandy loam with a moderate structure and reasonable pore development.
Totally the Ah + Au horizon can be up to 50-60 cm thick, and the horizon is thixotropic.
A weakly developed loamy Bw horizon has a more yellowish-brown colour and a moderate structure and pore development.
Depending on the local drainage conditions, a Bg horizon is present with characteristics comparable to the Bw and additional grey (reduction) mottling. Both Bw and Bg are thixotropic and they can be more sandy locally.
Total thickness varies between 40 and 80 cm.
Very often a transitional B/C horizon is observed over undisturbed subsoil material, in the form of silty clay to clay. In most cases this is at, or below, groundwater level.
The appearance of the subsoil material (much more clay, non-tixotropic), might indicate a lithologic discontinuity or at least an admixture of different parent material to the topsoil, required to give the observed topsoil properties.

In the survey area this soil type is mainly used for banana plantation, some minor parts are used for pasture in combination with secondary forest.

Suelo Ligia occurs mainly in the northern part of the survey area where it is mapped as a complex mapping unit with Suelo Aluvial. The area is flat to slightly uneven.

SUELO TORO AMARILLO (RJZ 26)

Just as Suelo Jardin, Suelo Toro Amarillo is a moderately to very poorly drained soil. It is distinguished from Suelo Jardin because of its coarse to very coarse texture.
Due to its low position, groundwater level is at or near the surface in most parts of the year. Consequently, only a thin Ap horizon has developed, with locally a strong accumulation of organic debris. A moderate development of a blocky subangular (fine) structure is possible.
Directly under the Ap horizon reducing conditions occur, resulting in a slightly humic, mottled Ag horizon overlying very strongly reduced, unaltered C material.
Except for the first 25-35 cm, which is often clay loam, the whole profile has a sandy or coarser texture. Because the sandy soil material has thixotropic properties, it is apparently derived of volcanic deposits.
Very often subsoil material, deeper then 60 cm, is gravelly or coarser.
A final important characteristic of this suelo and the following Suelo Jardin, is that their occurrence is strongly related to physiography and drainage pattern of the survey area.
Suelo Toro Amarillo is encountered in strips bordering the major rivers and creeks in the area, Suelo Jardin is also found here, and borders smaller creeks and temporarily active streams.
Based on texture and character of the major soil material of Suelo Jardin and Suelo Toro Amarillo, the indication as two separate soil types seems justified, although the poor drainage is the most important and shared property.

Due to this and the risk of inundation both soil types cannot be used for agriculture.

SUELO JARDIN (RJZ 27)

Suelo Jardin is a moderately to very poorly drained, shallow soil. A thin black Ap horizon overlies a transitional Ag horizon and a strongly reduced, with clear gley colours, C horizon below the groundwater level.
Texture is mainly clay to clay loam and occasionally somewhat more sandy layered material is observed in the subsoil.
The soil material is not thixotropic.
Total depth of the profile is only 30 to 50 cm, depending on the local groundwater level. Structure of the topsoil is often weak to moderate, blocky subangular.
Occurrence in the subsoil, of abundant Fe/Mn concretions or even a petroferric horizon is possible.

3.3 Soil relations

After discussing the soil map legend, and presenting the different soil types that have been distinguished in the survey area, it is relevant to give some more background information concerning relations between soils, physiographic position and soil development.
These relations can best be illustrated with a schematic cross-section through the survey area, depicting major characteristics and position of the specific soil types (Figure 5).

As is shown in Figure 5, seven soil types occur in a physiographical sequence. The majority of these soil types is closely related regarding the type of parent material.
A distinct exception is formed by Suelo Milano which is only found in a small part of the survey area and which is developed on an exposure of a different type of parent material.
Taking into account the deep thorough weathering, the reddish-brown colour, and other profile characteristics of Suelo Milano, this soil must be relatively old compared to the other soils in the area, with which it has almost no characteristics in common.
The intensely weathered, coarse textured parent material, probably deposited by lahars, provides a second reason to distinguish this soil type.

Located on the highest topographical position in the sequence is the Suelo Chirripó. As was described in paragraph 3.2, it resembles the Suelo Christina concerning its profile development and parent material. Because of its massive, structureless B-horizon the Suelo Chirripó is however, clearly different.
Mentioned property might indicate a more thorough and possibly longer development of the soil, on older but comparable parent material, as the Suelo Christina.
Also drainage, considerably worse in the Suelo Chirripó than in the Suelo Christina, might influence soil profile development.

Drainage is good in Suelo Christina, which is probably caused by the thickness of the coarse sandy cover in which the soil is developed. Nevertheless also here the presence of the well developed B horizon is probably related to the drainage conditions.

Also Suelo Unión is developed in the same parent material as Suelo Christina, and occurs in a complex pattern with this Suelo. The well drained soil, with an A-C profile is overlying fine textured subsoil deposits.
Sometimes the top of the C-horizon shows characteristics of a developing Bw-horizon. Again drainage seems to be important in this context.

Developed in much coarser material, probably deposited by lahars, is the Suelo Unión, phase $\frac{\text{Un-3P2}}{\text{A}}$, with stones high in the profile.

As illustrated in Figure 5, Suelo Ligia hardly has a cover of sandy, potential thixotropic (volcanic) material, over a subsoil, composed of fine grained fluvial deposits.
Due to soil forming and depositional processes soil material is intimately mixed, resulting in a less thixotropic and

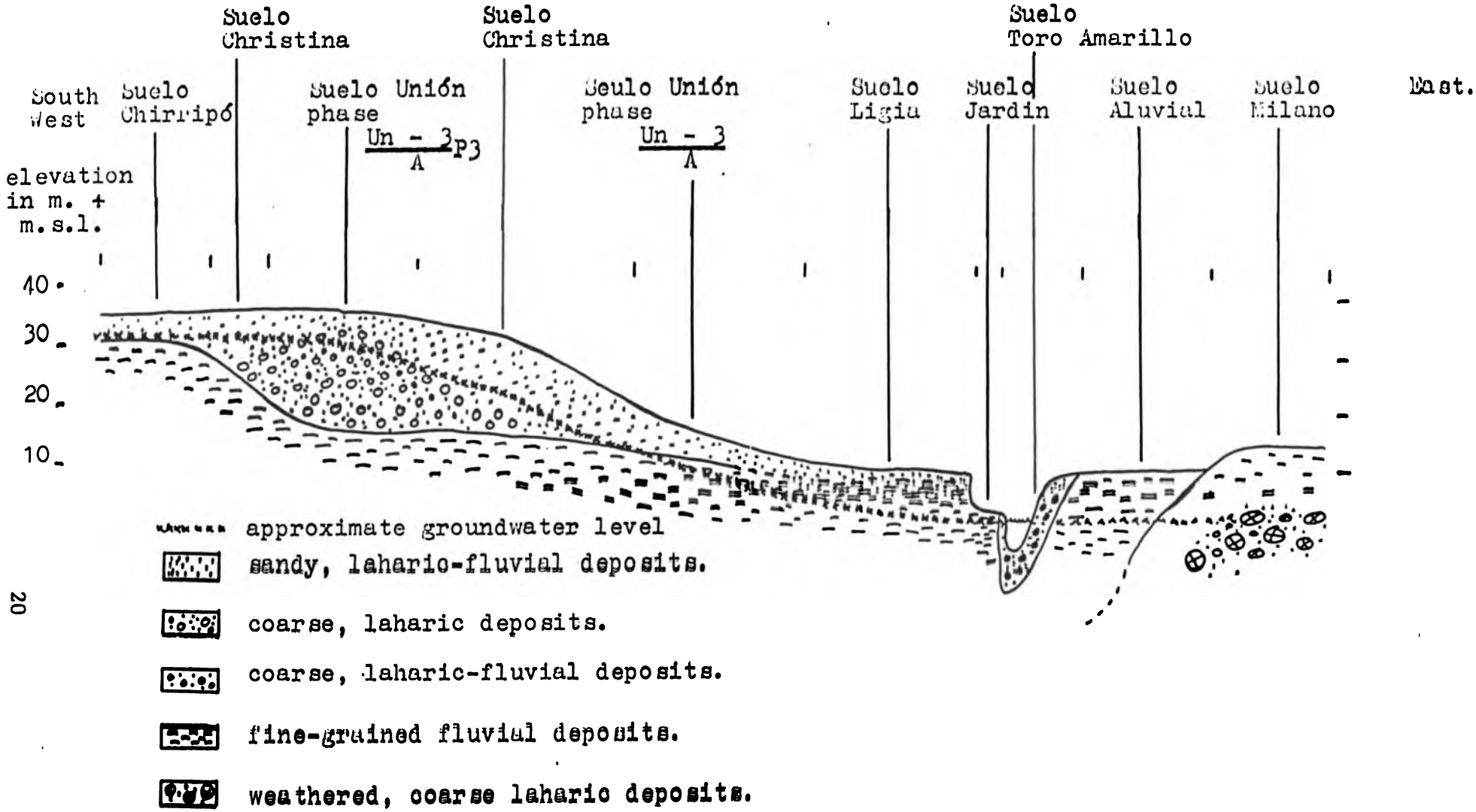


Figure 5: Soil relations, development and physiographic position, with the different types of parent material. (Dam, 1987).

less pronounced A and B horizon, as compared to Suelo Christina. Drainage is moderately good, partly due to the low topographical position of this soil type and to the finer texture of the soil material.

Considering the textural properties of Suelo Aluvial it is obvious that this soil type is developed in a different type of parent material ie. a sandy loam to clayey fluvial deposit.
The fact that no thixotropic properties are observed, probably because no allophane forming minerals are present in this material, can support this interpretation.
The same material is observed in an unaltered state throughout the whole survey area, but mainly in the subsoil, underlying other types of deposits.
Only where Suelo Aluvial occurs, (see the Soil map, Appendix IV) these deposits are found at the surface.

As was mentioned in paragraph 3.2 both Suelo Toro Amarillo and Jardin are characterized by their relatively weak profile development. This is mainly due to the fact that the groundwater-level is continuously high, or the soil is inundated, and development of a more complete profile is not possible.
Besides this, both soils occur in an area with active erosion and sedimentation.
The parent material of the soil types is derived of relatively young, unweathered volcanic deposits (coarse, potential thixotropic material, Suelo Toro Amarillo) and relatively older weathering products (clayey, non-thixotropic material, Suelo Jardin).

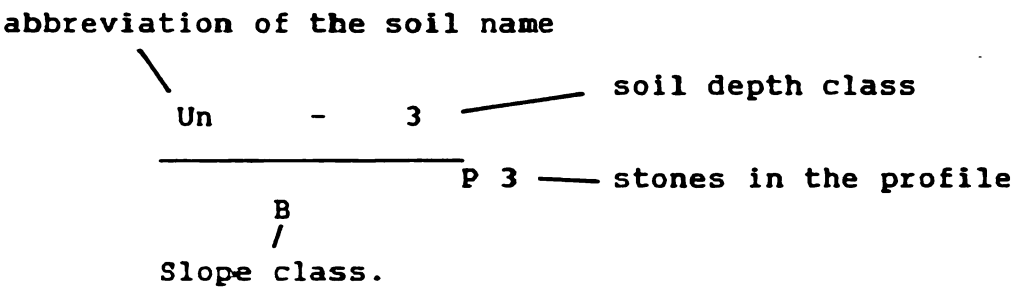
CHAPTER 4

THE SOIL MAP

In this chapter the soil map of the Rió Jiménez area, on a scale 1:20.000 is explained, with in paragraph 4.1 the mapping units and in paragraph 2 the soil map image.
The soil map is found as separate Appendix IV, in the back of this report.

4.1 Mapping units

As mapping unit the soil phase is chosen (see fieldwork instruction manual, Wielemaker, 1986).
The soil phase is a subdivision of the lowest category of the soil legend (here suelo), based on characteristics (or combinations of characteristics) significant for the use and management of the soil (Soil Survey Manual, 1951).
For the survey in the Rió Jiménez area (and other surveys) a limited number of soil phases has been defined, (fieldwork instruction manual, Wielemaker, 1986), and the separate soil map legend, Appendix IV.
This enables presentation of variation in soil (suelo) characteristics by means of mapping units composed of single soil phases or composed of complexes of soil phases of a suelo, or mapping units composed of complexes of phases of different suelos.
Mapping units are presented and explained using a combination of descriptive symbols.
An example is given below (see also Appendix IV, the soil map legend).



4.2 The soil map image (see Appendix IV)

As a final paragraph with respect to the soil map of the Rió Jiménez area, it was thought useful to give an analytical description of the soil map image. Occurrence and pattern of soils will be discussed and also a comment is given on the reliability of the mapping units and possible inclusions.

When the map image is studied, the following can be remarked:

1)Laharic-fluvial, coarse textured soils (see Chapter 3, the soil map legend), seem to occur mainly in the western, southwestern and central southern part of the survey area. (Except mapping Unit MI - 5).
2)Pattern of occurrence of the different soil types seems to be closely related to the drainage pattern, at least in a major part of the area.
3)Many soil types apparently occur in complexes.

The occurrence of laharic, coarse textured soils in the mentioned area is explained mainly by the presence of a different type of parent material in which these soils are developed.
The soils here are developed in a thin cover of coarse sand (and coarser deposits). In the remaining part of the area soil material mainly consists of clay to sandy loam, (fine grained, fluvial deposits), and other types of soils are developed here.
Suelo Milano (mapping unit MI -5) is an exception; it is a more developed, probably much older soil, developed on an outcrop of lahar material.
Distribution of the coarser laharic-fluvial deposits, on which the soils in the southwestern part are developed, indicates a southwesterly source of these materials, possibly the rivers Guácimo or Parismina.
The lower reaches of the river system receive fluviatile deposits only; more upstream material deposited by lahars can occur.
The Rió Jiménez area is located on the transition of these two areas, with two types of deposits, causing such a variation in soil types.

Since the cover of course laharic material over fine grained fluvial deposits is only thin, the continuous erosional activity of streams has locally removed the former.
This results in different soils along small creeks and brooks, in a different type of parent material (the underlying fine-grained fluvial deposits).
It explains largely the pattern of several map units.
As a result of the bad drainage and the high groundwater level (see Chapter 1) local variations in topography (within 0.5-1.5 M) result in much poorer drainage of the soil.
Consequently soil formation is influenced which accounts for the presence of different soil types in even the shallowest depressions (often connected with a dendritic river system).
It will be evident that the features discussed above cause a complex map pattern on a 1:20.000 scale map.
That even more complex patterns occur, which cannot be separately mapped, was partly explained in Chapter 3.
Suelos Christina and Unión are closely related and occur in a complex pattern.
The same holds for Suelo Toro Amarillo and Suelo Jardin; they occur in a complex pattern related to the complex occurrence of the deposits in which these soils are formed, within the active fluvial environment. .
Finally a complex mapping unit with Suelo Ligia and Suelo Aluvial

can be explained.
The complex occurrrence is probably due to the fact that the admixture of material (by fluvial and pedological processes, see paragraph 3.3) which causes development of Suelo Ligia instead of Suelo Aluvial,is a proces with varying intensity and location.

Reliability of the soil map and the respective mapping units is reasonable.
Given the variation in soils in the area, the density of the augerings is relatively low (1 on every 3 ha.) but besides information of augerings surface observations are made as well as observations in ditches and exposures (see map with locations of hand augerings, Appendix II).
It is the impression that errors caused by inclusions in the respective mapping units are relatively small.
An other soil type may be encountered, but since the soil types in the sequence Chirripó-Christina-Unión-Ligia-Aluvial are closely related and do not differ too much, consequences for use and management are consequently also small.

CHAPTER 5

LAND CAPABILITY

As a final chapter a land capability indication is given according to two land classification systems.
1) The " Manual para la determinacion de la capacidad de uso de las tierras de Costa Rica" (Centro Cientifico Tropical,1985).
2) The FAO land evaluation system. (FAO, 1976).

5.1 The "Manual para la determinacion de la capacidad de uso de las tierras de Costa Rica."

This land classification system groupes the land in 10 capability classes, according to the expected capability of the land, for a specified level and type of use.
It is a hierarchical system and classification is based on a number of evaluation parameters,ie. lifezone,precipitation characteristics,cloudiness, windiness, soil characteristics, erosion, drainage, slope and risk of flooding.
The first (best) class of the system has no limitations for highly productive crops, the higher classes all have limitations increasing from class II to class X (see below).
Land use type and intensity is adapted according the capability of the class.

Capability classes:

Class I: Annual crops (very high yield).
The soils in this class don,t have any limitations and the agroecological conditions permit sowing, tillage and harvesting for all kinds of annual crops, that are ecological suitable, without decreasing the productive capacity of the soil.

Class II: Annual crops (high yield).
Soils that have agroecological conditions that permit sowing, tillage and harvesting of a majority of annual crops that are ecologically suitable, without decreasing the productive capacity of the soil.

Class III: Annual crops (moderate yield)
Have agro-ecological conditions equal to the foregoing class but with more severe limitations. In spite of these limitations the production of the selected annual crops is economically manageable, without decreasing the productive capacity of the soil.

Class IV: Perennial crops, or semi-perennial crops.
Soils with agroecological conditions that don't always allow use of annual crops as defined before, but do allow the sowing, tillage and harvesting of crops with a period of growth of more then 2 years, or grasses and

shrubs that do not frequently need tillage and that protect the soil against erosion, except for a few and short periods, without decreasing the productive capacity of the soils.

Class V: Intensive grazing.
Soils that don't meet the minimal conditions for classification suited for crops as defined before, but are adequate for continuous grazing at a high level, without decreasing the productive capacity of the soil.

Class VI: Extensive grazing.
Soils that don't meet the required conditions to cultivate annual or perennial crops, but do allow continuous grazing at moderate or low level, without decreasing the productive capacity of the soil.

Class VII: Tree crops.
Soils that don't meet the minimal conditions to classify them as suitable for annual or perennial crops or pasture as defined before, but do present favourable conditions for the establishement of species of trees that give a protective plant cover, without decreasing the productive capacity of the soil.

Class VIII: Intensive forestry.
Soils that don't meet the minimal required conditions for crops or pasture, but do allow an intensive and permanent production of wood and other forest products of natural forest that can be technically managed, without decreasing the productive capacity of the soil.

Class IX: Extensive forestry.
Soils that don't allow use for crops or permanent pasture, but are suitable for extensive and permanent production of wood and other forestry products of natural forest that can be technically managed, without decreasing the productive capacity of the soil.

Class X: Protection.
Soils that don't meet the minimal required conditions for crops, pasture or forestry and do not fit in any of the given classes above.

A capability class can be seen as a group of soils (one soil type), which present an equal amount of limitations (or comparable conditions) for potential land use.
The "Manual" also introduces capability subclasses when specific limitations are present; in this way not only indicating general capability, but also specifying important limitations.
It is introduced on a more detailed application level.

The following limiting factors recognized in this landcapability system (CCT, 1985), and significant in the survey area, can be given:

-Erosion (e)
It can be specified on a detailed application level in:
e1) risk of erosion based on the presence of slopes.
e2) risk of erosion due to bad management.
e3) risk of erosion due to the presence of microrelief.

-Soil (s)
It can be specified on a detailed application level in:
s1) effective soil depth limitations.
s2) soil texture limitations.
s3) soil pH limitations.
s4) limitations due to the presence of rocks/stones in the profile.
s5) special soil limitations (toxicity, salinity etc.).

-Drainage (d)
Which can be specified in:
d1) limitations because of general drainage conditions (poor, excessive).
d2) limitations because of a risk of flooding.

The limiting factor climate is not included in this land classification, because it has a similar influence on all soils in the survey area.

In this classification system land use systems are defined according to their level of management (Traditional, Advanced, Mechanized).
For the survey area most management systems can be classified as Traditional.
Some land use systems occur like banana plantations and ornamental flower producing companies, that can be classified as Advanced. the highest level of management.

Based on the system that was shortly introduced above, a land capability classification for all mapping units (based on soil types) in the survey area can be given. Land capability classes and subclasses, together with the specific limitations are listed. The results are given as separate APPENDIX VI and VII.

5.2 The FAO land evaluation system

The FAO land evaluation system can be applied to determine the suitability of a specific area (a mapping unit) for a certain kind of use.In the system, present and potential suitability for a defined type of land use (a land utilization type, see below) is given,within a range of four suitability classes.
According to the land evaluation framework (FAO,1976) these are:

-Class S1: Highly suitable:
Land having no significant limitations to sustained application of a given use, or only minor limitations that will not significantly reduce productivity or benefits and will not raise inputs above an acceptable level.

-Class S2: Moderately suitable:
Land having limitations which in aggregate are moderately severe for sustained application of a given use; the limitations will reduce productivity and or benefits and increase required inputs to the extent that the overall advantage to be gained from the use, although still attractive, will be appreciably inferior to that expected on class S1 land.

Class S3: Marginally suitable:
Land having limitations which in aggregate are severe for sustained application of a given use and will so reduce productivity or benefits, or increase required inputs, that this expenditure will be only marginally justified.

Class N1: Currently not suitable:
Land having limitations which may be surmountable in time but which cannot be corrected with existing knowledge at currently acceptable cost; the limitations are so severe as to preclude succesful sustained use of the land in the given manner.

In addition land suitability subclasses are distinguished, reflecting the presence of certain kinds of limitations.
For the Río Jiménez survey area the following limiting factors are relevant:

(n) nutrient availability
(m) moisture availability
(r) rooting conditions
(w) drainage conditions
(f) risk of inundation
(k) soil workability
(e) erosion hazard
(d) soil degradation hazard

Other important limiting factors (climatic) are significant on suitability class level.

Present and potential suitability is given for a number of specified land utilization types. The following land utilization types were considered relevant for the survey area:

-annual crops, high requirements.
-annual crops, moderate to low requirements.
-perennial crops, high requirements.
-perennial crops, moderate to low requirements.
-pasture, moderate to low requirements.
-tree crops, moderate to low requirements.

Appendix VIII gives the current and potential suitability for the selected land utilization types, for each of the distinguished mapping units (based on soil types) of the survey area. Indicated is/are also the required improvement(s), to remove the subclass limitation(s).

CHAPTER 6

LITERATURE

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APPENDIX I. a) Soil description form.

FORMULARIO DE CAMPAÑA

Cartógrafos:

No.	Fecha	Coord.	E	N
Hoja Top.		No. Foto		año
Pendiente %	Longitud	»	Pos. en pend.	
Top. Terreno circ.		Capa freática		cms
Drenaje	Pedregosidad sup.		Clase -	dms
Uso actual		Estado cult.		
Riesgo inund.		Degr. capa sup.		

Símbolo de mapeo (preliminar):

Dibujo de situación

(Final):

Observaciones:

PROF. cm	COLOR Húmedo	MANCHAS Col	A	T	C	TEX	CON A	P	TI	CONCREC A	TA	D	TI	GRAVA A	F	T

APPENDIX I: b) Profile pit description form.

Formulario para la descripción de un perfil - Programa de cooperación CATIE-UAW

GENERAL

Nº de la observación	Ubicación	Clasificación preliminar
		final (Soil Taxonomy)
Fecha	Hoja topograf.	FAO/UNESCO preliminar
	Coordinadas: E N	final
Autores	Altura m	Serie

CLIMA

Estación del año	Precipitación promedio anual mm
Tiempo en la última semana	Temperatura promedio anual °C
.....	Régimen de humedad del suelo
.....	

GEOLOGIA

Material madre	Formación geológica	Mineralogia

GEOMORFOLOGIA

Unidad geomorfológica	Pendiente donde el perfil está situado	Evidencias de erosión o compactación
Forma del terreno circundante	Posición en la pendiente	Evidencias de sedimentación
Microtopografia	Longitud de la pendiente m	

HIDROLOGIA

Clase de drenaje	Profundidad de la copa freática	Riesgo de inundación y en cual época del año
Escurrimiento superficial	Condiciones de humedad del perfil	
Drenaje		Pedregosidad/afloramientos rocosos

FLORA Y FAUNA

Vegetación natural: cobertura	Tipos/especies	Año de la deforestación	
Arboles %		Fauna del suelo	El uso actual del suelo
+ arbustos %			
+ resto = 100%			Estado del cultivo
Suelo raso %			Uso anterior:
Pastos %			
Hierbas %			

APPENDIX I: b) Profile pit description form.

CARACTERISTICAS DEL PERFIL

Número de la muestra	HORIZONTE				COLOR							ESTRUCTURA			CUTANES			TEXTURA Y GRAVA	CONSIST.			CONCR.					Fragmentos de roca y mineral	POROS				RAICES		REACCION HCL	pH	OTROS
	SIMBOLO	PROF.		LIMITE	SECO	MOTEADOS																													
		Superior	Inferior	Anchura	Topogr.	HUMEDO	Color	Abund.	Tamaño	Contraste	Nitidez	Grado	Tamaño	Tipo	Cantidad	Espesor	Naturaleza		Seco	Húmedo	Mojado	Cantidad	Tamaño	Dureza	Forma	Color		Abundancia	Diámetro	Continuidad	Morfología	Cantidad	Tamaño			

OBSERVACIONES:

APPENDIX III.

SOIL PROFILE DESCRIPTIONS.

SUELO MILANO

Numero del perfil: RJZ 2.
Fecha: 11-3-1987.
Ubicacion: este de Rió Jiménez; 3446.I Guácimo, 581.0 E - 247.1 N.
Clasificación provisional USDA; tropudult.
Formación geologica: Sedimentos cuarternarios, depositos laharicos
Material de partida: sedimentos laharicos gruesas, derivado de rocas volcanicos.
Unidad geomorfológica: plano aluvial.
Forma del terreno circundante: plano o casi plano, poco ondulado.
Pendiente donde el perfil esta situado: llano o casi llano, 0-2 %.
Evidencias de erosión: no
Evidencias de compactación: no
Drenaje: bien
Pedregosidad superficial: no
Vegetación natural: no
Uso de la tierra: no
Fauna del suelo: Hormigas y lombrices.

Descripción del perfil RJZ 2.

Ap 0-10 cm: Pardo oscuro (10 YR 3/4) en húmedo; arcilla; estructura débil bloques subangulares, finas; ligeramente adherente, ligeramente plástico en mojado, friable en húmedo; pocos poros finos, interstitiales, continuos comunes raices finas; no tixotrópico; muestra no. RJZ 2-1; límite neto plano;

Au 10-70 cm: Pardo (10 YR 4/6) en húmedo; arcilla; estructura moderada migajosa, muy fina; ligeramente adherente, ligeramente plástico en mojado, muy friable en húmedo; muchos poros my finos, interstitiales, continuos; abundantes raíces medianas; no tixotrópico; muestra no. RJZ 2-2; límite plano gradual;

Bt1 70-125 cm: Pardo (10 YR 4.5/6) en húmedo; arcilla; estructura moderada bloques subangulares, muy finas; ligeramente adherente, ligeramente plástico en mojado. friable en húmedo; muchos poros muy finos, interstitiales, continuos; pocas raíces finas; no tixotrópico; muestra no. RJZ 2-3; límite plano gradual;

BC/Bt2 125-150 cm: Pardo (10 YR 4/6) en húmedo; arcilla; estructura moderada bloques subangulares, fina; ligeramente adherente, ligeramente plástico en mojado, friable en húmedo; frecuentes poros muy finos, interstitiales, continuos; pocas raices finas; no tixotrópico; muestra no. RJZ 2-4; límite plano gradual; fragmentos de rocas abundantes, piedras, meteorizadas;

C >150 cm: Pardo, (10 YR 4/6) en humedo; 90 % piedras redondeados, 3-15 cm diam.,2/3 meteorizadas, 10 % material de suelo como horizonte pasado. Muestra no. RJZ 2-5;

SUELO ALUVIAL.

Número del perfil: RJZ 21.
Fecha: 1-5-1987.
Ubicación: Mapa de localización de barrenas.
Oeste de Rió Jiménez, 3446, I Guácimo, 579.03/248.47
Clasificación provisional USDA; tropudult.
Formación geología: Sedimentos cuarternarios, depositos fluviales.
Material de partida: Arcillas, Arcillas francos.
Unidad geomorfológica: Plano aluvial.
Forma del terreno circundante: Plano o casi plano.
Pendiente donde el perfil esta situado: Llano o casi llano (0-2 %)
Evidencias de erosión: no
Evidencias de compactación: algunas manchas naranjas y rojas.
Drenaje: moderamente bien.
Pedrogosidad superficial: no
Vegetación natural: no
Uso de la tierra: pasto/maíz
Fauna del suelo: Hormigas y lombrices.

Descripcion del perfil RJZ 21

Ap 0–18 cm: Pardo oscuro, (7,5 YR 3/4) en húmedo; franco arcilloso; estructura moderada, bloques subangulares, fina o delgada, ligeramente adherente, ligeramente plástico, firme en húmedo; pocos poros medianos, tabulares, continuos; muchos poros muy finos, interstitiales, descontinuos; abundantes raíces medianas pH 5.2 muestra no. RJZ 21–1 límite neto ondulado;

Au 18–40 cm: Pardo (7.5 YR 4/4) en húmedo; franco arcilloso; estructura moderada, bloques subangulares, fina o delgada; ligeramente adherente, ligeramente plástico en mojado; firme húmedo; pocos poros medianos, tabulares, continuos; muchos poros muy finos y micro, interstitiales, descontinuos; comunes raíces medianas. pH 5.2; muestra no. RJZ 21–2; límite neto ondulado;

Btg 40–70 cm: Pardo amarillento, (10 YR 5/6) en húmedo; arcilla; frecuentes pequeñas manchas, color gris y naranjas; contraste indefinidez y nitidez difuso; estructura moderada, bloques subangulares/angulares, fina o delgada; cutanes zonales, moderamente espesos, naturaleza arcillosas; ligeramente adherente, ligeramente plástico en mojado, firme en húmedo; pocos poros medianos, continuos tabulares, muchos poros muy finos y micros, descontinuos, tabulares (inped); pocas raíces finas; pH 5.5 a 5.7; muestra no. RJZ 21–3; límite neto iregular;

B/Cg1 70–85 cm: Gris amarillento pardo (10YR 6/2) en húmedo; arcillla; frecuentes manchas pequeñas, colores pardos-naranjas, contraste definidas, nitidez difuso; estructura, moderada, bloques subangulares, fina o delgada; cutanes zonales, moderamente espesos, naturalezas arcillosas; pocos Fe-concreciones pequeños, blandos, esféricos, negros; frecuentes poros, finos, tubulares, continuos; pocas raíces finas; pH 5.3; muestra no. RJZ 21–4; límite neto ondulado;

B/Cg2 >85 cm: Gris amarillento pardo (10 YR 6/2) en húmedo; franco arcilloso; muchas manchas grandes, color pardo, contraste definidas, nitidez difuso; estructura débil bloques subangulares, fina o delgada; ligeramente adherente, ligeramente plástico mojado; friable húmedo; pocos Fe- concreciones, pequeños, blandos, esféricos; pocos poros finos, tabulares, continuos; pocos raíces finas; muestra no. RJZ 21–5

SUELO UNION.

Número del perfil: RJZ 22
Fecha: 1-5-1987.
Ubicación: Mapa de localización de barrenas, norte de Rio Jimenez.
3446, I Guácimo, 577.88/248.73
Clasificación provisional USDA; eutrandept.
Formación geológica: Sedimentos cuarternarios, depositos laharicos.
Material de partida: Arenas y rocas laharicos derivado de rocas volcánicos.
Unidad geomorfológica: Plano aluvial.
Forma del terreno circundante: plano o casi plano.
Pendiente donde el perfil esta situado: llano o casi llano, 0—2%
Evidencias de erosión: no
Evidencias de compactación: no
Drenaje: bien
Pedrogosidad superficial: no
Vegetación natural: no
Uso de la tierra: yuca/cassave y pasto.
Fauna del suelo: Hormigas y lombrices.

Descripción del perfil RJZ 22.

Ah 0-20 cm: Negro pardisco (10YR 2/3); franco arenoso; estructura débil, bloques subangulares, muy finas, local una estructura macizo; no adherente, no plástico mojado, suelto a muy friable húmedo; muy pocos fragmentos de grava, no alterados; muchos poros micros, muy finos y finos, vesiculares, descontinuos; abundantes raíces, muy finas a gruesas; muy tixotrópico; muestra no. RJZ 22-1; límite neto ondulado;

Ah2 20-64 cm: Negro pardisco(10 YR 2/2) en húmedo; franco arenoso; estructura fuerte, granular, muy finas, local macizo, mas de horizonte Ah1; no adherente, no plástico mojado, suelto a muy friable húmedo; muy pocos fragmentos de grava, no alterados; muchos poros, micro y muy finos, vesiculares, descontinuos, comunes raíces muy finas y finas, muy tixotrópico; muestra no.; RJZ 22-2; límite brusco plano;

C1 64- 90 cm: Negro pardisco (diferentes colores) en húmedo; arena; con frecuentes fragmentos de grava, no alterados; estructura débil cementado; no adherente, no plástico en mojado, suelto en húmedo; pocos poros muy finos, vesiculares; pocas raices muy finas; muestra no.RJZ 22-3 límite neto ondulado;

C2 >90 cm: Negro pardisco (10 YR 3/3, diferentes colores) en húmedo; arena, con pocos fragmentos de grava, no alterados; sin estructura de suelo, material de partida. Muestra no. RJZ 22-4;

SUELO CHIRRIPO.

Número del perfil: RJZ 25.
Fecha: 1-5-1987.
Ubicación: Mapa de localización de barrenas, 3446, I Guácimo, 574.46/248.22, 4 km oeste de Rió Jiménez.
Clasificación provisional USDA; eutrandept.
Formación geológica: Sedimentos cuarternarios, depositos laharicos-fluviales.
Material de partida: arenas, laharicos-fluviales, derivado de rocas volcanicos.
Unidad geomorfológica: Plano aluvial.
Forma del terreno circundante: plano o casi plano.
Pendiente donde el perfil esta situado: llano o casi llano, 0-2 %.
Evidencias de erosión: no.
Evidencias de compactación: no.
Drenaje: moderamente bien.
Pedregosidad superficial:no.
Vegetación natural: no
Uso de la tierra: maiz y pasto.
Fauna del suelo: Hormigas y lombrices.

Descripción del perfil RJZ 25.

Ah 0-25 cm: Pardo oscuro, (7.5 YR 3/3) en húmedo franco arcillo limoso; estructura moderada, bloques subangulares, fina o delgada; ligeramente adherente, ligeramente plástico en mojado, muy friable en húmedo; frecuentes poros finos y medianos, tabulares, continuos, frecuentes poros micros y muy finos, vesiculares, descontinuos; comunes raíces muy finas, finas y medianas; tixotrópico; muestra no.RJZ 25-1; límite gradual iregular;

Au 25-56 cm: Pardo, pardo-oscuro (7,5 YR 3/3 , 4/3); franco arcilla limoso; estructura moderada, bloques subangulares, a la baja mas migajosa; ligeramente adherente, ligeramente plástico en mojado, muy friable en húmedo; frequentes poros finos y medianos, tubulares, continuos, y frequentes poros micros y muy finos, vesiculares, discontinuos; comunes raices muy finas, finas y medianas; tixotrópico; muestra no. RJZ 25-2; límite neto plano;

Bw 56-80 cm: Pardo-amarillento, (10 YR 4/6, 5/6); franco arenoso; estructura muy débil/macizo, bloques subangulares, fina o delgada; ligeramente adherente, ligeramente plástico en mojado, firme en húmedo, ligeramente cementado; pocos poros finos, tubulares, continuos; no raíces; muy tixotrópico; muestra no. RJZ 25-3; límite neto iregular;

C 80-97 cm: Pardo, (10 YR 4/6, 4/4); arena; estructura débil a macizo, bloques subangulares, muy fina a muy delgada; no adherente, no plástico mojado, muy friable húmedo; pocos poros finos, tubulares continuos; pocas muy finas raíces; muy tixotrópico; muestra no. RJZ 25-4; límite neto ondulado;

2Cg1 97-112 cm: Pardo amarillento, (10YR 5/6,5/8); franco arcilloso; frecuentes manchas pequeñas, color gris, contraste indefinidas, nitidez difuso; estructura moderada, bloques subangulares, fina o delgada; ligeramente adherente, ligeramente plástico en mojado, muy friable en húmedo; pocos poros finos, tubulares, continuos; pocos raíces muy finas; tixotrópico; muestra no; RJZ 25-5; límite neto ondulado;

2Cg2 >112 cm: Débil naranja amarillento 10 YR 7/4); arcilla; frecuentes manchas pequeñas, color pardo y naranja, contraste definidas, nitidez difuso; estructura débil, bloques angulares, fina o delgada; ligeramente adherente, ligeramente plástico en mojado, muy friable en húmedo; pocos poros muy finos, no tixotrópico; muestra no. RJZ 25-6;

SUELO CHRISTINA.

Número del perfil: RJZ 23
Fecha: 1-5-1987.
Ubicación: Mapa de localización de barrenas; 3446,I Guácimo .
577.26/248.88, noroeste de Rió Jiménez.
Clasificación provisional USDA; eutrandept.
Formación geológica: Sedimentos cuarternarios,depositos laharicos-fluviales.
Material de partida: arenas, laharicas-fluviales, derivado de rocas volcanicos
Unidad geomorfológica: Plano aluvial.
Forma del terreno circundante: plano o casi plano.
Pendiente donde el perfil esta situado; llano o casi llano, 0-2 %.
Evidencias de erosión: no
Evidencias de compactación: no
Pedregosidad superficial: no
Drenaje: bien
Vegetacion natural: no
Uso de la tierra: cacao, y arboles de naranja y lemon dulce.
Fauna del suelo: Hormigas y lombrices.

Descripción del perfil RJZ 23.

Ap 0-15 cm: Pardo oscuro a pardo-negro,(7.5 YR 3/3,3/2); franco; estructura moderada, bloques subangulares, muy fina o muy delgada; ligeramente adherente, ligeramente plástico en mojado; muy friable en húmedo; muchos poros micros y muy finos, vesiculares, descontinuos, pocos poros finos y medianos, tubulares, continuos; abundantes raíces, muy finas a medianas; muy tixotrópico; muestra no. RJZ 23-1; límite neto ondulado;

Au 15-50 cm: Pardo oscuro, (7.5 YR 3/3,3/4); franco; estructura moderada, bloques subangulares/ granular, muy fina o muy delgada; ligeramente adherente, ligeramente plástico; muy friable a suelto húmedo; muchos poros micros y muy finas, vesiculares, descontinuos, comunes poros finos y medianos, tubulares, continuos; comunes raíces muy finas, finas y medianas; muy tixotrópico; muestra no.RJZ 23-2; límite neto ondulado;

Bw 50-85 cm: Pardo, (7,5 YR 4/4 - 4/6); franco arcilloso; estructura moderada a débil, bloques subangulares, muy fina o muy delgada y granular; ligeramente adherente, ligeramente plástico en mojado, suelto en húmedo; frecuentes poros micros y muy finos, descontinuos, vesiculares, frecuentes poros finos y medianos, tubulares, continuos; comunes raíces finas a muy finas; muy tixotrópico; muestra no. RJZ 23-3; límite neto ondulado;

B/C 85-110 cm: Pardo, (7,5 YR 4/3); arena; estructura débil bloques subangulares y granular muy fina a muy delgada; no adherente, no plástico en mojado, suelto en húmedo; (débil cementado); pocos poros micro y muy finos, vesiculares, descontinuos, y tambien pocos poros finos tubulares continuos; no raíces; probable muy tixotrópico; muestra no. RJZ 23-4 límite gradual ondulado;

C >110 cm: Pardo, (7.5 YR 4/3,4/4); arena, no cementado; sin estructura de suelo; con muy pocos fragmentos de grava, no alterados, material de partida.

SUELO LIGIA.

Número del perfil: RJZ 24.
Fecha: 1-5-1987.
Ubicación: Mapa de localización de barrenas, 3446,I Guácimo,
578.89/249.49, noroeste de Rió Jiménez.
Clasificación provisional USDA; eutrandept.
Formacion geológica: Sedimentos cuarternarios,depositos fluviales
Material de partida: Francos arcillosos,arenosos
Unidad geomorfológica: Plano aluvial.
Forma del terreno circundante: plano o casi plano.
Pendiente donde el perfil esta situado: llano o casi llano, 0-2 %.
Evidencias de erosión: no
Evidencias de compactación: no
Drenaje: moderamente bien.
Pedregosidad superficial: no
Vegetacion natural: no
Uso de la tierra: bananera
Fauna del suelo: Hormigas y lombrices.

Descripción del perfil RJZ 24.

Ah 0-10 cm: Pardo oscuro, (7,5 3/3); franco arcilloso; estructura fuerte bloques subangulares, muy fina o muy delgada; ligeramente adherente, ligeramente plástico en mojado, friable en húmedo; pocos poros finos y medianos, tubulares, continuos, frecuentes poros muy finos y micros, vesiculares, descontinuos; comunes raíces medianas; tixotrópico; muestra no. RJZ 24-1; límite neto ondulado;

Au 10-50 cm: Pardo (7.5 YR 4/4); franco; estructura moderada bloques subangulares, fina o delgada; ligeramente adherente, ligeramente plástico en mojado, friable húmedo; muchos poros micros y muy finos, vesiculares, descontinuos, y pocos poros finos y medianos, tubulares, continuos; pocas raíces finas y medianas; tixotrópico; muestra no. RJZ 24-2; límite gradual irregular;

Bw 50-72 cm: Pardo (10 YR 4/6); franco; estructura moderada bloques subangulares, fina o delgada; ligeramente adherente, ligeramente plástico en mojado, suelto húmedo; muchos poros micros y muy finos, vesiculares, descontinuos, y frecuentes poros finos y medianos, tubulares, continuos; tixotrópico; muestra no. RJZ 24-3; límite gradual irregular;

Bg 72-100 cm: Pardo (7.5 YR 4/3); franco; muchas manchas medianas, color gris, contraste indefinidas, nitidez difuso; estructura debil a moderada bloques subangulares, fina o delgada; no adherente, no plástico en mojado, muy friable en húmedo; frecuentes poros micros y muy finos, vesiculares, descontinuos, y pocos poros finos y medianos, tubulares, continuos; con pocas raíces muy finas y finas; ligeramente tixotrópico; muestra no. RJZ 24-4; límite difuso irregular;

B/Cg 100-140 cm: Pardo amarillento grisáceo, (10 YR 6/2); arcillo limoso; con frecuentes manchas medianas, color pardo, contraste indefinidas, nitidez difuso; estructura débil a moderada bloques subangulares fina o delgada; ligeramente adherente, plástico en mojado, friable en húmedo; con frecuentes poros micros y muy finos, vesiculares, descontinuos, y tambien pocos poros finos y medianos, tubulares, continuos; pocas raíces muy finas; no tixotrópico; muestra no. RJZ 24-5; límite gradual irregular;

C >140 cm: Pardo amarillento grisáceo, (10 YR 6/2); arcilla limoso; sin manchas, sin estructura de suelo; material de partida. Muestra no. RJZ 24-6;

SUELO TORO AMARILLO.

Número del perfil: RJZ 26
Fecha: 1-5-1987.
Ubicación: Mapa de localización de barrenas, 3446,I Guácimo 579.22/248.82, noroeste de Rió Jiménez.
Clasificación provisional USDA; andaquept.
Formacion geológica: Sedimentos cuarternarios, depositos fluviales recientes
Material de partida: sedimentes fluviales, componentes gruesas; arenas, gravas y rocas.
Unidad geomorfológica: Plano aluvial, cauces fluviales.
Forma del terreno circundante: plano o casi plano, poco ondulado.
Pendiente donde el perfil esta situado: llano o casi llano, 0-2 %.
Evidencias de erosión: corrientes fluviales muy recientes.
Evidencias de compactación: no
Drenaje:escasamente y muy escasamente drenado.
Pedregosidad superficial: casi siempre no, pero es posible
Vegetacion natural: bosque secundario.
Uso de la tierra: no
Fauna del suelo: Lombrices.

Descripción del perfil RJZ 26.

Ah 0-15 cm: Pardo oscuro. (10 YR 3/4); franco;
estructura moderada bloques subangulares, fina o delgada;
ligeramente adherente, ligeramente plástico en mojado,
muy friable en húmedo; pocos poros finos y medianos,
tubulares,continuos, y pocos poros micro y muy finos,
descontinuos, vesiculares; abundantes raíces muy finas,
finas y medianas (raíces de bambu); ligeramente
tixotrópico;
límite neto ondulado;

Ag 15-40 cm: Pardo (10 YR 4/4); franco arenoso;
con frecuentes medianas manchas, color gris, contraste
indefinidas, nitidez difuso; estructura débil bloques
subangulares, fina o delgada; ligeramente adherente,
no plástico en mojado, muy friable húmedo;
frecuentes poros finos y medianos, tubulares, continuos,
y tambien muchos poros micros y muy finos, vesiculares,
descontinuos; abundantes raíces (de bambu) muy finas,
finas y medianas; tixotrópico;
límite gradual irregular;

Cg1 40-60 cm: Amarillo-pardo grisáceo, (10 YR 4/2);
arena; con frecuentes manchas medianas, color pardo,
contraste definidas, nitidez difuso, tambien muchas
grandes manchas, color gris, contraste indefinidas,
nitidez difuso; no adherente, no plástico en mojado,
suelto en húmedo; no estructura, no poros, no raíces;
probablemente tixotrópico;
límite gradual irregular;

Cg2 >60 cm: Gris-verde, (5 G 5/1); arena;
pocos manchas medianas, color pardo, contraste
destacadas, nitidez neto; no adherente, no plástico en
mojado (toda la muestra es mojado); probablemente
tixotrópico; no estructura, no poros, no raíces;

SUELO JARDIN.

Número del perfil: RJZ 27
Fecha: 1-5-1987.
Ubicación: Mapa de localización de barrenas, 3446,I Guácimo,
578.97/248.10, noroeste de Rió Jiménez.
Clasificación provisional USDA; tropaquept.
Formacion geológica: Sedimentos cuarternarios, depositos fluviales recientes.
Material de partida: sedimentes fluviales, componentes finas, francos y arcillas.
Unidad geomorfológica: Plano aluvial, cauces fluviales.
Forma del terreno circundante: plano o casi plano, poco ondulado.
Pendiente donde el perfil esta situado: llano o casi llano, 0-2 %.
Evidencias de erosión: corrientes fluviales muy recientes.
Evidencias de compactación: algunas manchas pardos y naranjas en el horizonte Ap.
Drenaje: escasamente y muy escasamente drenado, profundidad de la capa freatica 45 cm.
Pedregosidad superficial: no
Vegetacion natural: bosque secundario, con muchas plantas aquaticas.
Uso de la tierra: no uso
Fauna del suelo: Lombrices.

Descripción del perfil RJZ 27.

Ah 0-10 cm: Negro pardento, (10 YR 3/2);
franco arcilloso; con frecuentes manchas medianas,
color naranjas, contraste definidas, nitidez neto;
estructura moderada bloques subangulares, fina o delgada;
ligeramente adherente, ligeramente plástico en mojado,
muy friable húmedo; pocos poros muy finos, tubulares,
descontinuos; comunes raíces, muy finas, finas y
medianas;
límite neto ondulado;

Ag 10-34 cm: Pardo amarillento (10 YR 5/4); arcilla;
frecuentes manchas grandes, color gris, contraste
definidas, nitidez difuso; estructura débil bloques
subangulares, fina o delgada; adherente y plástico en
mojado, muy friable en húmedo; pocos poros muy finos,
tubulares, discontinuos; pocas raices muy finas, finas y
medianas;
límite gradual ondulado;

Cg1 34-60 cm: Gris-verde, (10 G 6/1) y tambien un poco
de naranja amarillento (10 YR 7/2); arcilla;
frecuentes manchas medianas, color pardo, contraste
destacadas, nitidez difuso; sin estructura y poros;
adherente, plástico en mojado; con pocos Fe-concreciones
grandes, de forma esféricos, dureza blandos a duros;
pocas raíces muy finas y finas;
límite neto irregular;

Cg2 60-65 cm: Gris-verde, (10 G 6/1) y pardo oscuro,
(7.5 YR 3/4); arcilla/arena; sin estructura, poros y
raíces; ligeramente plástico, ligeramente adherente
mojado; este horizonte tiene abundantes a dominantes
Fe-concreciones grandes, dureza duros, forma irregulares,
con color párdo-negro.

LEGEND FOR THE 1:20.000 SOIL MAP OF THE RIO JIMENEZ AREA

FINE TEXTURED SOILS WITH CLAY ILLUVIATION (ULTISOLS/ALFISOLS)

Soils developed on laharic deposits

A moderately deep to deep, well drained fine textured soil with a clayey dark brown A-horizon and clay illuviation in the B-horizon. Without thixotropic properties in A and B-horizons, but with thixotropy in the C-horizon due to weathering of very coarse lahar deposits (volcanic).

Suelo Milano

Soils developed on fluvial deposits

A moderately deep, moderately well drained loamy to clayey soil, with a clayey loam to clayey A-horizon and with clay illuviation and some Fe/Mn concretions in the B-horizon. This soil has no thixotropic properties.

Suelo Aluvial

SOILS WITH CLEAR ANDIC PROPERTIES (ANDISOLS)

Soils developed on laharic deposits

A shallow to moderately deep, well drained soil, with a well developed, humic, very thixotropic A-horizon, overlying unaltered parent material composed of coarse to very coarse sand, gravel and stones.
Stones can occur high in the profile.

Suelo Unión, phase $\frac{\text{Un-3P2}}{\text{A}}$

Soils developed on laharic-fluvial deposits

A shallow to moderately deep, well drained soil with a well developed, sandy loam to sandy, very humic and thixotropic A-horizon, overlying coarse sandy, slightly gravelly parent material. No stones occur in the profile.

Suelo Unión, phase $\frac{\text{Un-3}}{\text{A}}$

A moderately well drained soil, with a silty/sandy clay loam, humic, very thixotropic A-horizon, overlying a slightly cemented, massive, very thixotropic, cambic B-horizon, developed in coarse sandy parent material.

Suelo Chirripó

A well drained, moderately deep soil with a sandy loam to clay loam, humic, very thixotropic A-horizon, overlying a well developed cambic B-horizon, also very thixotropic. Parent material consists of coarse sand.

Suelo Christina

A moderately well drained, moderately deep soil with a moderately well developed, loamy, humic A-horizon, overlying a weakly developed B-horizon, often showing grey mottling in the lower part.
The soil material, sandy loam to clay loam, is thixotropic.

Suelo Ligia

SOILS WITH LITTLE OR NO DISTINCT MARKS OF PEDOGENETIC PROCESSES BUT WITH ONE OR MORE HORIZONS WHICH SHOW ALTERATION OR CONCENTRATION (INCEPTISOLS)

Soils developed on laharic-fluvial deposits

A moderately well to very poorly drained, shallow soil with little profile development, on coarse sandy fluvial deposits with distinct thixotropic properties. In most augerings an A-C profile is observed.
Locally this soil contains stones and gravel, (phase $\frac{\text{Ta-3P2}}{\text{A}}$)

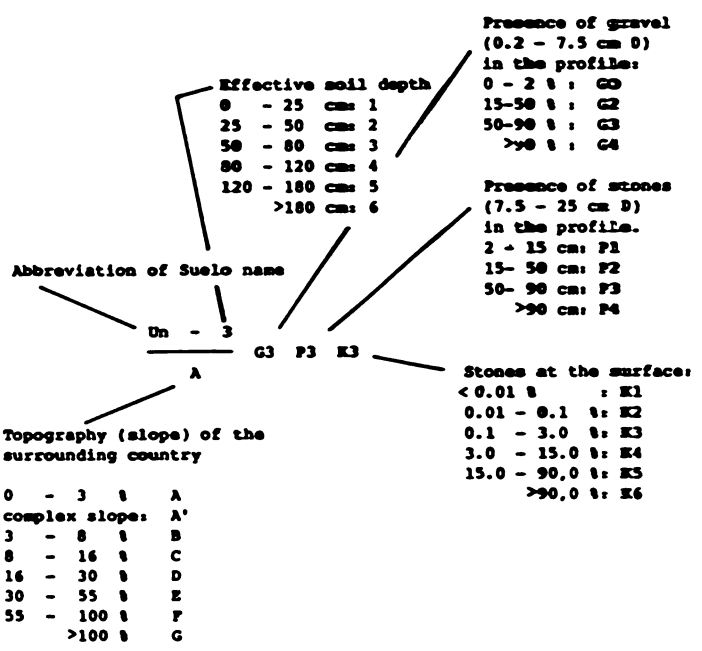
Suelo Toro Amarillo

Soils developed on fluvial deposits

A moderately well to very poorly drained, shallow, loamy to sandy clay soil, with Ah, Ag and C horizons, without thixotropic properties.

Suelo Jardin

EXPLANATION OF THE MAPPING SYMBOLS:



1 = $\frac{\text{Mi - 5}}{\text{A}}$

2 = $\frac{\text{Al - 4}}{\text{A}}$

3 = $\frac{\text{Un - 3}}{\text{A}}$ P3

4 = $\frac{\text{Un - 3}}{\text{A}}$

5 = $\frac{\text{Ch - 4}}{\text{A}}$

6 = $\frac{\text{Cr - 4}}{\text{A}}$ 60 % + $\frac{\text{Un - 3}}{\text{A}}$ 40 %

7 = $\frac{\text{Li - 4}}{\text{A}}$ 35 % + $\frac{\text{Al - 4}}{\text{A}}$ 65 %

8 = $\frac{\text{Ja - 3}}{\text{A}}$ 50 % + $\frac{\text{Ta - 3}}{\text{A}}$ 50 %

9 = $\frac{\text{Ja - 3}}{\text{A}}$ 40 % + $\frac{\text{Ta - 3}}{\text{A}}$ P2 60 %

LEGEND

	Suelo	Phase	Land capability class + subclass.
1	= Suelo Milano	Mi -55 / A	III, S2, S3, C2
2	= Suelo Chirripó	Ch - 4 / A	II, S1, D1
3	= Suelo Christina	Cr - 4 / A	II, S1
4	= Suelo Unión	Un - 3 / A	II, S1
4a	=	Un - 3 P3 / A	III, S2, S4
5	= Suelo Ligia	Li - 4 / A	II, S1, D1, C2
6	= Suelo Aluvial	Al - 4 / A	IV, S3, D1
7	= Suelo Jardin	Ja - 3 / A	VI, S3, S1, D1, D2
8	= Suelo Toro Amarillo	Ta - 3 / A	VI, S3, S1, D1, D2
8a	=	Ta - 3 P2 / A	VI, S1, S3, S4, D1, D2

Legend for the 1:20.000 soil map of the Río Jiménez area.

1) Fine textured soils with clay illuviation. (Ultisols/Alfisols).

1.1 Soils developed on laharic deposits.

1.1.1 A moderately deep to deep, well drained fine, textured soil with a clayey, dark brown to brown A-horizon and clay illuviation in the B-horizon. Without thixotropic properties in A and B-horizons, but with thixotropy in the C-horizon due to weathering of very coarse lahar deposits (volcanic).

Suelo Milano.

1.2 Soils developed on laharic-fluvial deposits.

1.3 Soils developed on fluvial deposits.

1.3.1 A moderately deep, moderately drained loamy to clayey soil, with a clayey loam to clayey A-horizon and with clay illuviation and some Fe/Mn concretions in the B-horizon. This soil has no thixotropic properties.

Suelo Aluvial.

2) Soils with clear andic properties. (Andisols).

2.1 Soils developed on laharic deposits.

2.1.1 A shallow to moderately deep, well drained soil, with a well developed, humic, very thixotropic A-horizon, overlying unaltered parent material composed of coarse to very coarse sand, gravel and stones. Stones can occur high in the profile.

Suelo Unión, phase $\frac{Un-3P2}{A}$

2.2 Soils developed on laharic-fluvial deposits.

2.2.1 A shallow to moderately deep, well drained soil with a well developed, sandy loam to sandy, very humic and thixotropic A-horizon, overlying coarse sandy, slightly gravelly parent material. No stones occur in the profile.

Suelo Unión, phase $\frac{Un-3}{A}$.

2.2.2 A moderately deep, moderately well drained soil, with a silty/sandy clay loam, humic, very thixotropic A-horizon, overlying a slightly cemented, massive, very thixotropic, cambic B-horizon, developed in coarse sandy parent material.

Suelo Chirripó.

2.2.3 A well drained, moderately deep soil with a sandy loam to clay loam, humic, very thixotropic A-horizon, overlying a well developed cambic B-horizon, also very thixotropic. Parent material consists of coarse sand.

Suelo Christina.

2.2.4 A moderately well drained, moderately deep soil with a moderately well developed, loamy, humic A-horizon, overlying a weakly developed B-horizon, often showing grey mottling in the lower part. The soil material, sandy loam to clay loam, is thixotropic.

Suelo Ligia.

3) Soils with little or no distinct marks of pedogenetic processes but with one or more horizons which show alteration or concentration. (Inceptisols).

3.1 Soils developed on laharic deposits.

3.2 Soils developed on laharic-fluvial deposits.

3.2.1 A moderately to very poorly drained, shallow soil with little profile development, on coarse sandy fluvial deposits with distinct thixotropic properties. In most augerings an A-C profile is observed. Locally this soil contains stones and gravels, (phase $\frac{Ta-3P2}{A}$).

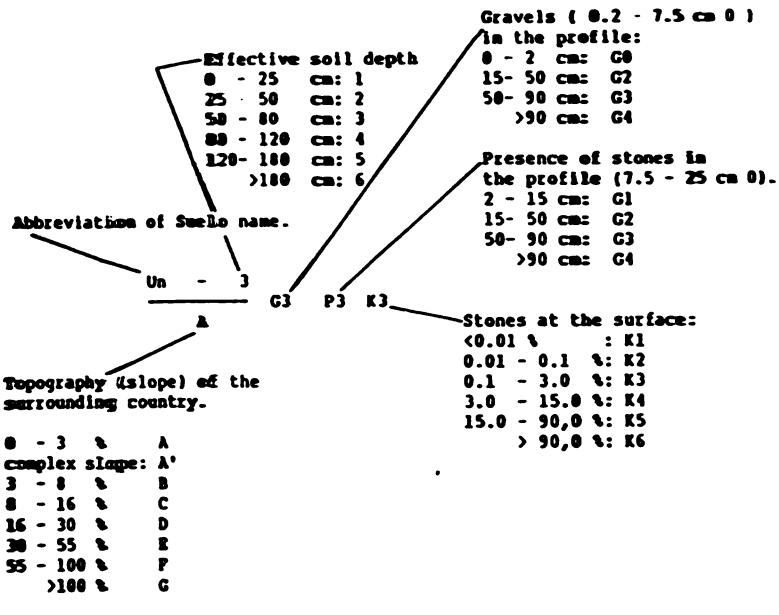
Suelo Toro Amarillo.

3.3 Soils developed on fluvial deposits.

3.3.1 A moderately to very poorly drained, shallow, loamy to sandy clay soil, with Ah, Ag and C horizons, without thixotropic properties.

Suelo Jardin.

Explanation of the mapping symbols:



1 = $\frac{Mi - 5}{A}$

2 = $\frac{Al - 4}{A}$

3 = $\frac{Un - 3}{A}$ P3

4 = $\frac{Un - 3}{A}$

5 = $\frac{Ch - 4}{A}$

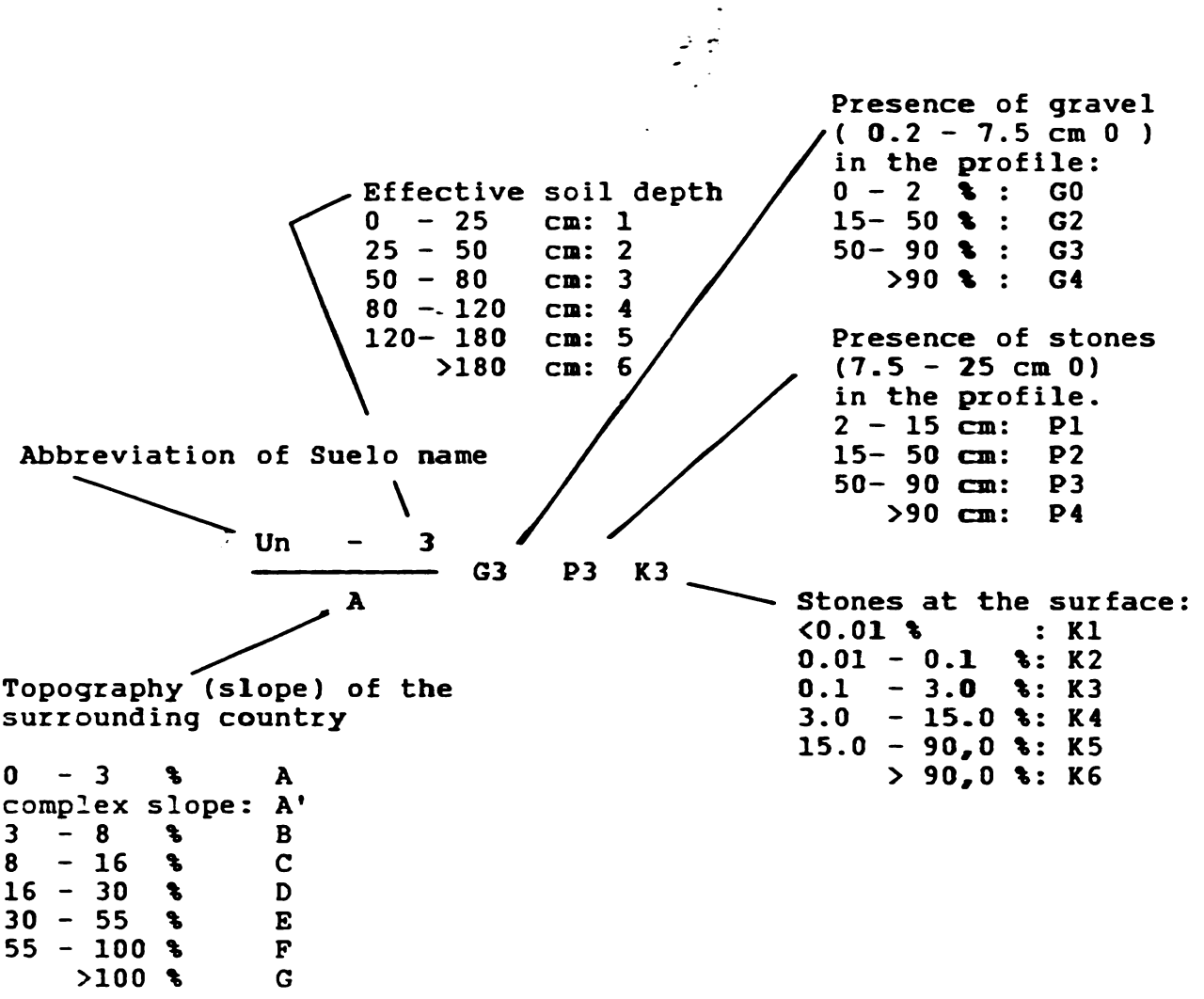
6 = $\frac{Cr - 4}{A}$ 60 % + $\frac{Un - 3}{A}$ 40 %

7 = $\frac{Li - 4}{A}$ 35 % + $\frac{Al - 4}{A}$ 65 %

8 = $\frac{Ja - 3}{A}$ 50 % + $\frac{Ta - 3}{A}$ 50 %

9 = $\frac{Ja - 3}{A}$ 40 % + $\frac{Ta - 3}{A}$ P2 60 %

EXPLANATION OF THE MAPPING SYMBOLS:



1 = Mi - 5 / A

2 = Al - 4 / A

3 = Un - 3 / A P3

4 = Un - 3 / A

5 = Ch - 4 / A

6 = Cr - 4 / A 60 % + Un - 3 / A 40 %

7 = Li - 4 / A 35 % + Al - 4 / A 65 %

8 = Ja - 3 / A 50 % + Ta - 3 / A 50 %

9 = Ja - 3 / A 40 % + Ta - 3 / A P2 60 %

1

LEGEND FOR THE 1:20.000 SOIL MAP OF THE RIO JIMENEZ AREA

FINE TEXTURED SOILS WITH CLAY ILLUVIATION (ULTISOLS/ALFISOLS)

Soils developed on laharic deposits

A moderately deep to deep, well drained fine textured soil with a clayey dark brown to brown A-horizon and clay illuviation in the B-horizon. Without thixotropic properties in A and B-horizons, but with thixotropy in the C-horizon due to weathering of very coarse lahar deposits (volcanic).

Suelo Milano

Soils developed on fluvial deposits

A moderately deep, moderately well drained loamy to clayey soil, with a clayey loam to clayey A-horizon and with clay illuviation and some Fe/Mn concretions in the B-horizon. This soil has no thixotropic properties.

Suelo Aluvial

SOILS WITH CLEAR ANDIC PROPERTIES (ANDISOLS)

Soils developed on laharic deposits

A shallow to moderately deep, well drained soil, with a well developed, humic, very thixotropic A-horizon, overlying unaltered parent material composed of coarse to very coarse sand, gravel and stones.
Stones can occur high in the profile.

Suelo Uni6n, phase $\frac{\text{Un-3P2}}{\text{A}}$

Soils developed on laharic-fluvial deposits

A shallow to moderately deep. well drained soil with a well developed, sandy loam to sandy, very humic and thixotropic A-horizon, overlying coarse sandy, slightly gravelly parent material. No stones occur in the profile.

Suelo Uni6n, phase $\frac{\text{Un-3}}{\text{A}}$

A moderately deep, moderately well drained soil, with a silty/sandy clay loam, humic, very thixotropic A-horizon, overlying a slightly cemented, massive, very thixotropic, cambic B-horizon, developed in coarse sandy parent material.

Suelo Chirripó

A well drained, moderately deep soil with a sandy loam to clay loam, humic, very thixotropic A-horizon, overlying a well developed cambic B-horizon, also very thixotropic. Parent material consists of coarse sand.

Suelo Christina

A moderately well drained, moderately deep soil with a moderately well developed, loamy, humic A-horizon, overlying a weakly developed B-horizon, often showing grey mottling in the lower part.
The soil material, sandy loam to clay loam, is thixotropic.

Suelo Ligia

SOILS WITH LITTLE OR NO DISTINCT MARKS OF PEDOGENETIC PROCESSES BUT WITH WITH ONE OR MORE HORIZONS WHICH SHOW ALTERATION OR CONCENTRATION (INCEPTISOLS)

Soils developed on laharic-fluvial deposits

A moderately well to very poorly drained, shallow soil with little profile development, on coarse sandy fluvial deposits with distinct thixotropic properties.In most augerings an A-C profile is observed.
Locally this soil contains stones and gravel,(phase Ta-3P2)
A

Suelo Toro Amarillo

Soils developed on fluvial deposits

A moderately well to very poorly drained, shallow, loamy to sandy clay soil, with Ah, Ag and C horizons, without thixotropic properties.

Suelo Jardin