SOILS OF THE RAINFOREST IN CENTAL GUYANA

The **Tropenbos-Guyana programme** operates in the framework of the international programme of the Tropenbos foundation. The multidisciplinary Tropenbos-Guyana programme contributes to conservation and wise utilization of forest resources in Guyana by conducting strategic and applied research aimed at the objective mentioned above and upgrading Guyanese capabilities in the field of forest related sciences.
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SOILS OF THE RAINFOREST IN CENTRAL GUYANA

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The Tropenbos - Guyana Programme

This book presents results of a soil inventory carried out in the Mabura-Kurupukari area in Central Guyana. Included are a soil map with description of mapping units, and profile descriptions with soil analytical data.

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The Netherlands

TROPENBOS The Tropenbos Foundation, The Netherlands

NARI National Agricultural Research Institute, Guyana

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Preface

The project

An essential part of the multidisciplinary research programmes of the Tropenbos foundation in general and the Tropenbos-Guyana programme in particular is the basic inventory, at reconnaissance scale, of the research area, as to its biotic and abiotic environment (landforms, soils, hydrology and vegetation). One of the aims of such overall inventories, is to provide an overview of the spatial variability and distribution of the major environmental factors. This is of importance to the selection of representative sites for further in-depth and detailed ecological studies. Secondly, the resources inventory is the basis for sound land use planning. The present survey forms a part of such an overall land inventory.

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Summary

This report presents the results of the land resources inventory carried out within the framework of the Tropenbos research programme in the Mabura-Kurupukari area in Central Guyana. The area is part of a logging concession in which selective logging takes place. The land resources survey is to provide base line data on which decisions regarding sustained use of the forest will be based.

Central Guyana is characterized by a humid (mean annual rainfall of about 2700 mm) and hot (mean annual temperature of about 25 °C) climate with rainfall exceeding potential evapotranspiration in all months except October. Most rains fall in the period May-August.

Geologically, the area consists of Precambrian rocks (schists, amphibolites and intrusive rocks and sandstones and mudstones at the southern slopes of the Akaiwanna mountains). Other conspicuous features are dolerite dykes of mainly Triassic age, still present in the area as small and larger hills. In the Tertiary era, erosion and peneplanation took place, leading to laterite formation which can be linked to planation surfaces of which relicts are still present in the area. The larger part of the area is influenced by Plio-Pleistocene, sandy and loamy deposits of the Berbice formation which fill a large basin in the northern half of Guyana.

The landforms present in the area are hills, some with clear (dissected) footslopes. Erosional plains occur at several levels in and around the hills. These plains are associated with laterite and in many places dissected. The larger part of the area is covered by sedimentary plains which, because of dissection, have a rolling to hilly relief. Small strips of alluvial plains are found along the major rivers.

The soils of the area can be subdivided into two broad groups: (i) shallow to deep, stony and gravelly, sandy clay loam to clay soils occurring on hills and dissected erosional plains, and (ii) deep, excessively drained, white sand soils and deep, well drained, brown loamy to clayey soils dominating the dissected sedimentary plains (locally known as the White Sands plateaus). A third but small area is occupied by poorly drained floodplain soils of creeks and rivers.

Soils of the hills have been formed in mainly basic, igneous (dolerites) and metamorphic rocks. In places ironstone formation (former planation levels) has greatly influenced the soils. Most hills are surrounded by dissected erosional plains which are underlain by various Precambrian rocks. Several of these plains bear witness of ironstone formations which causes soils to be either very gravelly or/and shallow and stony.

On the soil map, four mapping units covering the hills are indicated. Differentiating criteria are relative height of hills, relief, soil depth and stoniness. Two units with footslope soils are distinguished. The erosional plains are subdivided into five mapping units. Differentiating criteria are mainly relief, soil depth and stoniness.

Soils of the sedimentary plains have formed in the unconsolidated sediments of the Berbice Formation. Through weathering and translocation of weathering products and clay, the present day observed differentiation in texture in the soils of the Berbice formation has been created.

A common sequential pattern of soil types in the sedimentary plains is as follows:
excessively drained, white sands (*Tiwiwid sands*), having an extremely sharp boundary with the brown sands;
somewhat excessively drained, brown sands (*Tabela sands* with sand to loamy sand subsoils);
well drained, brown sandy loams to sandy clay loams (*Kasarama loamy sands* with sandy loam to sandy clay loam susoils);
well drained, brown sandy clays (*Ebini sandy loams* with sandy clay subsoils).

Imperfectly to poorly drained white sands with a hardpan (spodic B horizon) occur locally at lower slopes or (in the south) on flat areas (*Ituni sand*).

The Guyana soil series (names given in italics) are based on these differences in textural classes. The scale of our survey did not permit us to separate mapping units based on these classes, except for the white sands and in some cases more extended surfaces of the Tabela sands.

The white sand soils are subdivided in four mapping units, based on drainage condition and topsoil characteristics. The brown soils are subdivided in eight mapping units. Main differentiating criteria are relief and soil texture.

In the alluvial plains, three soil mapping units are separated, based on drainage condition and soil texture. One unit has a thick layer of peat overlying the mineral subsoil.

The soils are strongly acid, with remarkably low levels of nutrient reserves, very low cation exchange capacities and very low base saturations, which can be expected of deeply weathered soils under humid tropical conditions. Most soils, especially the loamy and clayey ones, have high levels of aluminium saturation which is toxic to many plants.

The available water holding potential of the soils is related to the texture: the white sands have a very low volume of available soil moisture (5 to 8%). The available soil moisture capacity of the loamy and clayey soils is somewhat higher, although still low with about 7 to about 10%.

The dominating clay mineral in the soils is kaolinite, pointing to strongly weathered soils. In some soils, gibbsite and goethite occur in small amounts.

Soil structures of most well drained soils are favourable as long as the soils are under a permanent vegetation cover. Exposure of the soil surface without careful and judicious organic matter management will lead to physical soil degradation (hardening, erosion). The soils are very low in nutrient levels and a change in land use from permanent natural forest to plantation forests or agricultural uses will disrupt the nutrient cycling patterns which are now sustaining the forest, leading to nutrient losses. Human interferences in the forest ecosystem will have an affect on the qualities of the soils, the extent of which will depend on the spatial and time dimensions of the human interferences. To quantify the effects of changes in land use on soil properties and qualities, further research is needed.

Chapter 1

Introduction

1.1 Tropenbos Guyana

The Tropenbos Guyana Programme started in September 1989 and its first phase expired at the end of 1993. A second phase was agreed upon and lasts from 1994 to the end of 1999. The major objectives of the Tropenbos Guyana Programme are to attain an understanding of the lowland tropical rainforest ecosystems to such a degree that timber harvesting under a sustainable forest management system can be achieved without it leading to bio-degradation and loss of proper hydrological functions of the exploited system. At the same time a satisfactory level of bio-diversity is to be maintained and an appropriate area of rain forest conserved.

In Guyana, the Tropenbos research activities are concentrated in the Mabura Hill logging concession of Demerara Timbers Limited, about 240 km south of Georgetown. The major research programmes are:

- soil and land resources inventory;
- modelling studies of the hydrological balances and nutrient cycles;
- a comparative study of floristic diversity; general information on lesser known tree species;
- studies of the population structure, dynamics and reproduction of important tree species;
- growth and productivity of timber species in relation to environmental constraints.

The Tropenbos Guyana Programme is coordinated by the Guyana Natural Resources Agency, the University of Guyana and the Utrecht University. Other Guyanese participating institutions are the National Agricultural Research Institute (NARI) and the Guyana Forestry Commission.

Office and field work for the land resources inventory was carried out in 1992 and 1993 by Mr. John Pulles, Unesco-MAB associate expert and Mr. Zab Khan, soil scientist with the National Agricultural Research Institute. The emphasis of the land resources inventory is put on a description of landforms, relief and in particular on soils.

1.2 Aims and objectives of the survey

The soil survey has the objective to contribute the understanding of the functioning of the forest ecosystem and to provide base line data upon which decisions regarding sustained use of the forest can be based. Moreover, locations of research sites can also be based on the information provided by the survey so that research results can be spatially extrapolated.

The survey has to collect basic inventory information on the soils and their spatial distribution in the area. As soil types generally show a direct relationship with landforms and both soils and landform are related to the underlying parent rock, also the geology and the landforms of the area are studied.

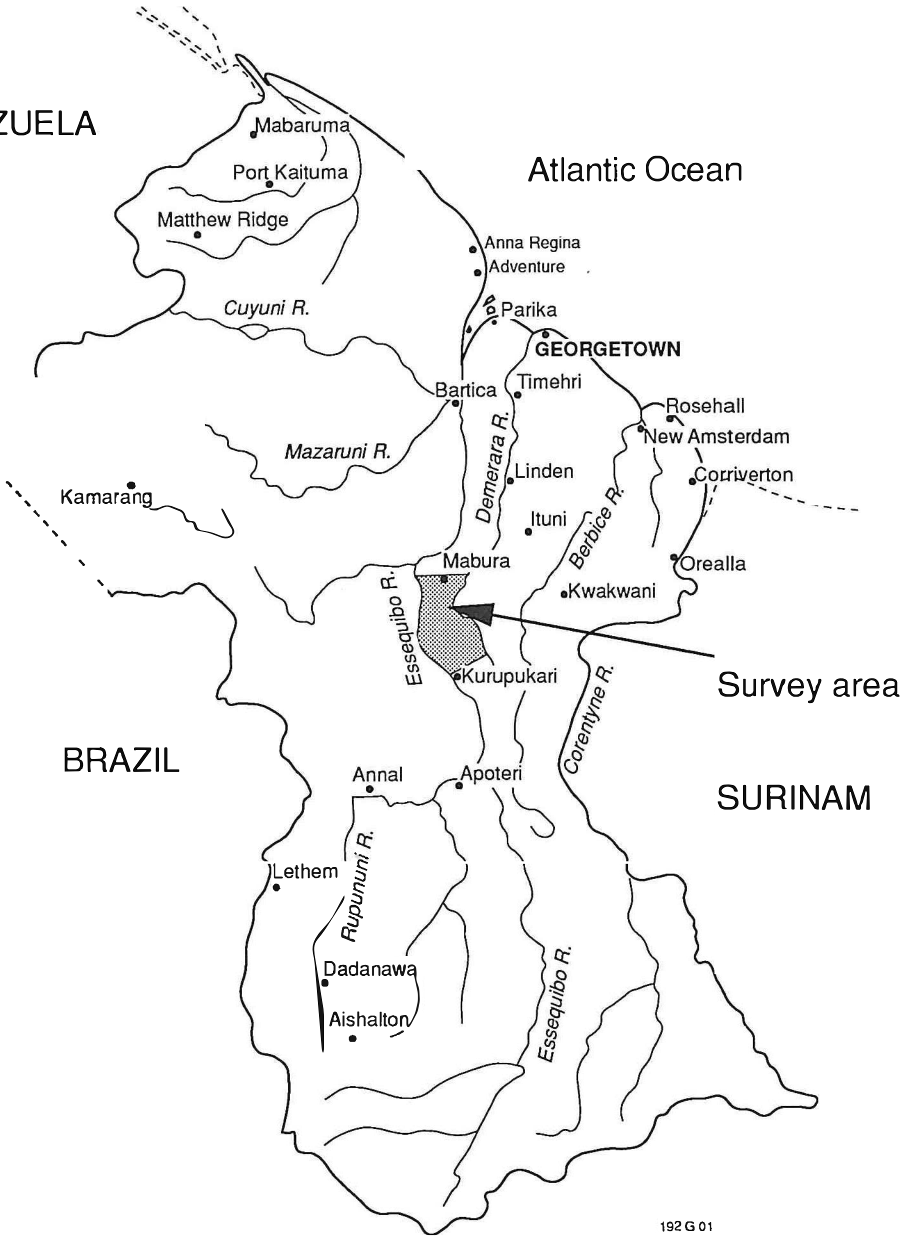


Figure 1 Location of survey area

Chapter 2

Environment

2.1 Location, infrastructure, and population

The survey area is situated in the central part of Guyana, between latitudes 4°40'N and 5°20'N, and longitudes 58°26'W and 58°54'W. The area is about 2200 km^2 large with a maximum north-south extent of 74 km, and an east-west width of 50 km. It covers the Demerara Timbers Ltd. 91/1 concession, which is located 230 km south of Georgetown.

The hatched area in figure 1 denotes the survey area. The northern boundary is formed by a straight east-west line, from Great Falls in Demerara river towards the Essequibo; the western boundary follows the Essequibo river southward to Kurupukari. The Cattle Trail from Kurupukari to Canister Falls in the Demerara river forms the southern boundary; the Demerara river delineates the eastern side of the survey area (see also figure 3).

Motorized access into the area is possible due to a network of tracks constructed for logging operations, but the accessability is not always assured as maintenance of the roads is directly related to the forest operations by the logging company. The network of tracks is fairly dense in the northern half of the area and is slowly extending towards the south. At the time of the survey, the southern part was accessible by car only via the so-called 'Brazil trail'.

Mabura township was newly constructed in the early eighties, for the benefit of personnel of the timber company and their families. It forms the major population centre, with approximately 1500 people. Apart from Mabura, only two small Amerindian villages are present in the area, one at Great Falls in the Northeast, the other one is Kurupukari, in the very South.

Apart from these villages, the area is uninhabited. Agricultural activities, mainly home gardens and some goat and cattle grazing, are concentrated around these villages, and occupy an almost negligible part of the survey area.

2.2 Climate

Being near to the equator, the humid tropical climate of Guyana is to a large extent controlled by the movement of the Inter-Tropical Convergence Zone (ITCZ). This results in a seasonality of the rainfall pattern in Guyana. From November to January, the ITCZ moves southward, bringing with it the short rainy season from December to February. This is followed by a relatively dry period in April and May. The northwards movement of the ITCZ brings the long rainy season which lasts from May through August. September and October are relatively dry months.

Climatic data, specific for the area, are derived from the Mabura Hill Weather Station. As this station became operational in 1991 only, data are supplemented by those of the Great Falls station, which was operational between 1965 and 1973.

Figure 2 shows the mean monthly rainfall and the monthly potential evapotranspiration data for Mabura. The rainfall figures are the 9 year (1965-1973) mean of Great Falls as these figures are believed to be representative for Mabura as well. The evapotranspiration data were calculated by Jetten (1994) and are the mean monthly data for Mabura of the years 1991 and 1993. Jetten (1994) reports that those years were more or less average ones. Figure 2 confirms the bimodal pattern of the rainfall. The wettest months are May - August with a precipitation between 300 and 400 mm. The short rainy season is in the period December - January with average monthly rainfall between 200 and 250 mm. The relatively dry months still have average rainfall of over 100 mm.

The mean monthly potential evapotranspiration is fairly constant and ranges between 100 and 150 mm. A potential moisture deficit occurs only in October, the driest month of the year.

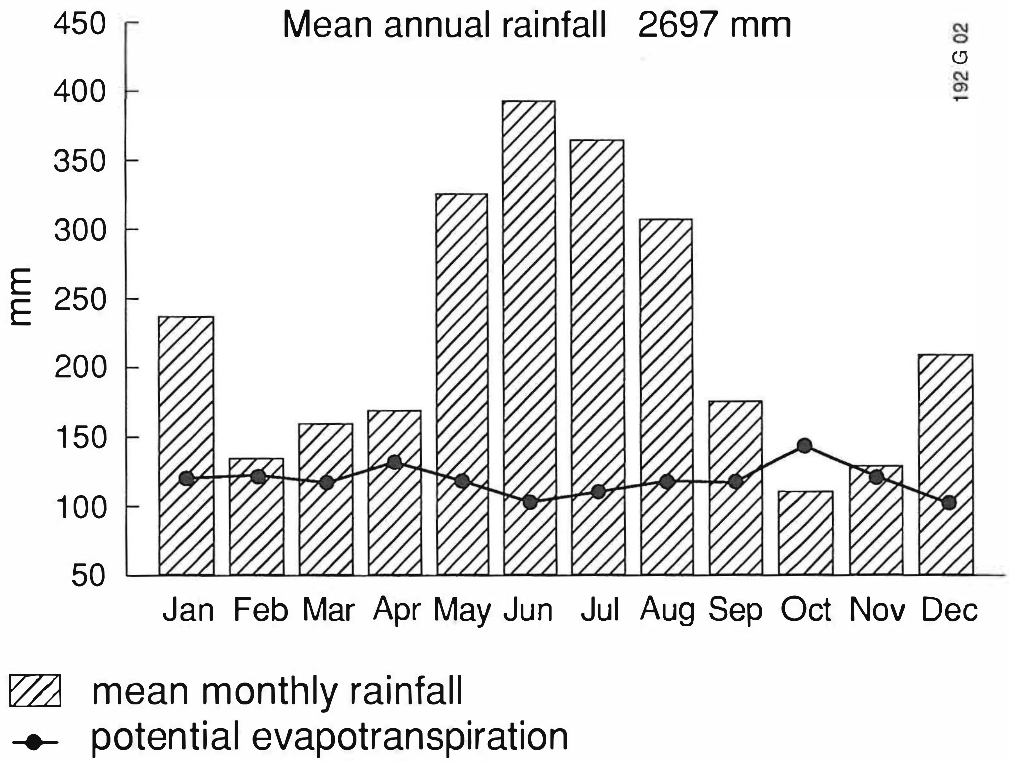


Figure 2 Mean montly rainfall and evapotranspiration of Mabura

The network of stations in the region is too wide to allow any concluding evidence on climatic uniformity over the study area. The distribution of vegetation types, however, suggests that a gradient exists towards drier conditions in the southern part of the survey area.

Orographic factors may cause local variations, such as the Akaiwanna mountains or the Mabura Hill range.

Mean monthly temperatures range from 23-24°C in January/February to about 26-27°C in October. This yearly variation of 2-4 degrees is exceeded by the daily variation, which on average is 6 degrees. Extreme temperatures may oscillate between 17 and 35 degrees (dataset is too small to give more exact figures).

The climate of the area can be classified according to Köppen as Tropical Rainforest Climate (Af): hot and rainy in all seasons. A more extensive analysis of the climatic data of the survey area is given by Jetten (1994).

2.3 Geology

Information on the geology of the Mabura-Kurupukari area is contained in the series of 1 : 200,000 scale geological map sheets that cover the area. These are Quarter Degree Sheet 0558SW: Omai, SW; Quarter Degree Sheet 0458NW: Kurupukari, NW; and a minor portion of Quarter Degree Sheet 0458NE: Kurupukari, NE, all produced and edited by the Geological Survey of Guyana (Barron, 1959, 1960, 1972a and -b).

Major geological events

The oldest rocks that are present in the survey area, belong to the Guyana Shield, and are of Precambrian age. These are metamorphized rocks, predominantly schists, amphibolites, granites and sandstones (Akaiwanna and Muruwa Formations of early Precambrian). After tectonic activities, new sedimentary deposits were formed (Roraima Formation), derived from the older rocks. These in turn, were partly metamorphized by basic intrusives, that created huge sills of great thickness (Roraima intrusive suite, of late Precambrian). Younger Basic intrusives, which took place latest in Mesozoic times, formed numerous minor dolerite dykes (see also table 1).

Following the formation of these younger dykes, there is a large unconformity until the next geological event in the Tertiary. During this large time-gap, uplift, erosion and peneplanation took place in several cycles, to which the formation of ironstone in the weathering mantle of the metamorphic and intrusive rocks is associated. In the resulting level country, tectonics became active: during Plio-Pleistocene times extensive terrestrial sandy deposits were laid down in a large, slowly subsiding basin over the northeastern half of Guyana. These are known as the White Sands Formation, or Berbice Formation. Renewed uplift and tilting caused the removal by erosion of the southwestern part of the sandy blanket and streams cut into the deposits, exposing the underlying rocks in large stretches of their stream beds. Witnesses of these geological events and resulting rock types, are present in the Mabura-Kurupukari area and are described hereafter.

Akaiwanna Formation

The Akaiwanna Formation in the area includes schists and amphibolites exposed in the Akaiwanna Mountains. The formation includes also phyllites, quartzites and meta-basites. The rocks of this formation belong, for the larger part, to the basic, dark coloured type, and are relatively rich in ferro-magnesian minerals. In situ soil formation on these rocks, if under well drained conditions, leads to red, fine textured (clayey) soils.

Table 1 Summary of major geological events

Formation	Lithology	Age
Riverine deposits and valley fills	Unconsolidated sandy to clayey strata; peat and muck	Recent
Berbice Formation (White Sand Formation)	Unconsolidated white sands and brown sands to loams	Plio-Pleistocene
300 ft level (Rupununi Surface)	Peneplanation and formation of Ironstone	Pliocene
1000 ft level (Kaietur Surface)	Peneplanation and formation of Ironstone	Oligocene to early Miocene
Younger Basic Intrusives	Mainly dolerite dykes, norites; inclined sheets	Paleo-Mesozoic, pred. Triassic
Roraima Intrusive Suite	Thick sheets (sills) of gabbro's; augite dolerites	Late Precambrian
Muruwa Formation	Sandstones and minor mudstones	(Younger) Precambrian
Akaiwanna Formation	Schists, amphibolites and partly metamorphosed intrusives, granites	(Older) Precambrian

Muruwa Formation

The Muruwa Formation consists of sandstones, approximately 3050 m thick. The sandstones enclose some 100 m of mudstone, which is locally tuffaceous. The round quartz grains comprising the sandstone are cemented by secondary quartz which, with fine grained quartz and sericite, makes up the matrix. The geological map indicates rocks of the Muruwa formation as a west-east strip just south of the Akaiwanna Mountains.
Sandstones are relatively poor in primary minerals. Soil formation leads to brownish coloured loams or sandier textures, rather than to red clayey soils on dark rock.

Roraima Formation

Younger, but still of Precambrian age, are the relics of large sills and inclined sheets of undifferentiated basic rock, referred to as the Roraima Intrusive Suite. These are manifest as near-horizontal sheets of coarse hypersthene gabbros. Various augite dolerites and gabbros are included, which form gently inclined or horizontal sheets in the Essequibo River from Siparunim mouth to the Akaiwanna Mountains.

The *Younger Basic Intrusive Suite* comprises small dolerite dykes, that trend east-northeast. Several are exposed in the Essequibo river bed, and in the northern-central parts among the dissected plains. Soils formed on these dykes are red and clayey and may have considerable amounts of laterite gravel.

The tops of the Akaiwanna Mountains consist of the laterized relics of an old 300-400 m high erosion surface. The mountains and other hilly areas are surrounded by a wide laterized bench some 120 m above sea level. Laterite gravel fans are not uncommon around the base of these laterized peneplains.

Berbice formation

The survey area covers the southwestern fringe of the White Sands Plateau and its transition to the Precambrian Plateau. The material of the White Sands Formation consists of unconsolidated (white) sands and (brown) sandy loams. The deposits extend into the neighbouring countries of Surinam and French Guyana, where the formation is known as 'Zanderij', and 'Sables Blancs', respectively. The sediment cover in the survey area is relatively thin, with the thickest deposits occurring in the northern part where nevertheless thicknesses of over 10 m are possible. The top of the white sand plateau lies at about 100 m above sea level. Kaolinitic clay forms beds and massive deposits below and occasionally within the sands, except when the base of the latter is high.

Riverine deposits and valley fills

Other superficial sediments are derived largely from the sandy Berbice formation. They occur as alluvium of the present floodplains of the Essequibo and Demerara rivers, and as valley fills in the larger tributaries. These are sandy, loamy and clayey deposits, mostly stratified, and occasionally including or covered by layers of peat or muck.

2.4 Landforms; geomorphology and relief

Daniel (1984) distinguishes four main geomorphological regions in Guyana:
the Coastal Plain (Corentyne Group);
the Sandy Rolling Land (synonymous with the White Sands Plateau);
the Pakaraima Mountain Region;
and the Precambrian Lowlands, covering over half of the country.

Of these geomorphological regions both the 'Sandy Rolling Land' and the 'Precambrian Lowlands' are present in the survey area. A minor part of the area is covered by mountainous landforms, in rocks of the Roraima Formation; but also as peaks within the Precambrian Lowlands (the Akaiwanna Mountains). The survey area is located at the fringe of the White Sands Plateau, bordering the Precambrian Lowlands.

The Guyana Shield has known a cyclic development of erosional landscapes with intermittent upwarping of the interior and downwarping of the coastal belt (Krook, 1979). In reaction to a period of uplift, a denudation cycle started, which finally resulted in a more or less flat surface sloping towards the coastal area, where the derived sediments formed a coastal plain. Renewed uplift and downwarping led to another denudation surface at a lower level. Three surfaces of Tertiary age are distinguished in Guyana (Gibbs and Barron, 1993):

a surface of Early Tertiary age, the *Kopinang Surface*, at an altitude of 630-690 m (2100-2300 ft) (this is not represented in the survey area);

the Late Tertiary I Surface, of Oligocene to early Miocene age: the *Kaieteur Surface*, at a level of 390-450 m (1280-1480 ft), which is also known as the *Higher Laterized Peneplain*;

the Late Tertiary II Surface, of Pliocene age; possibly the *Rupununi Surface* (100-170 m, 330-560 ft); also known as the *Lower Laterized Peneplain.*

A fourth level is formed by the Berbice, or White Sands Plateau, which is an aggradational landform, or sedimentary plain, by origin. In tum, this has been uplifted and partly dissected again.

Much has been preserved in Guyana of the Higher Laterized Peneplain, which has a conspicuous laterite covered surface. The flat tops of the Akaiwanna Mountains and the Wappu range represent remnants of this surface in the Mabura-Kurupukari area. Its elevation decreases towards the northeast: a slope of 0.2% in 15° N/NE direction is found between the flat tops of the Akaiwanna Mountains and the Wappu range. The ironstone capping of the land has been (and still is) instrumental as protection against erosion, dissection and lowering of the land, and is responsible for the mountainous relief sloping down towards the surrounding lower level landforms. Due to the cloudiness of the aerial photographs in the Akaiwanna area, no flat tops could be mapped. Moreover, it is likely that the spatial extent of these ironstone plateaus is limited.

The Lower Laterized Peneplain occurs in the survey area as ironstone plateaus at the foot of the mountains and major hill masses. It is found at an altitude, just above that of the White Sands Plateau. Characteristically, (minor) ironstone escarpments contour the, locally very flat, interfluves. Dissected, hilly to rolling topography marks the transition to the lower White Sands Plateau.

The most widespread physiographic feature in the area is the extensive, rolling and undulating landscape, belonging to the White Sands Plateau, with interfluves at an elevation of about 100 m. The original sedimentary plain, that must have had an almost flat surface with a gentle dip northwards, has been uplifted in Pleistocene times, and consequently dissected by renewed incision of the river courses. The almost flat and gently undulating interfluves border moderate to steep slopes, according to intensity of dissection. Where interfluves are flat and extensive, the sandy deposits have greater thickness, and soil drainage is rapid and by deep percolation. As a consequence, the density of drainage lines is low. Where the White Sands Plateau borders the Precambrian Lowlands, the sediment cover is relatively thin. Here, the deposits have been eroded away over long stretches of river courses, and the Precambrian base is exposed in river beds and valley incisions.

The present river flats of the Essequibo and the Demerara occur at an altitude of about 50 m. Small strips of sandy to clayey, young alluvial deposits are present locally. In places with poor drainage conditions, such as backswamp-like depressions, peat deposits have been formed.

2.5 Hydrology

The Demerara and the Essequibo rivers mark the eastern and western boundaries of the survey area respectively. Both rivers flow from South to North. The water divide is shown in the drainage map of figure 3. The survey area constitutes only a minor part of the catchments of both rivers. The catchment area of the Essequibo is much larger than that of the Demerara (see also figure 1).

Most of the survey area is drained by several tributaries to these rivers. Large tributaries are the Kuruduni in the Southeast and the Seballi river in the North-West, draining into the Demerara and Essequibo rivers, respectively.

The pattern of the drainage system in the area is largely dendritic and consequent. In some cases, however, geological structure is clearly reflected, such as an apparent fault line in the Akaiwanna Mountains. Some uncommon sharp angles in river courses suggest the underlying rock joints, or possible river capture in the past. Drainage density in the undulating southern area is markedly lower than in the more dissected northern part.

2.6 Vegetation

The two principal forest types occurring in the survey area are Mixed Rainforest and Dry Evergreen Forest (Ter Steege, 1993). The Mixed Rainforest is characterized by its great floristic diversity, although certain species tend to be locally dominant, among which one of the commercially most wanted species the Greenheart (*Chlorocardium rodiei*). The Dry Evergreen Forest is also called the Wallaba forest as both Soft Wallaba (*Eperua falcata*) and Ituri Wallaba (*Eperua grandiflora*), are dominating species.

A further subdivision leads to 5 forest vegetation associations (Ter Steege, 1993) which are clearly related to soil types and in particular to drainage conditions:

-1- Dry evergreen forest, occurring on the excessively drained deep, white sands (mapping unit Ps1). The dominant species are *Eperua falcata* and *Eperua grandiflora*. Other common species are *Tovimita* sp., *Swartzia* sp., *Aspidosperma excelsum* and *Catostemma* cf. *fragrans*. *Ormosia coutinhoi* is found near the borders with swampy areas.

-2- Mixed forest occurring on well drained soils. The dominant forest species are: *Chlorocardium rodiei*, *Eschweilera sagotiana* (plus other *Lecydidaceae*) and *Dicymbe altsonii*, alone or in combination.

-3- Mixed forest on well to poorly drained soils. *Eperua rubiginosa* is strongly dominant in this forest association. Other dominant species are *Chlorocardium rodiei*, *Eschweilera sagotiana* and *Mora gongrijpii*.

-4- Creek forest on poorly drained alluvial soils. Dominant species are *Eperua falcata* and *Catostemma* sp.. *Eperua rubiginosa*, *Chamaecrista adiantifolia* and *Diospyros ierensis* are frequently present.

-5- Palm-swamp forest on very poorly drained peat soils. Dominant species are *Eperua rubiginosa* and *Dycimbe altsonii*. Other common species are *Eperua falcata*, *Diospyros ierensis*, *Jessenia bataua*, *Tabebuia insignis*, *Iryanthera lancifolia*, *Symphonia globulifera* and *Couratari* cf. *gloriosa*.

The forest types 1 and 2 are dominant in those parts of the survey area where soils are developed in sediments of the Berbice Formation. It is also in a part of the sedimentary plains that Ter Steege (1993) did his research on soil - vegetation relationships. His research site is located in the so-called Waraputa Compartment, southwest of Mabura village. So far, the Tropenbos Guyana Programme has not yet carried out a comprehensive vegetation survey of the whole research area. Observations done by the soil surveyors, however, suggest that at all sites with deep, well drained soils, mixed, Greenheart bearing forest occur. Soils with large amounts of lateritic gravel may have different dominating species. Distinct trees on the lateritic soils are: Sarebebeballi (*Vouacapoua macropetala*), Greenheart (*Chlorocardium rodiei*) and Morabukea(*Mora gonggrijpii*).

The vegetation type on shallow lateritic soils, is likely to be more of the Dry evergreen forest type but not with Wallaba as dominating trees. A characteristic tree here is the wild Guava (*Myrtaceae* spp.).

In the southern part of the survey area, the dry evergreen forest on the white sands is no longer dominated by Wallaba species but by Muri and Dakama shrub.

Detailed soil-vegetation relationships for all soils in the study area can not be established as insufficient data are available. Further studies in this respect are necessary.

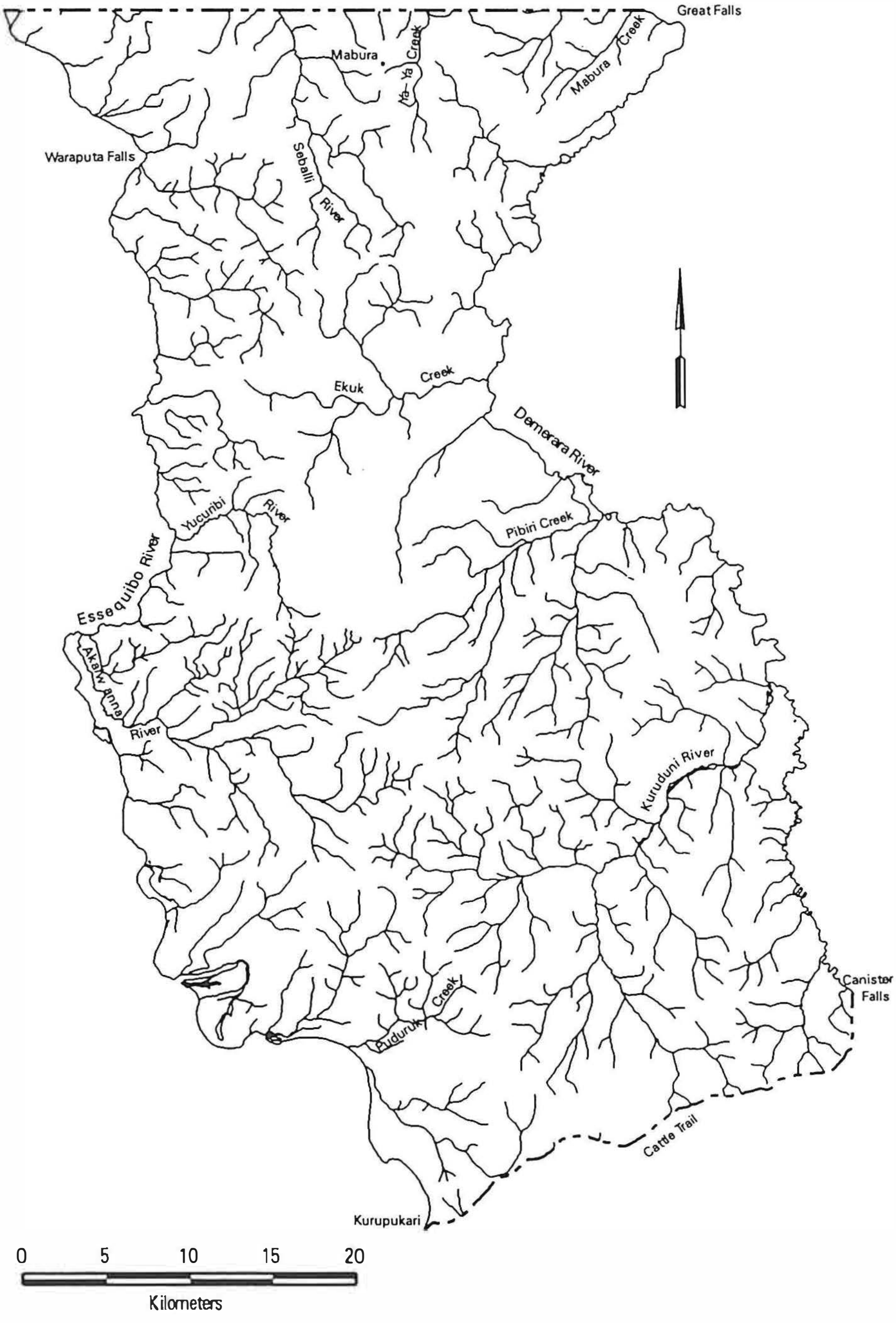


Figure 3 Drainage network of the Mabura–Kurupukari area

Chapter 3

Survey methods

3.1 Office

Office work consisted of the study of available materials of the survey area and its surroundings, such as soil and vegetation maps and reports, topographic and geological maps, etc.

The topographic map sheets at scale 1 : 50,000 which cover the survey area are 44NW, 44NE, 44SW, 44SE, 51NW, 51NE, 52NW, and 51SE. Major features such as contour lines, drainage ways, roads, and principal points of airphotos, were digitized using basic IDRISI digitizing software together with an A3-size digitizer. The map coordinates have been transformed into the Universal Transverse Mercator (UTM) coordinate system, which expresses the geographical location in meters.

Airphotos, most of which dating from 1965, and with a scale between 1 : 39,000 and 1 : 44,000 were available for the whole area. Serial numbers of the airphotos are, from North to South and West to East: cgm-1-8 (16-28), cgm-1-75 (99-108), cgm-1-153 (42-33), cgm-1-78 (38,30), cgm-1-80 (130-139), cgm-1-18 (28-39), cgm-1-80 (121-108), cgm-1-22 (21-24,83-74), cgm-1-76 (59-70), and cgm-1-22 (96-107). In general the photos are of good quality, except for the most northern ones and some cloud cover around the central Akaiwanna mountains.

Using stereoscopy, preliminary mapping unit boundaries were delineated, based on differences in major landforms, relief and vegetation cover and pattern. The office work, including the airphoto study, was followed by intensive fieldwork. After the fieldwork another round of airphoto interpretation was carried out to determine final mapping unit boundaries.

3.2 Field

In the first year of the survey the field work was concentrated on the northern, relatively well accessible part of the area. In the second year two major field periods of almost two months each were held in the southern part. The locations of the observations are shown in figure 4. Observations were done along roads and tracks and in transects starting from those. It is realized that observations along roads are not free from bias as most roads are located on top of the interfluves. Therefore, the locations of transects are perpendicular to major drainage lines and situated in as many different landforms as possible (which in practice meant: were accessible).

For observations in cutlines, the slope, direction, and distance to the previous observation was noted, which was used to calculate the location of each consecutive point.

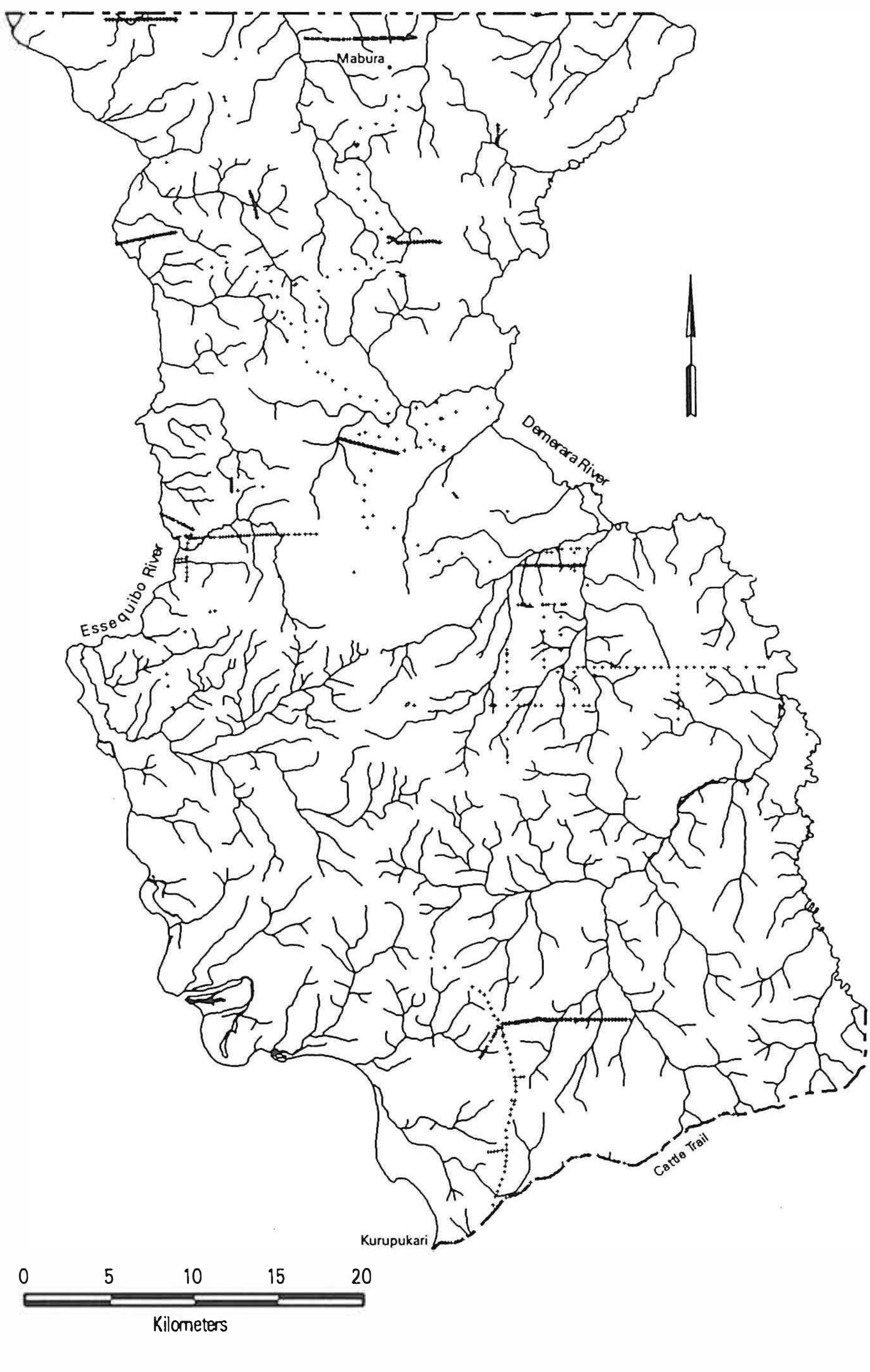


Figure 4 Locations of the observations

Distance measurement were done by counting steps or by chaining, in both cases corrected with a factor in order to fit between the starting and end point determined from the topographic map and/or GPS (Global Positioning System) reading.

Soil augerings were made to a depth of 120 cm, unless bedrock or stoniness limited penetration. Occasionally, augerings continued to a depth of 250 cm. Most soil pits reached a depth of 150 cm. Bulk samples were taken from each soil horizon in the soil pit for physical, chemical and mineralogical analysis. Undisturbed core samples (rings of 100 cm^3) were collected for the study of soil moisture characteristics.

The field observations were carried out according to the FAO guidelines for soil profile descriptions (FAO, 1990) and after Breimer et. al. (1984). In total 805 recorded soil augerings have been carried out in the survey area. In addition, 38 soil pits were dug and described of which 34 were sampled. Full profile descriptions with analytical data are given in annex B.

3.3 Laboratory

Analysis on the soil samples of the representative pits was carried out at the International Soil Reference and Information Centre, Wageningen, the Netherlands, using the methodologies approved by Tropenbos (Touber et. al., 1989). Samples taken from selected augerings were analyzed for texture at the NARI laboratory in Mon Repos, using the pipette method.

All soil samples were analyzed for: acidity (pH), available phosphorus, organic carbon, total nitrogen, electrical conductivity, cation exchange capacity, exchangeable cations, exchangeable acidity and texture. Of selected profiles, elemental composition of the total soil was determined as well as the mineralogical composition of the clay fraction.
In addition, soil moisture characteristics were determined for some profiles. A summary of the methods used in given in Annex B: Soil profile descriptions.

3.4 Data processing and map preparation

The contour lines have been used to calculate a grid of elevation points, a so-called digital elevation model (DEM), at a resolution of 250 m (figure 5), by spatial interpolation (kriging). This can be used to derive relief information and drainage maps.

Vector data were stored in a GIS. Due to the large amount of storage needed for the topographic information, the IDRISI software had to be adapted and a more powerful GIS was developed by J. Pulles. Attribute data is stored in Dbase files.

All vector and attribute data was finally transferred to the SC-DLO ArcInfo GIS. The vectors of the final soil map, prepared after the last round of airphoto interpretation, were digitized at the SC-DLO. The final map 'Landforms and soils of the Mabura-Kurupukari area' was compiled at the SC-DLO using ArcInfo GIS and printed on an offset press.

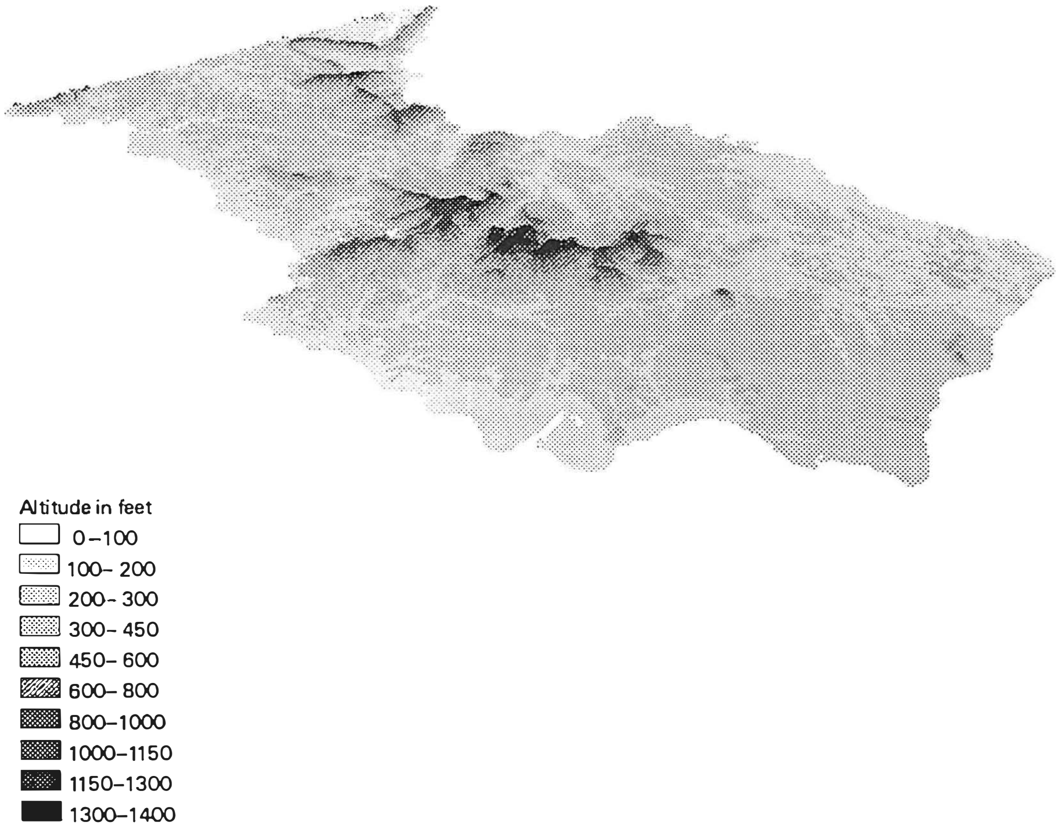


Figure 5 Digital Elevation Model of the Mabura–Kurupukari area

3.5 Observation density and reliability of the map

In total 805 observations were made within the study area covering a total of 218,699 ha. The calculated observation density is 272 ha per observation. This is one observation in every 2.7 cm^2 of the 1 : 100,000 map. This observation density theoretically is more than sufficient for a final map of 1 : 100,000.

The observations, however, are not evenly distributed over the survey area. The area was accessed by car and on foot only which strongly limited the territory that could be surveyed in the field. Moreover, roads are avoiding hilly and mountainous areas. Although in the northern part a fairly dense network of roads and tracks was present, hills remained inaccessible, except on foot. In the southern part, hardly any roads and tracks were present at the time of the survey and therefore observation density there is low.

The reliability of the soil map can too a large extent be deducted from figure 4, location of observations. The northeastern part and the central hills and the southwestern parts of the area could not be sufficiently checked in the field and mapping unit descriptions/soil types were inferred from airphoto observations, study of the geological maps and using expert knowledge.

3.6 Legend construction

In the legend of the map, landforms form the first entry. The mapping unit codes start with a capital letter which is related to the landform, for instance H stands for Hills. Landforms are subdivided according to differences in geology. This is presented in the legend but not reflected in the code of the mapping unit. A further subdivision is based on relief characteristics. The last but not the least important subdivision is based upon differences in soil characteristics whereby soil depth, drainage condition and texture form the main subdividing criteria.

The full legend is presented on the 'Landform and soil map of the Mabura - Kurupukari area'. The mapping units are given simple alpha-numerical codes, whereby a capital letter, in cases followed by a lower case one, denotes the landform. Subdivisions according to geology, relief and soils are not systematically reflected in the symbol but received numbers from 1 to 9.

The following landforms are recognized in the area (see also figure 6):

H Hills

This landform is characterized by an irregular relief, and slopes ranging from 5 to over 30%. A subdivision is made between high and low hills. High hills have the majority of slopes from 16 to over 30%. Relief intensity, being the difference in elevation between the hill tops or crests and the valley bottoms, is between 180 and 360 m. Maximum elevation of 425 m in the high hills is reached in the so-called Akaiwanna Mountains. The low hills reach a maximum elevation of 250 m and relief intensity is from 50 to not more than 180 m.

F Footslopes

Locally, at the foot of the hills, footslopes occur. Footslopes are sloping away from the hill with slope angles from 2 to about 10%. Due to dissection, slopes up to 16% occur and locally even steeper slopes are present.

Pe Erosional plains

Erosional plains occur at several levels in and around the hills. Most of these are related to former laterite accumulation surfaces which have been exposed after denudational processes and in several cases dissected. Within the erosional plains flat areas are present but where they have been dissected, slopes up to 16% occur and in places they maybe even more steeply dissected. Relief intensity is generally not exceeding 50 m, but exceptions occur.

Ps Sedimentary plains

The sedimentary plains are characterized by unconsolidated sandy and loamy sediments and cover the major part of the survey area. Although originally more or less flat, because of dissection dominant slopes may now reach angles of over 30%, giving rise to a hilly relief. Relief intensity generally is not exceeding 50 m.

A Alluvial plains

The alluvial plains are the (nearly) flat floodplains and valley bottoms with relief intensity less than 5 m.

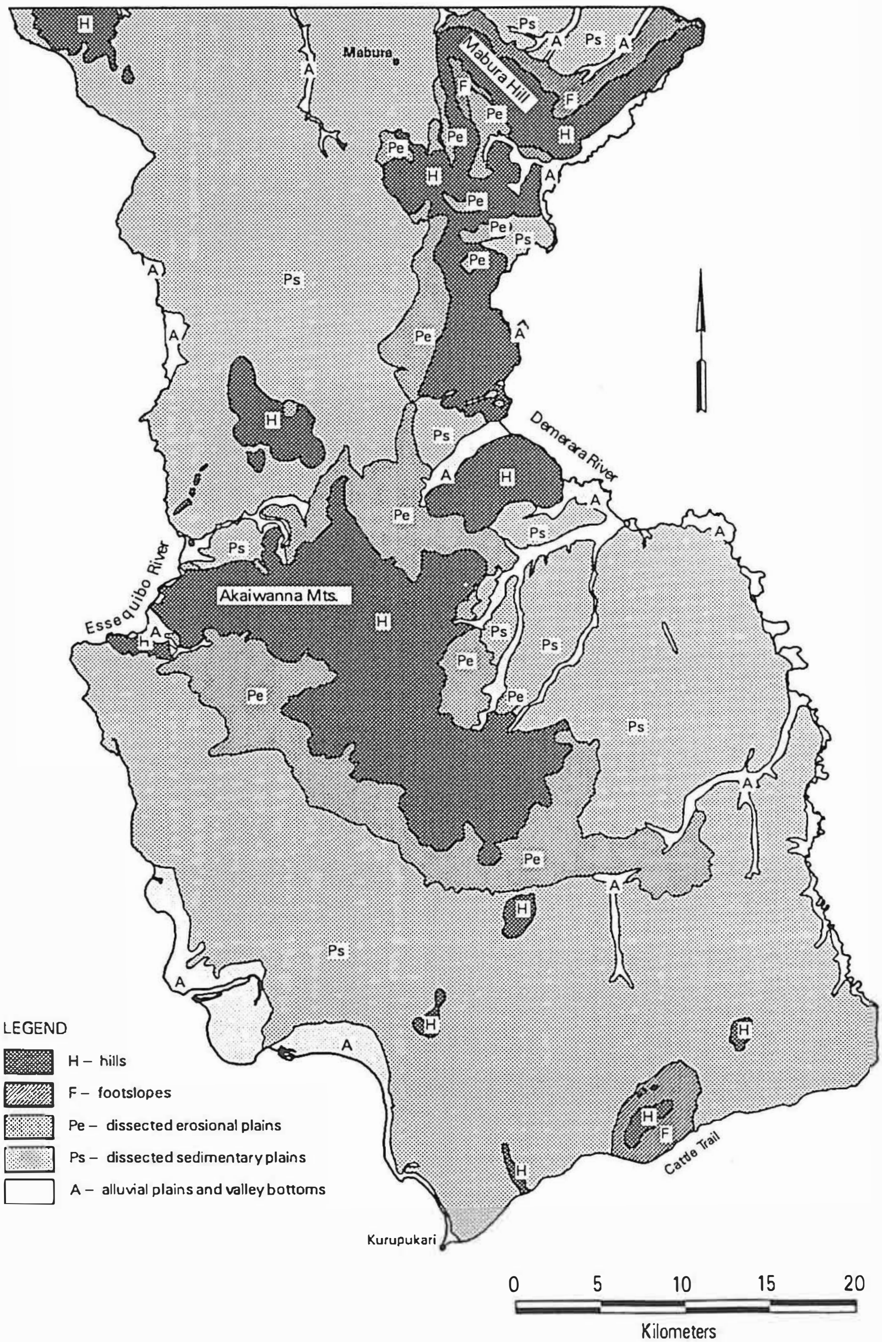


Figure 6 Landforms of the Mabura–Kurupukari area

Chapter 4

Soils

4.1 Previous work

The Food and Agriculture Organisation (FAO) of the United Nations carried out a reconnaissance soil survey in the period 1961-64 (FAO, 1966). They produced soil maps at a scale of 1 : 500,000 of the entire country except for about 10 percent which was not covered by aerial photographs. The soil mapping units of their reconnaissance survey are soil associations classified at Great Soil Group level. The major part of the present survey area is however not covered by this survey, since at that time the coverage by aerial photographs was insufficient.

Table 2 Guyanese soil names and their main properties

Guyanese soil name	Drainage condition	Topsoil texture	Textural range (with depth) of subsoil
Lama muck	very poor	peat	peat over sand or clay
Barima	somewhat poor to moderate	silt loam	silt loam to silty clay loam
Ituni	poor	sand to loamy sand	sand to loamy sand
Tiwiwid	excessif	sand	sand
Tabela	excessif	sand	loamy sand
Kasarama	well	sand to loamy sand	sandy loam to sandy clay loam
Ebini	well	sandy loam to sandy clay loam	sandy clay loam to sandy clay

The detailed soil survey carried out by Khan et. al. (1980) covered an area of 2000 hectares in the vicinity of the Mabura Township area (between Yaya Creek and Seballi River). A soil map was compiled at a scale of 1 : 30,000. Mapping units follow the Guyana soil series. The dominant soil type is Tiwiwid sand, a deep white sand soil. The Tiwiwid sands are bordered by a narrow stretch of Tabela sands (deep, excessively drained, reddish brown sands to loamy sands), followed by Kasarama and Ebini soils. The latter two are deep, well drained sandy loam (Kasarama) to sandy clay (Ebini) soils. In the valley bottoms, very poorly drained, mixed alluvial soils occur, which are locally bordered by poorly drained white sands (Ituni). This pattern of soil types described by Khan et. al. (1980) fits well in the information gathered by the present survey. Their scale of mapping permitted a more detailed separation in textural classes of the 'brown' soils than was possible in the present 1 : 100,000 survey. In table 2, the Guyanese soil names are given with their main properties. It concerns the soils developed in the Berbice formation and some alluvial soils.

Khan's report gives suggestions for use and management of the soils and it is concluded that the area is preferably be used for mixed agriculture although all soils have very low nutrient levels and most of these very low water holding capacities. If at all agriculture is considered, the importance of good organic matter management is stressed as well as the risk for erosion of the steeper slopes.

A detailed soil survey carried out by Eemisse (1991) covered an area of 900 hectares and is situated in the Mabura forest reserve, a project site of the Dutch Tropenbos Foundation. A soil map was compiled at a scale of 1 : 25,000. Mapping units are conform the FAO-UNESCO (1988) soil classification system. Main soil types are the haplic Arenosols (deep white sands in our survey classified as albic Arenosols, mapping unit Ps1), gleyic Arenosols (poorly drained sands, in our survey the carbic Podzols of mapping unit Ps3), and the haplic Ferralsols (deep, well drained 'brown' sandy loams to sandy clays, in our survey acri-haplic and acri-xanthic Ferralsols, mapping unit Ps8) in the sedimentary plains. In the erosional plains Eemisse (1991) finds dystric Leptosols, rudic phase. These are very gravelly soils (in our survey classified as dystric Leptosols, petroferric phase and acri-haplic Ferralsols, rudic phase, mapping unit Pe3). The general pattern of soil types is conform with the present survey although we could not make that many separations because of scale constraints. Opinions about classification, however, differ. Eemisse's survey was followed by a theorical study of soil moisture characteristics and a quantified land evaluation. As not sufficient data were available, results are not of much practical use.

The latter two surveys contributed to the present survey as they gave insight in especially the soil patterns occurring in the sedimentary plain.

4.2 Soil-landform relationships and soil genesis

At a first glance, the survey area can be divided into two broad areas: (i) the hills and dissected erosional plains with shallow to deep, stony and gravelly soils and (ii) the dissected sedimentary plains (locally known as the White Sands plateaus) with deep, excessively drained, white sand soils and deep, well drained, brown loamy and clayey soils. A third category, albeit a minor one, is formed by the floodplains of creeks and rivers.

Soils of the hills have formed in mainly basic, igneous (dolerites) and metamorphic rocks. In places ironstone formation (former planation levels) has greatly influenced the soils. Most hills are surrounded by dissected erosional plains which are underlain by various Precambrian rocks. Several of these plains bear the witnesses of ironstone formations which causes soils to be either very gravelly or/and shallow and stony.

Soils of the sedimentary plains have formed in the unconsolidated sediments of the Berbice Formation. Different opinions exist on the composition of these sediments at the time of deposition. Some believe that the material at the time of deposition already consisted of (bleached) white sands overlying the brown, more loamy and clayey deposits (Khan et. al., 1980). A majority, however, supports the idea that the Berbice sediments are continental deposits which were laid down by braided river systems as sandy, loamy and clayey deposits. These deposits have been mixed to considerable depths by biological actions and resulted in rather uniform loamy to clayey deposits ('brown soils'). Subsequent soil formation processes resulted in a loss of clay and iron and ultimately lead to the white sands. This formation theory is, among others, brought forward by Krook and Mulders (1970) who studied similar soils in Surinam and by Lucas et. al. (1981) who studied the soils in French Guyana.

Poels (1987) used soil texture, colour and the presence of gravel and stones as criteria to distinguish Precambrian from Pliocene materials. Precambrian soils have clayey textures (> sandy clay loam), reddish colours (< 7.5YR), and frequently gravel and/or stones. The 'brown' soils of the Berbice formation in general have textures of sandy loam to sandy clay loam and less that 5% silt throughout. The bulk of the sand fraction is between 0.3 and 0.5 mm.

The particle size distribution of the sand fractions of the white and brown sands shows similar characteristics (see figures 7 to 12 in section 4.4) pointing also to a common origin. In addition, the podzolisation process, which is the final soil forming process leading to the white sands, is shown by the occurrence of a spodic B-horizon. This horizon is characterized by dark coloured illuviated organic material with aluminium and in the survey area with little or no iron. This spodic horizon was encountered occasionally on excessively drained sites in the northern part of the survey area at the transition to the 'brown' soils. More often it is present in poorly drained sites at valley heads or in the southern part of the area where the deposits of the Berbice formation are less thick. So the white sands are considered giant podzols with an impressive pedogenetic history whereby prolonged dissociation of weatherable minerals and translocation of weathering products took place (Driessen and Dudal, 1991). The spodic horizons in the white sand soils are either very deep or not present at all.

The progressive weathering of the clay minerals and leaching of the silica and bases in the Berbice formation explains the differences in clay content in the brown sands which may occur within horizontal distances of only one hundred metres. The first process could have been a ferralization process combined with translocation of clay from the surface to the subsoil. The clay illuviation could have occurred in periods that the soil was still less weathered and soil pH was somewhat higher than at present. This process could have been accompanied by ferrolysis, an oxidation-reduction sequence leading to destruction of clay minerals. In wetter climates, such as occur at present, advanced hydrolysis leads to a relative build up of Fe and Al. With an increasing production of soluble humic (fulvic acids) substances, cheluviation (podzolization) processes took place whereby complexes are formed with Al^{3+} and Fe^{3+}. The chelates, when not fully saturated with metal ions, may move long distances with the percolation water through the soil and the discharging water may reach the creeks and rivers where it is responsible for the typical black colours. In this way the white sands may have been formed.

All loamy and clayey soils of the sedimentary plains show an increase in clay content with depth. This points to clay movement from the topsoil downwards (clay eluviation). Crook and Mulders (1971) found no clay cutans in the subsoil and therefore postulate that the clay eluviation process is related to past, possibly dryer climates. More research in the Guyana area is needed to arrive at conclusions on past and present soil formation processes.

A repetitive pattern of soil types in the sedimentary plains is as follows:

- white sands (Tiwiwid sands), having an extremely sharp boundary with the brown sands;
- brown sands (Tabela sands with sand to loamy sand subsoils);
- brown sandy loams to sandy clay loams (Kasarama loamy sands with sandy loam to sandy clay loam subsoils);
- brown sandy clays (Ebini sandy loams with sandy clay subsoils).

The Guyana soil series (names given in brackets) are based on these differences in textural classes (see also section 4.6). The scale of our survey did not permit us to separate mapping units based on these classes, except for the white sands and in some cases more extended surfaces of the Tabela sands.

The white sands

The white sands (mapping unit Ps1, covering 12.8% of the survey area) are excessively drained, very deep soils which consist for almost 100% of quartz sand. They are mainly located on the nearly flat interfluves but locally also on the slopes. These soils are acid and have extremely low levels of plant nutrients. Also the soil moisture storage capacity is very low.

Mapping units Ps2 (covering 3.6% of the area) and Ps3 (covering 0.3%) are the areas with the less well drained sandy soils with a hardpan (spodic B) cemented by organic matter (with aluminium). Locally these soils are known as Ituni sands and we call them Podzols. They occur throughout the sedimentary plains in valley heads and on lower slopes but are in many cases too small in extent to be mapped. Larger areas of the mapping units Ps2, occupying (nearly) flat terrain, are present in the southern part of the survey area. The soils of mapping unit Ps2, are very deep, imperfectly drained sands with a strongly cemented sand layer at a depth between 40 and 110 cm. The soils of mapping unit Ps3 are similar but poorly drained and therefore have peat topsoils of 5 to 30 cm thick. The more extensive occurrence of the Podsols in the southern part of the survey area is likely due to a thinner cover with Berbice sediments. These soils are chemically very poor and have stagnating water in the soil profile which, in times and places, reaches the surface.

In places the spodic B horizon is situated below a depth of 125 cm which leads to better drainage conditions. These soils get properties of mapping unit Ps1. In those area in the south where the depth of the spodic B is variable, a complex of mapping unit Ps1+2 occurs. This complex unit covers 0.7% of the survey area.

The brown sands and loams

The white sands are generally bordered by brown sand soils (Tabela sands), sometimes forming a strip of only 50 to 100 m after which more loamy soils are encountered. Only few mapping units (Ps5) could be separated which were sufficiently large to map them. Mapping unit Ps5 covers 0.2% of the survey area and is found on the nearly flat to undulating interfluves and upper slopes. The soils are somewhat excessively drained, very deep and have sand to loamy sand textures and yellowish brown to strong brown colours. These soils are chemically very poor and have low available soil moisture.

Bordering the white sands and the brown sands, more loamier soils are present. In many cases the Tabela, Kasarama and Ebini soil series could not be separated from each other on the map. Most of these soils occur on the slopes of the dissected sedimentary plains. Although no clear relationship between soil type and position on the slope could be defined, a general rule of thump is that more heavier textured soils occur on the more dissected areas and thus on steeper slopes.

Mapping units Ps4, covering 1.4% of the area, occur mainly in the eastern part of the area. They are covering flat to gently undulating broad interfluves. Mapping units Ps6, covering 4.9% of the area, occur in the central and southern part of the survey area. They are located on undulating interfluves and slopes. The soils of Ps4 and Ps6 are mainly of the Kasarama type but Tabela types (bordering white sands) are included as well as some Ebini types towards the steeper slopes. The soils of both mapping units are very deep, well drained, sandy loams to sandy clay loams with yellowish brown to strong brown colours. Topsoils are without exception lighter textured. The soils are chemically poor and have moderate available water holding capacities.

Mapping unit Ps5+6 occurs in the central northern part of the survey area and covers 1%. It covers interfluves and slopes with an undulating relief. Soils are of the Tabela and Kasarama type which could not be separated on the scale of the survey.

Mapping unit Ps7 is with 21.3% of the survey area the largest unit in the sedimentary plains. This unit covers extensive areas in the south and a small part in the northwest. It occupies wide interfluves and upper to lower slopes with an undulating relief. The soils are very deep, well drained with sandy loams to clay textures in the subsoils and lighter textured topsoils. Subsoil colours are yellowish brown to strong brown. Most soils are of the Ebini type and a smaller part is of the Kasarama type. The soils are chemically poor and have moderate amounts of available soil moisture capacities.

Mapping unit Ps8, covering 10.3% of the area, occurs widely in the northern part of the survey area on the more intensively dissected areas. It has similar soils as mapping unit Ps7.

Mapping unit Ps9, covering 4.1% of the survey area, occurs in the eastern and northern parts of the survey area. They cover steeply dissected parts of the survey area. The dominant soils, present on the interfluves and (mainly) upper slopes, are very deep, well drained with sandy loams to clay textures in the subsoils and lighter textured topsoils. Subsoils colours are yellowish brown to strong brown. Most soils are of the Ebini type and a smaller part is of the Kasarama type. A significant but minor portion, covering middle to lower slopes, is occupied by very deep, moderately well drained sandy clay loam to clay soils with brownish yellow to strong brown colours. These soils have plinthite in the subsoil. The soils are chemically poor and have moderate amounts of available soil moisture capacities.

It is not sure whether all soils have been formed in the sediments of the Berbice Formation. In some soil profiles, especially the ones with plinthite in the deeper subsoil, an unconformity was noticed in texture (jump in clay content), and also in the sand fractions distribution. It is well possible that the deeper part of these particular soils has been formed in weathering products of the underlying Precambrian rocks. Profile number 11 is an example of such a soil.

The soils of the hills

Although the soils on the hills have clayey textures and gravelly and/or stony characteristics, a separation was made in map units based on the relative height of the hills and the dominating parent materials. Within the hills, flatter parts with shallow, lateritic soils over massive laterite occur but could not be separated on the map.

High hills are dominating the landscape in the north east and central part of the survey area. Mapping unit H1 covers 7.8% of the area. Soils vary in depth from 50 to over 120 cm, are gravelly (commonly laterite) and locally stony, brown to red, clay loams to clays. Soils have low nutrient reserves although locally the vegetation might profit from weathering rocks.

Mapping unit H3 covers 7.4% of the survey area. The soils are heavily influenced by ironstone (laterite) which occurs as gravel in the soil and locally as massive rock below it. Soil depth varies from less than 50 cm where massive laterite occurs, to over 120 cm. Textures are clayey and subsoil colours brown to red.

Low hills are scattered throughout the survey area. Mapping units H2 cover 2.1% of the survey area and have moderately deep to very deep soils which have high amounts of ironstone gravel. Soil textures are clays with brown colours. Mapping units H4 cover 1.2% of the survey area. The soils are mostly shallow, gravelly and/or stony clays, overlying ironstone, but deep soils occur as well.

The soils of the footslopes

Dissected footslopes of hills, occur in the south (mapping unit F1 covering 0.8% of the survey area), and in the north, (mapping unit F2 covering 1.1% of the survey area). The footslope soils are very deep, well drained, brown to yellowish red, clay loams to clays which are gravelly and in places stony.

The soils of the erosional plains

Mapping unit Pe1, occupying 0.85% of the area, is a rolling, dissected plain at the foot of some low hills in the central south. Soils are believed to be very deep, gravelly clays.

Mapping units Pe2, Pe3 and Pe4, occurring at the foot of the hills are heavily influenced by ironstone and are considered remnants of former ironstone plateaus. Locally flat to gently sloping parts are still present (units Pe2, covering 1% of the area) but in many cases these could not be separated from the dissected parts (unit Pe3, covering 3.9%). In mapping unit Pe4 (covering 1.4%), hardly any flat plateau rests are present.
Soils of mapping unit Pe2 are shallow, very gravelly, sandy clay loams to clays, lying over hard laterite. Soils of unit Pe3 are shallow to very deep, dark brown to yellowish red, very gravelly sandy clay loams to clays, often overlying ironstone. The soils of unit Pe4 are similar of those of unit Pe3, but generally deeper (from 50 to over 120 cm).

Mapping unit Pe5, covering 3.3% of the area, occurs at the southern side of the Akaiwanna Mts. It is believed to have been influenced by ironstone and therefore the soils are gravelly and not everywhere very deep. The soils are deep to very deep, well drained with brown colours and sandy loam to sandy clay textures.

The soils of the alluvial plains and valley bottoms

The alluvial plains of the bigger rivers and the valley bottoms form (nearly) flat, low lying parts of the area. Most valley bottoms of the creeks and other tributaries are too narrow to be mapped at the scale of the survey. The larger tributaries have mixed alluvial soils (mapping unit A1, covering 2.8% of the survey area) which are very deep, well to somewhat imperfectly drained, loams and clays with often more sandier, deeper subsoils. Some larger alluvial flats of the Essequibo river in the south have a variety of alluvial soils that are likely poorly drained and have textures from sand to clay. Locally also peat soils may occur (mapping unit A3, covering 1.9% of the survey area). Mapping unit A2, covering 1.6% of the survey area, occurs mainly along the Demerara river and along some of its major tributaries. Its soils are very poorly drained, peat soils overlying sand or loam.

4.3 Soil chemical properties

Chemical data for each of the representative pits are presented in Annex B. In addition a summary is given in table 3, in which the data for each profile are aggregated for three standard average profile sections: topsoils (0-20cm), subsurface horizons (20-50cm), and deeper subsoils (50-100cm). This aggregation is to facilitate comparison among the various profiles.

On average, as is generally the case with deeply weathered soils under humid tropical conditions, soils are strongly acid, with remarkably low levels of nutrient reserves, very low cation exchange capacities and very low base saturations.

With respect to chemical properties, there is some differentiation among the map units within this overall very low chemical fertility class. This is mainly linked to soil texture which, in turn is related to parent material.

Cation exchange capacity

As to the levels of cation exchange capacity, a clear separation can be made between soils, developed on Precambrian and Mesozoic rocks on the one hand (H, F, and Pe units), and those developed on the Tertiary/Quaternary sediments of the Berbice Formation (Ps-units) on the other hand. The soils of the H, F and Pe units have average CEC values of 5-10 $cmol^+/kg_{soil}$ on average in topsoils, and 2-5 in subsurface and deeper horizons. In the soils of the Ps-units, values higher than 5 $cmol^+/kg_{soil}$ are scarce, and CEC levels in the subsoils are frequently lower than 2, occasionally less than 1 $cmol^+/kg_{soil}$. This difference is directly related to the clay content of the soils, rather than to a difference in clay type or organic matter content. Highest CEC levels are found in the soils of the river plains (A units) where CEC levels of the topsoils are 8-12 and in the subsoils around 5 $cmol^+/kg_{soil}$. The higher CEC levels in the soils of the alluvial plains are related to both higher clay and organic matter levels.

The CEC-clay figures of the soils throughout the area are in the range of 1-8 $cmol^+/kg_{clay}$. This points to a dominance of low activity clays such as kaolinite and gibbsite. This is supported by the mineralogical analysis whereby in most soils clay minerals are dominated by kaolinite.

Table 3 Soil analytical data summarized

Map U-nit	Profile Nr.[7]	Depth [1]	Tex-ture [2]	pH-H2O	CEC soil [3]	CEC clay [4]	B. Sat % [5]	Al. Sat % [6]	Org.C %	C/N	P-Bray ppm
H1	38	TS	SC	5.4	6.5	0	25	0	2.3	10	0.7
		SSH	SiC	5.5	6.0	12.9	10	-	0.2	5	0.0
		DSS	SiCL	5.2	6.7	18.9	3	74	0.2	-	0.0
H2	17	TS	CL	4.2	10.7	5.3	1	71	2.9	13	1.2
		SSH	vGrC	4.3	7.2	3.0	0	84	1.9	14	0.8
		DSS	GrC	4.3	4.5	3.9	0	54	0.8	10	0.1
	24	TS	GrSCL	3.7	6.2	0	11	50	2.4	24	0.4
		SSH	vGrSC	4.0	1.4	0	21	52	1.6	11	0.6
		DSS	C	4.6	2.1	0	10	28	0.7	12	0.3
	36	TS	SL-SCL	4.1	8.9	1.1	9	100	2.7	15	2.9
		SSH	vGrSCL	4.8	4.7	1.5	4	100	1.4	16	0.7
		DSS	sGrSC	4.9	2.1	1.7	14	100	0.5	12	0.7
	37	TS	SCL	4.2	8.6	6.3	6	76	2.2	13	3.1
		SSH	GrSCL	4.7	4.7	2.4	9	58	1.3	12	0.7
		DSS	GrC	4.8	4.0	3.7	15	43	0.7	11	0.8
F1	21	TS	s-vGrC	4.5	7.2	3.6	10	67	1.8	9	1.4
		SSH	GrC	4.6	3.8	3.2	13	61	0.9	9	0.3
		DSS	sGrC	4.8	3.0	2.1	10	50	0.5	7	0.1
	22	TS	GrSCL	4.1	8.9	0	13	50	3.0	12	0.7
		SSH	GrC	4.5	4.1	2.5	10	59	0.9	8	0.5
		DSS	vGrC	4.5	2.9	1.1	10	70	0.7	10	0.2
Pe3	1	TS	vGrLS	4.5	12.8	0	5	58	5.0	17	2.1
		SSH	vGrLS	5.0	5.5	2.2	0	71	1.2	11	0.3
	33	TS	vGrSCL	4.4	6.5	0	2	100	3.0	15	7.4
		SSH	vGrSCL	5.1	4.3	0	7	67	1.6	13	0.7
	34	TS	vGrSC	4.6	10.5	0	14	80	3.8	15	1.5
		SSH	vGrC	5.2	3.8	0.4	16	33	1.2	12	0.7
		DSS	GrC	5.2	2.5	0.7	8	0	0.7	11	0.8
Pe4	14	TS	GrStC	4.3	7.2	0	3	77	2.7	13	2.1
		SSH	C	4.5	5.3	5.8	0	93	0.6	14	0.7
		DSS	C	4.4	24.6	38.7	0	94	0.3	-	0.5
Ps1	8	TS	S	4.2	2.2	-	7	0	1.0	16	3.2
		SSH	S	5.2	1.7	-	0	0	0.1	9	0.2
		DSS	S	5.6	0.0	-	0	0	-	-	0.1
	12	TS	S	4.4	1.7	-	0	0	0.4	20	0.7
		SSH	S	4.6	1.7	-	0	0	0.2	-	0.5
		DSS	S	5.1	1.7	-	0	0	0.1	-	0.3

Table continues next page

Table 3 cont.

Ps1	23	TS	S	4.1	7.2	-	6	0	2.2	22	0.5
		SSH	S	5.0	0.3	-	-	0	0.1	-	0.3
		DSS	S	5.9	0.2	-	-	-	-	-	0.2
	(5)	TS	S	4.2	5.3	-	6	18	1.8	16	5.2
		SSH	S	4.3	1.7	-	0	0	0.4	13	0.5
		DSS	S	4.2	1.7	-	0	0	tr	-	0.8
Ps2	25	TS	S	4.4	1.6	-	2	0	0.5	20	0.5
		SSH	S	5.6	0.7	-	29	-	tr	-	0.3
		DSS	LS	3.9	17.4	-	1	84	3.3	30	2.9
Ps5	7	TS	LS	4.5	2.9	-	2	37	0.8	12	1.1
		SSH	LS	4.7	3.5	-	0	45	0.6	13	0.8
		DSS	LS	4.8	1.8	5.3	0	50	0.4	10	0.4
Ps6	30	TS	S	4.1	4.5	-	17	25	2.2	18	1.3
		SSH	SL	4.8	1.1	0	27	45	0.4	13	0.7
		DSS	SCL	5.0	0.6	0.5	33	25	0.2	10	0.0
	31	TS	S	4.2	3.2	-	40	2	1.4	17	0.6
		SSH	S-LS	4.1	3.3	-	9	55	0.7	11	0.7
		DSS	SL	4.8	2.7	6.3	22	41	0.5	16	0.7
	32	TS	S-SCL	4.4	4.1	1.5	7	36	1.3	15	4.8
		SSH	SCL	4.7	2.4	3.7	21	47	0.5	12	0.7
		DSS	SCL	4.7	2.3	6.6	17	42	0.2	10	0.8
	35	TS	S-SL	4.0	4.3	-	6	53	1.4	13	2.8
		SSH	SCL	4.5	1.8	1	39	37	0.6	11	0.7
		DSS	SCL	4.8	1.8	4.8	2	63	0.2	-	0.7
PS7	26	TS	S-SL	4.2	6.6	-	8	41	2.5	14	1.2
		SSH	SCL	4.4	2.1	2.3	8	51	0.6	11	0.7
		DSS	SCL	4.6	1.2	1.6	17	20	0.2	10	0.2
	27	TS	SCL	4.3	4.1	0	32	28	1.5	14	0.5
		SSH	SC	4.6	1.9	1	11	36	0.6	10	0.0
		DSS	SC	4.6	2.5	3.0	8	17	0.4	12	0.0
	28	TS	S	4.6	2.3	-	11	23	0.7	12	0.5
		SSH	LS	4.7	1.4	-	29	20	0.7	18	0.3
		DSS	LS	4.8	0.9	-	22	0	0.3	13	0.0
Ps8	2	TS	LS-SL	4.4	5.3	-	2	74	1.4	15	3.2
		SSH	SCL	4.5	3.5	7.8	0	82	0.6	15	0.2
		DSS	SCL	4.6	3.5	3.4	3	75	0.4	12	0.0
	4	TS	SL-SCL	4.5	5.7	-	0	83	1.4	14	2.3
		SSH	SCL	4.7	5.3	7.8	0	89	1.0	14	0.0
		DSS	SCL	4.7	3.5	5.3	0	88	0.6	15	0.0

Table continues on next page.

Table 3 cont.

Ps8	(5)	TS	S	4.2	5.3	-	6	18	1.8	16	5.2
		SSH	S	4.3	1.7	-	0	0	0.4	13	0.5
		DSS	S	4.2	1.7	-	0	0	tr	-	0.8
	6	TS	LS-SL	4.5	2.9	-	0	65	0.6	11	1.9
		SSH	SL-SCL	4.6	1.8	7.2	3	27	0.1	8	0.3
		DSS	C	4.8	3.5	7.1	0	50	0.2	-	0.1
	(7)	TS	LS	4.5	2.9	-	2	37	0.8	12	1.1
		SSH	LS	4.7	3.5	-	0	45	0.6	13	0.8
		DSS	LS	4.8	1.8	5.3	0	50	0.4	10	0.4
	15	TS	S	4.4	5.3	-	2	54	1.3	19	2.2
		SSH	LS	4.5	3.5	8.2	0	75	0.8	26	1.0
		DSS	SL	4.6	1.8	6.2	0	50	0.3	15	0.9
Ps9	10	TS	S-LS	4.4	3.5	-	3	43	1.1	15	1.1
		SSH	SL	4.6	1.8	4.3	2	40	0.3	11	0.4
		DSS	SL	4.6	1.7	5.8	0	50	0.2	10	0.2
	11	TS	SL-SCL	4.5	3.5	0	0	58	1.3	13	1.8
		SSH	SCL	4.8	1.8	7.9	0	55	0.5	11	0.5
		DSS	SCL	4.8	3.5	8.6	0	55	0.2	10	0.1
A1	13	TS	C	4.6	11.9	0	3	71	3.9	10	0.9
		SSH	C	4.6	5.4	0.7	0	78	1.6	11	0.3
		DSS	C	4.7	5.4	3.5	0	100	0.9	11	0.2
	16	TS	SiCL	4.3	8.1	0	1	73	2.6	12	3.4
		SSH	SiCL	4.2	7.1	5.2	0	78	1.7	12	2.1
		DSS	C	4.3	5.4	7.0	0	88	0.3	4	0.3
	29	TS	CL	5.4	11.8	0	69	3	4.1	13	1.7
		SSH	CL-C	5.4	6.3	8.1	39	10	1.0	9	0.4
		DSS	CL	5.4	4.8	7.6	46	17	0.6	10	0.0

1) TS: Topsoil, appr. 0-20 cm; SSH: sub-surface horizon, appr. 20-50 cm; DSS: deeper subsoil, appr. 50-100 cm; figures are weighted averages by approximation

2) C: clay; CL: clay loam; SC: sandy clay; SCL: sandy clay loam; SiC: silty clay; SiCL: silty clay loam; SL: sandy loam; LS: loamy sand; S: sand; Gr-: gravelly; vGr-: very gravelly; sGr-: slightly gravelly; St-: stony

3) in mol^+/kg; not calculated for S and LS; a CEC clay of 0 is likely caused by a too high estimate of contribution to the CEC by the O.C. (see below)

4) in mol^+/kg, obtained by reducing the CEC-soil with 3 mol^+/kg for each % organic C, and multiplying the remaining by 100/%clay $\{CEC_{clay} = [CEC_{soil} - (3x\%C_{org})] \times 100/\%clay\}$.

5) Base saturation: sum of bases as percentage of CEC_{NH4OAc}, measured at pH 7.

6) Aluminium saturation: Al as percentage of effective CEC, ie. sum of bases plus H and Al

7) Number between brackets (#) indicates that the profile is not typical for the mapping unit.

pH and base saturation

Throughout the area, pH-H2O values are on average between 4.5 and 5 (strongly acid), whereas the topsoil pH is in all cases considerably lower, i.e. 4 - 4.5. These lower topsoil values could well be related to the presence of organic acids, lowering the pH. Values, higher than 5 are occasionally met in 'young' soils of steep hilly areas on Precambrian rocks (western Akaiwanna), and in some alluvial soils.

Base saturation is extremely low throughout the area: about half of the data show values of less than 5%, while the majority of the remaining part indicates less than 20%. Most of the light textured soils of the sedimentary plains (developed on the Berbice Formation) are among the poorest category. Somewhat higher values are found in the soils of mapping units Ps6 and Ps7, where the base saturations reach levels of 20-50%. Levels of base saturation among the soils of mapping units H, F and Pe, tend to values of 5-20%.

Aluminium saturation

Base saturation and aluminium saturation are 'normally' to some extent complementary; (Compare for example Table 3, Map Unit A1: profiles 16 and 29: the lower the base saturation, the higher Al saturation, and vice versa). The white sands of the Berbice formation, however, show a contrasting situation: these soils have very low percentages aluminium saturation (<20%, mostly 0%) in combination with a very low base saturation (<5%). This is not so strange as there are hardly any sources for the Al: clay minerals lack (almost) entirely. Al toxicity is thus not to be expected in the white sands.

The sandy clay loams and sandy clays of the Berbice formation show Al saturation levels of more than 30%, and up to 100%. The Aluminium saturation in soils, developed on consolidated rock (H, F and Pe units), are in general between 50 and 100%. These high Al levels reach toxic levels for most agricultural crops. Some crops, such as tea, rubber, cassava, pineapple and some tropical grasses and legumes, can tolerate high exchangeable Al percentages. Not much is known on the tolerance levels of tropical forest trees for low pH or high Al levels, although because of their mere existence, most trees must be fairly tolerant.

Organic Carbon, C/N-ratio, and available P

As is normally the case with excessively drained sandy soils, the dark A-horizon, is relatively thin and contains on average little organic carbon. Average organic carbon levels for the top 20 cm of the soils in the sedimentary plains are frequently less than 1%: mostly between 1 and 2%. There is no systematic difference observed between the well drained soils with higher subsoil clay contents and soils with sand subsoils. This may well be related to the fact that all topsoils in the sedimentary plains are sandy and that turnover rates of the organic matter are high.

In contrast, levels of organic carbon in the surface horizons of the well drained soils of the mapping units H, F and Pe (developed on Precambrian and Mesozoic rocks) are always above 2% reaching levels of 4 to 5%. The same counts for the topsoils in the alluvial deposits. All of these soils have loamy to clayey topsoils, which is favourable for higher organic carbon levels and, moreover, the alluvial soils are less well drained which slows down the decomposition rate.

Levels of nitrogen are low throughout the area (the C/N-ratios on average are between 10 and 16), and in particular on the sandy topsoils of the Berbice formation (C/N-ratios in many places over 16) this low level of N is more outspoken. Also there is a clear trend of C/N-ratios being higher in the topsoils compared to the soil underneath. These higher C/N levels point to less well decomposed organic matter.

The levels of available phosphorus (P-Bray, ppm) are low to extremely low: levels in the topsoils rarely exceed 5 ppm and most commonly are between 1 and 5, whereas in 30% of the cases levels are less than 1 ppm. Subsurface horizons and deeper subsoils show levels, consistently less than 1. It is not possible to differentiate among soil mapping units in relation to these figures.

4.4 Physical properties

Soil moisture characteristics and bulk density

Soil moisture characteristics of 15 profiles have been determined in the laboratory. The soil moisture content was determined at 8 pF values, ranging between pF 0 (soil saturated with water), through pF 2.0 (soil moisture content at field capacity, i.e. the maximum amount of water that remains in the soil under free drained conditions) up to pF 4.2 (soil moisture content at permanent wilting point, after which it is for most plants impossible to use the remaining soil moisture). The plant available soil moisture is held between pF 2.0 and 4.2. The full dataset is given in Annex B.

To determine soil moisture characteristics undisturbed soil samples are needed which are taken in steel rings of 100 cm^3. It is almost impossible to take ring samples from the forest topsoils because of the many roots present. Also undisturbed samples from very gravelly soils can not be taken with the available rings. Therefore, most samples taken originate from soils of the sedimentary plains (Ps units) and of A1 units. The available soil moisture capacity of the soils is presented in table 4, in relation to the soil texture.

The sandy soils with less than 8% clay, have 5 to 8% (on a volume basis), available soil moisture. Loamy and clayey soils in the sedimentary plains, with clay contents of about 10 to 40% have 7 to 10% available soil moisture. These figures indicate a very low available soil moisture capacity for the sandy soils, as expected. It is however surprising that the loamy soils (sandy loams and sandy clay loams) also have low water holding capacities. This must then be explained by the highly weathered nature of the soils whereby hardly any silt is present and the clay minerals are bound together with sesquioxides, forming sand-sized micro-aggregates.

The bulk density figures of the soils in the sedimentary plains are between 1.4 and 1.6 kg/dm^3, which is a common range.

Table 4 Soil moisture characteristics of selected profiles

Unit/ Prof.	depth (cm)	text. class	clay %	b.d. kg/dm^3	pF 2.0	pF 4.2	% av. water
Ps1/2	25	S	2	1.5	8.8	1.2	7.60
5	70	S	1	1.5	6.5	1.1	5.40
Ps1	25	S	1	1.4	7.4	2.6	4.80
12	75	S	1	1.3	4.3	0.9	3.40
Ps1	15	S	2	1.4	8.5	2.0	6.50
23	70	S	2	1.4	4.0	1.0	3.00
Ps5	25	LS	5	1.5	25.7	12.6	13.10
7	75	LS	11	1.4	17.2	10.0	7.20
Ps7	20	S	7	1.4	14.4	6.5	7.90
28	50	LS	12	1.4	17.2	7.0	10.20
Ps8	25	LS	11	1.4	19.5	10.0	9.50
15	75	SL	15	1.4	19.6	10.8	8.80
Ps6	20	SL	20	1.4	30.8	20.0	10.80
32	40	SCL	24	1.5	26.2	17.3	8.90
	90	SCL	26	1.6	23.5	18.4	5.10
Ps7	20	SL	17	1.5	30.2	13.6	16.60
26	50	SCL	24	1.5	26.5	16.2	10.30
	100	SCL	27	1.5	28.8	19.2	9.60
Ps8	25	SCL	30	1.4	32.3	21.3	11.00
4	75	SCL	32	1.5	29.8	22.6	7.20
Ps8	25	SL	17	1.7	23.4	15.5	7.90
6	75	C	47	1.6	36.9	29.7	7.20
Ps8	25	SCL	21	1.6	28.8	18.8	10.00
2	75	SC	36	1.6	28.8	21.8	7.00
Ps7	25	SC	42	1.6	32.6	22.0	10.60
27	50	SC	44	1.5	34.2	25.2	9.00
F1/22	70	VgrC	71	1.2	48.3	34.7	13.60
A1	15	CL	36	1.1	54.7	37.7	17.00
29	35	C	42	1.2	48.1	40.3	7.80
	90	CL	40	1.3	45.0	34.4	10.60
A1	25	C	79	1.1	52.0	44.3	7.70
13	75	C	77	1.2	52.5	45.3	7.20

Particle size distribution

The particle size distributions of profiles 12, 7, 2, 6, 13 and 21 have been graphically presented in figures 7 to 12. The logarithm of the size fraction is given at the x-axis and the cumulative percentage at the y-axis. This type of presentation was also followed by Krook and Mulders (1971) and makes comparison easy. The graphs are arranged in textural order, from light to heavy textured soils. In table 5, short characteristics of the soils are given. Full details of these soils are given in Annex B.

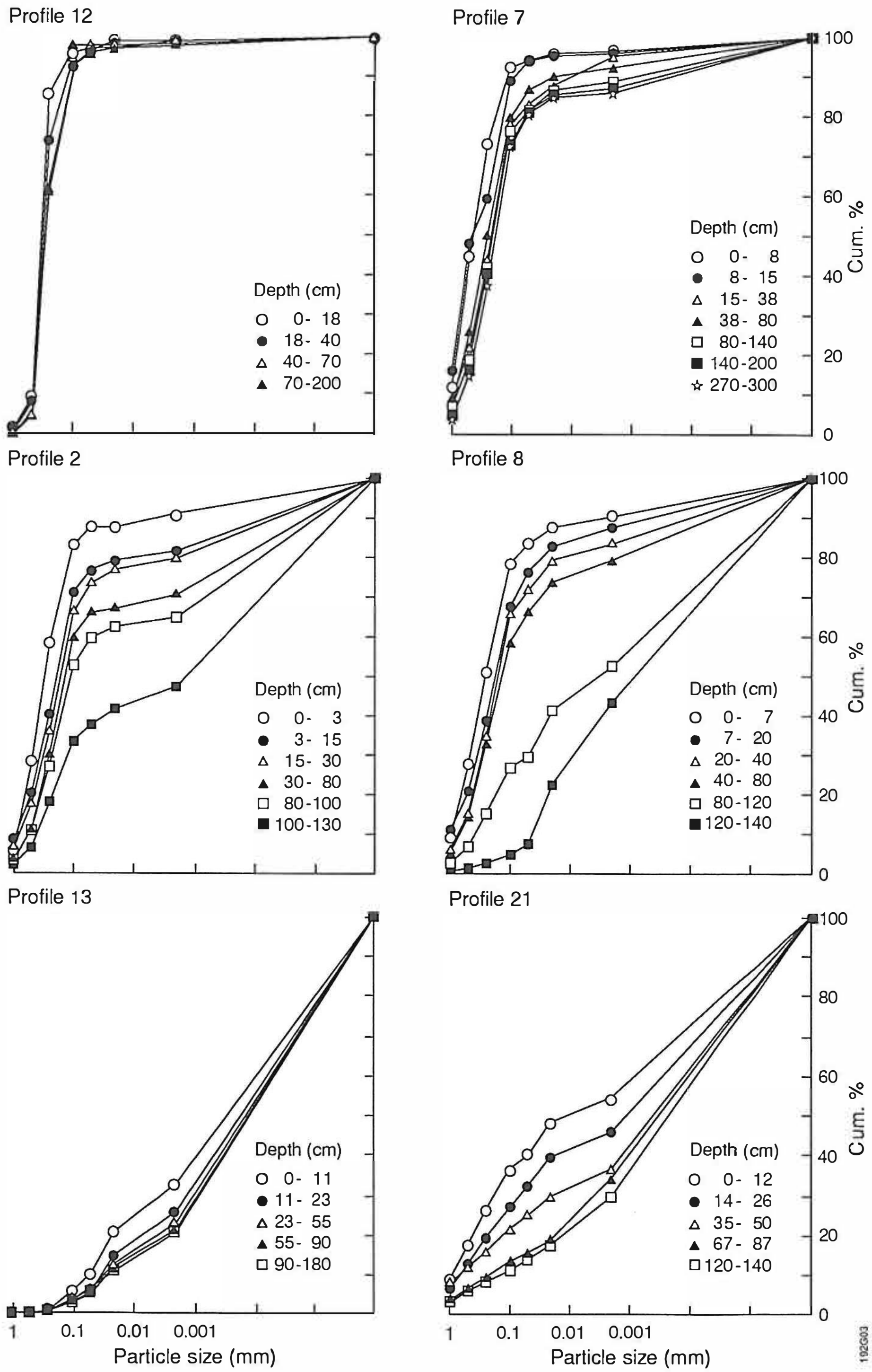
The soils in figures 7, 8 and 9 show particle size distribution curves with their inflection points at similar positions, irrespective of their clay contents. The fine earth has little coarse sand (over 500 micron), a high percentage medium to fine sand (500-100 micron) and little very fine sand and silt. This strongly points to a common origin of all the soils developed in the Berbice formation, as was already suggested in section 4.2. Profile 6, to a depth of 60 cm, fits in the characteristics of soils developed on sediments of the Berbice formation. Below 60 cm, the curves change and notably the silt fraction increases. It could well be that the lower part of this profile is developed in Precambrian rocks.

The texture distribution graphs of profiles 13 (soil developed on riverine alluvial) and 21 (footslope soil developed on dolerite) differ clearly from those of soils of the Berbice formation.

Table 5 Some characteristics of selected soils of which soil textural composition is graphically shown

Profile #	Soil name	Texture range topsoil-subsoil
12	Tiwiwid sand	sand throughout
7	Tabela loamy sand	sand - loamy sand - sandy loam
2	Kasarama sandy loam	loamy sand - sandy loam - sandy clay loam - sandy clay
6	Kasarama/Ebini (with plinthite)	loamy sand - sandy loam - sandy clay loam - clay
13	Mixed alluvium	clay throughout
21	Gravelly footslope soil	clay throughout

Also Krook and Mulders (1971) report that the cumulative curves of the fine earth fractions plotted with a semi-logarithmic horizontal axis (particle size), all show a similar curve in the coarse fractions and curve around 100 micron. The occurrence of clay and medium to coarse sand with a near absence of silt, fine sand and little coarse sand is characteristic of the Zanderij (Berbice) formation.



Figures 7-12 Particle size distribution of profiles 12, 7, 2, 6, 13 and 21

4.5 Mineralogical properties

Clay mineralogy

Table 6 Clay mineralogical data (X-ray diffraction)

Unit	Pro-file	Depth	Text-ure	Kaol-inite	Mica	Chlor-ite	Mixed layer	Quartz	Gibbs-ite	Goeth-ite
H2	37	108-125	GrC	+++	tr	tr			++/+++	++
Ps1 (Podzol)	5	33-9	S	+			0-tr	++		
		126-136	S	++			0-tr	+		
Pe3	1	25-55	VgrS CL	tr				+-++	tr	+-++
Ps5	7	15-38	LS	+++		tr-+		tr	tr-+	tr
		80-140	LS	+++		tr-+		tr	+	tr
		270-300	SL	+++		0-tr		0-tr	tr-+	tr
Ps8	6	20-40	SL	+++			tr	tr	tr-+	
		60-120	C	+++			0-tr		+	
		120-140	C	+++					+	
Ps9	10	19-34	SL	+++		0-tr			tr-+	+
		70-120	SL	+++		tr			tr-+	+
		280-300	SL	+++		0-tr			tr-+	+
	11	7-22	SCL	+++		tr			tr	tr
		45-105	SCL	+++		tr			tr	tr
		122-150	C	+++	0-tr	0-tr			0-tr	tr

The mineralogy of the clay fraction was determined for selected profiles. Throughout the survey area, kaolinite is the dominating clay mineral. In a profile of unit H2 (low hills in the south), gibbsite co-dominates next to kaolinite. Goethite is clearly present in a profile of unit H2 and in a profile of unit Pe3.

Both kaolinite and gibbsite point to strongly weathered soils. Kaolinite forms in poor parent material (felsic rocks) under freely drained conditions. These characterize the Berbice sediments. Gibbsite forms in richer parent materials (mafic rocks) under free drainage conditions. Both units H and Pe are formed on basic, mainly igneous rocks. Moreover, these units are influenced by ironstone formation which could explain the clear presence of goethite (a yellow coloured, hydrated iron oxide) in the clay fraction.

Elemental composition of total soil

The elemental composition of the soil was determined for profiles 1, 36, 37, 38, all developed on dolerite and of profiles 5, 6, 7, 10, all developed on sediments of the Berbice formation.

Bases, such as magnesium, calcium, potassium and sodium are virtually absent in all profiles, regardless their origin. This indicates an absence of weatherable primary minerals and points to strongly weathered soils. The soils developed on dolerite have higher sesquioxides levels than the soils of the Berbice formation, which is related to higher clay contents. It is noteworthy that the sesquioxide levels show a relative increase with depth, regardless of the clay content. This could point to podzolization (cheluvation) processes taking place in the soil. Further research is however needed to confirm this.

The soils of the Berbice formation all have very high levels of silica, often over 90%. The sesquioxide levels are directly related to the clay content. The silica is present in the sand fraction whereby it is remarkable that the fine sand and silt fractions are very low. Also quartz is virtually absent in the clay fraction. Therefore, next to strong weathering and leaching processes whereby virtually all bases disappeared, also silica has been leached.

4.6 Soil classification

The soils of the area have been classified according to the FAO-Unesco legend of the soil map of the world (ISRIC, 1989). In Guyana, soils are also classified according to a soil series concept. Definitions of soil series are based on drainage condition, colour and soil texture, both of the topsoil and of the subsoil (topsoil texture is given in the series name). As no definitions of series for the gravelly and stony soils could be obtained, only the soils of the alluvial plains and of the sedimentary plains have been classified according to the Guyanese system. In table 7, a correlation between mapping units, Guyana soil series and FAO soil classification names is given.

Soils classified according to the FAO system

Ferralsols

Most soils in the area classify as Ferralsols. The Ferralsols are deeply weathered soils, low in weatherable minerals with a CEC in the (ferralic) B-horizon of less than 16 cmol+/kg clay. Their clay content is over 8%. The haplic Ferralsols are neither very red nor yellow. The xanthic Ferralsols have a yellow B-horizon, caused by the presence of goethite. All Ferralsols show an increase in clay content with depth. Therefore, they show also characteristics of Acrisols (soils with an argic B-horizon, with a low base saturation and a CEC-clay of less that 24 cmol+/kg). To express the change in clay content with depth, next to the ferralic characteristics, the soils were named acri-haplic or acri-xanthic Ferralsols.

Soils of the hills, footslopes and erosional plains, which classify as Ferralsols, have gravel and stones in the profile or at the soil surface in varying amounts. This is expressed in the names of the phases. A skeletic phase refers to soils which consist of 40% or more of coarse fragments of ironstone of other hard materials. Soils with a rudic phase have such amounts of gravel, stones, boulders or rock outcrops in the surface layer or at the surface that the use of mechanized agricultural equipment (if the soil were to be used for agriculture) is impracticable.

Cambisols

The Cambisols are characterized by a cambic B-horizon. This horizon shows signs of weathering and contains weatherable minerals. A ferralic Cambisol has a CEC clay of the B-horizon lower than 24 cmol+/kg. The ferralic Cambisols in the high hills are gravelly and stony and therefore have a rudic phase. The Cambisols in the alluvial plains show oxidation and reduction mottles because of temporary water stagnation within 1 m depth and classify as gleyic Cambisols.

Leptosols

Leptosols are soils which are less than 30 cm deep over hard rock or ironstone or have over 80% of coarse material (gravel, stones) in the soil. The very shallow Leptosols which are less than 10 cm deep, are the lithic Leptosols. The Leptosols that have a base saturation in the B-horizon of less that 50% are dystric Leptosols. The dystric Leptosols over ironstone (if occurring within one metre of the surface) have a petroferric phase.

Arenosols

Arenosols are the coarse textured (coarser than sandy loam) sandy soils. Albic Arenosols are characterized by an albic E horizon. The albic E horizon has grey or whitish colours as clay and oxides have been removed from it to such an extent that the colours of the sand grains (often quartz) are determining the soil colour. The ferrali-luvic Arenosols show both an increase in clay content with depth (characteristic for the luvic Arenosols) as well as a low (<24 cmol+/kg) CEC clay.

Podzols

Podzols are characterized by a spodic B horizon. A spodic B is a subsurface horizon enriched with organic matter and aluminium, with or without iron. The spodic B found in the survey area is generally cemented by organic matter and aluminium. As it generally lacks free iron, the soil classifies as a carbic Podzol.

Fluvisols

Fluvisols are soils that show signs of recent accumulation of sediments. They can be stratified or have organic matter levels that decrease irregularly with depths, and are found in the river alluvial plains. Dystric Fluvisols have a base saturation of less that 50%.

Histosols

Histosols are soils that have 40 cm or more organic material (usually peat) within the upper 80 cm from the surface. The poorly drained ones with well decomposed organic material are the terric Histosols.

Gleysols

The Gleysols are soils with gleyic properties within 50 cm of the surface. Gleyic properties are caused by high ground water tables in the soils and reflected by signs of reduction.

Soil series of Guyana

Lama muck

Very poorly drained organic soil developed in depressions. The soil consists of a 20 to 40 cm thick layer of well decomposed black peat (muck) which may be overlain by a thin layer of peat. It is underlain by dark reddish brown peat. The soil is very strongly acid and may be underlain at depths over 90 to 100 cm with grey to light grey clay or sand.

Mixed alluvial land

Very poorly drained interstratified soil occurring on flood plains along banks of stream channels. It is characterized by a thin peaty surface underlain by alternating strata of sands, silts and clays. The soils are still subject to stream overflow and deposition.

Barima Silt Loam

A somewhat poorly to moderately well drained soil that occurs on flats along the main rivers and creeks. Near the banks of streams (levee soils) where drainage is more adequate, the soil has a dark brown to yellowish brown surface horizon and the subsoil and substratum consist of a yellowish brown to strong brown silty clay loam. Further inland where the drainage is somewhat sluggish, the soil is mottled and has lighter colours.

Tiwiwid sand

An excessively drained soil developed in sediments of the Berbice Formation (White Sands). The soil has a very dark grey to dark greyish brown sand topsoil over a light grey to almost white sand to loamy sand subsoil.

Ituni sand

An excessively drained soil developed in sediments of the Berbice Formation (White Sands). It occurs at creek heads or at lower slopes. The soil has a very dark grey to grey, sand to loamy sand topsoil underlain by white, loose sand which in turn overlies a very dark brown to black compacted organic pan horizon occurring at a depth ranging between 90 and 120 cm. This pan lies over white to brown sand to loamy sand.

Tabela sand

An excessively drained soil occurring in similar upland topographic positions as Tiwiwid sand (White Sands). It is characterized by a dark brown to dark greyish brown sand topsoil underlain by a yellowish or reddish-brown loose sand or very friable loamy sand subsoil.

Kasarama loamy sand

A well drained soil developed in sediments of the Berbice Formation. It is characterized by a dark brown to brown sand or loamy sand topsoil overlying a strong brown or yellowish red, very friable sandy clay loam subsoil. The soil, relative to the Tabela sand, has a higher clay content that increases with depth.

Ebini sandy loam

A well drained soil developed in sediments of the Berbice Formation. It has a dark brown to brown sandy loam surface underlain by a strong brown to yellowish red sandy clay to clay subsoil.

Table 7 Classification of the soils of the Mabura-Kurupukari area

Mapping unit	FAO-Unesco soil name	Guyana soil series
H1	ferralic Cambisols, rudic phase	n.a.
H2, F1	acri-haplic Ferralsols, skeletic phase	n.a.
H3, H4	dystric Leptosols, petroferric phase and haplic Ferralsols, skeletic phase	n.a.
F2	acri-haplic Ferralsols, partly rudic or skeletic phase	n.a.
Pe1	acri-haplic Ferralsols, partly skeletic phase	n.a.
Pe2	dystric and lithic Leptosols, petroferric phase	n.a.
Pe3	dystric Leptosols, petroferric phase and acri-haplic Ferralsols, rudic phase	n.a.
Pe4	dystric Leptosols, petroferric phase and acri-haplic Ferralsols, skeletic phase	n.a.
Pe5	acri-haplic and acri-xanthic Ferralsols, partly skeletic phase	n.a.
Ps1	albic Arenosols	Tiwiwid sand
Ps2, Ps3	carbic Podzols	Ituni sand
Ps4, Ps6	acri-haplic and acri-xanthic Ferralsols	mainly Kasarama loamy sand, but also Tabela sand
Ps5	ferrali-luvic Arenosols	Tabela sand
Ps7, Ps8	acri-haplic and acri-xanthic Ferralsols	Kasarama loamy sand and Ebini sandy loam, in places Tabela sand
Ps9	acri-haplic and acri-xanthic Ferralsols	Kasarama loamy sand and Ebini sandy loam
	acri-plinthic Ferralsols	Ebini sandy loam (with plinthite)
A1	gleyic Cambisols and dystric Fluvisols	Barima silt loam (dominant)
A2	terric Histosols	Lama muck and Anira peat
A3	Fluvisols, Gleysols, Cambisols, Histosols	Mixed alluvial land

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ANNEX B Soil profile descriptions and analytical data

Explanatory note for soil profile descriptions

Brief description of analytical procedures used for soil samples from Tropenbos Guyana.

Pretreatment: Sample air-dried, cleaned, crushed (not ground), passed through 2 mm sieve, homogenized. Moisture content determined.

pH (1:2.5): pH-H_2O: 20 g of soil shaken with 50 ml of water, pH read with electrode in upper part of suspension. pH-KCl: likewise but with 1 *M* KCl solution instead of water.

EC (1:2.5): Conductivity in pH-H_2O suspension to test for presence of salts.

Particle-size distribution: 20 g of soil treated with hydrogen peroxide 15% (i.e. overnight in the cold, then on water bath at ca. 80°C). Excess peroxide removed by boiling on hot plate for 1 hr. Washing by repeated decantation until dispersion. Dispersing agent added (20 ml solution of 4% Na-hexametaphosphate and 1% soda) and suspension shaken overnight. Sample then passed through 50 µm sieve. Sand fraction remaining on sieve dried and weighed. Clay and silt determined by pipetting from sedimentation cylinder. Weight fractions calculated on basis of final total sample weight (i.e. oven-dry sample exclusive of organic matter).

Cation exchange capacity (CEC) and exchangeable bases: With ammonium acetate method using automatic extractor. The sample was pre-leached with 1 *M* ammonium acetate pH 7 solution. Exchangeable bases were determined in the leachate by atomic absorption spectrometry (AAS). The sample was subsequently percolated with 1 *M* sodium acetate pH 7, the excess salt removed with 80% ethanol and the adsorbed sodium exchanged by percolation with 1 *M* ammonium acetate pH 7. The sodium in this percolate was determined by AAS and is a measure for the CEC.

Exchangeable acidity: The sample was extracted with a 1 *M* KCl solution and the exchanged acidity (H+Al) titrated with NaOH. Al in the extract was separately determined by AAS.

Organic carbon: With the Walkley-Black procedure. The sample was digested with a mixture of potassium dichromate and sulphuric acid at about 125°C. The residual dichromate was titrated with ferrous sulphate. The result is expressed in % carbon and a correction factor of 1.3 was applied to rectify incomplete combustion.

P-Bray: Phosphate was extracted with a mixture of HCl and NH_4F and determined colorimetrically.

Nitrogen: The Kjeldahl procedure was followed. The sample was digested in sulphuric acid and hydrogen peroxide with selenium as catalyst whereby organic nitrogen is converted to ammonium sulphate. The solution was then made alkaline and ammonia distilled. The evolved ammonia was trapped in boric acid and titrated with standard acid. The procedure determines all soil nitrogen (including adsorbed NH_4^+) except that in nitrates.

X-ray diffraction of the clay: The clay fraction was separated from the fine-earth and deposited in an oriented fashion on porous ceramic plates to be analyzed on an X-ray diffractometer (Philips PW 1820/1710 assembly. Various treatments (glycerol, K-saturation, heating) were applied for identification of the various clay mineral species.

Elemental analysis of total soil (i.e of the fine-earth): The sample was oven-dried at 105 °C, ignited at 900 °C and then fused with lithium tetraborate. The formed bead was analyzed for individual elements with a Philips PW 1404 X-ray fluorescence spectrometer.

Moisture retention characteristics (pF curves): The water content was determined of soil samples that were equilibrated with water at various suction values. For low suction (pF 0 to 2.7) core samples (100 ml) were equilibrated on a silt and kaolin bath respectively, for high suction (up to pF 4.2) disturbed samples were equilibrated in pressure plate extractors). The *bulk density* is calculated from the core sample weight.

(*Full description in:* Van Reeuwijk, L.P. (1993) Procedures for soil analysis. Techn. Pap. No. 9 (4th ed.). Int. Soil Ref. and Info. Centre (ISRIC), Wageningen, the Netherlands.)

Mineralogical composition of clay fraction:
Amounts given are relative quantities. Three (+++) plus means: dominant clay mineral, going down to +: present in small amounts. Trace (tr) indicates very small amounts present only.

For easy reference, profile numbers, mapping unit codes and coordinates are given in the following table.

Table 1 of Annex B Profile numbers, mapping unit symbols and coordinates

Profile number	Mapping unit	Coordinates (X,Y in m)
1	Pe3	312243, 564151
2	Ps8	311650, 576100
3	Ps1	310100, 579875
4	Ps8	310160, 581400
5	Ps1/Ps8	312420, 575615
6	Ps8	312250, 575800
7	Ps5/Ps8	312380, 575650
8	Ps1	312380, 575650
10	Ps9	297662, 588663
11	Ps9	297490, 588641
12	Ps1	299017, 588650
13	A1	318000, 581350
14	Pe4	318390, 581731
15	Ps8	310100, 581400
16	A1	289638, 588293
17	Pe3	314400, 557300
21	F1	325850, 521000
22	F1	326100, 521310
23	Ps1	332985, 523440
24	H2	319024, 518663
25	Ps2	317000, 517200
26	Ps7	318249, 529289
27	Ps7	319593, 529409
28	Ps7	320920, 529471
29	A1	318170, 550200
30	Ps6	318835, 550050
31	Ps6	318840, 549060
32	Ps6	319430, 548100
33	Pe3	317205, 550040
34	Pe3	317560, 550060
35	Ps6	322000, 551000
36	H2	299840, 557490
37	H2	299390, 559000
38	H1	301320, 553700

PROFILE 1

Legend unit:	Pe3
Soil classification:	Dystric Leptosol, petroferric phase
Description:	By John Pulles, 12-05-92
Location:	Near Ekuk creek, UTM coordinates: X=312243, Y=564151
Elevation:	About 300 ft.
Landform and slope:	Flat to rolling, locally dissected erosional plain, slope at site 6%
Parent material:	Ironstone over dolerite
Vegetation:	Forest, stem diameter less than 15 cm (wild Guava?)
Surface stoniness:	Gravelly and stony with blocks of ironstone
Drainage:	Excessively drained
Soil:	Shallow, extremely gravelly sandy clay loam over ironstone.

Depth (cm)	Hor.	Description
0 - 4	Ah1	dark brown (10YR2/2); gravel; many fine and very fine roots; abrupt and smooth transition to
4 - 20	Ah2	very dark greyish brown (10YR3/2); very gravelly (80%) sandy clay loam; 80%, 5-10 mm large, hard, angular, ironstone gravel; common fine roots; gradual and smooth transition to
20 - 30/55	Bw	dark brown to brown (7.5YR4/3); very gravelly (80%) sandy clay loam; 80%, 5-10 mm large, hard, angular, ironstone gravel; few fine and medium roots; over ironstone.

Remark: The difference between field texture and laboratory texture is likely caused by grinding some of the concretions.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	4	4.1	3.0	5.9	11.5	0.78	15	0.14	
2	4	25	4.6	3.9	0.8	2.8	0.16	18	0.09	
3	25	55	5.0	4.3	0.3	1.2	0.11	11	0.04	
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	2.2	1.5	0.1	0.4	0.7	0.3	4.9	29.2	14	
2	0	0	0.0	0.1	1.1	0.9	1.2	7.4	1	
3	0	0	0.0	0.0	0.7	0.5	0.7	5.5	0	
	Sand					**Silt**		**Clay**	**Texture**	**Gravel %**
	1000-2000	*500-l000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		
1	14.6	7.5	13.3	28.1	8.2	5.4	9.9	12.9	SL	81
2	15.3	6.1	18.2	30.6	10.4	3.7	6.7	8.9	LS	84
3	38.4	28.6	10.4	8.3	2.2	1.5	2.0	8.6	LS	84
	Elemental composition of total soil (wt%)									
	SiO_2	*TiO_2*	*Al_2O_3*	*Fe_2O_3*	*MnO*	*MgO*	*CaO*	*Na_2O*	*K_2O*	*P_2O_5*
1	50.73	7.38	2.2	15.3	0.1	0.14	0.02	<0.04	<0.00	0.1
2	68.46	7.72	1.9	16.5	0.1	0.12	<0.01	<0.04	<0.00	0.1
3	48.07	6.02	4.0	34.9	0.1	0.10	<0.01	<0.04	<0.00	0.1
	Elements		**Mineralogical composition of the clay fraction (XRD)**							
	BaO	*L.O.I.*	*Kaolinite*	*Mica Illite*	*Chlor ite*	*Mixed Layer*	*Quartz*	*Gibbs ite*	*Goethite*	
1	<0.03	25.88								
2	<0.03	5.65								
3	<0.03	7.96	tr				+-++	tr	+-++	

PROFILE 2

Legend unit:	Ps8
Soil classification:	Acri-haplic Ferralsol Kasarama sandy loam
Description:	On 12-05-92 by John Pulles
Location:	About 8 km S of Mabura village; UTM: X=311650 Y=576100
Elevation:	About 300 ft
Landform and slope:	Undulating to rolling sedimentary plain; upper slope, 4%
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Mixed forest with Greenheart
Drainage:	Well to moderately well drained
Soil:	Very deep, yellowish brown sandy clay loam with loamy sand to sandy loam topsoil.

Depth (cm)	Hor.	Description
0 - 3	Ah1	very dark greyish brown (10YR3/2); loamy sand; weak fine granular to subangular blocky; very friable, non sticky and non plastic; many fine to medium roots; clear and smooth transition to
3 - 15	Ah2	dark brown (10YR3/3); sandy loam; weak to moderate, fine subangular blocky; very friable, slightly sticky, and slightly plastic; few roots; few pores; gradual and smooth transition to
15 - 30	BA	dark yellowish brown (10YR4/4); sandy clay loam; weak to moderate, fine to medium subangular blocky; friable, slightly sticky and slightly plastic; few pores; diffuse and smooth transition to
30 - 60	Bws1	yellowish brown (10YR5/4); sandy clay loam; weak medium subangular blocky; friable, slightly sticky and slightly plastic; diffuse and smooth transition to
60 - 100	Bws2	yellowish brown (10YR5/4); sandy clay loam; few mottles, reddish brown, medium, faint to distinct, clear; few soft to hard fe-concretions, reddish brown, irregular; weak medium subangular blocky; friable, slightly sticky, and slightly plastic.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	lower	H_2O	KCl	mg/kg	%	%		mS/cm	
1	0	3	4.2	3.7	3.8	1.5	0.09	17	0.08	
2	3	15	4.5	4.0	3.0	1.4	0.08	15	0.05	
3	15	30	4.5	4.2	0.2	0.6	0.04	15	0.02	
4	30	60	4.6	4.2	0.0	0.4	0.03	12	0.03	
5	60	100	4.8	4.2	0.0	0.2			0.02	
6	100	130	5.0	4.2	0.0	0.2			0.02	
	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								%	
1	0	0.3	0.1	0.1	1.1	0.9	1.6	5.3	9	
2	0	0	0.0	0.0	1.4	1.1	1.4	5.3	0	
3	0	0	0.0	0.0	1.1	0.9	1.1	3.5	0	
4	0	0	0.0	0.1	1.1	0.9	1.2	3.5	3	
5	0	0	0.3	0.0	1.0	0.9	1.3	1.8	17	
6	0	0	0.0	0.0	1.1	1.0	1.1	3.7	0	
	Sand					Silt		Clay	Texture	
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		
1	5.8	22.5	30.7	23.9	4.8	0.0	3.3	9.0	LS	
2	8.7	11.9	21.2	29.3	5.5	2.2	2.7	18.2	SL	
3	6.9	11.2	18.7	28.7	7.8	3.2	3.0	20.5	SCL	
4	3.7	8.1	19.4	28.5	6.0	1.2	3.7	29.4	SCL	
5	3.6	7.7	17.2	23.7	7.2	3.0	2.0	35.8	SC	
6	2.4	4.7	11.3	14.8	4.2	4.3	5.4	52.9	C	

Soil moisture retention

depth (cm)\pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
25	33.9	33.7	33.6	28.8	24.6	23.7	19.8	18.8	1.60
75	35.7	35.6	33.2	28.8	26.3	25.2	23.2	21.8	1.60

PROFILE 3

Legend unit:	Ps1
Soil classification:	Albic Arenosol
	Tiwiwid sand
Description:	On 12-05-92 by John Pulles
Location:	About 6 km S of Mabura village; UTM: X=310100 Y=579875
Elevation:	About 300 ft
Landform and slope:	Flat to undulating sedimentary plain; upper slope, 10%
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Wallaba forest
Drainage:	Excessively drained
Soil:	Very deep, light grey sand.

Depth (cm)	Hor.	Description
0 - 6	Ah1	dark brown (7.5YR4/4); sand; loose, single grain; many roots; clear and smooth transition to:
7 - 17	Ah2	very dark greyish brown (10YR3/2); sand; loose single grain; gradual and smooth transition to:
17 - 130	C	light grey (10YR7/1); sand

PROFILE 4

Legend unit:	Ps8
Soil classification:	Acri-haplic Ferralsol Kasarama / Ebini sandy clay loam
Description:	By John Pulles on 19-05-92
Location:	About 5 km S of Mabura village, UTM: X=310160, Y=581400
Elevation:	About 200 ft
Landform and slope:	Rolling sedimentary plaine, slope at site 20% to W., profile on middle slope
Parent material:	Unconsolidated sediments of Berbice fromation
Vegetation:	Mixed forest, logged
Drainage:	Well drained
Soil:	Very deep, yellowish brown and brown sandy clay loam with thin sandy loam topsoil.

Depth (cm)	Hor.	Description
0 - 5	Ah1	dark greyish brown (10YR4/2); sandy loam; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; many fine and medium roots; clear and smooth transition to
5 - 18	Ah2	dark greyish brown (10YR4/2); sandy clay loam; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; common fine to medium roots;
18 - 47	BA	dark brown to brown (10YR4/3); sandy clay loam; weak fine subangular blocky; friable, slightly sticky, slightly plastic; few roots;
47 - 80	Bws1	yellowish brown (10YR5/4); sandy clay loam; weak fine subangular blocky; friable, slightly sticky, slightly plastic; very few roots;
80 - 120	Bws2	brown (7.5YR5/4); sandy clay; weak fine to medium subangular blocky; friable to firm, slightly sticky, plastic;

Notes: 1 cm litter layer and root mat

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	5	4.4	3.8	4.3	1.8	0.14	13	0.06	
2	5	18	4.6	4.1	1.7	1.3	0.09	14	0.04	
3	18	47	4.7	4.2	0.0	1.0	0.07	14	0.03	
4	47	80	4.7	4.3	0.0	0.6	0.04	15	0.02	
5	80	120	4.7	4.2	0.0	0.3	0.03	10	0.02	
	Ca	**Mg**	**Na**	**K**	**H+Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	0.0	0.0	0.0	0.0	1.9	1.6	1.9	7.0	0	
2	0.0	0.0	0.0	0.0	1.7	1.4	1.7	5.3	0	
3	0.0	0.0	0.0	0.0	1.8	1.6	1.8	5.3	0	
4	0.0	0.0	0.0	0.0	1.6	1.4	1.6	3.5	0	
5	0.0	0.0	0.0	0.0	1.5	1.4	1.5	3.5	0	
	Sand					**Silt**		**Clay**	**Texture**	**Gravel**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		%
1	6.6	10.9	18.1	27.8	8.5	4.9	5.6	17.8	SL	1
2	10.4	13.8	16.8	24.4	5.4	4.8	2.0	22.5	SCL	2
3	4.5	8.1	14.7	25.9	8.7	5.7	3.0	29.5	SCL	4
4	6.3	9.8	14.0	24.4	5.7	7.1	1.0	31.8	SCL	4
5	6.6	8.8	11.2	19.8	8.2	4.1	3.2	38.0	SC	3

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
25-30	43.9	42.5	37.2	32.3	31.8	28.8	25.6	21.3	1.4
75-80	36.3	35.4	33.4	29.8	29.7	27.7	25.7	22.6	1.5

PROFILE 5

Legend unit:	Transition Ps1-Ps8 (inclusion)
Soil classification:	Carbic Podzol
Description:	On 10-09-92 by John Pulles and Arie van Kekem
Location:	About 11 km S of Mabura village, UTM: X=312420, Y=575615
Elevation:	About 300 ft
Landform and slope:	Undulating to rolling sedimentary plain; lower slope of 36%
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Mixed forest with Greenheart
Drainage:	Somewhat excessively drained
Soil:	Somewhat excessively drained, greyish brown sand over very dark brown weakly cemented, sand, over hard, non porous, silty clay.

Depth (cm)	Hor.	Description
0 - 15	A	dark reddish brown (5YR3/2); medium sand with few coarse grains; weak coarse granular; very friable, non sticky, non plastic; many fine and very fine, common medium, and few coarse roots; very porous; smooth and clear transition to
15 - 33	AE	brown (10YR5/3); medium sand; weak medium subangular blocky; very friable to loose, non sticky, non plastic; few medium, common fine and very fine roots; many fine pores; gradual and smooth transition to
33 - 90	E1	light brownish grey (10YR6/2); medium sand; single grain; loose, non sticky, non plastic; few coarse roots; diffuse and smooth transition to
90 - 126	E2	greyish brown (10YR5/2); medium sand, with few coarse; single grain; loose, non sticky, non plastic; very few fine roots; gradual and irregular transition to
126 - 136/176	Bh	very dark brown (10YR2/2); medium sand, weakly cemented by humus; very friable to slightly hard with depth, non sticky, non plastic; abrupt and irregular transition to
136/176 -	2C	light brownish grey (10YR6/2), with organic matter in cracks; silty clay; massive, non porous; extremely hard when dry, slightly plastic, non sticky.

Notes: 2 cm litter (2-3 leaves thick); 0.5cm fermentation litter including roots, faecal pellets and worm casts. Water stagnation on clay layer, lateral flow.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	lower	H_2O	KCl	mg/kg	%	%		mS/cm	
1	0	15	4.2	3.1	5.2	1.8	0.11	16	0.06	
2	15	33	4.3	4.0	0.5	0.4	0.03	13	0.03	
3	33	90	4.2	3.4	0.8	tr.			0.03	
4	90	126	4.4	3.9	0.5	0.1			0.02	
5	126	136/176	4.5	4.2		2.4	0.07	35	0.01	
6	136/176		4.2	3.4		1.2	0.04	30	0.03	
	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								%	
1	0.0	0.3	0.0	0.0	0.8	0.2	1.1	5.3	6	
2	0.0	0.0	0.0	0.0	0.4	0.0	0.4	1.7	0	
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0	
4	0.0	0.0	0.0	0.0	0.1	0.0	0.1	1.7	0	
5	0.0	0.0	0.0	0.0	4.8	4.4	4.8	14.3	0	
6	0.0	0.0	0.0	0.0	4.7	4.6	4.7	16.3	0	
	Sand					Silt		Clay	Texture	
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		
1	4.0	15.5	38.7	32.6	2.7	3.3	1.0	2.2	S	
2	4.1	11.0	31.7	39.0	6.0	4.3	2.1	1.7	S	
3	3.7	9.9	32.7	42.6	4.1	4.0	1.6	1.4	S	
4	5.2	13.1	30.0	38.7	5.7	3.3	2.2	1.8	S	
5	4.2	14.1	29.4	36.6	3.4	9.1	2.3	0.9	S	
6	0.4	1.8	1.8	1.3	3.2	14.1	32.3	45.1	SiC	
	Elemental composition of total soil (wt%)									
	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5
1	97.34	0.2	0.15	0.11	<0.01	0.09	<0.01	<0.04	<0.00	<0.01
2	99.57	0.29	0.18	0.1	<0.01	0.1	<0.01	<0.04	<0.00	<0.01
3	98.41	0.29	<0.03	0.11	<0.01	0.1	<0.01	<0.04	<0.00	<0.01
4	100.03	0.33	0.21	0.09	<0.01	0.1	<0.01	<0.04	<0.00	<0.01
5	94.81	0.5	1.33	0.13	<0.01	0.08	<0.01	<0.04	<0.00	<0.01
6	64.5	1.07	22.29	1.12	0.01	0.04	<0.01	<0.04	0.44	0.03
	Elements		Mineralogical composition of the clay fraction (XRD)							
	BaO	L.O.I.	Kaolinite	Mica Illite	Chlorite	Mixed Layer	Quartz	Gibbsite	Goethite	
1	<0.03	3.380								
2	<0.03	0.850								
3	<0.03	0.160	+			0-tr	++			
4	<0.03	0.340								
5	<0.03	4.380	++			0-tr	+			
6	<0.03	12.170	+++	tr		0-tr	0-tr			

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
25	36.5	29.8	21.0	8.8	4.9	4.5	1.3	1.2	1.50
70	34.1	28.3	20.9	6.5	3.5	3.1	1.3	1.1	1.50

PROFILE 6

Legend unit:	Ps8
Soil classification:	Acri-plinthic Ferralsol Kasarama loamy sand/Ebini
Description:	By John Pulles and Arie van Kekem on 10-09-92
Location:	About 11 km S. of Mabura village; UTM: X=312250, Y=575800
Elevation:	About 300 ft?
Landform and slope:	Undulating to rolling sedimentary plain, pit on upper slope, 12-18% to N
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Mixed, primary forest
Drainage:	Moderately well drained
Soil:	Yellowish brown, sandy loam to sandy clay loam over mottled, slightly gravelly clay; with loamy sand topsoil.

Depth (cm)	Hor.	Description
0 - 7	Ah	dark brown to brown (7.5YR4/3); loamy sand; moderate fine and medium granular; very friable, non sticky, slightly plastic; many fine and medium roots; many pores; clear and smooth transition to
7 - 20	BA	yellowish brown (10YR5/4); very slightly gravelly loamy sand, medium to coarse sand fraction; few small, hard, irregular, fe-concretions; weak medium subangular blocky; very friable, slightly sticky, slightly plastic; many fine, few medium roots; many fine, few medium pores; clear and smooth transition to
20 - 40	Bws1	brownish yellow (10YR6/6); slightly gravelly, sandy loam to loamy sand; very faint, very few, reddish mottles; very weak, medium subangular blocky; very friable, slightly sticky, slightly plastic; few fine roots; many fine and medium pores; gradual and smooth transition to
40 - 60	Bws2	yellowish brown (10YR5/6); slightly gravelly sandy clay loam; few, small, hard, irregular, fe-concretions; weak fine angular blocky; friable, slightly sticky, slightly plastic; few fine roots; many fine and medium pores; clear and smooth transition to
60 - 120	2Bg	brownish yellow (10YR6/6); slightly gravelly clay; many, medium, distinct, clear 2.5YR4/8 mottles; few, small, hard, 2-20mm fe-concretions; weak fine angular blocky; friable, slightly sticky, plastic; few fine roots; many very fine, few fine pores; gradual and smooth transition to
120 - 140	2BCg	light gray to pale yellow (2.5Y7/3); slightly gravelly clay; many (40%), coarse, prominent, sharp 2.5YR4/8 mottles; very few, small and medium, hard, fe-concretions; weak fine angular blocky; friable to firm, slightly sticky, plastic; very few fine roots; many very fine, few fine pores.

Notes: Litter 80% coverage 2-3 leaves thick; F 0.5cm thick; 15% worm casts at surface. Augering to 250 cm, red 10R4/6 mottles.

Layer	Samp. Depth upper	Samp. Depth lower	pH H_2O	pH KCl	P-Bray mg/kg	OrgC %	N-Kjel %	C/N	ECe mS/cm
1	0	7	4.3	3.8	2.6	1.1	0.09	12	0.06
2	7	20	4.6	4.2	1.5	0.4	0.04	10	0.03
3	20	40	4.6	4.2	0.4	0.2	0.02	8	0.02
4	40	60	4.6	4.2	0.3	0.1	0.02		0.02
5	60	120	4.8	4.3	0.1	0.2	0.03		0.02
6	120	140	4.8	4.3	0.0	0.1	0.02		0.02

Layer	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	CEC/Clay
	cmol+/kg								%	
1	0.0	0.0	0.0	0.0	1.3	0.7	1.3	5.3	0	
2	0.0	0.0	0.0	0.0	0.7	0.5	0.7	1.8	0	4.8
3	0.0	0.0	0.1	0.0	0.7	0.2	0.8	1.8	6	7.2
4	0.0	0.0	0.0	0.0	0.7	0.2	0.7	1.8	0	7.1
5	0.0	0.0	0.0	0.0	0.4	0.2	0.4	3.5	0	6.1
6	0.0	0.0	0.1	0.0	0.4	0.2	0.5	7.0	1	11.8

Layer	Sand					Silt		Clay	Texture	Gravel %
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		
1	8.7	18.5	23.5	28.1	5.0	4.0	3.0	9.1	LS	2
2	10.7	9.9	17.7	29.5	8.6	6.7	4.7	12.3	SL	11
3	6.0	9.2	19.3	30.9	6.2	7.5	4.5	16.5	SL	12
4	5.0	9.5	18.2	25.7	7.8	7.4	5.5	21.0	SCL	26
5	2.2	4.5	8.3	11.5	3.2	11.6	11.4	47.3	C	7
6	0.5	0.9	1.3	2.1	2.3	15.5	20.7	56.7	C	5

Layer	Elemental composition of total soil (wt%)									
	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5
1	93.6	0.8	2.7	0.9	<0.01	0.1	<0.01	<0.04	0	<0.01
2	90.3	1.0	3.8	1.2	<0.01	0.1	<0.01	<0.04	0.01	<0.01
3	90.7	1.2	5.4	1.5	0.0	0.1	<0.01	<0.04	0.02	<0.01
4	87.8	1.3	6.5	2.1	<0.01	0.1	<0.01	<0.04	0.03	<0.01
5	65.5	2.6	18.4	5.2	0.0	<0.03	<0.01	<0.04	0.12	0.0
6	52.9	3.6	26.7	6.0	<0.01	<0.03	<0.01	<0.04	0.18	0.1

Layer	Elements		Mineralogical composition of the clay fraction (XRD)						
	BaO	L.O.I.	Kaolinite	Mica Illite	Chlorite	Mixed Layer	Quartz	Gibbsite	Goethite
1	<0.03	3.19							
2	<0.03	2.39							
3	<0.03	2.46	+++			tr	tr		tr-+
4	<0.03	2.96							
5	<0.03	7.54	+++			0-tr			+
6	<0.03	10.18	+++						+

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
25	30.8	29.7	28.9	23.4	20.1	19.0	16.8	15.5	1.71
75	39.7	39.2	39.1	36.9	35.2	34.5	32.2	29.7	1.60

PROFILE 7

Legend unit:	Inclusion of Ps5 in Ps8
Soil classification:	Ferrali-luvic Arenosol Tabela loamy sand
Description:	On 17-09-92 by John Pulles
Location:	About 11 km S. of Mabura village; UTM: X=312380, Y=575650
Elevation:	About 250 ft
Landform and slope:	Undulating to rolling sedimentary plain; 14%, concave upper slope
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Mixed forest, greenhearts
Drainage:	Well drained
Soil:	Very deep, strong brown sandy loam over sand, with sand to loamy sand topsoil.

Depth (cm)	Hor.	Description
0 - 6	Ah1	dark greyish brown (10YR4/2); medium sand; moderate fine granular; loose to very friable, non sticky, non plastic; many fine and very fine roots; many pores; clear and smooth transition to
6 - 15	Ah2	dark brown to brown (10YR4/3); loamy sand; weak to moderate fine subangular blocky; very friable, non sticky, non plastic; many fine, common medium roots; many fine and very fine pores; clear and smooth transition to
15 - 38	AB	yellowish brown (10YR5/4); loamy sand; weak medium subangular blocky; very friable, non sticky, non plastic; common fine, few coarse roots; many fine and very fine pores; gradual and smooth transition to
38 - 80	Bws1	yellowish brown (10YR5/6); loamy sand; weak medium subangular blocky; very friable, non sticky, non plastic; common fine, few medium roots; many fine, common very fine pores; diffuse and smooth transition
80 - 140	Bws2	strong brown (7.5YR5/6); sandy loam; weak to very weak fine subangular blocky; very friable, non sticky, non plastic; common fine roots; many fine pores; diffuse and smooth transition to
140 - 200	Bws3	yellowish red (5YR5/6); sand; few (<5%), fine (<10mm), distinct, diffuse 10YR6/4 mottles; very weak subangular blocky; loose, non sticky, non plastic; few fine roots; common fine pores.

Notes: Litter layer 2-3 leaves thick, 90-100% coverage; 1 cm root mat; 10% worm casts (10YR4/2).

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*
1	0	6	4.4	3.7	0.8	0.7	0.06	11	0.09
2	6	15	4.6	4.0	1.2	0.9	0.07	13	0.06
3	15	38	4.7	4.3	0.8	0.6	0.05	13	0.04
4	38	80	4.8	4.6	0.4	0.4	0.04	10	0.02
5	80	140	5.0	4.5	0.3	0.1	0.02		0.04
6	140	200	4.8	4.4	0.3	0.1	0.01		0.02
7	270	300	4.9	4.6	0.2				0.02

	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS
	cmol+/kg								*%*
1	0.0	0.0	0.1	0.0	0.7	0.2	0.8	1.8	6
2	0.0	0.0	0.0	0.0	1.1	0.5	1.1	3.5	0
3	0.0	0.0	0.0	0.0	1.1	0.5	1.1	3.5	0
4	0.0	0.0	0.0	0.0	0.4	0.2	0.4	1.8	0
5	0.0	0.0	0.0	0.0	0.4	0.2	0.4	1.8	0
6	0.0	0.0	0.0	0.0	0.4	0.2	0.4	1.8	0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0

	Sand					Silt		Clay	Texture	Gravel %
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		
1	11.9	32.7	28.4	19.0	2.0	1.2	0.6	4.1	S	2
2	7.4	18.6	24.0	29.7	7.0	3.0	2.3	8.0	LS	1
3	9.1	12.9	22.2	33.8	4.8	4.6	7.5	5.2	LS	2
4	4.3	11.8	21.8	34.7	8.9	5.0	2.2	11.3	LS	2
5	6.9	12.2	23.3	33.8	5.2	3.8	2.0	12.8	SL	1
6	4.1	11.3	22.4	34.4	8.3	4.2	1.0	14.3	SL	1
7	16.1	32.1	11.2	29.3	5.1	1.7	0.8	3.8	S	4

	Elemental composition of total soil (wt%)									
	SiO_2	*TiO_2*	*Al_2O_3*	*Fe_2O_3*	*MnO*	*MgO*	*CaO*	*Na_2O*	*K_2O*	*P_2O_5*
1	97.8	0.2	1.0	0.3	<0.01	0.1	<0.01	<0.04	<0.00	<0.01
2	91.0	0.6	4.5	0.6	<0.01	0.2	<0.01	<0.04	0.16	<0.01
3	93.4	0.7	3.5	0.8	<0.01	0.1	<0.01	<0.04	<0.00	<0.01
4	90.8	0.7	4.0	0.9	<0.01	0.1	<0.01	<0.04	<0.00	<0.01
5	92.2	0.7	4.5	0.9	<0.01	0.1	<0.01	<0.04	<0.00	<0.01
6	91.3	0.7	4.5	0.9	<0.01	0.1	<0.01	<0.04	<0.00	<0.01
7	98.3	0.5	1.1	0.3	<0.01	0.1	<0.01	<0.04	<0.00	<0.01

	Elements		Mineralogical composition of the clay fraction (XRD)							
	BaO	*L.O.I.*	*Kaolinite*	*Mica Illite*	*Chlorite*	*Mixed Layer*	*Quartz*	*Gibbsite*	*Goethite*	
1	<0.03	1.91								
2	<0.03	2.52								
3	<0.03	2.65	+++		tr-+		tr	tr-+	tr	
4	<0.03	2.49								
5	<0.03	2.21	+++		tr-+		tr	+	tr	
6	<0.03	2.19								
7	<0.03	0.65	+++		0-tr		0-tr	tr-+	tr	

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
25	38.7	38.3	35.4	25.7	20.6	19.6	13.9	12.6	1.48
75	40.7	35.1	27.4	17.2	13.6	12.5	10.4	10.0	1.39

PROFILE 8

Legend unit:	Ps1
Soil classification:	Albic Arenosol Tiwiwid sand
Description:	On 17-09-92 by John Pulles
Location:	About 11 km S of Mabura village; UTM: X=312380, Y=575650
Elevation:	About 300 ft
Landform and slope:	Flat to gently undulating sedimentary plain; concave upper slope / summit of 4%
Parent material:	Unconsolidated sediments of the Berbice formation
Vegetation:	Wallaba forest
Drainage:	Excessively drained
Soil:	Very deep, white sand.

Depth (cm)	Hor.	Description
0 - 5	Ah	very dark greyish brown (10YR3/2), with bleached grains; sand, medium; single grain; loose, non sticky, non plastic; abundant roots; many pores; clear and smooth transition to
5 - 20	AC	greyish brown (10YR5/2); sand; single grain; loose, non sticky, non plastic; many fine and medium roots; common very fine pores; gradual and smooth transition to
20 - 50	C1	light grey (10YR7/2); sand; single grain; loose, non sticky, non plastic; common fine and medium roots; common very fine pores; diffuse and smooth transition to
50 - 200	C2	white (10YR8/1); sand; single grain; loose, non sticky, non plastic; common medium roots; common very fine, few fine roots.

Notes: Litter 90% 2-3 layers; very dark brown worm casts 5%; 0.25 cm fermented layer.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*
1	0	5	4.2	3.1	3.6	1.1	0.07	16	0.23
2	10	16	4.2	3.2	3.0	0.9	0.05	17	0.20
3	30	40	5.2	4.2	0.2	0.1	0.01	9	0.02
4	120	130	5.6	4.6	0.1				0.02

Layer	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS
	cmol+/kg								*%*
1	0.0	0.3	0.0	0.0	0.8	0.0	1.1	3.5	9
2	0.0	0.0	0.1	0.0	0.6	0.0	0.7	1.7	6
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0

Layer	Sand					Silt		Clay	Texture
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*	
1	0.6	6.7	47.2	34.8	5.4	2.8	0.7	1.7	S
2	1.0	7.1	46.8	37.8	4.0	0.8	0.4	2.0	S
3	0.7	5.7	40.5	41.5	5.8	3.8	0.2	1.7	S
4	1.7	8.9	36.4	40.4	7.7	2.7	0.2	2.0	S

PROFILE 10

Legend unit:	Ps9
Soil classification:	Acri-xanthic Ferralsol Kasarama sandy loam
Description:	On 13-11-92 by John Pulles and Zab Khan
Location:	About 13 km W of Mabura; UTM: X=297662, Y=588663
Elevation:	About 300 ft
Landform and slope:	Rolling to hilly sedimentary plain; convex upper slope, 5%
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Forest, trees diameter of about 40 cm
Drainage:	Somewhat excessively drained
Soil:	Very deep, strong brown sandy loam with sand over loamy sand topsoil.

Depth (cm)	Hor.	Description
0 - 5	Ah1	dark brown (7.5YR3/3); medium sand; single grain; loose, non sticky, non plastic; common fine and medium, very few coarse roots; many pores; clear and smooth transition to
5 - 19	Ah2	dark yellowish brown (10YR4/4); loamy sand; weak fine subangular blocky; very friable, slightly sticky, non plastic; few fine and very fine, very few medium and coarse roots; common very fine pores; clear and smooth transition to
19 - 34	Bws1	yellowish brown (10YR5/6); sandy loam; weak fine subangular blocky; very friable, slightly sticky, non plastic; few medium, very few coarse and fine roots; common very fine pores; gradual and smooth transition to
34 - 70	Bws2	strong brown (7.5YR5/6); sandy loam; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; few medium, very few fine and very fine roots; common very fine pores; diffuse and smooth transition to
70 - 120	Bws3	strong brown (7.5YR5/6); sandy loam; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; very few roots; common very fine pores; diffuse and smooth transition to
120 - 180	Bws4	strong brown (7.5YR5/6); sandy loam; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; very few medium and very fine roots; few very fine pores.

Notes: At 290 cm, sand fraction becomes coarser.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	5	4.3	3.5	1.3	1.0	0.08	13	0.07	
2	5	19	4.4	4.0	1.0	1.1	0.07	15	0.06	
3	19	34	4.5	4.2	0.6	0.5	0.04	12	0.04	
4	34	70	4.7	4.4	0.3	0.2	0.02	10	0.02	
5	70	120	4.6	4.5	0.2	0.2	0.02	10	0.02	
6	120	180	4.8	4.6	0.2	0.1			0.02	
7	280	300	5.0	4.8	0.1	0.1			0.02	
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	0.0	0.0	0.1	0.0	0.8	0.2	0.9	3.5	3	
2	0.0	0.0	0.1	0.0	1.3	0.7	1.4	3.5	3	
3	0.0	0.0	0.0	0.0	0.9	0.5	0.9	1.8	0	
4	0.0	0.0	0.1	0.0	0.5	0.2	0.6	1.8	6	
5	0.0	0.0	0.0	0.0	0.4	0.2	0.4	1.7	0	
6	0.0	0.0	0.0	0.0	0.2	0.0	0.2	1.8	0	
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0	
	Sand					**Silt**		**Clay**	**Texture**	**Gravel %**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		
1	6.8	25.0	34.9	21.1	2.5	1.9	0.2	5.1	S	1
2	4.8	10.0	26.7	34.8	8.0	2.2	0.2	13.3	LS	1
3	3.2	8.4	25.6	37.5	5.5	1.9	0.2	17.6	SL	1
4	2.5	7.4	26.0	34.5	8.0	3.8	0.2	17.5	SL	1
5	3.5	9.8	26.9	33.1	5.2	2.2	0.2	19.1	SL	1
6	2.8	8.2	25.3	32.6	8.2	3.2	0.2	19.5	SL	1
7	4.5	14.5	19.8	35.1	5.5	3.4	0.0	17.2	SL	2
	Elemental composition of total soil (wt%)									
	SiO_2	*TiO_2*	*Al_2O_3*	*Fe_2O_3*	*MnO*	*MgO*	*CaO*	*Na_2O*	*K_2O*	*P_2O_5*
1	96.6	0.5	1.2	1.0	<0.01	0.1	<0.01	<0.04	<0.00	<0.01
2	90.8	1.1	3.6	2.1	0.0	0.1	<0.01	<0.04	<0.00	0.0
3	89.9	1.3	4.6	2.6	0.0	0.1	<0.01	<0.04	<0.00	0.0
4	88.4	1.3	4.9	2.8	0.0	0.1	<0.01	<0.04	<0.00	0.0
5	87.9	1.3	5.3	2.8	0.0	0.1	<0.01	<0.04	<0.00	0.0
6	87.4	1.3	5.4	2.8	0.0	0.1	<0.01	<0.04	<0.00	0.0
7	91.5	1.1	4.9	2.2	0.0	0.1	<0.01	<0.04	<0.00	<0.01
	Elements		**Mineralogical composition of the clay fraction (XRD)**							
	BaO	*L.O.I.*	*Kaolinite*	*Mica Illite*	*Chlorite*	*Mixed Layer*	*Quartz*	*Gibbsite*	*Goethite*	
1	<0.03	2.4								
2	<0.03	3.23								
3	<0.03	2.8	+++		0-tr			tr-+	+	
4	<0.03	2.64								
5	<0.03	2.72	+++		tr			tr-+	+	
6	<0.03	2.6								
7	<0.03	2.26	+++		0-tr			tr-+	+	

PROFILE 11

Legend unit:	Ps9
Soil classification:	Acri-plinthic Ferralsol Ebini - plinthite, sandy clay loam
Description:	On 13-11-92 by John Pulles and Zab Khan
Location:	About 14 km W of Mabura village; UTM: X=297490, Y=588641
Elevation:	About 300 ft
Landform and slope:	Rolling to hilly, sedimentary plain; convex upper slope of 10% to N
Parent material:	Unconsolidated sediments of the Berbice formation (sands over clay)
Vegetation:	Mixed forest, stem diameter of larger trees about 30 cm
Drainage:	Well to moderately well drained
Soil:	Very deep, yellowish brown sandy clay loam over strongly mottled (plinthite) clay; with dark brown sandy loam topsoil

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Depth (cm)	Hor.	Description
0 - 7	Ah	dark brown (10YR3/3); sandy loam; weak fine granular; very friable, slightly sticky and slightly plastic; few coarse and fine, common medium and very fine roots; common very fine and few fine pores; clear and smooth transition to
7 - 22	Bws1	brown (10YR5/3); sandy clay loam; weak medium subangular blocky; friable, slightly sticky and slightly plastic; few medium, very few coarse and fine roots; common very fine pores; clear and smooth transition to
22 - 45	Bws2	yellowish brown (10YR5/4); sandy clay loam; weak medium subangular blocky; friable, slightly sticky and slightly plastic; very few roots; common very fine and few fine pores; gradual and smooth transition to
45 - 105	Bws3	brownish yellow (10YR6/6); sandy clay loam; weak medium subangular blocky; friable, slightly sticky and slightly plastic;
105 - 122	2C1	very pale brown (10YR7/4); clay; 60% mottles red (10R4/6), coarse, distinct, clear; large plinthite concretions, hard and soft, irregular; moderate medium subangular blocky; very firm, slightly sticky and slightly plastic
122 - 150	2C2	very pale brown (10YR7/3); clay; 40% mottles yellowish red (5YR5/6); moderate medium subangular blocky; very firm, slightly sticky and slightly plastic.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	7	4.3	3.6	1.9	1.9	0.15	13	0.10	
2	7	22	4.6	4.1	1.7	1.0	0.08	13	0.05	
3	22	45	4.8	4.4	0.5	0.5	0.04	11	0.03	
4	45	105	4.8	4.3	0.1	0.2	0.02	10	0.02	
5	105	122	4.8	4.2	0.1	0.2	0.03	6	0.02	
6	122	150	4.8	4.1	0.1	0.1	0.03	4	0.01	
	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								*%*	
1	0.0	0.0	0.0	0.0	2.0	1.1	2.0	3.5	0	
2	0.0	0.0	0.0	0.0	1.5	0.9	1.5	3.5	0	
3	0.0	0.0	0.0	0.0	0.9	0.5	0.9	1.8	0	
4	0.0	0.0	0.0	0.0	0.9	0.5	0.9	3.5	0	
5	0.0	0.0	0.0	0.0	1.5	0.9	1.5	3.5	0	
6	0.0	0.0	0.0	0.0	2.4	1.6	2.4	5.3	0	
	Sand					Silt		Clay	Texture	Gravel
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		%
1	6.5	23.7	23.5	17.9	6.1	4.8	0.2	17.3	SL	2
2	4.2	10.6	23.9	26.4	6.0	5.8	1.7	21.4	SCL	1
3	3.8	10.2	21.2	23.9	8.1	7.4	0.0	25.3	SCL	2
4	6.0	10.8	18.2	20.8	4.9	4.9	0.7	33.6	SCL	2
5	1.7	7.3	10.3	10.2	3.6	5.1	5.6	56.1	C	31
6	0.1	3.1	6.2	4.9	1.3	6.6	7.9	69.9	C	23
			Mineralogical composition of the clay fraction (XRD)							
			Kaolinite	*Mica Illite*	*Chlorite*	*Mixed Layer*	*Quartz*	*Gibbsite*	*Goethite*	
2			+++		tr			tr	tr	
4			+++		tr			tr	tr	
6			.+++	0-tr	o-tr			0-tr	tr	

PROFILE 12

Legend unit:	Ps1
Soil classification:	Albic Arenosol Tiwiwid sand
Description:	On 13-11-92 by John Pulles
Location:	About 14 km W. of Mabura village, UTM: X=299017, Y=58865
Elevation:	About 300 ft
Landform and slope:	Flat to gently undulating sedimentary plain; 5% convex middle slope
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Wallaba forest
Drainage:	Excessively drained
Soil:	Very deep, light grey sand.

Depth (cm)	Hor.	Description
0 - 18	Ah	dark greyish brown (10YR4/2); fine sand; single grain; loose, non sticky and non plastic; very few coarse, few fine and medium roots; clear and smooth transition to
18 - 40	AC	greyish brown (10YR5/2); fine sand; single grain; loose, non sticky and non plastic; few medium and very few fine roots; gradual and smooth transition to
40 - 70	C1	light grey (10YR7/2); fine sand; single grain; loose, non sticky and non plastic; very few medium roots; gradual and smooth transition:
70 - 200	C2	white (10YR8/1); fine sand; single grain; loose, non sticky and non plastic; very few medium roots.

Remarks: first 2-3 cm in A consist of root mat with sand, same colour.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	18	4.4	3.4	0.7	0.4	0.02		0.03	
2	18	40	4.6	3.5	0.5	0.2	0.03		0.03	
3	40	70	5.1	4.0	0.3	0.1			0.03	
4	70	200	5.9	4.8	0.1				0.02	

	Ca	Mg	Na	K	H+Al	Al	ECEC	CEC	BS	
	cmol+/kg								*%*	
1	0.0	0.0	0.0	0.0	0.2	0.0	0.2	1.7	0	
2	0.0	0.0	0.0	0.0	0.2	0.0	0.2	1.7	0	
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0	
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	

	Sand					Silt		Clay	Texture	
	1000-2000	*500-l000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		
1	0.8	7.8	76.7	12.4	0.1	0.2	0.2	1.7	S	
2	0.5	5.0	68.6	22.0	1.1	0.2	1.4	1.2	S	
3	0.5	4.4	58.7	29.3	3.6	2.5	0.0	1.0	S	
4	1.4	8.2	51.8	31.7	2.7	1.6	0.2	2.3	S	

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
25	40.5	33.4	14.4	7.4	5.8	5.2	3.4	2.6	1.43
75	35.2	30.6	15.1	4.3	3.3	2.7	1.3	0.9	1.34

PROFILE 13

Legend unit:	A1
Soil classification:	Ferrali-dystric Fluvisol
Description:	On 18-11-92 by John Pulles and Zab Khan
Location:	About 8 km SE of Mabura village, IMBO compartment; UTM: X=31800, Y=581350
Elevation:	About 200 ft
Landform and slope:	Floodplain, flat (0%)
Parent material:	Alluvial deposits, clays
Vegetation:	Mora forest
Drainage:	Well to moderately well drained
Ground water:	At about 150 cm
Flooding:	Yearly for a short duration
Soil:	Yellowish brown, mottled clay with groundwater table between 0.55 and about 2 m.

Depth (cm)	Hor.	Description
0 - 11	Ah1	dark brown to brown (10YR4/3); clay; moderate medium granular; friable, slightly sticky, slightly plastic; many fine and medium roots; common fine and very fine pores; clear and smooth transition to
11- 23	Ah2	dark yellowish brown (10YR4/4); clay; moderate medium subangular blocky, breaking apart; friable, slightly sticky, slightly plastic; few fine and medium , very few coarse roots; common very fine pores; gradual and smooth transition to
23 - 55	Bw1	dark yellowish brown (10YR4/6); clay; moderate medium subangular blocky; firm, slightly sticky, slightly plastic; very few fine and medium roots; gradual and smooth transition to
55 - 90	Bwg	yellowish brown (10YR5/4); clay; 25% small, medium, diffuse 5YR5/6 mottles; weak medium subangular blocky; firm, slightly sticky, slightly plastic; gradual and smooth transition to
90 - 160	BCg	light olive brown (2.5Y5/4); clay; 50% coarse, prominent, clear 2.5YR4/6 mottles; weak medium subangular blocky; firm, slightly sticky, slightly plastic.

Notes: Many worm casts at surface, thin litter layer.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	lower	H_2O	KCl	mg/kg	%	%		mS/cm	
1	0	11	4.4	3.9	1.3	5.1	0.48	11	0.09	
2	11	23	4.8	4.1	0.6	2.7	0.27	10	0.05	
3	23	55	4.6	4.3	0.3	1.6	0.15	11	0.02	
4	55	90	4.7	4.6	0.2	0.9	0.08	11	0.02	
5	90	160	4.8	5.5	0.2	0.4	?		0.02	
	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								%	
1	0.0	0.3	0.1	0.1	3.4	2.8	3.9	14.7	3	
2	0.0	0.3	0.0	0.0	1.7	1.4	2.0	9.1	3	
3	0.0	0.0	0.0	0.0	0.9	0.7	0.9	5.4	0	
4	0.0	0.0	0.0	0.0	0.2	0.2	0.2	5.4	0	
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2	0	
	Sand					Silt		Clay	Texture	
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		
1	0.0	0.1	0.6	2.3	2.3	9.7	10.8	74.3	C	
2	0.0	0.1	0.6	2.4	1.6	7.1	9.3	78.9	C	
3	0.0	0.1	0.5	3.0	2.9	4.4	9.9	79.2	C	
4	0.0	0.0	0.7	3.2	1.9	6.7	10.5	76.9	C	
5	0.0	0.0	0.8	5.1	4.0	10.6	12.5	67.0	C	

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
25	57.7	56.8	54.6	52.0	51.3	49.8	46.7	44.3	1.13
75	56.1	55.2	54.3	52.5	51.8	50.3	48.0	45.3	1.19

PROFILE 14

Legend unit:	Pe4 (not representative)
Soil classification:	Dystric Plinthosol, skeletic phase
Description:	On 14-11-92 by John Pulles
Location:	About 8 km SE of Mabura village; UTM: X=318390, Y=581731
Elevation:	125 ft
Landform and slope:	Rolling erosional plain; convex middle slope, 12% to S
Parent material:	Colluvial material over dolerite derived clay
Vegetation:	Mixed forests
Surface stoniness:	None
Drainage:	Imperfectly drained
Soil:	Very deep clay soil with plinthite from 50 cm depth; with a 30 cm thick, gravelly and stony, sandy clay and clay, topsoil.

Depth (cm)	Hor.	Description
0 - 13	Ah1	dark greyish brown (10YR4/2); gravelly and stony sandy clay; weak fine granular; friable, slightly sticky, slightly plastic; many fine, common medium, few coarse roots; clear and smooth transition to
13 - 30	Ah2	greyish brown (10YR5/2); gravelly and stony clay; weak fine granular; friable, slightly sticky, slightly plastic; few medium, very few fine roots; clear and smooth transition to
30 - 48	2BA	light grey (10YR7/1); clay; 50% fine medium diffuse 10YR5/6 mottles; weak medium subangular blocky; firm, slightly sticky, slightly plastic; very few fine roots; common very fine and fine pores; gradual and smooth transition to
48 - 87	2Bsq1	light grey (10YR7/1); clay; 20% distinct, medium 7.5YR5/6 and 2.5YR4/6 mottles; weak medium angular blocky; firm, slightly sticky, slightly plastic; common very fine pores; gradual and smooth transition to
87 - 160	2Bsq2	light grey (10YR7/1); gravelly clay; 35% coarse distinct clear 2.5YR4/6 mottles; 15% 5-10 mm hard and soft irregular fe-concretions; weak coarse angular blocky; firm, slightly sticky, slightly plastic; few very fine pores.

Note: Abundant worm casts at surface.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe
	upper	lower	H_2O	KCl	mg/kg	%	%		mS/cm
1	0	13	4.3	3.6	2.3	3.3	0.24	14	0.12
2	13	30	4.4	4.0	1.9	2.0	0.16	12	0.06
3	30	48	4.5	4.1	0.7	0.6	0.04	14	0.02
4	48	87	4.4	4.0	0.5	0.3	0.01		0.02
5	87	160	4.3	4.0	0.5	0.2	0.01		0.02

	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS
	cmol+/kg								%
1	0.0	0.3	0.1	0.1	3.1	2.5	3.6	8.9	6
2	0.0	0.0	0.0	0.0	1.9	1.6	1.9	5.3	0
3	0.0	0.0	0.0	0.0	1.5	1.4	1.5	5.3	0
4	0.0	0.0	0.0	0.0	1.7	1.6	1.7	24.6	0
5	0.0	0.0	0.0	0.0	1.5	1.1	1.5	24.6	0

	Sand					Silt		Clay	Texture	Gravel
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		%
1	13.3	11.6	14.3	11.9	4.5	2.1	3.4	39.0	SC	17
2	13.3	5.2	8.4	12.0	3.4	4.2	6.3	47.2	C	73
3	2.3	1.9	3.9	6.6	3.2	2.8	18.6	60.6	C	9
4	1.4	1.2	1.3	1.4	0.7	3.3	29.5	61.2	C	6
5	2.2	2.5	3.9	2.9	1.6	5.9	28.7	52.2	C	21

PROFILE 15

Legend unit:	Ps8
Soil classification:	Acri-xanthic Ferralsol Kasarama loamy sand
Description:	On 09-12-92 by John Pulles
Location:	About 5 km S of Mabura village; UTM: X=310100, Y=581400
Elevation:	About 200 ft
Landform and slope:	Undulating to rolling sedimentary plain; convex interfluve, 3% to SW
Parent material:	Unconsolidated sediments of the Berbice formation
Vegetation:	Mixed, Greenheart bearing forest
Drainage:	Well drained
Soil:	Very deep, dark brown sandy loam; with 11 cm sand topsoil.

Depth (cm)	Hor.	Description
0 - 3	Ah1	dark greyish brown (10YR4/2); sand; single grain; loose, non sticky, non plastic; many roots; many pores; clear and smooth transition to
3 - 11	Ah2	dark greyish brown (10YR4/2); sand; weak fine subangular blocky; loose, non sticky, non plastic; common medium, few fine roots; common fine pores; clear and smooth transition to
11 - 30	BA1	dark brown to brown (10YR4/3); loamy sand; weak fine subangular blocky; very friable, slightly sticky, non plastic; very few fine and medium roots; common fine pores; gradual and smooth transition to
30 - 63	BA2	dark brown to brown (10YR4/3); loamy sand; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; very few coarse and medium roots; few fine pores; clear and smooth transition to
63 - 110	Bws1	strong brown (7.5YR4/6); sandy loam; very weak fine subangular blocky; very friable, slightly sticky, slightly plastic; very few medium roots; few fine pores; diffuse and smooth transition to
110 - 160	Bws2	strong brown (7.5YR5/6); sandy loam; very weak fine subangular blocky; very friable, slightly sticky, slightly plastic; few fine pores.

Note: Very thin, 100% coverage, litter layer at surface; rootmat about 3 cm thick.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	3	4.2	3.3	2.4	2.2	0.10	22	0.09	
2	3	11	4.4	3.8	2.2	1.1	0.06	18	0.05	
3	11	30	4.5	4.2	1.5	0.8	0.03	26	0.03	
4	30	63	4.6	4.4	0.6	0.8	0.03	26	0.02	
5	63	110	4.6	4.7	0.9	0.3	0.02	15	0.02	
6	110	160	4.5	4.4	0.6	0.2			0.02	
7	250	270	4.6	4.4	0.5	0.1			0.02	
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	0.0	0.3	0.1	0.0	1.1	0.7	1.5	5.3	8	
2	0.0	0.0	0.0	0.0	1.3	0.9	1.3	5.3	0	
3	0.0	0.0	0.0	0.0	1.3	0.9	1.3	3.5	0	
4	0.0	0.0	0.0	0.0	0.9	0.7	0.9	3.5	0	
5	0.0	0.0	0.0	0.0	0.4	0.2	0.4	1.8	0	
6	0.0	0.0	0.0	0.0	0.5	0.5	0.5	1.8	0	
7	0.0	0.0	0.0	0.0	0.4	0.2	0.4	1.7	0	
	Sand					**Silt**		**Clay**	**Texture**	**Gravel**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		**%**
1	14.0	28.2	28.5	21.2	2.1	1.4	0.5	4.1	S	3
2	12.1	20.2	24.4	28.0	5.3	1.7	0.0	8.4	S	2
3	10.3	17.9	24.8	29.7	4.0	1.2	1.2	11.0	LS	2
4	8.6	13.9	21.9	31.5	7.2	2.1	1.4	13.3	LS/SL	4
5	6.2	13.5	21.7	34.4	5.4	3.0	1.3	14.5	SL	3
6	6.7	10.6	20.7	33.9	8.5	2.5	0.2	16.8	SL	3
7	6.1	12.6	21.7	38.8	5.0	1.2	0.7	13.9	LS	3

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
25	40.9	36.2	26.6	19.5	18.4	16.4	11.3	10.0	1.41
75	44.8	41.0	28.6	19.6	18.5	15.4	12.5	10.8	1.37

PROFILE 16

Legend unit:	A1
Soil classification:	Dystric Fluvisol
Location:	About 24 km W of Mabura village; near Essequibo, Mango landing; UTM: X=289638, Y=588293
Description:	On 08-07-92 by John Pulles, Zab Khan and David Fredericks
Elevation:	About 100 ft
Landform and slope:	Flat to nearly flat alluvial plain; 0% slope
Parent material:	Alluvial deposits
Vegetation:	Forest
Drainage:	Imperfectly drained
Soil:	Very deep, yellowish brown, silty clay loam over mottled clay; with 25 cm silty clay loam topsoil.

Depth (cm)	Hor.	Description
0 - 10	Ah1	dark greyish brown (10YR4/2); silty clay loam; moderate medium granular; friable, slightly sticky, slightly plastic;
10 - 25	Ah2	greyish brown (10YR5/2); silty clay loam; moderate medium granular; friable, slightly sticky, slightly plastic;
25 - 44	BA	yellowish brown (10YR5/4); silty clay loam; moderate medium subangular blocky; friable, slightly sticky, plastic;
44 - 80	Bg1	light yellowish brown (10YR6/4); clay; many medium prominent 5YR4/6 mottles; moderate medium angular blocky; friable, slightly sticky, plastic; few coarse roots;
80 - 110	Bg2	light yellowish brown (10YR6/4); clay; moderate medium angular blocky; friable, slightly sticky, plastic;
110 - 180	Cr	light grey (10YR7/1); clay; many medium prominent 7.5YR5/6 mottles; moderate medium angular blocky; friable, slightly sticky, plastic; few coarse roots.

Notes: structure easily falls apart into finer aggregates.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*
1	0	10	4.3	3.8	4.1	3.1	0.24	13	0.06
2	10	25	4.3	3.8	2.8	2.2	0.19	11	0.05
3	25	44	4.2	3.9	2.1	1.7	0.14	12	0.04
4	44	80	4.3	3.9	0.3	0.3	0.07	4	0.03
5	80	110	4.6	3.9	0.2	0.3	0.04	7	0.02
6	110	180	4.6	3.8	1.4	0.2	0.05	4	0.02
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**
	cmol+/kg								*%*
1	0.0	0.0	0.0	0.1	2.6	2.1	2.7	9.0	1
2	0.0	0.0	0.0	0.1	2.2	1.6	2.3	7.2	1
3	0.0	0.0	0.0	0.0	2.3	1.8	2.3	7.1	0
4	0.0	0.0	0.0	0.0	2.6	2.3	2.6	5.4	0
5	0.0	0.0	0.0	0.0	2.9	2.5	2.9	7.2	0
6	0.0	0.0	0.0	0.0	3.3	2.8	3.3	10.7	0
	Sand					**Silt**		**Clay**	**Texture**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*	
1	0.1	0.1	0.1	0.1	5.3	33.3	25.4	35.7	SiCL
2	0.1	0.1	0.1	0.1	5.3	30.6	26.9	36.8	SiCL
3	0.1	0.1	0.1	0.1	5.7	30.0	25.6	38.5	SiCL
4	0.1	0.1	0.1	0.1	3.3	15.3	16.9	64.3	C
5	0.0	0.0	0.0	0.0	1.5	16.4	23.6	58.3	C
6	0.0	0.0	0.0	0.0	0.4	11.4	25.5	62.6	C

PROFILE 17

Legend unit:	Pe3
Soil classification:	Haplic Ferralsol, skeletic phase
Description:	On 15-07-92 by John Pulles and Zab Khan
Location:	About 5.5 km W of Pibiri field camp UTM: X=314400, Y=557300
Elevation:	About 400 ft
Landform and slope:	Flat to hilly dissected erosional plain, bordering dolerite hills; middle slope, 14%
Parent material:	Dolerite, dominated by laterite
Vegetation:	Mixed, Greenheart bearing forest
Surface stoniness:	Not observed / not noted down
Drainage:	Well to moderately well drained
Soil:	Very deep, red clay, with ironstone gravel between 20 and 70 cm depth; with 20 cm clay loam topsoil.

Depth (cm)	Hor.	Description
0 - 20	Ah	dark reddish brown (5YR3/4); clay loam; fine granular; very friable, slightly sticky, slightly plastic; many fine and medium, common large roots;
20 - 50	BA	reddish brown (5YR4/4); very gravelly clay; 75% 5-15 mm ironstone fragments; fine granular; friable, slightly sticky, slightly plastic; common fine and medium, few coarse roots;
50 - 70	Bws1	yellowish red (5YR4/6); gravelly clay; 50% 5-15 mm ironstone fragments; slightly sticky, slightly plastic;
70 - 105	Bws2	red (2.5YR4/6); clay; fine to medium angular blocky; slightly sticky, plastic; common medium roots; soft very pale brown pieces of weathered rock;
105 - 150	Bws3	red (10R4/6); clay; slightly sticky, plastic; soft very pale brown pieces of weathered rock.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	20	4.2	3.7	1.2	2.9	0.23	13	0.08	
2	20	50	4.3	4.0	0.8	1.9	0.14	14	0.05	
3	50	70	4.4	4.2	0.2	1.1	0.09	12	0.04	
4	70	105	4.2	4.4	0.1	0.6	0.06	9	0.09	
5	105	150	4.3	4.8	0.0	0.4	0.03	11	0.06	
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	0.0	0.0	0.0	0.1	3.4	2.5	3.5	10.7	1	
2	0.0	0.0	0.0	0.0	2.5	2.1	2.5	7.2	0	
3	0.0	0.0	0.0	0.0	1.6	1.1	1.6	5.4	0	
4	0.0	0.0	0.0	0.0	0.5	0.2	0.5	3.6	0	
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0	
	Sand					**Silt**		**Clay**	**Texture**	**Gravel**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		%
1	11.6	11.5	7.7	7.6	4.2	9.4	9.9	38.1	CL	19
2	8.3	5.6	6.1	8.4	3.3	8.7	9.5	50.2	C	78
3	5.7	6.6	5.5	6.1	3.9	8.3	10.6	53.2	C	39
4	6.7	5.0	3.3	3.8	1.9	8.3	17.6	53.3	C	20
5	6.2	5.8	3.2	3.2	2.7	11.5	22.8	44.5	C	14

PROFILE 21

Legend unit:	F1
Soil classification:	Acri-haplic Ferralsols, skeletic phase
Description:	On 05-03-93 by John Pulles and Zab Khan
Location:	About 17 km W of Cannister falls, along cattle trail; UTM: X=325850, Y=521200
Elevation:	About 250 ft
Landform and slope:	rolling, locally dissected, footslope; convex middle slope, 18%
Parent material:	Dolerite
Vegetation:	Forest with many lianas
Surface stoniness:	none
Drainage:	Well drained
Soil:	Very deep, red, gravelly clay with 12 cm thick clay topsoil.

Depth (cm)	Hor.	Description
0 - 12	Ah	dark brown to brown (10YR4/3); slightly gravelly (2%) clay; moderate fine subangular blocky, falling apart; friable, slightly sticky, slightly plastic; common coarse and medium, many fine roots; clear and smooth transition to
12 - 28	AB	yellowish brown (10YR5/6); very gravelly (70%) clay; moderate fine subangular blocky; friable, slightly sticky, slightly plastic; common fine, few medium roots; few medium and fine pores; clear and smooth transition to
28 - 57	Bws1	strong brown (7.5YR5/8); gravelly (40%) clay; moderate fine angular blocky; friable, slightly sticky, slightly plastic; very few medium roots; gradual and smooth transition to
57 - 97	Bws2	red (2.5YR4/8); slightly gravelly (5%, 5 mm) clay; moderate fine angular blocky; friable, slightly sticky, slightly plastic; very few roots; gradual and smooth transition to
97 - 160	Bws3	red (2.5YR4/8); gravelly (40%, 10-20 mm) clay; 20% fine distinct clear pale brown mottles; hard, angular rock fragments; moderate fine angular blocky; friable, slightly sticky, slightly plastic.

Notes: 80% worm casts at surface.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	12	4.4	3.6	2.0	2.5	0.26	10	0.10	
2	14	26	4.6	3.9	0.6	1.2	0.13	9	0.03	
3	35	50	4.6	4.0	0.3	0.9	0.10	9	0.03	
4	67	87	4.8	4.3	0.1	0.5	0.07	7	0.02	
5	120	140	5.0	4.9	0.1	0.2	0.03	6	0.02	

	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								*%*	
1	0.2	0.3	0.4	0.1	2.8	2.1	3.8	7.2	14	
2	0.0	0.0	0.3	0.0	2.6	2.3	2.9	7.3	4	
3	0.0	0.3	0.2	0.0	1.8	1.4	2.3	3.8	13	
4	0.0	0.0	0.3	0.0	0.7	0.5	1.0	3.0	10	
5	0.0	0.0	0.2	0.0	0.1	0.0	0.3	2.9	7	

	Sand					Silt		Clay	Texture	Gravel
	1000-2000	*500-l000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		%
1	8.8	8.0	9.6	10.1	3.9	8.2	5.9	45.5	C	9
2	6.8	5.7	6.6	8.1	5.6	6.6	6.6	54.1	C	46
3	7.9	4.2	3.9	5.6	3.3	4.7	7.2	63.2	C	29
4	3.1	2.8	2.2	2.9	2.9	3.9	12.1	70.3	C	15
5	3.9	2.8	2.7	4.1	2.4	2.6	16.0	65.5	C	23

PROFILE 22

Legend unit:	F1
Soil classification:	Acri-haplic Ferralsol, skeletic phase
Description:	On 6-3-93 by John Pulles and Zab Khan
Location:	About 17 km W of Cannister falls, along cattle trail; UTM: X=326100 Y=521310
Elevation:	About 250 ft
Landform and slope:	Rolling footslope; convex crest of 3%
Parent material:	Dolerite
Vegetation:	About 40 m high forest, medium dense undergrowth, stems diameter about 30 cm
Surface stoniness:	None
Drainage:	Well drained
Soil:	Very deep, yellowish red, very gravelly (ironstone gravel) clay; with 17 cm gravelly sandy clay loam; over weathering dolerite.

Depth (cm)	Hor.	Description
0 - 5	Ah1	dark brown (10YR3/3); gravelly (30%) sandy clay loam; moderate fine granular; very friable, slightly sticky, slightly plastic; common medium and coarse, many fine roots; clear and smooth transition to
5 - 17	Ah2	dark yellowish brown (10YR4/4); very gravelly (80%) sandy clay to clay; moderate medium granular; friable, slightly sticky, slightly plastic; common fine, few coarse and medium roots; clear and smooth transition to
17 - 48	Bws1	yellowish brown (10YR5/4); gravelly (50%) clay; moderate fine subangular blocky; friable, slightly sticky, slightly plastic; very few fine and coarse, few medium roots; common very fine pores; gradual and smooth transition to
48 - 96	Bws2	yellowish red (5YR5/8); very gravelly (70%) clay; moderate fine subangular blocky; friable, slightly sticky, slightly plastic; very few fine roots; few pores; clear and smooth transition to
96 - 160	CR	red (2.5YR4/8); very gravelly (90%) clay; fine, faint, diffuse 7.5YR5/6 mottles from weathered rock; weak fine angular blocky to massive compact; friable, slightly sticky, slightly plastic; very few fine roots.

Notes: less than 1 cm root mat; litter 3 leaf layers thick.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	5	3.9	3.4	0.5	3.5	0.25	14	0.20	
2	5	17	4.2	3.7	1.0	2.6	0.24	11	0.10	
3	17	48	4.5	3.9	0.5	0.9	0.11	8	0.04	
4	48	96	4.5	4.0	0.2	0.7	0.07	10	0.03	
5	96	160	4.8	4.3	0.1	0.1			0.02	
	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								*%*	
1	0.6	0.7	0.3	0.1	1.4	0.9	3.1	9.9	17	
2	0.0	0.3	0.4	0.0	3.5	3.0	4.2	7.9	9	
3	0.2	0.0	0.2	0.0	2.3	1.6	2.7	4.1	10	
4	0.0	0.0	0.3	0.0	1.7	1.4	2.0	2.9	10	
5	0.0	0.0	0.3	0.0	0.8	0.5	3.6	1.6		
	Sand					Silt		Clay	Texture	Gravel %
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		
1	22.1	15.0	11.9	8.4	3.4	4.4	3.1	31.6	SCL	29
2	12.7	7.0	9.8	10.8	3.6	5.1	7.5	43.6	C(SC)	70
3	9.0	6.1	6.8	7.6	4.7	5.3	5.3	55.2	C	43
4	7.5	3.1	2.8	3.7	1.9	4.1	5.1	71.7	C	47
5	20.3	12.3	2.8	1.7	0.9	3.6	7.2	51.2	C	46

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
70	53.7	53.7	53.0	48.3	46.7	44.7	38.4	34.7	1.18

PROFILE 23

Legend unit:	Ps1
Soil classification:	Albic Arenosol Tiwiwid sand
Description:	On 08-03-93 by John Pulles and Zab Khan
Location:	About 10 km SW of Cannister falls, along cattle trail; UTM: X=332985, Y=523440
Elevation:	About 250 ft
Landform and slope:	Flat to gently undulating sedimentary plain; convex crest, 2% to SW
Parent material:	Unconsolidated sediments of the Berbice formation
Vegetation:	Muri scrub, in places Dakama
Drainage:	Excessively drained
Soil:	Very deep, light grey sand.

Depth (cm)	Hor.	Description
0 - 4	Ah1	dark reddish brown (5YR3/2); root mat, sand; abrupt and smooth transition to
4 - 26	Ah2	very dark grey (10YR3/1); sand; single grain, weakly coherent; loose, non sticky, non plastic; common roots; clear and smooth transition to
26 - 58	C1	light grey (10YR6/1); sand; single grain, weakly coherent; loose, non sticky, non plastic; common roots; pinkish grey to brown colour along root channels; clear and smooth transition to
58 - 90	C2	light grey (10YR7/1); sand; single grain, weakly coherent; loose, non sticky, non plastic; few roots; gradual and smooth transition to
90 - 135	C3	light grey (10YR7/1); sand; single grain, weakly coherent; loose, non sticky, non plastic; gradual and smooth transition to
135 - 170	C4	white (10YR8/2); sand; single grain, weakly coherent; loose, non sticky, non plastic.

Note: some krotovinas present up to 100 cm depth

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*
1	0	4	3.8	2.4	0.6	7.2	0.34	21	0.08
2	4	26	4.2	2.6	0.4	0.9	0.04	22	0.03
3	26	58	5.0	3.6	0.3	0.1			0.03
4	58	90	5.9	4.3	0.2				0.02
5	90	135	6.0	4.9	0.2				0.02
6	135	170	6.2	5.1	0.1				0.02

	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS
	cmol+/kg								*%*
1	0.0	1.0	0.5	0.1	1.2	0.0	2.8	21.9	7
2	0.0	0.0	0.2	0.0	0.9	0.0	1.1	3.5	6
3	0.0	0.0	0.2	0.0	0.1	0.0	0.3	0.3	
4	0.0	0.0	0.2	0.0				0.2	
5	0.0	0.0	0.2	0.0				0.9	
6	0.0	0.0	0.3	0.0				0.3	

	Sand					Silt		Clay	Texture
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*	
1	1.6	15.1	57.6	20.1	0.9	1.1	1.6	2.1	S
2	0.5	7.0	54.1	31.3	3.3	1.7	0.0	2.1	S
3	1.4	8.7	55.0	28.6	2.0	1.9	0.5	1.9	S
4	1.4	9.9	48.3	33.0	3.1	1.4	1.4	1.6	S
5	1.8	11.5	46.6	33.2	2.3	0.5	1.6	2.6	S
6	2.3	11.7	38.7	37.8	4.8	0.5	1.5	2.7	S

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
15	42.3	40.9	25.9	8.5	6.6	5.5	2.1	2.0	1.40
70	37.6	36.3	25.5	4.0	3.2	2.7	1.1	1.0	1.42

PROFILE 24

Legend unit:	H2
Soil classification:	Acri-haplic Ferralsol, skeletic phase
Description:	On 10-03-93 by John Pulles and Zab Khan
Location:	About 6 km NE of Kurupukari falls; UTM: X=319024, Y=518663
Elevation:	About 250 ft
Landform and slope:	Low hill; convex middle slope, 11%
Parent material:	Dolerite
Vegetation:	Mixed forest with Greenheart and Yaruba
Surface stoniness:	Very gravelly surface (ironstone gravel)
Drainage:	Well drained
Soil:	Very deep, brown, gravelly clay; with 33 cm thick very gravelly, sandy clay loam to sandy clay, topsoil.

Depth (cm)	Hor.	Description
0 - 10	Ah1	dark brown (7.5YR3/2); gravelly sandy clay loam; moderate medium granular; very friable, slightly sticky, slightly plastic; many fine, common medium and coarse roots; clear and smooth transition to
10 - 33	Ah2	dark yellowish brown (10YR4/4); very gravelly sandy clay; moderate medium granular; very friable, slightly sticky, slightly plastic; common roots; clear and smooth transition to
33 - 75	Bws1	dark brown to brown (7.5YR4/4); clay; moderate medium subangular blocky; friable, slightly sticky, slightly plastic; few medium and very few fine roots; few fine pores; gradual and smooth transition to
75 - 103	Bws2	strong brown (7.5YR4/6); slightly gravelly (soft rock fragments) clay; moderate medium subangular blocky; friable, slightly sticky, slightly plastic; very few roots; few fine pores; clear and smooth transition to
103 - 160	Bws3	red (2.5YR4/6); clay; weak medium subangular blocky; friable, slightly sticky, slightly plastic; very few fine pores.

Notes: 80% of surface covered with very thin litter layer (2 leaf layers); very gravelly surface (70%, 2-5 mm).

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	lower	H_2O	KCl	mg/kg	%	%		mS/cm	
1	0	10	3.7	3.6	0.4	2.4	0.01	24	0.20	
2	10	33	4.0	3.9	0.6	1.6	0.14	11	0.10	
3	33	75	4.6	4.3	0.3	0.7	0.06	12	0.03	
4	75	103	4.7	4.8	0.2	0.4	0.04	10	0.02	
5	103	160	4.9	5.3	0.2	0.2	0.02	10	0.02	
	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								%	
1	0.0	0.3	0.3	0.1	2.5	1.6	3.2	6.2	11	
2	0.0	0.0	0.3	0.0	1.8	1.1	2.1	1.4	21	
3	0.0	0.0	0.2	0.0	0.5	0.2	0.7	2.1	10	
4	0.0	0.0	0.2	0.0	0.1	0.0	0.3	1.8	11	
5	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.9	22	
	Sand					Silt		Clay	Texture	Gravel %
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		
1	14.6	15.2	16.5	15.4	3.1	3.4	3.4	28.5	SCL	49
2	11.1	8.9	13.0	13.9	4.9	3.6	3.3	41.2	SC	68
3	7.8	6.4	7.0	10.2	3.1	3.2	4.1	58.2	C	26
4	11.2	12.0	5.7	5.6	2.7	3.6	5.5	53.8	C	28
5	18.0	14.0	4.9	4.1	1.6	5.0	7.4	45.0	C	12

PROFILE 25

Legend unit:	Ps2
Soil classification:	Carbic Podzol
Description:	On 10-03-93 by John Pulles and Zab Khan
Location:	About 3.5 km E. of Kurupukari falls, along cattle trail. UTM: X=31700, Y=517200
Elevation:	About 200 ft
Landform and slope:	Flat to gently undulating sedimentary plain; flat at site (0% slope)
Parent material:	Unconsolidated sediments of the Berbice formation
Vegetation:	About 3 m high Muri scrub
Drainage:	Poorly drained; ponded for 3 to 6 months a year
Soil	Grey sand over black to dark yellowish brown, hard, loamy sand.

Depth (cm)	Hor.	Description
0 - 8	AE	very dark grey (10YR3/1); sand; single grain; loose, non sticky, non plastic; common fine, few medium roots; clear and smooth transition to
8 - 24	E1	dark grey (10YR4/1); sand; single grain; loose, non sticky, non plastic; very few fine roots; clear and wavy transition to
24 - 46	E2	grey to light grey (10YR6/1); sand; single grain; loose, non sticky, non plastic; abrupt and wavy transition to
46 - 53	Bh	black (10YR2/1); loamy sand; particles coated with humus; single grain; loose, non sticky, non plastic; abrupt and broken transition to
53 - 93	Bmh	dark yellowish brown (10YR4/6) changing with depth to strong brown (7.5YR4/6); loamy sand; extremely hard when dry, extremely firm, non sticky, non plastic; few very fine pores.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*
1	0	8	4.3	2.7	0.3	1.2	0.06	20	0.03
2	8	24	4.4	3.2	0.6	0.2	0.01	20	0.02
3	24	46	5.6	4.4	0.3	tr			0.02
4	46	53	3.9	3.1	2.9	3.3	0.11	30	0.04
5	53	93	4.2	3.6	4.4	3.2	0.07	45	0.03
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**
	cmol+/kg								*%*
1	0.0	0.0	0.2	0.0	1.0	0.0	1.2	3.3	6
2	0.0	0.0	0.0	0.0	0.3	0.0	0.3	0.7	0
3	0.0	0.0	0.2	0.0			0.2	0.7	29
4	0.0	0.0	0.2	0.0	6.8	5.9	7.0	17.4	1
5	0.0	0.0	0.0	0.0	5.3	4.4	5.3	22.4	0
	Sand					**Silt**		**Clay**	**Texture**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*	
1	4.0	20.7	33.7	25.0	7.5	3.4	2.6	3.1	S
2	6.6	21.2	27.9	27.1	7.0	4.5	3.1	2.6	S
3	10.3	25.3	27.0	23.4	5.5	5.2	2.5	0.9	S
4	6.1	18.0	25.2	24.0	9.6	8.4	2.7	5.9	LS
5	5.0	17.9	27.1	23.1	6.9	8.4	4.9	6.6	LS

PROFILE 26

Legend unit:	Ps7
Soil classification:	Acri-xanthic Ferralsol
Description:	On 22-03-93 by John Pulles and Zab Khan
Location:	About 14 km NNE of Kurupukari; UTM: X=318249, Y=529289
Elevation:	About 250 ft
Landform and slope:	Undulating sedimentary plain; flat at site
Parent material:	Unconsolidated sediments of the Berbice formation
Vegetation:	Not described
Drainage:	Well drained
Soil:	Brownish yellow, sandy clay loam with sand to sandy loam topsoil.

Depth (cm)	Hor.	Description
0 - 5	OA	brown (7.5YR5/3) sand and litter with root mat and worm cast; at bottom cm of layer, sand is intermixed; abrupt and smooth transition to
5 - 16	Ah	dark brown to brown (10YR4/3); sandy loam; weak, medium subangular blocky; very friable, slightly sticky, slightly plastic; common fine and medium, few coarse roots; few pores; clear and smooth transition to
16 - 36	BA	dark yellowish brown (10YR4/4); sandy clay loam; weak medium subangular blocky; very friable, slightly sticky, slightly plastic; common fine and medium, few coarse roots; common fine pores; gradual and smooth transition to
36 - 62	Bws1	yellowish brown (10YR5/6); sandy clay loam; weak medium subangular blocky; friable, slightly sticky, slightly plastic; few fine and medium, very few coarse roots; common fine pores; gradual and smooth transition to
62 - 99	Bws2	brownish yellow (10YR6/6); sandy clay loam; weak medium subangular blocky; friable, slightly sticky, slightly plastic; very few roots; few fine pores; gradual and smooth transition to
99 - 160	Bws3	reddish yellow (7.5YR6/6); sandy clay loam; weak medium subangular blocky; friable, slightly sticky, slightly plastic; very few fine roots; few fine pores.

Notes: charcoal fragments at 30 cm

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe
	upper	lower	H_2O	KCl	mg/kg	%	%		mS/cm
1	5	0	4.6	3.1	0.2	5.9	0.31	19	0.11
2	0	16	4.0	3.8	1.7	1.3	0.12	11	0.08
3	16	36	4.4	4.0	1.0	0.8	0.06	13	0.04
4	36	62	4.4	4.0	0.5	0.4	0.04	10	0.03
5	62	99	4.7	4.3	0.2	0.2	0.02	10	0.02
6	99	160	4.6	4.2	0.0	0.2			0.02
7	250	270	4.8	4.5	0.0	0.1			0.02

	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS
	cmol+/kg								%
1	1.6	0.7	0.4	0.2	0.5	0.2	3.4	11.6	25
2	0.0	0.0	0.0	0.0	1.9	1.1	1.9	4.2	0
3	0.0	0.0	0.1	0.0	1.6	0.9	1.7	2.3	4
4	0.0	0.0	0.2	0.0	1.2	0.7	1.4	1.9	11
5	0.0	0.0	0.2	0.0	0.8	0.2	1.0	1.2	17
6	0.0	0.0	0.2	0.0	0.9	0.2	1.1	1.1	18
7	0.0	0.0	0.2	0.0	0.3	0.2	0.5	0.9	22

	Sand					Silt		Clay	Texture
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2	
1	6.6	30.7	44.9	10.2	0.9	1.3	0.8	4.8	S
2	1.7	10.3	37.7	25.3	4.2	2.4	1.4	17.0	SL
3	1.7	8.0	33.2	25.6	3.2	3.3	0.9	24.1	SCL
4	0.6	5.8	30.4	26.1	5.0	3.6	0.5	28.0	SCL
5	2.6	9.2	30.0	23.2	3.3	3.6	0.7	27.4	SCL
6	1.3	8.8	29.4	19.6	4.4	3.8	0.5	32.2	SCL
7	2.2	10.7	24.7	22.8	3.5	3.9	9.6	22.6	SL

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
20	39.9	39.8	39.3	30.2	27.6	24.0	15.1	13.6	1.46
50	37.3	37.1	36.0	26.5	24.9	22.1	16.7	16.2	1.51
100	36.3	36.2	36.1	28.8	27.7	25.2	19.8	19.2	1.54

PROFILE 27

Legend unit:	Ps7
Soil classification:	Acri-haplic Ferralsols Ebini sandy clay loam
Description:	On 31-03-93 by John Pulles and Zab Khan
Location:	About 15 km NNE of Kurupukari; UTM: X=319593 Y=529409
Elevation:	About 250 ft
Landform and slope:	Undulating sedimentary plain; convex upper slope, 8%
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Mixed forest with Greenheart and Kakarali
Drainage:	Well drained
Soil:	Very deep, brown sandy clay with 23 cm sandy clay loam topsoil.

Depth (cm)	Hor.	Description
0 - 13	Ah1	dark brown to brown (10YR4/3); sandy clay loam; moderate fine subangular blocky; friable, slightly sticky, slightly plastic; many fine and medium, common coarse roots; few fine pores; clear and smooth transition to
13 - 23	Ah2	yellowish brown (10YR5/4); sandy clay loam; moderate medium subangular blocky; friable, slightly sticky, slightly plastic; common roots; few pores; clear and smooth transition to
23 - 43	Bws1	yellowish brown (10YR5/6); sandy clay; moderate medium subangular blocky; friable, slightly sticky, slightly plastic; few fine and medium roots; few pores; gradual and smooth transition to
43 - 64	Bws2	strong brown (7.5YR5/6); sandy clay, coarse; moderate medium subangular blocky; friable, slightly sticky, slightly plastic; very few fine and medium roots; few pores; gradual and smooth transition to
64 - 170	Bws3	yellowish red (5YR5/6); sandy clay, with many quartz grains, not rounded; fine distinct diffuse pale brown (10YR7/4) mottles; weak, coarse subangular blocky, friable when crushed; friable, slightly sticky, slightly plastic; few pores.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	13	4.1	3.7	0.6	1.7	0.12	14	0.16	
2	13	23	4.5	3.9	0.3	1.2	0.09	14	0.06	
3	23	43	4.6	4.0	0.0	0.6	0.06	10	0.04	
4	43	64	4.6	4.1	0.0	0.4	0.03	12	0.03	
5	80	90	4.5	4.0	0.0	0.2	0.020	10	0.02	
6	135	145	4.7	4.2	0.0	0.1			0.02	
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	0.2	0.3	1.6	0.1	1.8	0.9	4.0	4.7	47	
2	0.0	0.3	0.3	0.0	1.4	0.7	2.0	3.5	17	
3	0.0	0.0	0.2	0.0	1.2	0.5	1.4	1.9	11	
4	0.0	0.0	0.2	0.0	1.0	0.2	1.2	2.5	8	
5	0.2	0.0	0.2	0.0	0.9	0.5	1.3	1.1	36	
6	0.0	0.0	0.2	0.0	0.5	0.0	0.7	1.6	13	
	Sand					**Silt**		**Clay**	**Texture**	**Gravel**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		%
1	9.0	21.0	18.6	17.1	3.5	2.7	1.7	26.4	SCL	1
2	13.3	13.7	14.0	14.7	5.3	3.9	1.4	33.7	SCL	4
3	9.8	11.0	13.1	14.7	3.4	3.4	2.2	42.4	SC	6
4	16.1	17.6	8.4	7.4	2.7	1.9	2.1	43.8	SC	7
5	15.0	17.3	8.8	7.2	1.6	2.5	4.2	43.5	SC	4
6	10.0	21.1	8.6	5.9	2.0	2.1	4.3	46.0	SC	0

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
25	38.8	38.5	37.5	32.6	31.6	29.8	27.3	22.0	1.55
50	39.0	38.9	37.6	34.2	33.5	31.9	29.8	25.2	1.54

PROFILE 28

Legend unit:	Ps7
Soil classification:	Ferrali-luvic Arenosol Tabela sand/loamy sand
Description:	On 31-03-93 by John Pulles and Zab Khan
Location:	About 15 km NNE of Kurupukari; UTM: X=320920 Y=529471
Elevation:	About 250 ft
Landform and slope:	Undulating sedimentary plain; crest, 2%
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Mixed forest
Drainage:	Well to somewhat excessively drained
Soil:	Very deep, strong brown sand; with 28 cm sand topsoil.

Depth (cm)	Hor.	Description
0 - 15	Ah1	dark brown to brown (10YR4/3); sand; single grain; loose, non sticky, non plastic; many fine and medium, few coarse roots; clear and smooth transition to
15 - 28	Ah2	dark brown to brown (10YR4/3); sand; weak fine subangular blocky; loose, non sticky, non plastic; many fine and medium roots, few coarse; few pores; gradual and smooth transition to
28 - 70	BA	dark yellowish brown (10YR4/6); loamy sand; weak fine subangular blocky; loose, non sticky, non plastic; common medium, few fine and coarse roots; few pores; gradual and smooth transition to
70 - 110	Bws1	strong brown (7.5YR4/6); loamy sand; weak fine subangular blocky, falling apart under light pressure; loose, non sticky, non plastic; few medium, very few fine and coarse roots; few pores; gradual and smooth transition to
110 - 170	Bws2	strong brown (7.5YR5/6); loamy sand to sandy loam; weak fine subangular blocky; loose, non sticky, non plastic; very few medium roots; few pores.

Notes: 50% of surface covered with litter, 1 leaf layer thick; 1-1.5 cm thick root mat in topsoil.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	lower	H_2O	KCl	mg/kg	%	%		mS/cm	
1	0	15	4.7	3.4	0.3	0.6	0.05	12	0.06	
2	15	28	4.5	3.9	0.7	0.8	0.07	11	0.09	
3	28	70	4.7	4.3	0.3	0.7	0.04	18	0.03	
4	70	110	4.8	4.4	0.0	0.3	0.02	13	0.02	
5	110	170	4.6	4.5	0.0	0.2			0.02	
	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								%	
1	0.0	0.0	0.3	0.0	0.7	0.0	1.0	2.4	13	
2	0.0	0.0	0.2	0.0	1.3	0.7	1.5	2.3	9	
3	0.2	0.0	0.2	0.0	0.6	0.2	1.0	1.4	29	
4	0.0	0.0	0.2	0.0	0.3	0.0	0.5	0.9	22	
5	0.0	0.0	0.2	0.0	0.1	0.2	0.3	0.5	40	
	Sand					Silt		Clay	Texture	Gravel %
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		
1	7.7	34.1	42.7	9.4	0.7	1.8	0.9	2.7	S	0
2	7.3	19.3	41.1	19.9	2.7	0.9	1.8	7.0	S	3
3	5.7	15.0	39.0	22.8	2.6	2.5	0.7	11.6	LS	1
4	4.6	14.6	37.0	23.3	3.7	3.2	1.2	12.4	LS	1
5	4.0	12.5	37.8	26.1	2.5	3.0	0.9	13.2	LS/SL	1

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
20	28.9	27.2	20.4	14.4	13.0	11.8	7.8	6.5	1.35
50	42.2	39.8	26.9	17.2	15.5	13.8	7.7	7.0	1.35

PROFILE 29

Legend unit:	A1
Soil classification:	Dystric Fluvisol/gleyic Cambisol
Description:	On 20-08-93 by John Pulles and Zab Khan
Location:	About 7 km S of Pibiri field camp; UTM: X=318170, Y=550200
Elevation:	About 150 ft
Landform and slope:	Floodplain; flat at site
Parent material:	Recent, unconsolidated, alluvial deposits
Vegetation:	Mixed forest, dominated by Mora species
Drainage:	Moderately well to imperfectly drained
Soil:	Yellowish brown to pale brown, mottled clay loam with dark brown clay loam topsoil. Groundwater fluctuates between 33 and about 200 cm depth.

Depth (cm)	Hor.	Description
0 - 9	Ah	dark brown (10YR3/3); clay loam; moderately developed medium granular structure; very friable when moist, slightly sticky and slightly plastic when wet; common fine roots; common fine pores; clear and smooth transition to
9 - 33	AB	dark yellowish brown (10YR4/4); clay loam; moderate fine to medium subangular blocky; very friable, slightly sticky, slightly plastic; few coarse and fine, common medium roots; common fine and few medium pores; gradual and smooth transition to
33 - 56	Bg1	yellowish brown (10YR5/4); clay; 20% mottles yellowish red (5YR5/6), fine, faint, diffuse; moderate fine to medium subangular blocky; friable, slightly sticky, slightly plastic; very few fine and medium roots; common fine pores; gradual and smooth transition to
56 - 95	Bg2	yellowish brown (10YR5/4); clay loam; 40% mottles yellowish red (5YR5/6), fine, distinct, clear; soft manganese concretions; moderate fine to medium angular to subangular blocky; very few fine roots; common fine pores; gradual and smooth transition to
95 - 135	BCg3	pale brown (10YR6/3); clay; 50% mottles yellowish red (5YR5/6), fine, distinct, clear; soft manganese concretion; moderate fine to medium angular to subangular blocky; common fine pores.

Note: at 220 cm, grey (N/6); clay; plastic, slightly sticky.

Layer	Samp.Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	9	5.4	4.2	1.7	4.1	0.32	13	0.42	
2	9	33	5.4	4.3	0.8	1.3	0.15	9	0.06	
3	33	56	5.4	4.1	0.0	0.8	0.09	9	0.03	
4	56	95	5.4	4.4	0.0	0.6	0.06	10	0.02	
5	95	135	5.5	4.3	0.0	0.6	0.07	9	0.02	
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	4.9	2.4	0.8	0.1	0.8	0.3	9.0	11.8	69	
2	1.1	1.4	0.6	0.0	0.7	0.2	3.8	6.6	47	
3	0.0	1.4	0.5	0.0	1.3	0.5	3.2	6.1	31	
4	0.0	1.8	0.4	0.0	0.7	0.5	2.9	4.8	46	
5	0.0	2.2	0.4	0.0			2.6	5.5	47	
	Sand					**Silt**		**Clay**	**Texture**	
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		
1	0.1	0.2	0.8	13.3	20.3	11.2	20.3	33.7	cl	
2	0.0	0.2	0.6	13.5	16.3	13.7	19.4	36.4	cl	
3	0.0	0.1	0.7	9.5	17.6	10.7	19.7	41.8	c	
4	0.0	0.1	0.7	14.8	14.9	9.9	19.8	39.7	cl	
5	0.0	0.1	0.8	8.8	13.1	10.8	20.0	46.5	c	

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
10-15	57.9	57.2	56.8	54.7	52.0	49.6	44.9	37.7	1.13
30-35	53.7	53.2	51.7	48.1	46.4	44.8	43.7	40.3	1.23
85-90	51.2	50.5	49.0	45.0	42.6	40.7	39.6	34.4	1.28

PROFILE 30

Legend unit:	Ps6
Soil classification:	Acri-haplic Ferralsol Kasarama loamy sand
Description:	On 30-08-93 by John Pulles and Zab Khan
Location:	About 6.5km SSW of Pibiri field camp; UTM: X=318835 Y=550050
Elevation:	About 200 ft
Landform and slope:	Undulating sedimentary plain; convex upper slope, 4% to N
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	Mixed forest
Drainage:	Well drained
Soil:	Very deep, dark brown sandy loam; with 30 cm thick sand and loamy sand topsoil.

Depth (cm)	Hor.	Description
0 - 4	OA	dark brown (7.5YR3/2); bleached sand grains with semi-decomposed leafs and twigs; abrupt and smooth transition to
4 - 16	Ah1	dark brown to brown (7.5YR4/4); sand; single grain; loose, non sticky, non plastic; many fine and common medium roots; clear and smooth transition to
16 - 30	Ah2	dark brown to brown (10YR4/3); loamy sand; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; common medium, few fine roots; 40-50% of soil consists of 5 mm worm casts; clear and smooth transition to
30 - 68	BA	dark yellowish brown (10YR4/4); sandy loam; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; few fine and medium roots; common fine pores; gradual and smooth transition to
68 - 119	Bws1	yellowish brown (10YR5/6); sandy clay loam; weak fine to medium subangular blocky, easily falling apart; very friable, slightly sticky, slightly plastic; very few medium roots; common fine pores; diffuse and smooth transition to
119 - 195	Bws2	yellowish brown (10YR5/8); slightly gravelly (3%, 3-10 mm, hard, irregular, ironstone and quartz), sandy clay loam; moderate medium subangular blocky; very friable, slightly sticky, slightly plastic; few fine pores.

Notes: 95% of surface covered with litter, dry, 3 leaf layers thick; worm casts present.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*
1	0	4	4.4	2.9	0.8	4.2	0.17	25	0.05
2	7	13	3.8	3.6	1.4	0.5	0.04	12	0.02
3	20	26	4.2	4.1	2.9	0.9	0.06	15	0.07
4	40	55	4.8	4.2	0.7	0.4	0.03	13	0.02
5	85	100	5.0	4.4	0.0	0.2	0.02	10	0.02
6	135	150	5.0	4.6	0.8	0.1			0.01
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**
	cmol+/kg								*%*
1	0.0	0.4	0.5	0.1	1.4	0.2	2.4	8.3	12
2	0.0	0.0	0.3	0.0	0.9	0.5	1.2	1.4	21
3	0.0	0.0	0.4	0.0	1.5	0.9	1.9	2.9	14
4	0.0	0.0	0.3	0.0	0.8	0.5	1.1	1.1	27
5	0.0	0.0	0.2	0.0	0.6	0.2	0.8	0.6	33
6	0.0	0.0	0.4	0.0	0.3	0.0	0.7	0.4	
	Sand					**Silt**		**Clay**	**Texture**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*	
1	6.1	28.9	47.3	12.8	0.8	0.5	0.3	3.3	S
2	3.5	20.2	48.1	21.0	1.8	1.1	0.2	4.2	S
3	2.0	8.8	29.1	35.2	7.6	2.6	0.2	14.5	LS
4	4.4	10.9	31.2	28.9	4.6	1.8	0.5	17.7	SL
5	1.9	7.8	27.9	31.0	6.7	1.7	0.0	23.0	SCL
6	4.7	10.8	28.1	26.1	4.3	3.1	0.2	22.7	SCL

PROFILE 31

Legend unit:	Ps6
Soil classification:	Acri-haplic Ferralsol Kasarama loamy sand
Description:	On 30-8-93 by John Pulles and Zab Khan
Location:	About 7 km S of Pibiri field camp; UTM: X=318840, Y=549060
Elevation:	About 200 ft
Landform and slope:	Undulating sedimentary plain; 1% slope to NW
Parent material:	Unconsolidated sediments of Berbice formation, over colluvial material derived from ironstone sedimentary plain
Vegetation:	Mixed forest
Drainage:	Well drained
Soil:	Very deep, strong brown, very gravelly sandy clay loam with 26 cm thick sand topsoil; gravel from 58 cm depth.

Depth (cm)	Hor.	Description
0 - 3	OA	dark reddish brown (5YR2.5/2); sand; loose, non sticky, non plastic; many fine and medium roots; abrupt and smooth transition to
3 - 26	Ah	dark greyish brown (10YR4/2); sand; single grain; loose, non sticky, non plastic; few very coarse, common fine and medium roots; clear and smooth transition to
26 - 58	AB	dark brown to brown (10YR4/3); sand to loamy sand, light; weak medium subangular blocky, easily crushed; loose, non sticky, non plastic; common medium roots; common fine pores; gradual and smooth transition to
58 - 102	Bws1	strong brown (7.5YR4/6); very gravelly (75%, 5-40mm, irregular and rounded) sandy loam; granular; very friable, slightly sticky, slightly plastic; few medium roots; common fine pores; gradual and smooth transition to
102 - 170	Bws2	strong brown (7.5YR5/6); very gravelly (90%) sandy clay loam; granular; very friable, slightly sticky, slightly plastic; very few medium roots.

Notes: Litter 100%, 3 leaves thick; no worm casts visible except in root mat. In augering at 230 cm, soil changes into coarse sandy loam, 7.5YR5/6.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	lower	H_2O	KCl	mg/kg	%	%		mS/cm	
1	0	3	3.9	2.6	0.0	5.1	0.25	20	0.18	
2	7	22	4.3	3.6	0.7	0.5	0.03	16	0.10	
3	35	49	4.1	4.1	0.7	0.7	0.06	11	0.11	
4	73	87	4.8	4.4	0.7	0.5	0.03	16	0.02	
5	125	145	4.8	4.5	0.0	0.3	0.03		0.02	
6	270	290	5.1	4.7	0.0	0.1			0.02	
	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								%	
1	0.5	1.3	0.3	0.1	2.2	0.3	4.4	12.1	18	
2	0.2	0.0	0.3	0.0	0.5	0.0	1.0	1.0	50	
3	0.0	0.0	0.2	0.1	1.7	1.1	2.0	3.3	9	
4	0.4	0.0	0.2	0.0	1.1	0.7	1.7	2.7	22	
5	0.0	0.0	0.1	0.0	0.6	0.5	0.7	1.8	6	
6	0.2	0.0	0.0	0.0	0.2	0.2	0.4	1.1	18	
	Sand					Silt		Clay	Texture	Gravel %
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		
1	3.5	26.9	48.1	14.1	1.5	2.0	0.6	3.4	S	n.d..
2	2.3	20.7	50.4	21.8	1.1	0.2	0.2	3.3	S	n.d.
3	2.3	9.5	31.2	37.6	7.5	3.0	0.7	8.2	S-LS	n.d.
4	2.0	8.5	30.1	31.2	5.3	3.8	0.2	18.9	SL	n.d.
5	3.2	7.1	24.7	24.3	6.4	3.9	0.0	30.4	SCL	n.d.
6	14.9	30.2	20.3	13.6	2.3	3.7	0.5	14.6	SL	n.d.

PROFILE 32

Legend unit:	Ps6
Soil classification:	Acri-xanthic Ferralsol Kasarama sandy clay loam
Description:	On 31-08-93 by John Pulles and Zab Khan
Location:	About 7 km S of Pibiri field camp; UTM: X=319430, Y=548100
Elevation:	About 250 ft
Landform and slope:	Undulating sedimentary plain; convex upper slope, 5%
Parent material:	Unconsolidated sediments of Berbice formation
Vegetation:	mixed forest with Morabukea
Drainage:	Well drained
Soil:	Very deep, yellowish brown, sandy clay loam; with 29 cm thick sand to sandy loam topsoil.

Depth (cm)	Hor.	Description
0 - 8	Ah1	dark brown to brown (7.5YR4/2); sand, medium; single grain and weak fine granular; loose, non sticky, non plastic; many roots; abrupt and smooth transition to
8 - 29	Ah2	dark brown to brown (10YR4/3); sandy loam to sandy clay loam; weak very fine granular and fine subangular blocky; very friable, non sticky, slightly plastic; common fine and medium, few coarse roots; clear and smooth transition to
29 - 50	BA	dark yellowish brown (10YR4/4); sandy clay loam; weak medium subangular blocky; very friable, slightly sticky, slightly plastic; few fine, common medium roots; common fine pores; gradual and smooth transition to
50 - 130	Bws1	yellowish brown (10YR5/6); sandy clay loam; weak medium subangular blocky; very friable, slightly sticky, slightly plastic; few to common medium, few coarse roots; common fine pores; gradual and smooth transition to
130 - 185	Bws2	strong brown (7.5YR5/6); sandy clay loam; weak medium to coarse subangular blocky; very friable, slightly sticky, slightly plastic; very few fine roots; few fine pores.

Notes: Charcoal pieces at 80 and 40 cm. Few quartz and ironstone gravel from 20 cm.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	8	4.5	3.3	4.7	1.4	0.09	16	0.09	
2	11	26	4.3	4.2	4.8	1.2	0.08	15	0.07	
3	32	47	4.7	4.3	0.7	0.5	0.04	12	0.02	
4	62	77	4.7	4.3	0.8	0.2	0.02	10	0.02	
5	102	117	4.8	4.3	0.0	0.1			0.02	
6	150	165	5.3	4.3	0.7				0.02	
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	0.0	0.3	0.3	0.1	1.0	0.5	1.7	4.8	15	
2	0.0	0.0	0.1	0.0	1.7	0.9	1.8	3.7	3	
3	0.4	0.0	0.1	0.0	1.0	0.7	1.5	2.4	21	
4	0.0	0.0	0.3	0.1	0.8	0.5	1.2	2.3	17	
5	0.2	0.0	0.2	0.0	0.8	0.2	1.2	1.6	25	
6	0.0	0.0	0.0	0.1	0.7	0.2	0.8	1.2	8	
	Sand					**Silt**		**Clay**	**Texture**	
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		
1	7.8	31.9	38.4	13.7	1.9	0.0	0.2	6.1	S	
2	5.5	11.0	24.1	29.8	6.2	3.2	0.0	20.2	SL/SCL	
3	5.7	9.7	19.4	27.2	8.3	4.2	1.4	24.2	SCL	
4	4.4	11.5	24.4	24.6	5.2	4.0	0.2	25.8	SCL	
5	3.3	9.4	22.0	25.8	7.4	2.7	0.2	29.0	SCL	
6	5.2	12.7	20.0	23.6	5.5	3.1	0.2	29.8	SCL	

Soil moisture retention

depth (cm)/pF	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2	BD
15-20	44.4	43.2	37.2	30.8	27.7	26.1	20.7	20.0	1.44
37-42	37.4	35.3	29.9	26.2	24.0	22.6	19.4	17.3	1.53
88-93	34.1	33.3	29.6	23.5	20.9	19.8	19.4	18.4	1.62

PROFILE 33

Legend unit:	Pe3
Soil classification:	Dystric Leptosol, rudic and petroferric phase
Description:	On 31-08-93 by John Pulles and Zab Khan
Location:	About 6.5 km SSW of Pibiri field camp; UTM: X=317205, Y=550040
Elevation:	About 300 ft
Landform and slope:	Flat (ironstone) erosional plain, locally dissected; 0% slope
Parent material:	Ironstone
Vegetation:	Low and thin forest with wild Guava and Kakaralli
Surface stoniness:	Stony and gravelly (ironstone)
Drainage:	Somewhat excessively drained
Soil:	Moderately deep, extremely gravelly, sandy clay loam over ironstone.

Depth (cm)	Hor.	Description
0 - 21	Ah	dark brown (7.5YR3/2); very gravelly and stony (80%) sandy clay loam; weak fine granular; common fine and medium roots; gradual and smooth transition to
21 - 45/60	BA	dark brown to brown (10YR4/3); very gravelly (80%) sandy clay loam; weak fine granular; common fine and medium roots; over ironstone rock.

Notes: Litter coverage 90% of surface, 3 leaf layers thick; frequent worm casts.

Layer	Samp. Depth upper	Samp. Depth lower	pH H_2O	pH KCl	P-Bray mg/kg	OrgC %	N-Kjel %	C/N	ECe mS/cm	
1	5	15	4.4	4.0	7.4	3.0	0.21	15	0.24	
2	30	40	5.1	4.5	0.7	1.6	0.12	13	0.04	

	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								%	
1	0.0	0.0	0.0	0.1	2.0	1.4	2.1	6.5	2	
2	0.0	0.0	0.2	0.1	0.6	0.2	0.9	4.3	7	

	Sand					Silt		Clay	Texture	Gravel %
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		
1	5.2	2.0	5.9	26.8	19.0	11.8	4.6	24.7	SCL	n.d.
2	15.9	4.4	4.3	20.1	12.8	11.2	5.0	26.2	SCL	n.d.

PROFILE 34

Legend unit:	Pe3
Soil classification:	Acri-haplic Ferralsol, rudic phase
Description:	On 31-08-93 by John Pulles and Zab Khan
Location:	About 7.5km SW of Pibiri field camp; UTM: X=317560, Y=550060
Elevation:	About 250 ft
Landform and slope:	Flat to steeply dissected (ironstone) erosional plain; 45%, middle, straight slope to E.
Parent material:	ironstone, over igneous rock
Vegetation:	Primary forest with Greenhearts
Surface stoniness:	Gravelly and stony
Drainage:	Somewhat excessively drained
Soil:	Very deep, very gravelly clay over rotten rock.

Depth (cm)	Hor.	Description
0 - 6	Ah1	dark brown (7.5YR3/2) sandy clay loam; root mat with sand at surface; loose, non sticky, non plastic; many fine and medium roots; abrupt and smooth transition to
6 - 17	Ahcs2	dark brown to brown (7.5YR4/3); very gravelly and stony (80%, ironstone) sandy clay; weak fine granular; very friable, slightly sticky, slightly plastic; many medium to coarse roots, common fine; clear and smooth transition to
17 - 60	Bcs	dark brown to brown (7.5YR4/4); very gravelly (90%) clay; weak fine granular and subangular blocky; very friable, slightly sticky, slightly plastic; few fine and medium roots; gradual and smooth transition to
60 - 93	BCcs	yellowish red (5YR4/6); gravelly (30%) clay; weak medium subangular blocky; friable, slightly sticky, slightly plastic; few fine roots; few fine pores; gradual and smooth transition to
93 - 185	C	yellowish red (5YR4/6); clay; weak coarse subangular blocky; friable, slightly sticky, plastic; common fine pores.

Notes: Litter cover 95% of surface, 2 leaf layers thick. In augering at 250 cm texture changes to loamy sand, red, with increasing yellowish brown mottling due to rotten rock (granite?).

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	6	4.7	3.6	0.8	4.4	0.27	16	0.11	
2	6	17	4.5	3.9	2.1	3.4	0.22	15	0.09	
3	32	45	5.2	4.5	0.7	1.2	0.10	12	0.02	
4	70	83	5.2	4.7	0.8	0.7	0.06	11	0.01	
5	133	145	5.3	5.1	0.0	0.3			0.01	
	Ca	**Mg**	**Na**	**K**	**H + Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	0.9	0.8	0.4	0.3	2.1	1.3	4.5	13.4	18	
2	0.4	0.3	0.3	0.0	2.4	1.6	3.4	8.4	12	
3	0.4	0.0	0.2	0.0	0.7	0.2	1.3	3.8	16	
4	0.0	0.0	0.2	0.0	0.2	0.0	0.4	2.5	8	
5	0.0	0.0	0.1	0.0	0.1	0.0	0.2	2.3	4	
	Sand					**Silt**		**Clay**	**Texture**	**Gravel**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		**%**
1	19.0	26.4	15.4	5.9	2.9	4.7	0.5	25.1	SCL	n.d.
2	9.8	15.7	13.8	10.5	4.5	4.2	3.0	38.4	SC	n.d.
3	4.6	5.1	9.1	10.9	6.6	5.4	2.7	55.6	C	n.d.
4	3.3	7.8	9.9	9.7	4.2	4.4	2.1	58.6	C	n.d.
5	3.4	12.6	13.2	8.7	2.9	4.3	3.4	51.5	C	n.d.

PROFILE 35

Legend unit:	Ps6
Soil classification:	Acri-xanthic Ferralsol
Description:	On 08-09-93 by Zab Khan
Location:	About 6.5 km S. of Pibiri field camp; UTM: X=322000, Y=551000
Elevation:	About 200 ft
Landform and slope:	Flat to undulating sedimentary plain; flat at site
Parent material:	Unconsolidated sediments of the Berbice formation
Vegetation:	Mixed primary forest with Greenheart and Kakarali trees
Drainage:	Well drained
Soil:	Very deep, (yellowish) brown, sandy clay loam with sand to loamy sand topsoil.

Depth (cm)	Hor.	Description
0 - 5	Ah1	dark brown (10YR3/3); sand; single grain; loose, non sticky, non plastic; many fine and medium roots, few coarse; abrupt and smooth transition to
5 - 23	Ah2	dark brown to brown (10YR4/3); sandy loam; weak medium subangular blocky; friable, non sticky, non plastic; common fine and medium roots; few fine pores; clear and smooth transition to
23 - 50	Bws1	yellowish brown (10YR5/6); sandy clay loam; weak medium subangular blocky; friable, non sticky, slightly plastic; common fine and medium roots; common fine pores; clear and smooth transition to
50 - 67	Bws2	yellowish brown (10YR5/8); sandy clay loam; weak medium subangular blocky; friable, slightly sticky, slightly plastic; few fine roots; common fine pores; gradual and smooth transition to
67 - 184	Bws3	strong brown (7.5YR5/6); sandy clay loam; weak medium subangular blocky; friable, slightly sticky, slightly plastic; few fine roots; common fine pores.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	5	4.2	3.4	2.1	1.4	0.10	14	0.10	
2	5	23	3.9	3.8	3.1	1.4	0.11	13	0.12	
3	23	50	4.5	4.1	0.7	0.6	0.05	11	0.04	
4	50	67	4.8	4.3	0.7	0.2			0.02	
5	67	118	4.8	4.4	0.7	0.1			0.12	
6	118	184	4.9	4.5	0.7	0.1			0.01	

	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								*%*	
1	0.0	0.0	0.0	0.1	1.0	0.5	1.1	4.7	2	
2	0.0	0.0	0.2	0.1	2.0	1.4	2.3	4.2	7	
3	0.6	0.0	0.0	0.1	1.2	0.7	1.9	1.8	39	
4	0.0	0.0	0.1	0.0	0.7	0.5	0.8	1.9	5	
5	0.0	0.0	0.0	0.0	0.6	0.2	0.6	1.6	0	
6	0.0	0.0	0.2	0.1	0.4	0.2	0.7	2.8	11	

	Sand					Silt		Clay	Texture	
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		
1	2.3	22.4	49.4	15.8	1.8	2.1	0.2	6.0	S	
2	1.4	11.1	35.7	25.9	3.0	3.4	0.2	19.2	SL	
3	1.7	9.4	30.1	26.0	4.7	2.8	1.4	23.9	SCL	
4	2.1	10.8	32.0	22.4	3.0	3.5	0.2	26.0	SCL	
5	1.6	8.1	29.7	24.1	4.6	3.2	0.5	28.2	SCL	
6	1.5	10.2	32.6	21.4	2.7	2.5	0.2	28.9	SCL	

PROFILE 36

Legend unit:	H2
Soil classification:	Ferric Acrisol, skeletic phase
Description:	On 04-10-93 by John Pulles and Julian Charles
Location:	Near Essequibo, N of Akairama Mts; UTM: X=299840, Y=557490
Elevation:	About 300 ft
Landform and slope:	Small hill, rolling to hilly; crest, 4%
Parent material:	Dolerite
Vegetation:	Mixed forest
Surface stoniness:	Nil
Drainage:	Well drained
Soil:	Very deep, yellowish red, very gravelly clay with sandy clay loam topsoil.

Depth (cm)	Hor.	Description
0 - 7	Ah1	dark brown (10YR3/3); sandy loam; moderate medium granular; very friable, slightly sticky, slightly plastic; common fine and medium, few coarse roots; many pores; clear and smooth transition to
7 - 25	Ah2	dark brown to brown (10YR4/3); sandy clay loam; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; common fine and medium, few very coarse roots; many fine pores; clear and smooth transition to
25 - 60	Bt1	dark brown to brown (7.5YR4/4); very gravelly (70%, 10-60 mm, ironstone, irregular) sandy clay loam; weak fine subangular blocky; friable, slightly sticky, slightly plastic; few fine, very few medium roots; common fine pores; gradual and smooth transition to
60 - 105	Bt2	yellowish red (5YR4/6); slightly gravelly (<2%) sandy clay; weak medium subangular blocky; friable, slightly sticky, slightly plastic; very few fine and medium roots; common fine pores; gradual and smooth transition to
105 - 120/140	Bt3	yellowish red (5YR4/8); gravelly (40%) clay; weak medium subangular blocky; friable, slightly sticky, slightly plastic; very few fine roots; common fine pores.

Notes: Gravel in profile may occur at varying depths.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	0	7	3.9	3.6	3.6	3.3	0.23	14	0.14	
2	10	22	4.3	4.0	2.2	2.2	0.15	15	0.05	
3	35	50	4.8	4.4	0.7	1.4	0.09	16	0.02	
4	75	90	4.9	4.5	0.7	0.5	0.04	12	0.01	
5	105	120	5.1	4.8	0.0	0.5	0.04	12	0.01	

	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								*%*	
1	0.4	0.4	0.3	0.1	3.7	2.8	4.9	9.0	13	
2	0.2	0.0	0.3	0.0	3.9	2.6	4.4	8.8	6	
3	0.0	0.0	0.1	0.1	0.6	0.9	0.8	4.7	4	
4	0.0	0.0	0.2	0.1	0.7	0.5	1.0	2.1	14	
5	0.4	0.0	0.2	0.1	0.3	0.0	0.6	2.3	30	

	Sand					Silt		Clay	Texture	Gravel
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		%
1	3.0	7.3	21.7	28.7	11.9	5.9	6.7	14.8	SL	n.d.
2	3.9	5.6	15.8	26.4	10.2	6.8	6.8	24.5	SCL	n.d.
3	3.7	3.7	11.4	20.7	11.8	8.6	5.8	34.3	SCL	n.d.
4	4.5	4.2	12.5	21.8	9.2	6.4	5.4	36.0	SC	n.d.
5	4.7	4.2	8.3	14.6	8.8	6.3	7.9	45.2	C	n.d.

	Elemental composition of total soil (wt%)									
	SiO_2	*TiO_2*	*Al_2O_3*	*Fe_2O_3*	*MnO*	*MgO*	*CaO*	*Na_2O*	*K_2O*	*P_2O_5*
2	65.4	0.90	13.7	6.6	<0.1	0	0	0	0.02	<0.1
5	52.5	1.46	22.5	11.5	<0.1	0	0	0	<0.1	<0.1

	Elements		Mineralogical composition of the clay fraction (XRD)							
	BaO	*L.O.I.*	*Kaolinite*	*Mica Illite*	*Chlorite*	*Mixed Layer*	*Quartz*	*Gibbsite*	*Goethite*	
2		11.9								
5		12.8								

PROFILE 37

Legend unit:	H2
Soil classification:	Acri-haplic Ferralsol, skeletic phase
Description:	On 06-10-93 by John Pulles
Location:	About 1 km E of Essequibo, N of Akairama Mts; UTM: X=299390, Y=559000
Elevation:	About 200 ft
Landform and slope:	Low hill, undulating to hilly; crest, 4% to W
Parent material:	Dolerite intrusion
Vegetation:	Mixed forest
Surface stoniness:	None
Drainage:	Well drained
Soil:	Very deep, yellowish red to red, gravelly (rounded ironstone gravel, <2 cm) clay with sandy clay loam topsoil; over weathered rock.

Depth (cm)	Hor.	Description
0 - 8	Ah1	dark brown (10YR3/3); sandy clay loam; medium fine subangular blocky; very friable, slightly sticky, slightly plastic; many fine and medium, few coarse roots; common fine pores; clear and smooth transition to
8 - 17	Ah2	dark brown to brown (7.5YR4/4); sandy clay loam; weak fine subangular blocky; very friable, slightly sticky, slightly plastic; many fine and medium, few coarse roots; common fine pores; clear and smooth transition to
17 - 39	Bt1	reddish brown (5YR4/4); gravelly (25%, < 20 mm, ironstone) sandy clay loam to sandy clay; weak fine to medium subangular blocky; friable, slightly sticky, slightly plastic; few fine, common medium roots; common fine pores; gradual and smooth transition to
39 - 73	Bt2	yellowish red (5YR4/8); gravelly (45%) clay; weak medium subangular blocky; friable, slightly sticky, slightly plastic; few medium roots; common fine pores; gradual and smooth transition to
73 - 160	BC	red (2.5YR4/6); gravelly (30%, < 15 mm, angular and irregular) clay; weak coarse subangular blocky; 45% rock structure, strongly weathered; friable, slightly sticky, slightly plastic; very few medium roots; common fine pores.

Notes: Litter 100%, 2 layers; abundant worm casts resulting in micro-relief at surface.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	lower	H_2O	KCl	mg/kg	%	%		mS/cm	
1	0	7	3.8	3.6	4.0	3.6	0.25	14	0.16	
2	9	16	4.4	3.9	2.2	1.9	0.15	13	0.05	
3	22	34	4.7	4.2	0.7	1.3	0.11	12	0.03	
4	49	63	4.8	4.3	0.8	0.7	0.06	11	0.02	
5	108	125	5.3	4.7	0.7	0.4	0.03	13	0.01	

	Ca	Mg	Na	K	H + Al	Al	ECEC	CEC	BS	
	cmol+/kg								%	
1	0.2	0.3	0.1	0.1	4.3	3.5	5.0	10.3	7	
2	0.0	0.0	0.3	0.1	3.0	2.8	3.4	6.9	6	
3	0.2	0.0	0.1	0.1	2.0	1.4	2.4	4.7	9	
4	0.2	0.0	0.3	0.1	1.5	0.9	2.1	4.0	15	
5	2.1	0.0	0.2	0.1	0.1	0.1	2.5	2.6	92	

	Sand					Silt		Clay	Texture	Gravel %
	1000-2000	500-1000	250-500	100-250	50-100	20-50	2-20	<2		
1	3.9	7.6	16.8	22.5	8.7	6.4	6.9	27.2	SCL	n.d.
2	6.2	6.2	12.4	19.6	11.1	8.2	6.9	29.5	SCL	n.d.
3	5.9	5.1	10.5	18.6	9.0	8.3	8.5	34.0	SCL/SC	n.d.
4	4.2	4.6	8.3	13.8	9.6	8.2	6.5	44.8	C	n.d.
5	4.2	4.4	6.3	13.5	7.3	7.9	11.9	44.4	C	n.d.

	Elemental composition of total soil (wt%)									
	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5
2	63.5	0.96	15.4	6.6	tr.	0	0	0	0.03	tr.
5	46.1	1.86	27.5	12.1	tr.	0	0	0	0.06	tr.

	Elements		Mineralogical composition of the clay fraction (XRD)							
	BaO	L.O.I.	Kaolinite	Mica Illite	Chlorite	Mixed Layer	Quartz	Gibbsite	Goethite	
2		11.5								
5		14.3	+++	tr	tr			++-+++	++	

PROFILE 38

Legend unit:	H1
Soil classification:	Ferralic Cambisol; rudic phase (others likely: ferric Acrisols, skeletic phase)
Description:	By John Pulles
Location:	In W. of Akaiwanna mountains; UTM: X=301320, Y=553700
Elevation:	About 1000 ft
Landform and slope:	Steeply dissected hills; upper slope, convex, 14%
Parent material:	Dolerite
Vegetation:	Mixed primary forest
Surface stoniness:	5% coverage, boulders larger than 1 m
Drainage:	Well drained

Depth (cm)	Hor.	Description
0 - 10	Ah	dark brown to brown (10YR4/3); sandy clay; friable, slightly sticky, slightly plastic; gradual and smooth transition to
10 - 35	Bw	dark yellowish brown (10YR4/4); silty clay; slightly gravelly (5%, 2-10 mm); friable, slightly sticky, slightly plastic; clear and smooth transition to
35 - 120	Bw2	yellowish red (5YR4/6); silty clay; friable, slightly sticky, slightly plastic.

Layer	Samp. Depth		pH		P-Bray	OrgC	N-Kjel	C/N	ECe	
	upper	*lower*	*H_2O*	*KCl*	*mg/kg*	*%*	*%*		*mS/cm*	
1	15	25	5.4	4.7	0.7	2.3	0.22	10	0.06	
2	50	70	5.5	4.5	0.0	0.2	0.04	5	0.02	
3	100	120	5.2	4.2	0.0	0.2			0.02	
	Ca	**Mg**	**Na**	**K**	**H+Al**	**Al**	**ECEC**	**CEC**	**BS**	
	cmol+/kg								*%*	
1	0.4	1.0	0.0	0.2	0.2	0.0	1.8	6.5	25	
2	0.0	0.3	0.2	0.1	-	-	0.6	6.0	10	
3	0.0	0.0	0.1	0.1	2.9	2.3	3.1	6.7	3	
	Sand					**Silt**		**Clay**	**Texture**	**Gravel %**
	1000-2000	*500-1000*	*250-500*	*100-250*	*50-100*	*20-50*	*2-20*	*<2*		
1	6.1	2.4	4.2	18.8	12.3	7.7	11.0	37.5	SC	n.d.
2	0.4	0.5	2.0	8.0	4.2	9.3	34.0	41.8	SiC	n.d.
3	0.2	0.4	1.9	6.1	5.4	12.2	41.7	32.2	SiCL	n.d.

	Elemental composition of total soil (wt%)									
	SiO_2	*TiO_2*	*Al_2O_3*	*Fe_2O_3*	*MnO*	*MgO*	*CaO*	*Na_2O*	*K_2O*	*P_2O_5*
1	53.3	4.31	13.5	16.1	<0.1	0.29	0	0	0	<0.1
3	44.3	1.99	24.8	18.0	<0.1	0.43	0	0	0	<0.1
	Elements		**Mineralogical composition of the clay fraction (XRD)**							
	BaO	*L.O.I.*	*Kaolinite*	*Mica Illite*	*Chlorite*	*Mixed Layer*	*Quartz*	*Gibbsite*	*Goethite*	
1		11.2								
3		11.6								

ANNEX C Mapping unit descriptions

General

Terminology of soil characteristics and relief, used in the descriptions of mapping units follows the FAO Guidelines for Soil Profile Description (FAO, 1990). Soil colour codes and descriptions are in accordance with the Munsell Soil Color Charts (Munsell Products, 1973). The (semi-quantitative) qualifications of chemical soil properties follow those as given in the Booker Tropical Soil Manual (Landon, 1984). It should be noted that these qualifications are generalized and refer to agricultural use and therefore may not necessaryli be valid for forestry.

The terms laterite and ironstone are used synonymously.

Soil depth classes are as follows:
 shallow 0-25 cm; moderately deep 25-80 cm; deep 80-120 cm and very deep >120 cm.

Topsoil thickness classes are defined as follows:
 shallow 0-20 cm; moderately thick 10-30 cm and thick 20-40 cm.

Information on vegetation was not systematically recorded; for those mapping units of which vegetation information is available, it is indicated in the text. This concerns generalized information only as the soil surveyor's knowledge of species was limited. An overview of forest vegetation types in the area is given in section 2.6.

The sequence of map units is not alphabetical by mapping unit symbol, but according to the sequence in which they appear in the soil map legend. The main hierarchical order is from high to low. See section 3.6 for the explanation of the map unit hierarchy.

Surface area figures are given for each unit, in hectares and in percentages of the total area mapped. They have been determined by GIS means (Arc-Info). The total surface size of the area mapped is 218,699 ha (2,187 km^2).

H Hills

Mapping unit H1

Area:	17,004 ha; 7.8% of the survey area, divided over 2 polygons.
Nr. of observations:	18 augerings
Profile numbers:	Number 38 (augering, from which samples taken and analyzed)

setting
Mapping unit H1 constitutes steeply dissected high hills. These occur as a high ridge in the northeastern part (elevation 200 to 1000 ft, Mabura Hill) of the survey area and as extensive hilland in the central-western part (elevation 150 to 1400 ft, Akaiwanna Mts.). The relief intensity is 600 to 800 ft. These areas are the most dissected parts among the hills. Interfluves are locally broad, probably marking the remnant of an older erosion bevel. General slopes are between 16 and 30%, but steeper ones occur as well.
Soils have formed in metamorphic, mainly basic rocks of Precambrian age (Akaiwanna Formation and Roirama Intrusive Suite). Dolerite is the most common rock found in the Mabura Hills and the Akaiwanne Mts.

soils, general
The soils are moderately deep to very deep, over rock, with stony and bouldery surface. They are well to somewhat excessively drained, brown to red, clay loam to clay, containing moderate to high amounts of gravel, and are locally stony.

associated units and inclusions
In places, the landform/soil of mapping unit H3 is included. In creek bottoms, various alluvial soils occur.

topsoils
Stones and boulders appear at the surface with an average density of 20 - 40% cover. The mineral soil is covered with a thin litter layer, and a rootmat of 2-4 cm thick. Topsoils are 10 to 20 cm thick, dark brown, with sandy clay loam to clay textures, containing 30 - 70% fine, mostly lateritic, gravel. The pH is around 5.4, organic matter content is about 2-3% with a C/N ratio of 10. Available P content is very low (≤ 1 ppm). Exchangeable base saturation is about 25%.

sub-surface horizons
Sub-surface horizons are reaching a depth of about 50 cm, are brown to reddish brown, and have clay to clay loam textures. Organic carbon contents drops to about 0.2%.

subsoils
Subsoils, from a depth of about 50 cm, are strong brown to yellowish red, with textures ranging from clay to clay loam or silty clay. The pH is about 5.5. Exchangeable bases are virtually absent.

soil classification

FAO/Unesco:	Ferralic Cambisols, rudic phase
Soil Taxonomy:	Oxic Dystropepts

Mapping unit H2

Area:	4,537 ha, 2.1% of survey area; distributed over 17 polygons
Nr. of observations:	10 augerings
Profile numbers:	No. 24; 36; 37; (17)

setting
Mapping unit H2 represents moderately high, undulating to rolling, low hills, of less than 800 ft high. General slopes are between 5% (top-level) and 30% (slopes to surrounding country); the relief intensity is 200 to 400 ft. It concerns mostly isolated hills or hill-complexes, with their crests at an elevation of 600 to 800 ft a.s.l. They are found scattered throughout the survey area. The landforms rise up to 400ft above the surrounding country. Rock type is generally ferruginous Precambrian intrusive or igneous (gabbros, dolerites, amphibolites) in some cases shales, rich in ferromagnesian minerals.

soils, general
The soils are moderately deep to very deep, over rock, locally shallow. The surface soil commonly contains a high amount of fine ironstone gravel. They are well drained, yellowish red, gravelly to very gravelly clays, over weathered rock; with moderately thick, dark brown, very gravelly sandy clay loam topsoils; in places with gravelly or stony surfaces.

topsoils
The mineral soil is covered with a thin litter layer, and a thin rootmat. Topsoils are 10 to 20 cm thick, dark brown, with sandy clay loam to clay loam textures, mostly containing about 70% fine, lateritic, gravel. The pH is around 4 (3.7-4.2), the organic carbon content is about 2.5 to 3.5% with a C/N ratio of 13 to 14. Available P content is very low (0.4-4.0 mg/kg). CEC is between 6 and 10 cmol+/kg, and the exchangeable base saturation is between 1 and 10%.

sub-surface horizons
Sub-surface horizons (up to about 40 cm deep) are reddish brown, and have sandy clay to clay loam textures, with a moderate to high amount (25-75%) of fine ironstone gravel. The soil structure is weak, fine to medium subangular blocky. Organic carbon content varies between 1 and 2 %; the C/N-ratio between 12 and 14. Levels of CEC are 2-5 cmol+/kg, and base saturation is 10 to 20%.

subsoils
Subsoils, from a depth of about 50 cm, are strong brown to yellowish red, with textures ranging from clay to sandy clay, with low to high amounts of fine ironstone gravel. The pH is about 4.5. CEC is 2 to 4 cmol+/kg, with base saturation levels between 10 and 15%.

clay mineralogy
Kaolinite, Gibbsite and Goethite are the dominant clay minerals.

soil classification

FAO/Unesco:	Acri-haplic Ferralsols, skeletic phase
Soil Taxonomy:	Typic and Acrudoxic Kandiudults

Mapping unit H3

Area:	16,232 ha, 7.4% of survey area, distributed over 3 polygons
Nr. of observations:	8 augerings
Profile numbers:	None

setting
Mapping unit H3 comprises landforms and soils, dominated by ironstone formation, and developed in metamorphic, mainly basic rocks. They constitute steeply dissected high hills (up to 1400 ft), with slopes from 16% to over 30%. These occur in the central-southern part of the survey area, and attain an elevation of 250-1400 ft. The relief intensity is 600 to 800 ft. Interfluves are locally broad, probably marking the remnants of an older erosion level (the Higher Laterized Peneplain described by Barron, 1972), capped by ironstone. The presence of ironstone, on many places at shallow depth, separates this unit from mapping unit H1. Where ironstone is dominantly present at shallow depth, the vegetation is dominated by scrub.

soils, general
The soils are shallow to very deep, over rock or ironstone. The surface soil commonly contains a high amount of fine ironstone gravel. Locally outcrops of ironstone occur. The soils are well drained, brown to red, gravelly to very gravelly clays, over weathered rock or over solid ironstone; with thin, dark brown, gravelly or stony, sandy loam to sandy clay topsoils; in places with stony surfaces.

associated units and inclusions
Locally, soils of mapping unit H1 occur. In creek bottoms, various alluvial soils are found.

topsoils
Topsoils are 10 to 20 cm thick, dark brown, with (sandy) clay loam textures, mostly containing a high amounts of fine, lateritic, gravel.

sub-surface horizons
Sub-surface horizons (up to about 40 cm deep), are reddish brown, and have sandy clay to clay loam textures, with a moderate to high amount (25-75%) of fine ironstone gravel. Soil structure is weak, fine to medium subangular blocky.

subsoils
Subsoils, from a depth of about 50 cm, are strong brown, yellowish red, and red, with textures ranging from sandy clay to clay, with variable amounts of fine ironstone gravel.

soil classification

FAO/Unesco:	Acri-haplic Ferralsols, skeletic phase
Soil Taxonomy:	Kandiudults

Mapping unit H4

Area:	2,525 ha, 1.2% of survey area, distributed over 5 polygons
Nr. of observations:	9 augerings
Profile numbers:	None

setting

Mapping unit H4 constitutes of dissected, moderately high and low, isolated hills. These occur scattered over the survey area, with a higher frequency in the central-eastern and northeastern parts of the area. They attain an elevation of approximately 800 ft, but lower ones are common. The relief intensity is 400 ft, maximally. Interfluves are locally broad and level and relatively flat slope-sections occur as well, probably marking the remnants of an old erosion bevel (the Lower Laterized Peneplain - Barron, 1972), capped by ironstone. General slopes are between 5 and 30%.

Landforms and soils of this unit are separated from those of mapping unit H2, as they are dominated by ironstone formation. They are developed in metamorphic, mainly basic rocks (Akaiwanna Formation or Roraima Intrusive Suite).

soils, general

The soils are mostly shallow, but also deep to very deep, over ironstone or rock. The surface soils commonly contain high amounts of fine ironstone gravel. Locally outcrops of ironstone are common. The soils are well drained, brown to red, very gravelly loams to clays, over solid ironstone; with thin, dark brown, very gravelly sandy loam to sandy clay topsoils; in places with gravelly and/or stony surfaces.

associated units and inclusions

In creek bottoms, various alluvial soils are found.

topsoils

Topsoils are 10 to 20 cm thick, dark brown, with sandy loam to sandy clay textures, mostly containing a high amount of fine, lateritic, gravel.

sub-surface horizons

Sub-surface horizons (up to about 40 cm deep), are reddish brown, and have sandy clay to clay loam textures, with moderate to high amounts (25-75%) of fine ironstone gravel. Soil structure is weak, fine to medium subangular blocky.

subsoils

Subsoils, from a depth of about 50 cm, are strong brown, yellowish red, and red, with textures ranging from sandy clay loam to sandy clay, with moderate to high amounts of fine ironstone gravel.

soil classification

FAO/Unesco:	Acri-haplic Ferralsols, skeletic phase
Soil Taxonomy:	Kandiudults

F Footslopes

Mapping unit F1

Area:	1,725 ha, 0.8% of the survey area, distributed over 1 polygon
Nr. of observations:	17 augerings
Profile numbers:	21 and 22

setting

Mapping unit F1 constitutes low angle slopes or pediments at the foot of hills. They occur in the south at an elevation of 250-300 ft; the relief intensity is less than 100 ft. General slopes of the broad interfluves are between 2 and 16%; valley incisions may have slopes over 16%.
Soils have formed in dolerite, or in otherwise basic rocks of Precambrian or Paleozoic age; to a lesser extent they are derived from colluvium. In places surface stoniness occurs, generally as boulders of dolerite. Ironstone is in many places present as fine gravel in the soil profile.

soils, general

The soils are very deep, over rock, in places with stony and bouldery surfaces. They are well drained, yellowish brown to yellowish red, clays, containing moderate to high amounts of ironstone gravel. Topsoils are dark brown, sandy loams to sandy clay loams.

associated units and inclusions

Locally, landform/soil unit H2 occurs (dolerite intrusions surfacing).

topsoils

In places, stones and boulders appear at the surface with an average density of 20 - 40% cover. The mineral soil is covered by a thin litter layer; in some places a thin rootmat is present. Topsoils are 10 to 20 cm thick, dark brown, with sandy loam to sandy clay loam textures, containing 10 to 40% fine, mostly lateritic, gravel. The pH is between 4 and 4.5; organic carbon content is about 2 to 3% with a C/N ratio of 10 to 15. Available P content is very low (2.0 to 0.5 mg/kg). Exchangeable base saturation is about 5 to 15%.

sub-surface horizons

Sub-surface horizons are reaching a depth of about 50 cm; are yellowish brown sandy clays to strong brown clays, containing commonly 20 to 40% ironstone gravel. The pH is around 4 to 4.5; organic carbon contents drop to about 0.8%, with a C/N ratio of 8 to 10. Levels of CEC and base saturation are around 4 cmol+/kg and 10%, respectively.

subsoils

Subsoils, from a depth of about 50 cm, are yellowish brown, strong brown to yellowish red or red clays, with low to high amounts of ironstone gravel. The pH is about 4.5 to 5.0. The cation exchange capacity is less than 3 cmol+/kg; exchangeable bases are virtually absent.

soil classification

FAO/Unesco:	Acri-haplic Ferralsols, skeletic phase
Soil Taxonomy:	Kandiudults

Mapping unit F2

Area:	2,502 ha, 1.1% of survey area, divided over 3 polygons
Nr. of observations:	no augerings
Profile numbers:	none

setting

Mapping unit F2 constitutes of dissected footslopes, or pediments, that surround hills of basic rocks. They occur in the northeast, along the northern foot of the Mabura Hill range. The relief intensity is around 100-200 ft.; elevation is 150-350ft. General slopes of the broad interfluves are between 5% and 10%; valley incisions have slopes up to 20-30%.

Soils have formed in colluvium, derived from dolerite, or from otherwise basic rocks of Precambrian or Paleozoic age. In places surface stoniness occurs, generally as dolerite boulders. Ironstone is in many locations present, mostly as gravel in the soil.

soils, general

Very deep, well drained; yellowish red to yellowish brown, gravelly to very gravelly clay loam to clay; with moderately thick, non-gravelly to gravelly, sandy loam to sandy clay loam topsoil; in places stony surface.

Insufficient data for further detailed description

soil classification

FAO/Unesco:	Acri-haplic Ferralsols, partly rudic or skeletic phase
Soil Taxonomy:	Kandiudults

Pe Dissected Erosional Plains

Mapping unit Pe1

Area:	1,758 ha, 0.8% of the survey area, distributed over 1 polygon
Nr. of observations:	no augerings
Profile numbers:	none

setting

Mapping unit Pe1 consists of a pediment plain with a rolling topography. It occurs in the central-southwest, and has a limited extent. The relief intensity is around 100 ft.; elevation is 150-350 ft. General slopes of the broad interfluves are between 5% and 16%; valley incisions may have steeper slopes.

Soils have formed in undifferentiated basic rocks of Precambrian age. In places inclusions of small hills occur (map unit H2). Ironstone occurs mainly as gravel in the soil.

soils, general

Very deep, well drained; yellowish brown to red, gravelly to very gravelly clay; over rock; with moderately thick, gravelly, dark brown loamy topsoil.

Insufficient data for further detailed description

soil classification

FAO/Unesco:	Acri-haplic Ferralsols, partly skeletic phase
Soil Taxonomy:	Kandiudults

Mapping Unit Pe2

Area:	2,166 ha, 1.0% of the survey area, divided over 12 polygons
Nr. of observations:	1 augering
Profile numbers:	none

setting

Mapping units Pe2, Pe3, Pe4 and Pe5 constitute an assembly of ironstone plateau remnants and derived dissected country. The landforms and soils are dominated by ironstone formation, and are originally developed in various, mainly basic, Precambrian rocks. The relief of unit Pe2 is almost flat (interfluves; upslope areas bordering escarpments) to rolling (valley incisions, higher dissected parts); relief intensity is up to 200ft., and elevation is 250-500ft. Broad interfluves (plateau remnants, mostly at a level of around 200-300ft elevation) have slopes of 2 - 5%; valley incisions have slopes to over 16%.

The ironstone and the soils overlay dolerite, or otherwise basic rocks, but also several other rock types. The mapping unit (and the next ones of Pe3 and -4) cover the so called Lower Laterite, considered part of a laterized peneplain (Barron, 1972). Especially on flat parts, shallow soils over laterite dominate. In places surface stoniness (ironstone gravel and boulders) occurs.

The vegetation is dominated by scrubs and small, low trees where extensive shallow ironstone occurs.

soils, general
The soils of unit Pe2 are shallow, somewhat excessively drained, sandy clay loams to clay, with high amounts (>70%) of fine ironstone gravel. In places stones or boulders occur at the surface. The soils have dark greyish brown colours.

associated units and inclusions
In places the deeper soils of unit Pe3 occur.

topsoils
In places, stones and boulders of laterite appear at the surface, with densities of up to 80% cover. In some places a thin rootmat is present. The surface is covered by leaf litter, of 2-3 leaf-layers thick.
Topsoils are 10 to 20 cm thick, dark brown to very dark greyish brown, sandy clay loams, containing 40 to 80% fine, lateritic gravel. The pH is around 4 to 4.5; organic carbon content is about 2-3% with a C/N ratio of 15 or more. Available P content is very low (1 - 7 mg/kg). Cation Exchange Capacity is 6 to 7 cmol+\kg; base saturation percentage is not more than 2%.

sub-surface horizons
In places, sub-surface horizons are reaching a depth of about 30-50 cm; are dark greyish brown sandy clay (loams), containing commonly 40 to 80% ironstone gravel. The pH is around 5; organic carbon contents drop to about 1.5%, with a C/N ratio of 10 to 15. Levels of CEC and base saturation are around 5 cmol+\kg and 0 - 7 %, respectively. The transition to the underlying ironstone rock is abrupt, broken and very irregular.

clay mineralogy
Gibbsite and mixed layer clay minerals are dominant; traces of kaolinite and quartz are present.

soil classification

FAO/Unesco:	Dystric and lithic Leptosols, petroferric phase
Soil Taxonomy:	Petroferric Dystropepts

Mapping unit Pe3

Area:	8,563 ha, 3.9% of the survey area, divided over 12 polygons
Nr. of observations:	31 augerings
Profile numbers:	1 and 33 (shallow); and 34 (deep)

setting
Mapping units Pe2, -3, -4 and -5 constitute an assembly of ironstone plateau remnants and derived dissected country. The relief of unit Pe3 is almost flat (interfluves; upslope areas bordering escarpments) to hilly (valley incisions, uplands); relief intensity is up to

200 ft., and the elevation is 250-600 ft. Broad interfluves (plateau remnants) have slopes of less than 5%; valley incisions have slopes to over 16%.
The ironstone and the soils overlay dolerite, or otherwise basic rocks, but also several other rock types. This mapping unit forms part of the so called 'Lower Laterite'; a part of a laterized peneplain (Barron, 1972). In places surface stoniness occurs, generally as laterite. Ironstone is on many locations present as fine gravel in the soil profile.

soils, general
The soils of the almost flat and undulating areas tend to be shallow and moderately deep, with high amounts (>70%) of fine ironstone gravel; whereas the very deep soils are most common on sloping areas, and contain moderate amounts of gravel (20-40%). All soils are well drained sandy clay loams to clays, with somewhat lighter textured topsoils. The shallow, gravelly soils are dark greyish brown; yellowish brown to yellowish red colours are common in the deeper soils.

associated units and inclusions
Locally, map unit H2 occurs (dolerite intrusions surfacing); also intergrades to soils, developed on sandy deposits of the Berbice Formation occur (Ps-units), having more sandy topsoils.

Shallow soils of Pe3 (as in map unit Pe2)
topsoils
In places, stones and boulders of laterite appear at the surface, with densities of up to 80% cover. In some places a thin rootmat is present. The surface is covered by leaf litter, of 2-3 leaf-layers thick.
Topsoils are 10 to 20 cm thick, dark brown to very dark greyish brown, sandy clay loams, containing 40 to 80% fine, lateritic gravel. The pH is around 4 to 4.5; organic carbon content is about 2-3% with a C/N ratio of 15 or more. Available P content is very low (1 - 7 mg/kg). Cation Exchange Capacity is 6 to 7 cmol+\kg; base saturation percentage is not more than 2%.

sub-surface horizons
In places, sub-surface horizons are reaching a depth of about 30-50 cm; are dark greyish brown sandy clay (loams), containing commonly 40 to 80% ironstone gravel. The pH is around 5; organic carbon contents drop to about 1.5%, with a C/N ratio of 10 to 15. Levels of CEC and base saturation are around 5 cmol+\kg and 0 - 7 %, respectively. The transition to the underlying ironstone rock is abrupt, broken and very irregular.

clay mineralogy
Gibbsite and mixed layer clay minerals are dominant; traces of kaolinite and quartz are present.

soil classification

FAO/Unesco:	Dystric and lithic Leptosols, petroferric phase
Soil Taxonomy:	Petroferric Dystropepts

Deep soils of Pe3 (soils as in map unit Pe4)
topsoils
In few places, stones appear at the surface, with an average density of up to 20% cover. The mineral soil is covered by a thin litter layer; a thin rootmat is present.
topsoils are 10 to 20 cm thick, dark brown sandy clay loams, containing 10 to 40% fine, lateritic gravel. The pH is around 4.5; topsoils have an organic carbon content of 2-3% with a C/N ratio of 15. Available P content is very low (1-2 mg/kg). Exchangeable base saturation is about 10 to 15%; the level of CEC is 10 cmol+\kg.

sub-surface horizons
Sub-surface horizons are reaching a depth of about 50 cm; are brown to reddish brown sandy clay loams to (sandy) clays, containing commonly 20-40% ironstone gravel, but locally up to 80%. The pH is around 5; organic carbon contents drop to about 1.2%, with a C/N ratio of 10 to 15. Levels of CEC and base saturation are around 4 cmol+\kg and 15%, respectively.

subsoils
Subsoils, from a depth of about 50 cm, are yellowish brown, strong brown to yellowish red or red clays, with low amounts of ironstone gravel. The pH is about 4.5 to 5.5. The cation exchange capacity is 2 to 3 cmol+\kg or even less; exchangeable base saturation percentage is very low: 4 to 8%.

soil classification

FAO/Unesco:	Acri-haplic Ferralsols, rudic phase
Soil Taxonomy:	Kandiudults

Mapping unit Pe4

Area:	3,057 ha; 1.4% of the survey area, divided over 4 polygons
Nr. of observations:	17 augerings
Profile numbers:	none

setting
Mapping units Pe2, Pe3, Pe4 and Pe5 constitute an assembly of ironstone plateau remnants and derived dissected country. The landforms and soils are dominated by ironstone formation, and are developed in various, mainly basic, Precambrian rocks. The relief of map unit Pe4 is undulating (interfluves; upslope areas bordering escarpments) to hilly (valley incisions, higher parts). The main characteristic that separates this map unit from Pe3 is its higher density of valley incisions. Relief intensity is up to 200 ft., and elevation is 250-600 ft. Broad interfluves (plateau remnants) have slopes of less than 5%; valley incisions have slopes to over 16%.
The ironstone and the soils overlay dolerite, or otherwise basic rocks, but also several other rock types. This mapping unit forms part of the so called 'Lower Laterite', considered part of a laterized peneplain (Barron, 1972). In places surface stoniness occurs, generally as laterite. Ironstone is on many locations present as fine gravel in the soil profile.

soils, general

The soils of the undulating areas tend to be moderately deep to very deep, with high amounts (>70%) of fine ironstone gravel, whereas the very deep soils are most common on sloping areas, and contain moderate amounts of gravel (20-40%). All soils are well drained sandy clay loams to clays, with somewhat lighter textured topsoils. The soils have dark brown to yellowish red colours.

associated units and inclusions

Locally, landforms/soils of map unit H2 occur (dolerite intrusions surfacing) and valley bottoms with alluvial soils; also intergrades to soils, developed on sandy deposits of the Berbice Formation (mapping units Ps-) occur, having more sandy ***topsoils***.
The soils of this mapping unit differ little from the deep soils component of map unit Pe3

topsoils

In few places, stones appear at the surface, with an average density of up to 20% cover. The mineral soil is covered by a thin litter layer; a thin rootmat is present.
topsoils are 10 to 20 cm thick, dark brown sandy clay loams, containing 10 to 40% fine, lateritic gravel. The pH is around 4.5; topsoils have an organic carbon content of 2-3% with a C/N ratio of 15. Available P content is very low (1-2 mg/kg). Exchangeable base saturation is about 10 to 15%; the level of CEC is 10 cmol+\kg.

sub-surface horizons

Sub-surface horizons are reaching a depth of about 50 cm; are brown to reddish brown sandy clay loams to (sandy) clays, containing commonly 20-40% ironstone gravel, but locally up to 80%. The pH is around 5; organic carbon contents drop to about 1.2%, with a C/N ratio of 10 to 15. Levels of CEC and base saturation are around 4 cmol+\kg and 15%, respectively.

subsoils

Subsoils, from a depth of about 50 cm, are yellowish brown, strong brown to yellowish red or red clays, with low amounts of ironstone gravel. The pH is about 4.5 to 5.5. The cation exchange capacity is 2 to 3 cmol+\kg or even less; exchangeable base saturation percentage is very low: 4 to 8%.

soil classification

FAO/Unesco:	Acri-haplic Ferralsols, locally rudic phase
Soil Taxonomy:	Kandiudults

Mapping Unit Pe5

Area:	7,269 ha, 3.3% of survey area, divided over 6 polygons
Nr. of observations:	no augerings
Profile numbers:	none

setting

Mapping unit Pe5 constitutes a west-east stretching area, south of the Akaiwanna Mountains. Its landforms and soils are developed in sandstones and mudstones of Proterozoic age (Muruwa Formation); they are partly dominated by ironstone formation. The landforms are part of the Lower Laterized Peneplain (Barron, 1976), at an elevation of 200-400 ft. Ironstone buffs and minor escarpments are common at around 250 ft altitude, above which the relief is (gently) undulating. The overall relief is undulating to rolling (slopes 2-16%) and locally steeply dissected near the escarpments.
The vegetation consists of a high, closed forest type.

soils, general

The soils are deep to very deep and well drained. They are dark yellowish brown to strong brown, sandy loams to sandy clay loams, and have moderately thick, loamy sand to sandy loam topsoils. The deeper subsoils exist of gravelly to very gravelly, yellowish red, sandy clays to clays. Ironstone gravel, with a concentration of 50 to 80%, is on many places present, from any depth between the surface and 100 cm.

No further detailed field information available.

soil classification

FAO/Unesco:	Acri-haplic and acri-xanthic Ferralsols, partly skeletic phase
Soil Taxonomy:	Kandiudults

Ps Dissected Sedimentary Plains (WHITE SANDS PLATEAU)

Mapping unit Ps1

Area:	27,918 ha, 12.8 % of the survey area, divided over 85 polygons
Nr. of observations:	142 augerings
Profile numbers:	3, 8, 12 and 23

setting

Mapping units Ps1 occur extensively in the northern, south eastern and south western part of the survey area. Landforms and soils are developed in unconsolidated sandy and loamy deposits of the Berbice Formation. The relief is flat to gently undulating, slopes range from 0 to 5%. The mapping unit represents most of the flat to gently undulating interfluves of the locally known as White Sands Plateau. Throughout the survey area the altitude of these plateaus range between 250 and 300 feet.
Wallaba forest is characteristic of the white sand soils. In the southern part of the area, possibly because of some disturbance of the vegetation cover in the past, also Muri and Dakama scrub occur on the white sands.

soils, general

The soils are very deep, in places over 10 m, having light grey colours with sand textures throughout and with excessive drainage conditions. The clay contents are about 2%. Typically, the sands have 75 to 85% in the fractions 100 to 500 micron. With depth, the fraction 250-500 micron decreases whereas the fraction 100-250 micron increases. The litter layer at the surface is very thin.

associated units and inclusions

Small portions of map unit Ps5 are included, having a slightly more accentuated relief, and yellowish brown loamy sand soils. These occur especially around the edges of the mapping unit.
Locally, in the central parts and near valley bottoms, portions of mapping unit Ps2 are included. These concern the imperfectly drained light grey sands.

topsoils

The topsoils are generally about 20 cm thick, with very dark greyish brown to dark grey colours and sand textures. Topsoil thickness ranges from 5 to about 30 cm. The thickest topsoils are found in the southern part of the survey area. Topsoils have 0.5 to 1.1 % organic carbon with a C/N ratio of about 20. pH levels are about 4.2. Available P contents are very low (< 1 mg/kg). CECs are very low (1.5 to 4 cmol+/kg) and exchangeable base contents are so low that they cannot be measured with the standard analytical methods.

sub-surface horizons

Sub-surface horizons are generally very thin as the organic matter content rapidly deceases with depth. They are greyish brown in colour with organic carbon contents of about 0.2 to 0.5%. In the south, subsurface horizons may extend up to 30 to 50 cm depth.

subsoils
All subsoils are invariably white to light grey sands which consist for almost 100% of quartz. The pH ranges from 4.5 to 6.

soil moisture characteristics
A saturated soil contains about 40% water which rapidly decrases to 4 to 6 % at field capacity (pF 2.0) and only 1 to 2 % remains at the permanent wilting point (pF 4.2). Available soil moisture is therefore extremely low (about 34 mm in the top 100 cm).

soil classification

FAO/Unesco:	Albic Arenosols
Soil Taxonomy:	Typic Quartzipsamments
Guyana series:	Tiwiwid sands

Mapping unit Ps2

Area:	7,859 ha, 3.6 % of the survey area, divided over 9 polygons
Nr. of observations:	11 augerings
Profile numbers:	No. 25

setting
Mapping units Ps2 occur in the southern and southwestern part of the survey area. Soils are formed in the unconsolidated, sandy sediments of the Berbice formation. The mapping unit is one other component of the widespread flat to gently undulating interfluves of the White Sands Plateau. The altitude of the interfluves with this soil type ranges between 200 and 300 feet. The major part of this unit has an almost flat relief. These soils occur at lower slope positions, valley heads and locally on flat interfluves.

soils, general
The soils are very deep, and imperfectly drained. They are light grey sands, with a typical brown to black, strongly cemented humic (loamy) sand layer of minor to moderate thickness at a depth between 40 and 110 cm. The litter layer at the surface is very thin.

associated units and inclusions
Small portions of Ps5, Ps3 and Ps1 are included in the mapping units.

topsoils
The topsoils are generally about 5 to 30 cm thick, having black to dark grey colours and sand textures of loose consistence. Topsoils have 1.2 % organic carbon in the surface layer, dropping sharply to less than 0.5 with depth. C/N ratio is about 20. pH levels are about 4.3. Available P contents are very low (<0.6 mg/kg).
CEC is also very low (3.5 in the surface layer, dropping to 0.7 cmol+/kg at 10 cm) and exchangeable base contents are so low that they cannot be measured with the standard analytical methods.

sub-surface horizons
Sub-surface horizons are generally very poor as they constitute an eluvial horizon. They are grey to light grey sands with only traces of organic carbon content, a CEC of 0.5-0.9 cmol+/kg and a near-zero base saturation.

subsoils
Subsoils tend to have sand to loamy sand textures; characteristic is the presence of a dark, cemented, humic layer, that hampers a free drainage in the soil. It has a pH of around 4; 3 to 3.5 % organic carbon; a CEC of 15 to 25 cmol+/kg and near-zero base saturation.

soil classification

FAO/Unesco:	Carbic Podzol
Soil Taxonomy:	Placorthods
Guyana series:	Ituni sand

Mapping unit Ps1+2

Area:	1,623 ha, 0.7 % of the survey area; divided over 6 polygons
Nr. of observations:	20 augerings
Profile numbers:	None

setting
Mapping unit Ps1+2 occurs as some smaller patches in the south eastern and north western parts of the survey area. It constitutes a complex of the soil types of mapping units Ps1 and Ps2. This complex unit is one other component of the widespread flat to gently undulating interfluves of the White Sands Plateau. Soils have formed in unconsolidated deposits of the Berbice Formation. The altitude of the interfluves with this soil type ranges between 250 and 300 feet in the south eastern area, and around 150 ft in the north western part. The major part of this unit has a gently undulating relief.

soils, general
The soils of this unit constitute a complex of:

- soils of unit Ps1:
  The soils are very deep, in places over 10 m, having light grey colours with sand textures throughout and with excessive drainage conditions. The clay contents are about 2%. Typically, the sands have 75 to 85% in the fractions 100 to 500 micron. With depth, the fraction 250-500 micron decreases whereas the fraction 100-250 micron increases. The litter layer at the surface is very thin.
- soils of map unit Ps2:
  The soils are very deep, and imperfectly drained. They are light grey sands, with a typical brown to black, strongly cemented humic (loamy) sand layer of minor to moderate thickness at a depth between 40 and 110 cm. The litter layer at the surface is very thin.

For further details, see the descriptions of map units Ps1 and Ps2

Mapping unit Ps3

Area:	699 ha, 0.3 % of the survey area, divided over 14 polygons
Nr. of observations:	2 augerings
Profile numbers:	None

setting

Mapping unit Ps3 occurs as small scattered patches in the southern part of the survey area. Soils are formed in the sandy sediments of the Berbice formation. The mapping unit is one other component of the widespread flat to gently undulating interfluves of the White Brown Sands Plateau. The soils are situated in wide, shallow valley heads of drainage lines. These depressions with poor drainage conditions favour the formation of peat at the surface. Their altitude is around 200 ft, and the major part of this unit has an almost flat relief.

soils, general

The soils are similar to those of map unit Ps2, but have in addition, in places, a thin to moderately thick peaty topsoil. They are very deep, and imperfectly drained, light grey sands, with a typical brown to black, strongly cemented humic (loamy) sand layer of minor to moderate thickness at a depth between 40 and 110 cm depth.

topsoils

The topsoils typically exist of about 5 - 30 cm thick peat, having black to dark brown colours.

sub-surface horizons

Sub-surface horizons are generally very poor as they constitute an eluvial horizon. They are grey to light grey sands with only traces of organic carbon content.

subsoils

Subsoils tend to have sand to loamy sand textures; characteristic is the formation of a dark, cemented, humic layer, starting between a depth of 40 cm and 110 cm, being a few to 30 cm thick, and hampering a free drainage in the soil.

soil classification

FAO/Unesco:	Carbic Podzol
Soil Taxonomy:	Placaquods
Guyana series:	Ituni sand

Mapping unit Ps4

Area:	3,076 ha, 1.4 % of the survey area, divided over 4 polygons
Nr. of observations:	8 augerings
Profile numbers:	None

setting
This mapping unit occupies some areas in the central-eastern zone of the survey area. The soils are formed in unconsolidated sandy and loamy deposits of the Berbice formation, and constitutes one of the 'brown' components of the White Sands Plateau. Mapping units Ps4 ocur on flat to gently undulating broad interfluves of the dissected sedimentary plains. Altitude is approximately 200-250 ft.

soils, general
The soils are very deep and well drained yellowish brown to strong brown, sandy loam to sandy clay loams. Topsoils are moderately thick, sand to sandy loams. The surface is covered with a very thin litter layer (few leaves thick) and roots are concentrated in the top 20 cm of the soil. The soils are similar to those as described under map unit Ps6.

associated units and inclusions
The texture of the soils in this map unit which border the white sands (soils of map unit Ps1)
are sandier than soils in more central positions. Towards steeper valley slopes, at lower levels in the landform, soils of map unit Ps7 occur locally.

topsoils
Topsoils are 20 to 30 cm thick, dark brown to brown in colour, and with sand to loamy sand (sandy loam) textures. They have loose to weak, fine subangular blocky structures. Soil pH is about 4.0 (3.8 to 4.2) and organic carbon contents are about 1.5 to 4 % in the top 5 cm, decreasing to 0.5 to 1.5 % at 5 to 30 cm depth. Available P content is very low with 1 to 4 mg/kg soil. Topsoil CEC's depend very much on the organic matter levels and are in the range of 1.5 to 4 cmol+/kg. Bases are virtually absent in the topsoils.

sub-surface horizons
The subsurface horizons range from 30 to 50/70 cm depth, are dark brown to yellowish brown sandy loams, and have weak, fine to medium subangular blocky structures. The soil pH is slightly higher than in the topsoils: 4.4. to 4.8. The organic carbon contents decrease to 0.4-0.8% at about 60 cm depth. CEC levels are very low (1 to 3 cmol+/kg) and bases could not be measured.

subsoils
The subsoils are yellowish brown to strong brown, sandy clay loams, occasionally sandy loams. They have weakly developed, fine to medium, subangular blocky structures. The CEC levels are very low (1 to 2.5 cmol+/kg) and exchangeable bases are virtually not present. In places, the subsoils contain ironstone gravel.

soil moisture characteristics
The amount of available soil moisture is moderate as it ranges between 10% in the topsoil and 5% in the subsoil; this is 100 to 50 mm per meter soil depth.

soil classification

FAO/Unesco:	Acri-haplic and acri-xanthic Ferralsols
Soil Taxonomy:	Arenic and Acrudoxic Kandiudults
Guyana:	Kasarama loamy sands

Mapping unit Ps2+4

Area: 4,044 ha, 1.8% of the area, divided over 2 polygons
Nr. of observations: 1 augering
Profile numbers: none

setting
Mapping unit Ps2+4 occurs as an extensive patch in the southwestern part of the survey area. It constitutes a complex of the soil types of mapping units Ps2 and Ps4. This complex unit is one other component of the widespread flat to gently undulating interfluves of the dissected sedimentary plain (White Sands Plateau). The altitude of the interfluves with this soil type ranges between 200 and 250 feet. The major part of this unit has a gently undulating relief, with low relief energy. Soils are developed in the unconsolidated sediments of the Berbice Formation.

soils, general
The soils of this unit constitute a complex of:
- soils of map unit Ps2:
  The soils are very deep, and imperfectly drained. They are light grey sands, with a typical brown to black, strongly cemented humic (loamy) sand layer of minor to moderate thickness at a depth between 40 and 110 cm. The litter layer at the surface is very thin.
- soils of unit Ps4:
  The soils are very deep and well drained yellowish brown to strong brown, sandy loam to sandy clay loams. Topsoils are moderately thick, sand to sandy loams. The surface is covered with a very thin litter layer (few leaves thick) and roots are concentrated in the top 20 cm of the soil.

For further details, see the descriptions of map units Ps2 and Ps4

Mapping unit Ps5

Area: 367 ha, 0.2 % of the survey area, divided over 5 polygons
Nr. of observations: 18 augerings
Profile numbers: number 7 represents this mapping unit

setting
These mapping units occupy small areas in the northern half of the survey area. The soils are formed in unconsolidated deposits of the Berbice formation. The mapping units occupy the nearly flat to undulating crests and upper slopes of the dissected sedimentary plain (White Sands Plateau). Slopes are 2 to 8%.
The vegetation is a mixed forest with Greenhearts and Mora species.

soils, general
The soils are very deep and somewhat excessively drained, with sand to loamy sand textures. This mapping unit is closely associated with the white sands and forms a transition to the more loamier soils of the mapping units Ps6 and Ps8.

topsoils
Topsoils are about 20 cm thick, dark brown, sands to loamy sands with weak to moderate fine granular to subangular structures. The pH of the ***topsoils*** is about 4.5, organic carbon contents is about 0.8% with a C/N-ratio of 11. The CEC is very low (2 cmol+/kg) as is available P (less than 2 mg/kg). Exchangeable bases could not be detected.

sub-surface horizons
The sub-surface horizons are 20 to 30 cm thick, yellowish brown and have sand to loamy sand textures. Soil pH is 4.7 to 4.8 and is slightly higher than in the topsoils. Organic matter contents drop to about 0.5%.

subsoils
The subsoils are yellowish brown to strong brown, loamy sands with weakly developed, fine to medium subangular blocky structures. The pH is between 4.8 and 5.0. Organic carbon contents are about 0.1%. The CEC is below 2 cmol+/kg and exchangeable bases could not be detected.

soil moisture characteristics
The available soil moisture capacity in the top 40 cm is 13%, deeper in the profile the available soil moisture capacity decreases to 7.%. Total pore space throughout the profile is about 40%.

mineralogy
The total soil consists for 90 to 93% of SiO2. Al oxides make up about 4% and Fe oxides about 0.8%. The clay fraction is dominated by kaolinite, and only traces of chlorite, gibbsite and goethite are present.

soil classification

FAO/Unesco:	Ferrali-luvic Arenosols
Soil Taxonomy:	Arenic Kandiudults
Guyana series:	Tabela loamy sands

Mapping unit Ps6

Area:	10,646 ha, 4.9 % of the survey area, divided over 6 polygons
Nr. of observations:	43 augerings
Profile numbers:	profiles 30, 31, 32, 35

setting
Unit Ps6 occupies some undulating areas of the central-eastern part, generally bordering the flatter white sand areas (Ps1) on interfluve positions on one side, and the stronger sloping Ps8 towards the river incisions. The soils are formed in unconsolidated sandy and loamy sediments of the Berbice formation. The unit has an altitude between 150 and 250 ft. and slopes range from 2 to 8%, locally up to 16%. Relief intensity is 50 to 100 ft. The vegetation is characterized by a mixed forest with Greenhearts. Tree diameters of the larger ones range from 20 to over 80 cm. The thickest trees are frequently Morabucea}.

soils, general
The soils are very deep and well drained, yellowish brown to strong brown, sandy loams to sandy clay loams. Topsoils are moderately thick to thick, sands to sandy loams. The surface is covered with a very thin litter layer (few leaves thick) and roots are concentrated in the top 20 cm of the soil. The soils are similar to those as described under map unit Ps4.

associated units and inclusions
This unit borders the white sands (soils of map unit Ps1). The textures of the soils bordering the white sands are therefore sandier (mostly the intergrade soil types of Ps5) than soils in a more central position. Towards steeper slopes soils of mapping unit Ps8 occur.

topsoils
Topsoils are 20 to 30 cm thick, dark brown to brown in colour, and with sand to loamy sand (sandy loam) textures. They have loose to weak, fine subangular blocky structures. Soil pH is about 4.0 (3.8 to 4.2) and organic carbon contents are about 1.5 to 4 % in the top 5 cm, decreasing to 0.5 to 1.5 % at 5 to 30 cm depth. Available P content is very low with 1 to 4 mg/kg soil. Topsoil CEC's depend very much on the organic matter levels and are in the range of 1.5 to 4 cmol+/kg. Bases are virtually absent in the topsoils.

sub-surface horizons
The sub-surface horizons range from 30 to 50/70 cm depth, are dark brown to yellowish brown sandy loams, and have weak, fine to medium subangular blocky structures. The soil pH is slightly higher than in the topsoils: 4.4. to 4.8. The organic carbon contents decrease to 0.4-0.8% at about 60 cm depth. CEC levels are very low (1 to 3 cmol+/kg) and bases could not be measured.

subsoils
The subsoils are yellowish brown to strong brown, sandy clay loams, occasionally sandy loams. They have weakly developed, fine to medium, subangular blocky structures. The CEC levels are very low (1 to 2.5 cmol+/kg) and exchangeable bases are virtually not present. In places, the subsoils contain ironstone gravel.

soil moisture characteristics
The amount of available soil moisture is moderate as it ranges between 10% in the topsoil and 5% in the subsoil; this is 100 to 50 mm per meter soil depth.

soil classification

FAO/Unesco:	Acri-haplic and acri-xanthic Ferralsols
Soil Taxonomy:	Arenic and Acrudoxic Kandiudults
Guyana:	Kasarama loamy sands

Mapping units Ps5+6

Area:	2,218 ha; 1.0% of the survey area, divided over 1 polygon
Nr. of observations:	23 augerings
Profile numbers:	none

setting

Units Ps5+6 occupy some minor undulating areas of the central part, just north of the Akaiwanna Mts. The physiographic appearance is similar to that of units Ps5 and Ps6 in all aspects. The soils are formed in unconsolidated sediments of the Berbice formation.

soils, general

The soils are very deep, somewhat excessively to well drained yellowish brown to strong brown, loamy sands to sandy clay loams. Topsoils are moderately thick and thick, sands and loamy sands. For more details, see descriptions of mapping units Ps5 and Ps6.

Mapping unit Ps7

Area:	46,668 ha, 21.3 % of the area, divided over 9 polygons
Nr. of observations:	133 augerings
Profile numbers:	No. 26, 27 and 28

setting

Mapping units Ps7 occur extensively in the southern part of the survey area, with general elevations of 150-250 ft. The relief intensity is less than 50 ft. but locally up to 100 ft. Interfluves are wide and undulating. The slopes are in general between 2 and 8% but middle and lower slopes can be up to 16% where creeks have cut into the landscape. Soils have formed in the unconsolidated sediments of the Berbice formation, predominantly in the 'brown' component of the 'White Sands Plateau'.
These units are under mixed, Greenheart bearing, forest with tree diameters of the larger trees between 40 and 60 cm.

soils, general

The soils are very deep and well drained; they are yellowish brown to strong brown, sandy loams to clays with the somewhat heavier textures dominating. In the deeper subsoils, colours generally change to yellowish red. Topsoils are moderately thick, loamy sands to sandy clay loams.

associated units and inclusions
Near to the transitions with the neighbouring white sands, sand and loamy sand soils of unit Ps5 are included in this mapping unit. Creek bottoms contain various alluvial soils.

topsoils
Topsoils are 15 to 30 cm thick, dark yellowish brown to dark brown sands to loamy sands. They are structureless to weakly developed subangular blocky. The pH is between 4.0 and 4.6; organic carbon content is about 1.2 -1.7%, with higher values near the surface (4-5%); a C/N of about 11-15. Available P content is very low (0.5-1.0). Levels of the CEC do not exceed 2-4 cmol+/kg, but CEC levels near the surface are about double. Exchangeable base contents are 5-10%, in the surface layer 20-40%.

sub-surface horizons
Sub-surface horizons are reaching a depth af about 50 cm, locally 70. They are (dark) yellowish brown and have textures of loamy sand to sandy (clay) loam. Organic carbon contents drop to about 0.5%. The pH is around 4.5. Cation exchange capacity attains 1.5 - 2.0 cmol+/kg, with a base saturation of 10%, locally up to 30%.

subsoils
Subsoils, from a depth of about 50-70 cm, are strong brown and yellowish red, with textures ranging from sandy loam to sandy clay, but also locally clay. Structures are weak, fine, subangular blocky. pH is about 4.5-4.8. CEC values range from less than 0.5 to 1.9 cmol+/kg. Exchangeable bases are virtually absent.

soil moisture characteristics
A saturated soil contains about 35-40% water which decrases to 28 to 34% at field capacity (pF 2.0). 15 to 25 % remains at the permanent wilting point (pF 4.2). Available soil moisture is therefore about 10 - 15 % (100-150 mm per 100 cm soil), which is rather high.

soil classification

FAO/Unesco:	Acri-haplic and acri-xanthic Ferralsols
Soil Taxonomy:	Acrudoxic Kandiudults
Guyana series:	Kasarama sandy loams and Ebini sandy clay loams

Mapping unit Ps8

Area:	22,641 ha, 10.3 % of the area, divided over 11 polygons
Nr. of observations:	137 augerings
Profile numbers:	No.'s 2, 4, 6, 7 and 15

setting
Mapping unit Ps8 occurs extensively in the northern and northwestern part of the survey area, with minor tracts in the central-eastern part. It concerns the more intensively dissected parts of the sedimentary plains. They are found as lower parts of larger catchments of the tributaries to the Essequibo and Demerara rivers. This unit has a general elevation of 150-300ft., with a relief intensity of 100 to 150 ft. The slopes of

divides and interfluves are gentle to undulating (2-8%), but middle and lower slopes are commonly up to 16%.
Soils have formed in the unconsolidated sediments of the Berbice formation, predominantly in the 'brown' component of the 'White Sands Plateau'.
These units are under mixed, Greenheart bearing, forest with tree diameters of the larger trees between 40 and 60 cm.

soils, general
The soils are very deep and well drained; they are yellowish brown to strong brown, sandy loams to clays. Topsoils are thin to moderately thick, loamy sands or sandy loams to sandy clay loams. Deeper subsoils are locally yellowish red clays, and may contain ironstone gravel.

associated units and inclusions
At the crests of interfluves, near to the transitions with the neighbouring white sands, soils of units Ps1 and Ps5 (sands and loamy sands) occur as inclusions in this mapping unit. Steeper slopes may locally have reddish gravelly clay subsoils, indicating the nearness of underlying Precambrian rocks. Creek bottoms contain various alluvial soils.

topsoils
Topsoils are 10 to 20 cm thick, dark yellowish brown to dark brown loamy sands to sandy (clay) loams. Structures are weak fine granular to weakly developed subangular blocky. The pH is between 4.2 and 4.6; organic carbon content is about 1.0 -1.5%; a C/N ratio of about 11-15. Available P content is very low (2-4 mg/kgin the surface layer; 1.5-3.0 mg/kg at around 10 cm depth). Levels of the CEC do not exceed 5 cmol+/kg. Exchangeable base contents are 0-10%.

sub-surface horizons
Sub-surface horizons are reaching a depth af about 30 cm, locally 60. They are (dark) brown to yellowish brown and have textures of loamy sand to sandy (clay) loam. Structure is weak, fine to medium subangular blocky. Organic carbon contents drop to levels between 0.1 and 0.8%. The pH is around 4.0-4.5. Cation exchange capacity attains 1.8 - 3.5 cmol+/kg, with a base saturation of near zero, locally up to 5%.

subsoils
Subsoils, from a depth of about 60 cm, are strong brown, yellowish brown and in places yellowish red, with textures ranging from sandy loam to (sandy) clay. Structures are weak to moderate, fine, subangular blocky. pH is about 4.5-4.8. CEC values range from 1.8 to 3.5 cmol+/kg. Exchangeable bases are virtually absent.

soil moisture characteristics
A saturated soil contains about 30-45% water. This decreases to 20 to 37% at field capacity (pF 2.0). 10 to 30 % remains at the permanent wilting point (pF 4.2). Available soil moisture is therefore about 10 - 7% (100-70 mm per 100 cm soil) in the surface soil, and around 7% in the subsoils. This points to a moderate to moderately low water holding capacity.

clay mineralogy
Kaolinite dominates the mineralogical composition of the clay fraction. Minor amounts of Gibbsite, and traces of Chlorite, Quartz and Goethite are found as well.

soil classification

FAO/Unesco:	Acri-haplic and acri-xanthic Ferralsols
Soil Taxonomy:	Acrudoxic Kandiudults and Arenic Kandiudults, in places Arenic Plinthic Kandiudults
Guyana series:	Kasarama sandy loams and Ebini sandy clay loams

Mapping unit Ps9

Area:	8,939 ha, 4.1 % of the area, divided over 8 polygons
Nr. of observations:	40 augerings
Profile numbers:	10 and 11

setting
Mapping unit Ps9 occurs in the northwestern part (elevation 150 to 350 ft, interfluves at 250 to 350 ft) of the survey area and in the eastern part, just W of the Demarara river (elevation 150-250 ft, interfluves around 250 ft, with a relief intensity 100 to 150 ft). These areas are the most dissected parts of the 'White Sands Plateau'. Interfluves are small and undulating. General slopes are between 5 and 16% but middle and lower slopes can be up to 40% where creeks have deeply cut into the landscape. Soils have formed in the unconsolidated sediments of the Berbice formation.
These units are under mixed, Greenheart bearing, forest with tree diameters of the larger trees between 40 and 60 cm.

soils, general
On the interfluves and upper slopes, very deep, well drained; sandy loam to clay soils occur with lighter textured topsoils (similar to the soils of mapping unit Ps7)
and
generally on steeper lower to upper slopes (15-40%), but also on gentler upper slopes, very deep, moderately well drained; sandy clay loam to clay soils are found; with plinthite starting between 50 and 105 cm depth. The topsoils have lighter textures.

associated units and inclusions
In places landforms and soils of map unit H2 occurs (dolerite intrusions surfacing). Where this mapping unit borders map units Ps1 soils of units Ps4 and Ps5 occur. In creek bottoms, various alluvial soils occur.

The very deep, well drained, sandy loam to clay soils of the interfluves:

topsoils
Topsoils are 15 to 30 cm thick, dark yellowish brown to dark brown sands to loamy sands. They are structureless to weakly developed subangular blocky. The pH is between 4.0 and 4.6; organic carbon content is about 1.2 -1.7%, with higher values near the surface (4-5%); a C/N of about 11-15. Available P content is very low (0.5-1.0). Levels

of the CEC do not exceed 2-4 cmol+/kg, but CEC levels near the surface are about double. Exchangeable base contents are 5-10%, in the surface layer 20-40%.

sub-surface horizons
Sub-surface horizons are reaching a depth af about 50 cm, locally 70. They are (dark) yellowish brown and have textures of loamy sand to sandy (clay) loam. Organic carbon contents drop to about 0.5%. The pH is around 4.5. Cation exchange capacity attains 1.5 - 2.0 cmol+/kg, with a base saturation of 10%, locally up to 30%.

subsoils
Subsoils, from a depth of about 50-70 cm, are strong brown and yellowish red, with textures ranging from sandy loam to sandy clay, but also locally clay. Structures are weak, fine, subangular blocky. pH is about 4.5-4.8. CEC values range from less than 0.5 to 1.9 cmol+/kg. Exchangeable bases are virtually absent.

soil moisture characteristics
A saturated soil contains about 35-40% water which decrases to 28 to 34% at field capacity (pF 2.0). 15 to 25 % remains at the permanent wilting point (pF 4.2). Available soil moisture is therefore about 10 - 15 % (100-150 mm per 100 cm soil), which is rather high.

soil classification

FAO/Unesco:	Acri-haplic and acri-xanthic Ferralsols
Soil Taxonomy:	Acrudoxic Kandiudults
Guyana series:	Kasarama sandy loams and Ebini sandy clay loams

The very deep, moderately well drained, sandy clay loam to clay soils of upper to lower slopes:

topsoils
Topsoils are 10 to 15 cm thick, dark brown to yellowish brown loamy sand or sandy loam to sandy clay textures. The structures are weakly developed granular. pH is about 4.3 and organic C content about 1.9% with a C/N of 13. Available P is about 1.9 mg/kg. Exchangeable base contents are too low to be measured. The CEC is 3.5 cmol+/kg.

sub-surface horizons
The change from coarser textured topsoils to heavier subsoils occurs within 15 to 35 cm. Organic C content declines from 1 to 0.2% at 45 cm depth.

subsoils
Subsoils are brown to brownish yellow sandy clay loams to clays. Plinthite starts between 50 and 105 cm depth with typically red colours in a very pale brown soil matrix. Subsoil pH is 4.8 throughout. Exchangeable bases contents are too low to be determined.

clay mineralogy
Kaolinite is the dominant clay mineral throughout the profile. Next to kaolinite, traces of chlorite, gibbsite and goethite were found.

soil classification

FAO/Unesco:	Acri-plinthic Ferralsols
Soil Taxonomy:	Acrudoxic Plinthic Kandiudults
Guyana series:	Ebini sandy clay loams

A Alluvial Plains and Valley Bottoms

Mapping unit A1

Area:	6,141 ha, 2.8 % of the survey area, divided over 28 polygons
Nr. of observations:	34 augerings
Profile numbers:	13, 16 and 29

setting

Mapping unit A1 constitutes the flat, low lying valley bottoms and flood plains along streams, i.e. mainly tehe Demerara River and its larger tributaries. These (narrow) plains occur at around 150 ft above sea level; relief intensity is negligible. General slopes are less than 1%.

Soils have formed in the recent, unconsolidated alluvial deposits, which are temporary flooded, and that have locally a permanently high groundwater table. The vegetation is composed of mixed forest; in many places Mora-forest type is dominant.

soils, general

Soils are very deep, moderately well to imperfectly drained; in places groundwater is standing in the profile (i.e. within 120 cm). Soils are yellowish brown to light olive brown, mottled, loams to clays; with silty loam to silty clay loam topsoils.

associated units and inclusions

Locally, soils are clearly stratified, with sandy textured layers in the subsurface and deeper subsoils; in places transitions occur to soils of unit A2 and/or unit A3.

topsoils

Topsoils are about 10 cm thick, dark brown to dark greyish brown silty loam to (silty) clay loam, of friable to very friable consistence and moderate, medium granular structure. The pH ranges from 4.4 to 5.5. The organic Carbon content is relatively high: 3-5%, with a C/N-ratio of 13-11. Levels of cation exchange capacity range from 10-14 cmol+/kg, generally with very low base saturation (1-3%). [Soil profile 29 has a base saturation of 69%].

sub-surface horizons

Sub-surface horizons are 30-50 cm deep greyish brown to dark yelowish brown silty loams, silty clay loams, clay loams or clays of weak to moderate, medium subangular blocky structure. The pH ranges between 4.3 and 5.4. Organic carbon levels drop to 1.3 - 2.7%, with C/N-ratios of 9-12. Levels of CEC vary around 7 cmol+/kg; base saturation is extremely low: less than 1%. [Profile 28 with 47%]

subsoils

The deeper subsoils extend to greater depth (over 2 m), and are in (many) places seasonally waterlogged. They are pale brown, yellowish brown and olive brown firm clays to light clays, with distinct yellowish red mottles. Structures are moderate, fine to medium angular blocky. The cation exchange complex level is around 5 cmol+/kg; base saturation is virtually nil. [one obs. with 45%]

soil moisture characteristics
The available soil moisture capacity in the top 0 cm is 17%, deeper in the profile the available soil moisture capacity decreases to 7-8%. Total pore space throughout the profile is about 50-55%.

soil classification

FAO/Unesco:	Gleyic Cambisols and dystric Fluvisols
Soil Taxonomy:	Aquic Dystropepts
Guyana series:	Barima silt loams

Mapping unit A2

Area:	3,537 ha, 1.6 % of the survey area, divided over 18 polygons
Nr. of observations:	3 augerings
Profile numbers:	none

setting
Mapping unit A2 constitutes the flat, marshy valley bottoms and regularly flooded plains along the Demerara River. These (narrow) plains occur at an altitude of around 150 ft; relief intensity is negligible. General slopes are less than 1%.
Soils have formed in recent, unconsolidated mineral deposits, which are covered by a layer of muck (mixture of some fine textured sediments and decaying plant materials). The land is (semi)-permanently waterlogged, and has a permanently high watertable. The vegetation is composed of low palm tree species.

soils, general
Soils are very deep, very poorly drained; in places groundwater is standing at the surface. The profile consists of 20 to more than 100 cm of black to dark brown peat, over dark greyish brown to light grey, sand to loam

associated units and inclusions
Locally, soils are without peat cover, and clearly stratified, with sandy textured layers in the sub-surface and deeper subsoils; in places transitions occur to soils of unit A1 and/or unit A3.

topsoils
Topsoils are 20-80 cm thick, dark greyish brown to black peat of very friable to loose consistence.

sub-surface horizons
Sub-surface horizons are very deep greyish brown to light grey sands, or of otherwise light textures of weak structure and consistence.

soil classification

FAO/Unesco:	terric Histosols
Soil Taxonomy:	Troposaprists
Guyana series:	Lama Muck

Mapping unit A3

Area:	4,253 ha, 1.9 % of the survey area, divided over 2 polygons
Nr. of observations:	2 augerings
Profile numbers:	none

setting

Mapping unit A3 constitutes the flat, (partly) regularly flooded plains along the Essequibo River, along the southeastern side of the survey area. These plains occur at around 150 ft asl; relief intensity is negligible. General slopes are less than 1%. The mapping unit is composed of a complex of old river courses, their levees and backswamps.

Soils have formed in recent, unconsolidated mineral deposits, which are partly covered by a layer of muck (mixture of some fine textured sediments and decaying plant materials). On many places, however, Precambrian hard rock lies at the surface, indicating that the alluvial sediments are shallow. The land is partly waterlogged, temporary flooded, and has a high watertable.

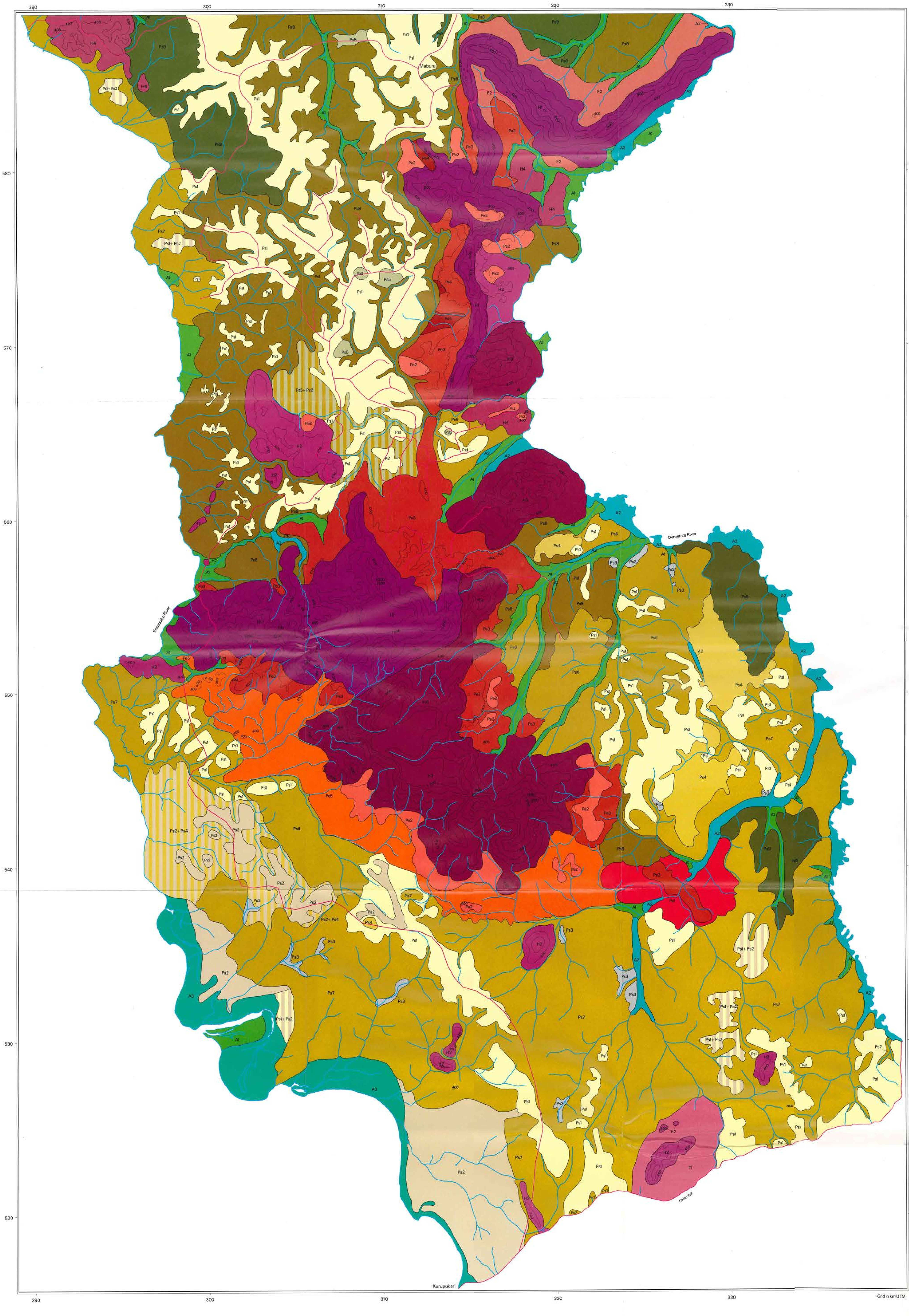
soils, general

Very deep, very poorly to imperfectly drained soils with various colours and textures, in places stratified; in places shallow over rock; in places groundwater is standing at the surface.

Insufficient data for detailed description

LANDFORMS AND SOILS OF THE MABURA-KURUPUKARI AREA

CENTRAL GUYANA



SCALE 1 : 100 000

LEGEND

H HILLS

Landforms and soils developed in metamorphic and igneous, mainly basic rocks

Steeply dissected high hills (up to 1400 ft); slopes from 16% to over 30%

H1 — moderately deep to very deep; well to somewhat excessively drained; brown to red; gravelly, locally stony, clay loam to clay; over rock; with stony and bouldery surface (ferralic CAMBISOLS, rudic phase)

Undulating to rolling, low hills (less than 800 ft), slopes from 5 to 30%

H2 — moderately deep to very deep; well drained; yellowish red; gravelly to very gravelly, clay; over weathered rock; with moderately thick, dark brown, very gravelly sandy clay loam topsoil; in places with gravelly or stony surface (acri-haplic FERRALSOLS, skeletic phase)

Landforms and soils dominated by ironstone formation and developed in metamorphic and igneous, mainly basic rocks

Steeply dissected high hills (up to 1400 ft); slopes from 16% to over 30% (remnants of Higher Laterized Peneplain)

H3 — shallow to very deep; somewhat excessively to well drained; brown to red; very gravelly, sandy clay loam to clay; over ironstone or rock; with thin, very gravelly and stony, sandy loam to sandy clay topsoil; with gravelly to stony surface (dystric LEPTOSOLS, petroferric phase and haplic FERRALSOLS, skeletic phase)

Undulating to rolling, low hills (less than 800 ft), slopes from 5 to 30% (remnants of Lower Laterized Peneplain)

H4 — shallow to very deep; somewhat excessively to well drained; brown to red; very gravelly, sandy clay loam to clay; over ironstone or rock; with thin, very gravelly and stony, sandy loam to sandy clay topsoil; with gravelly to stony surface (dystric LEPTOSOLS, petroferric phase and haplic FERRALSOLS, skeletic phase)

F FOOTSLOPES

Landforms and soils developed in basic, metamorphic and igneous rocks

Rolling land at the foot of hills, locally dissected, slopes from 2 to 16%

F1 — very deep; well drained; yellowish red to yellowish brown; gravelly to very gravelly, clay; moderately thick, sandy loam to sandy clay loam topsoil; locally stony surface (acri-haplic FERRALSOLS, skeletic phase)

Rolling, dissected land at the foot of hills, slopes from 5 to more than 16%

F2 — very deep; well drained; yellowish red to yellowish brown; gravelly to very gravelly, clay loam to clay; with moderately thick, non gravelly to gravelly, sandy loam to sandy clay loam topsoil; in places stony surface (acri-haplic FERRALSOLS, partly rudic or skeletic phase)

Pe DISSECTED EROSIONAL PLAINS

Landforms and soils developed in Precambrian basic rocks

Rolling pediment plain, slopes 5 - 16%

Pe1 — very deep; well drained; yellowish brown to red; gravelly to very gravelly, clay; over rock; with moderately thick, gravelly, dark brown, loamy topsoil (acri-haplic FERRALSOLS, partly skeletic phase)

Landforms and soils dominated by ironstone formation, developed in various, mainly basic, Precambrian rocks

Flat to rolling land, slopes from 0 to 16% (remnants of Lower Laterized Peneplain)

Pe2 — shallow; somewhat excessively drained; dark greyish brown; very gravelly, sandy clay loam to clay; over ironstone; with none to very stony or bouldery surface (dystric and lithic LEPTOSOLS, petroferric phase)

Nearly flat to hilly, locally steeply dissected land, slopes from 2 to over 16% (remnants of Lower Laterized Peneplain)

Pe3 — shallow to very deep; somewhat excessively to well drained; dark brown to yellowish red; very gravelly, sandy clay loam to clay; over ironstone; with thin to moderately thick, very gravelly, loam to clay topsoil; with gravelly and stony to exceedingly stony surface (dystric LEPTOSOLS, petroferric phase and acri-haplic FERRALSOLS, rudic phase)

Undulating to rolling, locally dissected land, slopes from 2 to 16% (remnants of Lower Laterized Peneplain)

Pe4 — moderately deep to very deep; well drained; dark brown to yellowish red; very gravelly, sandy clay loam to clay; over ironstone; with thin to moderately thick, very gravelly, loam to clay topsoil; with gravelly and stony to exceedingly stony surface (dystric LEPTOSOLS, petroferric phase and acri-haplic FERRALSOLS, skeletic phase)

Landforms and soils developed in Precambrian sandstones and mudstones; partly dominated by ironstone formation

Undulating to rolling, locally steeply dissected land, slopes from 2 to 16% (remnants of lower Laterized Peneplain)

Pe5 — deep to very deep; well drained; dark yellowish brown to strong brown; sandy loam to sandy clay loam; with moderately thick, loamy sand to sandy loam topsoil; over gravelly to very gravelly, yellowish red, sandy clay to clay; ironstone gravel (50 - 80%) starting anywhere between surface and 100 cm depth (acri-haplic and acri-xanthic FERRALSOLS, partly skeletic phase)

Ps DISSECTED SEDIMENTARY PLAINS (WHITE SANDS PLATEAU)

Landforms and soils developed in unconsolidated, sandy and loamy, deposits

Flat to gently undulating land, slopes from 0 to 5%

Ps1 — very deep; excessively drained; light grey sand; with thin to moderately thick, sand topsoil (albic ARENOSOLS)

Ps2 — very deep; imperfectly drained; light grey sand; over a brown to black, soft to strongly cemented, thin to moderately thick, humic sand layer, starting between 40 and 110 cm depth; with thin to moderately thick, sand topsoil (carbic PODZOLS)

Ps1+ 2 — complex of soils of units Ps1 and Ps2

Ps3 — very deep; poorly drained; light grey sand; over a brown to black, strongly cemented, thin to moderately thick, humic sand layer, starting between 40 and 110 cm depth; in places with thin to moderately thick, peaty topsoil (carbic PODZOLS)

Ps4 — very deep; well drained; yellowish brown to strong brown; sandy loam to sandy clay loam; with moderately thick, sand to sandy loam topsoil (acri-haplic and acri-xanthic FERRALSOLS)

Ps2+ 4 — complex of soils of units Ps2 and Ps4

Undulating land, slopes from 2 to 8%

Ps5 — very deep; somewhat excessively drained; yellowish brown to strong brown; sand to loamy sand; with moderataly thick, sand topsoil (ferrali-luvic ARENOSOLS)

Ps6 — very deep; well drained; yellowish brown to strong brown; sandy loam to sandy clay loam; with moderately thick to thick, sand to sandy loam topsoil (acri-haplic and acri-xanthic FERRALSOLS)

Ps5+ 6 — complex of soils of mapping units Ps5 and Ps6

Ps7 — very deep; well drained; yellowish brown to strong brown; sandy loam to clay; with moderately thick, loamy sand to sandy clay loam topsoil (acri-haplic and acri-xanthic FERRALSOLS)

Undulating to rolling land, slopes from 2 to 16%

Ps8 — very deep; well drained; yellowish brown to strong brown; sandy loam to clay; with moderately thick, loamy sand to sandy clay loam topsoil (acri-haplic and acri-xanthic FERRALSOLS)

Rolling to hilly land, slopes from 5 to 30%

Ps9 — very deep; well drained; yellowish brown to strong brown; sandy loam to clay; with moderately thick, loamy sand to sandy clay loam topsoil (acri-haplic and acri-xanthic FERRALSOLS) and very deep; moderately well drained; brownish yellow to strong brown; sandy clay loam to clay; with plinthite starting between 50 and 105 cm depth; with moderately thick, sandy loam to sandy clay topsoil (acri-plinthic FERRALSOLS)

A ALLUVIAL PLAINS and VALLEY BOTTOMS

Landforms and soils developed in unconsolidated, unspecified, recent alluvium

Flat and nearly flat land, slopes from 0 to 2%

A1 — very deep; moderately well to imperfectly drained; yellowish brown to light olive brown; mottled; loam to clay; with thin, silty loam to silty clay loam topsoil (gleyic CAMBISOLS and dystric FLUVISOLS)

A2 — very deep; very poorly drained; 20 to over 100 cm of black to dark brown, peat; over dark greyish brown to light grey, sand to loam (terric HISTOSOLS)

A3 — very deep; very poorly to imperfectly drained soils with various colours and textures; in places stratified (FLUVISOLS, GLEYSOLS, HISTOSOLS, gleyic CAMBISOLS)

KEY

road

river

contour line; interval 200 ft (from 400 ft and above)

The Winand Staring Centre for Integrated Land, Soil and Water Research (SC-DLO) The Netherlands

TROPENBOS The Tropenbos Foundation, The Netherlands

NARI National Agricultural Research Institute, Guyana

Field survey 1992-1994 by J. Pulles and Z. Khan
Map and Legend compilation: A.J. van Kekem
Cartography: C. Schuling (SC-DLO), June 1995
Aerial photography: 1965
Topographic base: digitized by J. Pulles. from 1:50,000 scale topographic maps
ANNEX A of:
A.J. van Kekem, J. Pulles and Z. Khan, 1995.
Soils of the rain forest in Central Guyana.