



NEW ZEALAND OFFICIAL  
DEVELOPMENT ASSISTANCE

# FIJI

## Soil Taxonomic Unit Description Handbook

*Supplement  
to the  
national  
soil map*

**D. M. Leslie**  
**V. B. Seru**



**Volume 1**  
Ba to Nukusa soils

**FIJI  
SOIL TAXONOMIC  
UNIT DESCRIPTION  
HANDBOOK**



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SOIL TAXONOMIC  
UNIT DESCRIPTION  
HANDBOOK

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## **Foreword**

I am pleased to write this foreword to the Soil Taxonomic Unit Description Handbook for the soils of Fiji. This is the culmination of nearly 20 years of work and shows the persistence of my Ministry to better understand our nation's soil resources and to apply a modern soil classification system to Fiji.

The initial classification of the soils of Fiji was fully described by I. T. Twyford and A. C. S. Wright in 1965. Their publication of "The Soil Resources of the Fiji Islands", Volume 1 had a comprehensive and descriptive treatise of our soils. Volume 2 contained a series of maps covering 11 different themes from soils maps to distribution of population. This work has served Fiji well.

However, the decision to embark on a modern soil mapping, correlation and classification project was made in 1979. A bilateral agreement between the governments of New Zealand and Fiji undertook to correlate our soils into a more universal system. The United States Soil Taxonomy soil classification system (1975) was adopted.

Many factors have prolonged the publishing of these STUDs. My Ministry was fortunate in 1990 to enlist the services of the two scientists who originally began the soil correlation work. I thank Dave Leslie of Landcare Research, New Zealand and Vilitati Seru of my Ministry for concluding and publishing this work.

The STUDs describe the 227 soil series identified and mapped in Fiji. They include comprehensive information about the physical, chemical, mineralogical properties of soils with geographical information about their occurrence and distribution, plus climatological and topographical aspects of our soils.

The Integrated Approach to the Planning and Management of Land Resources in Agenda 21 of the United Nations Conference on Environment and Sustainable Development (UNCED) would find this publication extremely useful.

I have no doubt that officers of my Ministry and other students of soil science will find in these STUDs the answers they need to increase production from the land.

**[Luke V. Ratuvuki]**  
Permanent Secretary  
Agriculture, Fisheries and Forests  
FIJI





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Our grateful thanks go to all those who have contributed in the interval between the completion of the field work, the writing of the handbook and its publication, for word processing, layout, editing and graphics. This was undertaken over a long period with the authors in different countries. These include: Tessa Roach, Fay Oxenham, Nickola Overall and Lynn Forbes whose editing and layout work is greatly appreciated. Thanks to Kirsty Wilson for the cover and to Greg Comfort at Manaaki Whenua Press.

Finally we are indebted to Bruce Millar and the late Mike Leamy, successive DSIR directors for their continuing support and encouragement throughout this project.



## Preface

This handbook has been prepared to assist scientists, extensionists, teachers and land managers who, in the course of their work, use soil maps and require detailed information about the soil resources of Fiji.

The Soil Taxonomic Unit Descriptions (STUDs) have been prepared as a supplement to the national soil map. They provide the basic reference for the 227 soil series identified in the national survey.

The availability of these data to planners and managers will assist in improving environmental assessment and management, economic planning and sustainable land use from increased primary sector development.

Terms and descriptions used in the handbook are in part those proven to be appropriate to Fiji by Twyford and Wright (1965) and the Land Use Section of Fiji MAFFA. Others have been developed for application in many countries by such agencies as FAO and the US Department of Agriculture. Using universal standards and soil classifications enhances international correlation and understanding of Fiji's soil resources.

During the last 30 years most primary sector development in Fiji has been based on the comprehensive national soil survey conducted in the 1950s by Twyford and Wright (1965) and subsequent sustainable capability mapping by Land Use Section staff who, until the mid-1980s, based their work on that of Twyford and Wright.

Twyford and Wright developed a 'local' soil classification unique to Fiji which has made it difficult to correlate Fiji soils with those of other countries.

The Government of Fiji sought the assistance of the New Zealand Government and the New Zealand Department of Scientific and Industrial Research to provide technical assistance in a 5-year soil mapping, correlation and classification project. M.D. Laffan and S.M. Smith conducted the soil survey of Rotuma in 1980. Then the detailed soil surveys of MAF's agricultural research stations (Dobuilevu, Koronivia, Legalega, Naduruloulou, Nawaicoba, Seaqaqa, Sigatoka, Waidradra and Wainigata) and the Tutu and Vunilagi Estates were conducted through 1980 - 1982. D.M. Leslie was attached to the Land Use Section at Koronivia Research Station from 1981 - 85 to correlate these detailed soil surveys and coordinate the national soil survey. V.B. Seru undertook the major part of the soil mapping of Vanua Levu during 1992 - 94.

The national soil map is held on a geographic information system at Koronivia Research Station and maps can be generated on request.



# STUD Format and Descriptions

## 1. Introduction

Soil taxonomic unit descriptions are prepared for each soil taxonomic unit recognised and named in the national soil survey of Fiji and are the primary document for correlation and reference.

The first part of each description is mainly reference and classification data for the unit.

The second part of the description covers the site and environmental characteristics of the unit in terms of such factors as parent material, vegetation, slope and climate.

The third part deals with the morphological and chemical properties of the soil, defining it in terms of a modal profile description and the allowable range of properties within the unit. This part also describes the features which distinguish it from closely related soils.

Finally, the typifying or representative soil profile for the unit is described.

## 2. Explanation of headings used in Soil Taxonomic Unit Descriptions

### Reference/classification

**REFERENCE:** The history of the soil name is given, with details of earlier surveys in which the soil was identified. Where a new series has been created, the original soil set (Twyford & Wright, 1965) in which it was included is given, together with the reasons for its separation from the original set.

**CLASSIFICATION:** The soil series recognised in this survey have been classified according to three soil classification systems:

- A. Soil Taxonomy: to family level (Soil Survey Staff, 1975),
- B. The legend of the FAO World Soil Map (FAO, 1974), and
- C. The system developed for the reconnaissance soil survey of Fiji (Twyford & Wright, 1965).

### INCLUDED MAPPING UNITS AND SYMBOLS:

At soil series level the taxonomic unit represents a central concept with limited variation about it. Phases are subdivisions of the series based on characteristics that are potentially significant to land use, e.g., slope.

The symbol designates the soil mapping unit (shown on the soil map) where the taxonomic unit described is the dominant one.

### Environmental Factors

**GEOGRAPHICAL DISTRIBUTION:** The distribution and geographic extent of the soil unit.

**PARENT ROCK:** Parent rock is the rock from which the parent material is derived.

**PARENT MATERIAL:** Parent material is the weathered unconsolidated material from which the soil has been formed.

**PHYSIOGRAPHIC POSITION / LANDFORM:** Describes the landscape element and major landform on which the soil occurs, e.g., convex backslopes of moderately dissected hill country.

## SLOPE CLASS

### AND RANGE OF SLOPES:

Slope is given in terms of slope classes defined by Land Use Section (1977)

- Flat to gently undulating (0 - 3°)
- Undulating (4° - 7°)
- Easy rolling (8° - 11°)
- Rolling (12° - 15°)
- Strongly rolling (16° - 20°)
- Moderately steep (21° - 25°)
- Steep (26° - 35°)
- Very steep (>35°)

### VEGETATION AND LAND USE:

Gives the altitudinal range in metres above mean sea level over which the soil unit occurs in this survey.

### RAINFALL:

Gives annual average rainfall range (mm); dry season rainfall range; and the wet season rainfall range under which the soil occurs.

### TEMPERATURE:

Gives the mean annual temperature (°C).

### SOIL MOISTURE REGIME:

Gives the soil moisture regime, according to Soil Taxonomy (Soil Survey Staff, 1975), under which the soil occurs in this survey.

Ustic - soils are dry for a significant part of the year but moisture is present at a time when conditions are suitable for plant growth.

Udic - soils are moist throughout the year and the amount of stored moisture plus rainfall is approximately equal to, or exceeds the amount of evapotranspiration.

Perudic - Rainfall exceeds evapotranspiration in all months of most years but water moves freely through the soil in all months.

Aquic - Implies a reducing regime that is virtually free of dissolved oxygen because the soil is saturated by ground water in some or most months.

### SOIL TEMPERATURE REGIME:

Gives the soil temperature regime, according to Soil Taxonomy (Soil Survey Staff, 1975) under which the soil occurs. Soils in the survey have developed under either an isothermic or an isohyperthermic temperature regime. For isothermic, the mean annual temperature is between 15° and 22°C while for the isohyperthermic, the mean annual temperature is greater than 22°C. The iso- prefix indicates that the difference between the averages for coolest and warmest months is less than 5°C.

### SOIL DRAINAGE CLASS:

Gives the overall drainage class in terms of those given by Taylor and Pohlen (1979). They are: very poorly drained; poorly drained; imperfectly or somewhat poorly drained; moderately well drained; well drained; somewhat excessively drained; and excessively drained. The class refers to natural drainage conditions prevailing at sites at which the soil occurs.

### PERMEABILITY CLASS:

Gives the soil permeability class in terms of those given in the soil survey manual (Soil Survey Staff, 1951). Seven classes of soil permeability ranging from very slow to very rapid are recognised.

<b>FLOODING:</b>	Describes the severity and susceptibility, or otherwise, to flooding experienced by the soil.
<b>EROSION:</b>	Gives the severity and type of soil erosion under the major present land uses. Records evidence of accelerated removal or deposition of material as the result of erosion processes and distinguishes between water erosion (sheet, rill, gully); water deposition; wind erosion; and wind deposition. While difficult to define class to indicate the severity of erosion, a subjective distinction between 'nil', 'slight', 'moderate', 'severe' and 'very severe' degrees of erosion.
<b>RANGE OF PROFILE FEATURES:</b>	Indicates the accepted range of profile characteristics over which the taxonomic unit may vary. Beyond this range, a different taxonomic unit may be identified. The number of recorded observations, from which the range of profile features was compiled, is given. Includes details of the range in colour, texture, stoniness, etc.
<b>VARIANTS:</b>	These are minor taxonomic units which vary in some property (properties) from the dominant taxonomic unit (series). The soil variant used to avoid unnecessary multiplication of series names. Distinguishing morphological and environmental features are given.
<b>SIMILAR SOILS AND DISTINGUISHING FEATURES:</b>	Lists soils which are similar and/or related to the taxonomic unit being described. Key morphological and environmental features which distinguish the soils are given.
<b>GENERAL CHEMICAL, PHYSICAL &amp; MINERALOGICAL PROPERTIES:</b>	Ratings, where known, are given for the more important chemical properties.
<b>LABORATORY NUMBERS:</b>	Where available, laboratory numbers are given for samples. Abbreviations preceding numerals indicate the laboratory which conducted the analyses as follows: KRS           Koronivia Research Station, MAF, Fiji SB            New Zealand Soil Bureau, DSIR, Wellington USP           University of the South Pacific, Suva DPI           Department of Primary Industries, Queensland ORSTOM      Office de la Recherche Scientifique Outre-Mer, Bondy, France MU            Massey University, Palmerston North, New Zealand
<b>SOIL LIMITATIONS:</b>	Gives the main soil limitations which affect land use.
<b>ADDITIONAL COMMENTS:</b>	These are given where necessary.

### **Typifying Profile**

This is the detailed description for the modal concept of the taxonomic unit. Site information listed refers to the given profile only. Where identified, typifying profiles for important phases or variants of the modal unit are included. Terminology follows Taylor and Pohlen (1979) and horizon designations follow Milne et al. (1995).





## Physiographic legend

In the soil legend (below), the soil series have been mainly arranged under physiographic headings with the initial subdivision separating soils of the lowlands and foothills from those of the uplands. This separation reflects the change in soil temperature regime at 600 metres altitude viz isothermic soil temperature regime (STR) above 600 metres altitude and isohyperthermic STR below.

The second level separation groups soils into major landform categories, for example, “soils of the marine marshes”, “soils of the fans and outwash surfaces “ etc.

At the third category level, soils are further differentiated on the basis of the parent material from which they develop, for example, “from river alluvium from acidic soils”.

The fourth category subdivides soils on the basis of their internal drainage class, for example “imperfectly drained”, “poorly drained” etc., then where appropriate, a final differentiation is made based on the soil moisture regime under which the form, for example, aquic, udic, perudic or ustic.

### Soil map of Fiji - Physiographic Legend

#### SOILS OF THE LOWLANDS AND FOOTHILLS (<600m altitude, isohyperthermic soil temperature regime)

	Soil Map Symbol
<b>SOILS OF THE MARINE MARSH (Aquic soil moisture regime (SMR))</b>	
• from marine and estuarine alluvium	
Imperfectly drained	
LABASA SOILS	1
Poorly drained	
TIRI SOILS	2
SOSO SOILS	3
DREKETI SOILS	4
Very poorly drained	
DOGO SOILS	5
 <b>SOILS OF THE BEACH STRANDS DUNES AND ESTUARIES</b>	
• from calcareous sands	
Excessively drained	
Udic/perudic SMR	
NUKU SOILS	6
Ustic SMR	
YASAWA SOILS	7
Poorly drained	
Udic/Perudic SMR	
TACILEVU SOILS	8
• from sands of high quartz content	
Well drained to excessively drained	
Udic/Perudic SMR	
VUNIBAU SOILS	9
WAIKALOU SOILS	10
Udic SMR	
VOLIVOLI SOILS	11
VUNAVUTU SOILS	12
Very poorly to poorly drained (Aquic SMR)	
DEUBA SOILS	13

- from sands of low quartz content  
Excessively drained  
Udic / Perudic SMR  
DAWASAMU SOILS 14
- from river alluvium from basic and intermediate rocks over  
calcareous sands  
Poorly drained (Aquic SMR)  
VUNILAGI SOILS 15
- from mixed calcareous sands and organic materials  
Poorly drained (Aquic SMR)  
RANA SOILS 16
- from organic materials over sands of high quartz content  
Poorly drained (Aquic SMR)  
QARIBUTA SOILS 17
- from estuarine alluvium from basic and intermediate rocks  
Poorly drained (Aquic SMR)  
NAKELO SOILS 18
- from estuarine alluvium from acidic rocks  
Poorly drained (Aquic SMR)  
TOGORU SOILS 19
- from mixed 'black' sands and calcareous sands over coral beach rock  
Well drained  
Udic Perudic SMR  
NASELESELE SOILS 20

#### **SOILS OF THE MAJOR FLOOD PLAINS**

- from river alluvium from basic and intermediate rocks
  - (a) Levees
    - Well drained
      - Udic/ Perudic SMR  
MUAINASE SOILS 21
      - REWA SOILS 22
      - Ustic SMR  
LAWAI SOILS 23
    - (b) 'Redict' river channels
      - Moderately well drained
        - Udic / Perudic SMR  
TAMANUA SOILS 24
        - Imperfectly drained
          - Udic / Perudic SMR  
NADURU SOILS 25

(c) Terraces		
Well drained		
Udic / Perudic SMR		
WAINIBUKA SOILS		26
Ustic SMR		
SIGATOKA SOILS		27
Imperfectly drained		
Udic / Perudic SMR		
WAINIVESI SOILS		28
Poorly drained - very poorly drained (Aquic SMR)		
NAVUA SOILS		29
TOKOTOKO SOILS		30
NAUSORI SOILS		31
• from organic materials		
Very poorly drained (Aquic SMR)		
MELIMELI SOILS		32
<b>SOILS OF THE RELICT TERRACES</b>		
• from river alluvium from acidic rocks		
(a) High terraces		
Imperfectly drained		
Udic / Perudic SMR		
WAINIKAVOU SOILS		33
Ustic SMR		
SAUNAKA SOILS		34
(b) Slope margins of dissected high terraced		
Well drained		
Ustic SMR		
NAMAKA SOILS		35
• from river alluvium from basic and intermediate rocks		
Terraces		
Well drained		
Ustic SMR		
NADI SOILS		36
KOROVULI SOILS		37
<b>SOILS OF THE PLATEAU</b>		
• from basic and intermediate rocks		
(a) Plateau surfaces		
Well drained		
Udic / Perudic SMR		
NASEGAI SOILS		38
Ustic SMR		
NAMOSAU SOILS		39
BUA SOILS		40
VUNICIBICIBI SOILS		41
KOROKADI SOILS		42
(b) Slope margin of dissected plateau		
Well drained		
Ustic SMR		
BA SOILS		43

- from rocks of acid composition
  - (a) Plateau surfaces
    - Imperfectly drained
      - Udic/ Perudic SMR
        - KORONIVIA SOILS 44
      - Ustic SMR
        - LOVONIVIA SOILS 45

**SOILS OF THE SECONDARY FLOODPLAINS AND DEPRESSIONS**

- from river alluvium from basic and intermediate rocks
  - Well drained
    - Udic / Perudic SMR
      - SEREA SOILS 46
  - Imperfectly drained
    - Udic Perudic SMR
      - WAIDRADRA SOILS 47
      - SAWAKASA SOILS 48
    - Ustic SMR
      - VATUMA SOILS 49
  - Poorly drained (Aquic SMR)
    - NAREWA SOILS 50
    - BUCAISAU SOILS 51
    - MATAVELO SOILS 52
    - SAWENI SOILS 53
  - Ustic SMR
    - NIKA SOILS 54
  - Very poorly drained (Aquic SMR)
    - BATIKI SOILS 55
- from river alluvium from mixed composition rocks
  - Poorly drained (Aquic SMR)
    - NADRUKA SOILS 56
- from river alluvium from andesitic rocks
  - Poorly drained (Aquic SMR)
    - VEISARU SOILS 57
  - Ustic SMR
    - RAWITI SOILS 58
- from river alluvium from basaltic rocks
  - Well drained
    - Udic / Perudic SMR
      - WAIBULA SOILS 59
- from river alluvium from acidic rocks
  - Well drained
    - Udic / Perudic SMR
      - NAVUNIKODI SOILS 60
      - SALIADRAU SOILS 61
    - Ustic SMR
      - LATO SOILS 62
      - LAGILAGI SOILS 63

Imperfectly to poorly drained (Aquic SMR)	
NACOKULA SOILS	64
KEDRA SOILS	65
TALACAGI SOILS	66
NAQILAI SOILS	67
• from mixed organic and mineral materials from basic and intermediate rocks	
Very poorly drained (Aquic SMR)	
WAINIKAI SOILS	68
VUREVURE SOILS	69
<b>SOILS OF THE FANS AND OUTWASH SURFACES</b>	
• from river alluvium from basic and intermediate rocks	
Well drained	
Ustic SMR	
NASOU SOILS	70
DRASA SOILS	71
MOLAMOLAU SOILS	72
Imperfectly drained	
Ustic SMR	
LAUTOKA SOILS	73
<b>SOILS OF THE KAARST LANDSCAPE</b>	
• from marine limestones and elevated calcareous reef rock	
Well drained	
Udic / Perudic SMR	
WAILOTUA SOILS	74
LAMI	75
Ustic SMR	
TAU SOILS	76
VATULELE SOILS	77
• from residual materials over raised coralline limestone	
Well drained	
Ustic SMR	
CIKOBIA SOILS	78
OGEA SOILS	79
TUVUCA SOILS	80
NAYAU SOILS	81
NAEVUEVU SOILS	82
• from colluvium of mixed limestone and basic rocks	
Well drained	
Ustic SMR	
EKUBU SOILS	83
<b>SOILS OF THE 'YOUNG' VOLCANIC LANDSCAPE (Udic/Perudic SMR)</b>	
• from andesite ash	
Well drained	
LOMAJE SOILS	84

•	from very young 'aa' lava Excessively drained VUNA SOILS	85
•	from very young 'pahoehoe' lava Somewhat excessively drained LOSA SOILS	86
•	from basaltic ash Somewhat excessively drained WAIQERE SOILS	87
	WAIOPA SOILS	88
	ONO SOILS	89
	DULEVI SOILS	90
•	from basaltic ash over scoria REREE SOILS	91
	LAUCALA SOILS	92
•	from young 'pahoehoe' lavas Somewhat excessively drained TAVEUNI SOILS	93
	KORO SOILS	94
	URA SOILS	95
	NACAMAKI SOILS	96
	RAVILEVU SOILS	97
•	from young 'aa' lavas Somewhat excessively drained VAKAWAU SOILS	98
	KIRIKIRI SOILS	99
	HAFHAFU SOILS	100
•	from older 'pahoehoe' lavas Well drained NABEKA SOILS	101
	WAIORU SOILS	102
	TABAKA SOILS	103
	QELANI SOILS	104
	NASAU SOILS	105
•	from basaltic scoria cones Well drained NACAUGAI SOILS	106
	TAVUYAGA SOILS	107
	MAFUA SOILS	108
•	from basaltic tuffaceous cones Well drained ROROA SOILS	109

## SOILS OF THE HILL COUNTRY

- from *in situ* calcareous tuffs, sandstones and marls
  - Well drained
    - Udic / Perudic SMR
      - SAMABULA SOILS 110
      - NALOTU SOILS 111
    - Ustic SMR
      - KOROMAVU SOILS 112
      - KEYIASI SOILS 113
      - NADROGA SOILS 114
      - MOMI SOILS 115
      - SABETO SOILS 116
      - NQALOTU SOILS 117
  - Poorly drained
    - Ustic SMR
      - EMURI SOILS 118
- from colluvium derived from calcareous tuffs, sandstones and marls
  - Moderately well drained
    - Udic / Perudic SMR
      - SUVA SOILS 119
    - Ustic SMR
      - YAKO SOILS 120
- from basic and intermediate sedimentary rocks
  - Well drained
    - Udic / Perudic SMR
      - BURENITU SOILS 121
      - DOBUILEVU SOILS 122
      - MATAWAILEVU SOILS 123
      - LOBAU SOILS 124
      - VISA SOILS 125
      - SOTE SOILS 126
      - WAIMARO SOILS 127
      - SERUA SOILS 128
      - WAIDINA SOILS 129
      - NACULA SOILS 130
    - Ustic SMR
      - VASILAU LAU SOILS 131
  - Imperfectly drained
    - Udic / Perudic SMR
      - WAISAVA SOILS 132
      - DARIA SOILS 133
- from quartz rich and acidic tuffs
  - Well drained
    - Udic / Perudic SMR
      - NAMUANA SOILS 134
      - SAROWAQA SOILS 135
      - GAIGAI SOILS 136
      - DRITI SOILS 137
      - NAMATI SOILS 138
      - NAMARA SOILS 139



Ustic SMR	
WAINIKORO SOILS	140
NUKUDAMU SOILS	141
NUKUSA SOILS	142
VATUVONU SOILS	143
KURUKURU SOILS	144
KELIKOSO SOILS	145
VEREVERE SOILS	146
Imperfectly drained	
Ustic SMR	
UAUA SOILS	147
• from <i>in situ</i> quartzporphyry and quartzite rocks	
Somewhat excessively drained	
Udic / Perudic SMR	
LUTU SOILS	148
USTIC SMR	
MALOLO SOILS	149
• from silicified and indurated tuffs, sandstones, marls and agglomerates	
Well drained	
Udic / Perudic SMR	
VATUBABA SOILS	150
NADAWA SOILS	151
RAURIKO SOILS	152
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KORONIQALA SOILS	157
• from <i>in situ</i> acidic rocks (granite, andesite and dacite)	
Well drained	
Udic / Perudic SMR	
NAMOSI SOILS	158
NAULUVATU SOILS	159
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VUNATOTO SOILS	162
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• from <i>in situ</i> argillaceous and contact metamorphic rocks	
Well drained	
Ustic SMR	
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- from basic and intermediate igneous rocks
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## Volume 1

Ba	Ledrutua	Namosau
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Bucaisau	Lodoni	Naqalotu
Bureni	Lomaiviti	Naqilai
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Deuba	Manuka	Navai
Dobuilevu	Mataiwailevu	Navava
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Dogotuki	Matavelo	Navunikodi
Drasa	Melimeli	Nawai
Dreketi	Molamolau	Naweni
Driti	Momi	Nayau
Dulevi	Monasavu	Nika
Ekubu	Muainase	Nuku
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Gaigai	Nabiti	Nukusa
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Gau	Nabuono	
Hafhafu	Nacamaki	
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Korotuku	Nadroga	
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Kubuna	Naduru	
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Qaributa	Vakawau
Qeleni	Varaciva
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Rauriko	Vatubaba
Ravilevu	Vaukoula
Raviravi	Vatulele
Rawiti	Vatuma
Reree	Vatuvonu
Rewa	Veisaru
Rewasa	Verevere
Roroa	Visa
Rukuruku	Vitawa
Sabeto	Volivoli
Saliadrau	Vuna
Salialailai	Vunatoto
Samabula	Vunavutu
Sarowaqa	Vunibau
Saunaka	Vunicibici
Savudrodoro	Vunilagi
Sawakasa	Vurevure
Saweni	Vuya
Seatura	Waibici
Serea	Waibula
Serua	Waidina
Sigatoka	Waidradra
Solevu	Waikalou
Soqulu	Wailotua
Soso	Wailulu
Sote	Waimaro
Suva	Wainibuka
Tabaka	Wainikai
Tabia	Wainikavou
Tabuquto	Wainikoro
Tacilevu	Wainivesi
Talacagi	Wainunu
Tamanua	Waioba
Tau	Waioru
Tavenui	Waiqere
Tavua	Waisava
Tavuyaga	Yakita
Tiri	Yako
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Tokotoko	Yasawa
Totoya	Yavuna
Tuva	
Tuvuca	
Uaua	

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**Soil Series**

**Volume 1**



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Ba series**

REFERENCE: The Ba gravelly clay (35d) defined by Twyford & Wright (1965) as forming on deep, strongly weathered parent materials in association with Namosau series and where the latter has been severely eroded. Ba series are shallow soils with the weathered parent rock normally encountered within 20-50 cm of the surface. They form part of the Raviravi set.

The central concept for Ba series is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Ustoxic Dystrypept, fine, kaolinitic, isohyperthermic
- (b) FAO: Ferralic Cambisol
- (c) Twyford and Wright: Ferruginous latosol with a moderate to strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Ba soils, undulating phase (43B)	Ba soils, strongly rolling phase (43E)
Ba soils, easy rolling phase (43C)	Ba soils, moderately steep phase (43F)
Ba soils, rolling phase (43D)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Ba soils form on rolling country often in association with Namosau soils. Ba soils are the major soil type of the so called 'Ba Closed Area', north Viti Levu.

PARENT ROCK: *In situ* andesites (and less commonly basalts).

PARENT MATERIAL: Very strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: In general short (100-150 m) length planar hill surfaces with uneven microrelief of incised rills, concave and convex hollows and humps indicative of tree wind throw and differential deposition and removal of erosion products.

SLOPE CLASS AND RANGE OF SLOPES: All slope classes from undulating to moderately steep (4-25°) and less commonly slopes up to 35°.

VEGETATION AND LAND USE: Supports a degraded talasiga vegetation of Nokonoko and *Dicranopteris* fern with 50% bare ground and surface boulders and iron concretions.

RANGE OF ELEVATION: 15-150 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Very severe past erosion viz sheet, rill and wind erosion with minor soil slips and debris slides on steeper slopes.

## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

Typically shows an eroded ground surface with ironstone lag gravels and many surface boulders, and 15 cm of dark reddish brown slightly gritty clay loam, of weakly developed medium blocky structure breaking easily to fine blocky and crumb, friable, and slightly sticky moist, overlying 10 cm of dark reddish brown gritty clay loam, of weakly developed fine nut with crumb structure, very friable, slightly sticky moist, with a few strongly weathered stones, overlying more than 40 cm of dark red and reddish grey clay loam, of massive structure, sticky moist, and firm, with common pinkish white (5YR 8/2) and grey (7.5YR N5/0) soft nodules of kaolinite and alumina.

### DIAGNOSTIC HORIZONS:

Ochric epipedon, cambic horizon.

### RANGE OF PROFILE FEATURES:

Ba series have an Ah, Bw, BC1 horizon sequence.

The A horizon thickness ranges from 12-25 cm; colours include dark reddish brown (2.5YR 2/4, 3/4, 5YR 3/2, 3/3 and 3/4); textures vary gravelly or gritty clays or clay loams; and structures may be weak; moderate or strongly developed fine nut, granular or crumb (commonly with single grain); and ironstone nodules (the gravel component) may be few, common, many or profuse.

The Bw horizon thickness ranges from 8-15 cm; colours include dark reddish brown (2.5YR 3/4, 5YR 3/3, 3/4) and red (2.5YR 4/6, 4/8); textures range as for A horizon; iron sandstone nodules may be common, many or profuse; and soft yellowish grey alumina or kaolinite nodules may be few, many or absent.

The BC1 horizon thickness exceeds 100 cm of dark red (2.5YR 3/6) and red (2.5YR 4/6, 4/8) clay or clay loam; and with common pinkish white (5YR 8/2) and grey (7.5YR N5/0) soft nodules of kaolinite and alumina.

### VARIANTS:

None recognised

### SIMILAR SOILS AND

### DISTINGUISHING FEATURES:

None recognised

### GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:

Profiles are strongly acid, % base saturation very low. Phosphorus and organic carbon values are also very low. Only magnesium, amongst the exchangeable cations has low values with very low values measured for calcium, potassium and sodium. CEC is low but rises to medium values in the parent material.

The mineralogical class is kaolinitic.

The particle size class is fine with the fine earth fraction dominated by clay >50% in the soil but dropping to <40% in the parent material where silt fraction increases.

### LABORATORY Nos:

SB9394A-D

### SOIL LIMITATIONS:

Past severe soil erosion that has resulted in a very uneven ground surface and a severe potential for further sheet and rill erosion; severe soil moisture deficits experienced during the dry season; strong acidity; and nutrient deficiencies of nitrogen, potassium and phosphorus.

## Typifying Profile

SOIL NAME: Ba soils, easy rolling phase.  
PROFILE No.: LK15  
SITE LOCATION: Map I iii (Lakeba) 452740E 114650N. Lakeba Island, Lau Group.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Linear surface within convex hummocks in lower midslope position.  
PARENT MATERIAL: Colluvium derived from andesitic rocks over *in situ* andesite.  
SLOPE: 9°  
ASPECT: West  
ELEVATION: 65 m  
MICRORELIEF: Abundant stones (3-5 cm) and boulders (15 cm) on surface.  
SITE VEGETATION: 50% depletion. Dominated by fern (*D. linearis*) and odd Casuarina and Pandanus tree.  
LAND USE: Unused  
DRAINAGE: Well drained; moderate permeability; rapid runoff.  
EROSION: Severe sheet slope wash and rill erosion. Evidence of mass movement in the area.  
DISTURBANCE: Past erosion  
LABORATORY Nos: SB9394A-D

### PROFILE DESCRIPTION

Ba soils, easy rolling phase

Ah	0-14 cm (14 cm)	Dry; dark reddish brown (5YR 3/4), moist dark reddish brown (5YR 3/4), rubbed reddish brown (5YR 4/4) slightly gritty clay loam; friable; non-plastic; slightly sticky; primary structure of weakly developed medium blocky with crumb breaking to a secondary structure of very weakly developed fine nut with crumb; abundant medium and coarse roots; many casts; few stones; indistinct regular boundary,
Bw	14-23 cm (9 cm)	Dry; dark reddish brown (5YR 3/3), rubbed dark reddish brown (5YR 3/4) gritty clay loam; very friable; slightly sticky; non-plastic; very weakly developed fine nut with crumb and single grain; many to abundant medium and fine roots; few to many casts; rare very strongly weathered medium and fine stones; sharp regular boundary,
BC1	40 cm+	Moist; dark red (10R 3/6) and reddish grey (10R 6/1) rubbed weak red (10R 4/2) clay loam; friable; sticky; non-plastic; massive breaking to single grain; common pinkish white (5YR 8/2) and grey (7.5YR N5/0) soft nodules of kaolinite and alumina; rare fine roots; rare casts; strongly weathered <i>in situ</i> rock.



# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Batawai series**

REFERENCE: Batawai clay (27g) and Batawai hill soils (27gH) defined by Twyford & Wright (1965) as deep red soils on rolling and hilly land developed from basic tuffs under a climate with little or no dry season.

Forms part of the Sote set.

The central concept of Batawai soils is retained in this survey.

### CLASSIFICATION:

- (a) Soil Taxonomy: Oxic Humitropept, fine, ferruginous, isohyperthermic
- (b) FAO: Ferralitic Cambisol
- (c) Twyford & Wright: Humic latosol, with weak or no dry season

### INCLUDED MAPPING UNITS AND SYMBOLS:

Batawai soils, undulating phase (204B)	Batawai soils, strongly rolling phase (204E)
Batawai soils, easy rolling phase (204C)	Batawai soils, moderately steep phase (204F)
Batawai soils, rolling phase (204D)	Batawai soils, steep phase (204G)

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Batawai soils are developed on rolling and hilly slopes in southern Viti Levu, particularly in the Serua ranges.

PARENT ROCK: Tuffaceous rocks of basic composition.

PARENT MATERIAL: Deep strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Convex surfaces on rolling and hilly backslopes and ridges in moderately dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: From undulating through all slope classes to steep (5- $<35^{\circ}$ ).

VEGETATION AND LAND USE: Much under tall forest, and where cleared considerable areas are unused. Used for cassava food gardens but followed by 10 to 15 years of bush fallow.

RANGE OF ELEVATION: 30-250 m.

RAINFALL: Average annual range: 3,200-4,500 mm;  
dry season range: 900-1,700 mm;  
wet season range 1,900-3,000 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Medium

FLOODING: Never floods

EROSION: Moderate and severe sheet, rill and soil slip erosion potential on slopes  $>11^{\circ}$  where forest cleared and cultivated.



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of yellowish red very friable clay loam, of weak fine and medium nut structure, overlying 80 cm of red very friable silty clay loam, of weakly developed, medium blocky structure, overlying 40 cm of dark red very friable silty clay loam of weak very fine and nut structure on brownish yellow and red friable strongly weathered <i>in situ</i> rock, of massive structure breaking to single gain with prominent iron/manganese coatings to the rock structures.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Batawai series have Ah, Bw, Bt, BC horizon sequence.</p> <p>The Ah horizon thickness ranges from 10 to 15 cm; its colours include yellowish red (5YR 4/6, 4/6) and reddish brown (5YR 4/3, 4/4); textures include clay and clay loam; consistence friable or very friable; and structures weak or moderate very fine, fine or medium nut.</p> <p>The Bw1 horizon thickness ranges from 20 to 50 cm; its colours include red (2.5YR 4/6, 4/8, 5/6, 5/8); textures are clay, clay loam, or silty clay loam; and structures are weak or moderate medium or coarse blocky.</p> <p>The Bw2/Bw3 horizons thickness ranges from 50 to 100 cm; its colours include red (2.5YR 4/6, 4/8, 5/6,5/8) and dark red 2.5YR 3/6); textures are clay, clay loam or silty clay loam; and structures may be weak, moderate or strong, fine, medium or coarse blocky or nut.</p> <p>BC horizons encountered between 125 to 200 cm; colours include red and yellow parent material mottled and with abundant profuse iron/manganese coatings.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be strongly to extremely acid; organic carbon and nitrogen are of medium value in the topsoil (0-13cm) and very low below it; % base saturation is very low throughout; CEC is medium in the topsoil and low below it; exchangeable calcium is very low; potassium is low in the topsoil and very low below it; and magnesium is medium in the topsoil and low or very low in the other horizons.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is ferruginous.</p>
LABORATORY Nos:	KRS V118-123 (inclusive)
SOIL LIMITATIONS:	Slope; clayey textures; erosion potential on slopes >11° when forest cleared; strong soil acidity; and nutrient deficiencies of potassium, phosphorus and nitrogen.

## Typifying Profile

SOIL NAME: Batawai soils, easy rolling phase.  
PROFILE No.: VS05  
SITE LOCATION: Forestry road 10 km inland from Galoa village, Serua Province.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex summit interfluvium in strongly rolling hill country.  
PARENT MATERIAL: Strongly weathered colluvium from basic and intermediate rocks on strongly weathered *in situ* rock of the same composition.  
SLOPE: 10°  
ASPECT: West  
ELEVATION: 250 m  
MICRORELIEF: Even  
SITE VEGETATION: Indigenous forest  
LAND USE: Unused  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: KRS V118-123 (inclusive)

### PROFILE DESCRIPTION

Ah	0-13 cm (13 cm)	Moist; yellowish red 5YR 4/6) clay loam; weakly developed very fine and medium nut structure; very friable; slightly sticky; slightly plastic; abundant very fine and fine and medium roots; distinct smooth boundary,
Bw1	13-55 cm (42 cm)	Moist; red (2.5YR 4/6) silty clay loam; weakly developed medium blocky structure breaking to weak very fine nut structure; very friable; slightly sticky; slightly plastic; common very fine and fine roots; diffuse smooth boundary,
Bw2	55-95 cm ( cm)	Moist; red (2.5YR 3/6) to dark red (2.5YR 3/6) silty clay loam; weakly developed coarse blocky structure; very friable; slightly sticky; slightly plastic; few very fine roots; few strongly weathered subrounded stones; diffuse smooth boundary,
Bw3	95-143 cm (48 cm)	Moist; red (2.5YR 3/6) silty clay loam; weakly developed very fine nut and crumb structure; very friable; slightly sticky; slightly plastic; few very fine roots; distinct smooth boundary,
BC1	43-183 cm (40 cm+)	Moist; brownish yellow (19YR 6/6) loam; massive breaking to single grain; friable; slightly sticky; many prominent black (7.5YR N2/0) iron/manganese coatings to structural faces of the rock; strongly weathered <i>in situ</i> rock with rock structures preserved; distinct smooth boundary,

BC2

18-220 cm  
(37+)

Moist; red (2.5YR 4/6) silt loam; massive breaking to single grain; friable to firm; slightly plastic; many prominent black (7.5YR N2/0) iron manganese coatings to structural faces of the rock; strongly weathered *in situ* rock with rock structures preserved.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Batiki series**

REFERENCE: New soil series introduced in the soil survey of Naduruloulou Agricultural Research Station (Palmer & Smith, 1984) to include very poorly drained soils of swamp land, derived from fine textured alluvium and colluvium with an  $\bar{n}$  value  $>0.7$ .

The soil was previously included with the Nausori clay (45d) by Twyford & Wright (1965). Leslie (1984) has classified Nausori series as Typic Tropaquent and Batiki series classifies as a Hydraquent.

The series is named after the old Batiki village on the western margin of Naduruloulou Agricultural Research Station, adjacent to the Rewa River.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Hydraquent, fine, kaolinitic, isohyperthermic
- (b) FAO: Dystric Gleysol
- (c) Twyford and Wright: Gley soil with a very weak or no dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Batiki soils (55)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs in the tributary valleys of the Rewa and Navua river systems in ESE and SSE Viti Levu.

PARENT ROCK: Marine silt stones and sandstones of basic and intermediate composition.

PARENT MATERIAL: Fine textured alluvium and colluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Swamp land and valleys.

SLOPE CLASS AND RANGE OF SLOPES: Flat,  $0^\circ$

VEGETATION AND LAND USE: Mainly reeds and long grasses. Duruka (*Saccharum edule*) commonly grown.

RANGE OF ELEVATION: 3-25 m a.m.s.l.

RAINFALL: Annual average range: 2150-4280 mm;  
dry season range: 800-1600 mm;  
wet season range: 1800-2800 mm.

TEMPERATURE: Mean annual:  $24.5^\circ\text{C}$ .

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Very poorly drained.

PERMEABILITY CLASS: Moderate

FLOODING: Water table at or near surface at least during the wet season (November to April). During normal years flooding occurs on 5 occasions with ponding up to 10 days at each event.

EROSION: No erosion risk.

**Batiki**

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	<p>Dark coloured A horizons of textures varying from silt loam to clay loam overlying gleyed, clayey textured C horizons.</p> <p>C horizons vary from grey to greenish grey and may have high chroma mottles. Horizons have no discernible structure although the A horizon may have a weakly developed nut structure. A horizons generally contain many poorly decomposed plant remains. The water table is frequently at or near the surface and horizons are very wet. The soil is soft and unconsolidated and the soil, when squeezed in the hand, flows readily between the fingers.</p>
DIAGNOSTIC HORIZONS:	Ochric epipedon
RANGE OF PROFILE FEATURES:	<p>Batiki series have Ap1, Ap2, Cr horizon sequence. Water table was too high to allow pits to be dug.</p> <p>Based on 10 auger observations main features are: The A horizons are up to 30 cm in thickness and textures range between silt loam, silty clay loam, and clay loam. The Cr horizon colours are of 5Y, 5G or 5GY (sometimes 10YR) hues; have up to 30% high chroma mottles, and textures range between clay and silty clay.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Wainikai series: Have similar C horizons but differ in that a histic epipedon forms the upper part of their profiles.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Strongly acid soils. The mineralogy of the clay fraction is kaolinitic.
LABORATORY Nos:	KRS T1391-1395 (inclusive)
SOIL LIMITATIONS:	Soft, unconsolidated nature of the soil. Water table at or near the surface for much of the year.

## Typifying Profile

SOIL NAME: Batiki soils  
PROFILE No.: N35  
SITE LOCATION: See soil map of Naduruloulou Agricultural Research Station (Palmer & Smith, 1984). Grid Reference - Sheet: Viti Levu 14 (1:50 000) 604E 123N.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Middle parts of narrow swampy valleys.  
PARENT MATERIAL: Fine textured alluvium.  
SLOPE: 0°  
ASPECT: Not applicable  
ELEVATION: 12 m  
MICRORELIEF: Few hummocks (<30 cm amplitude).  
SITE VEGETATION: Grasses, mainly Navua sedge (*Cypreus aromaticus*) and Para grass (*Brachiaria mutica*).  
LAND USE: Mainly unused. Some Duraka (*Saccharum edule*) grown as a food crop.  
DRAINAGE: Very poorly drained.  
EROSION: None  
DISTURBANCE: Cultivated for Duraka.  
LABORATORY Nos: KRS T1391-1395 (inclusive)

### PROFILE DESCRIPTION

#### Batiki soils

Ap1	0-20 cm (20 cm)	Dark brown (7.5YR 3/2) silty clay loam; wet; slightly sticky; slightly plastic; massive; many poorly decomposed plant remains; many fine roots; indistinct boundary,
Ap2	20-30 cm (20 cm)	Very dark greyish brown (10YR 3/2) silty clay loam; wet; slightly sticky; slightly plastic; massive; many poorly decomposed plant remains; many fine roots; distinct boundary,
Cr	30-125 cm (95cm+)	Greenish grey (5G 5/1) clay with common (15%) distinct medium strong brown mottles; wet; sticky; plastic; massive; few fine roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Bua series**

REFERENCE: Bua gravelly clay (35c) and Bua hill soils (35cH) defined by Twyford & Wright (1965) as strongly degraded soils from basic rocks with 'talasiga' vegetation formed under a climate with a strong dry season.

Forms part of the Raviravi set. This central concept as previously defined for Bua soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Kanhaplustalf, very fine, ferruginous, isohyperthermic
- (b) FAO: Eutric Planosol
- (c) Twyford and Wright: Ferruginous latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Bua soils, flat to gently undulating phase (40A)	Bua soils, rolling phase (40D)
Bua soils, undulating phase (40B)	Bua soils, strongly rolling phase (40E)
Bua soils, easy rolling phase (40C)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Bua soils develop over wide areas on the dry sides of both Vita Levu and Vanua Levu. In Vanua Levu, Bua soils are widespread throughout the lowlands of Macuata province and the north part of Bua province.

PARENT ROCK: Basalts and basic andesites.

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Planar slopes in flattish to easy rolling land.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), easy rolling (8-11°), rolling (12-15°), and strongly rolling phase (16-20°).

VEGETATION AND LAND USE: Normally supports only poor fern and grass with occasional small shrubs like *usi*, *doi*, *cerua*, *mako*, and *nuqanuqa*, pandanus palms and *nokonoko* trees. With fertiliser inputs is used for sugar cane and rain fed rice.

RANGE OF ELEVATION: 20-150 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Has experienced severe sheet and rill erosion in the past. Moderate to very severe potential for further erosion.



## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

Typically shows 17cm of dark reddish brown friable silty clay loam, of moderate fine nut structure, overlying 30 cm of red firm gravelly clay loam, of moderate medium blocky structure breaking to fine crumb and nut, overlying 60 cm of red friable to firm clay loam, of weak to moderate fine and medium blocky structure, or 30 cm or more of yellowish red mottled red friable clay loam, of weak medium blocky structure breaking to simple grain. The mottles are oriented in such a way suggestive of embryonic iron pan development.

### DIAGNOSTIC HORIZONS:

Ochric epipedon, argillic horizon.

### RANGE OF PROFILE FEATURES:

Bua series have a Ap, Bw, Bt1, Bt2, BC horizon sequence.

The Ap horizon thickness ranges from 5-20 cm; its colours include dark reddish brown (5YR 3/3, 3/4 2.5YR 3/4) and reddish brown (2.5YR 4/4, 5YR 4/3, 4/4); structures may be moderate or strong fine or medium nut or granular; and consistence is either friable or very friable.

The Bw horizon thickness ranges from 8-20 cm; its colours include reddish brown (5YR 4/4, 5/4 and 2.5YR 4/4, 5/4); structures may be weak or moderate fine nut or granular; consistence may be firm friable or very friable.

The Bt1 horizon thickness ranges from 10-35 cm; its colours include dark red (2.5YR 3/6) and red (2.5YR 4/6, 4/8); structures are weak or moderate, fine or medium, nutty or blocky.

The Bt2 horizon thickness ranges from 50-120 cm; its colours include dark red (2.5YR 3/6), red (2.5YR 4/6, 4/8) and weak red (10R 4/3, 4/4); few, common and many black and yellow weathered parent material fragments; and consistence may be firm, friable or very friable.

A mottled BC with elements of a Bfm horizon encountered below the argillic horizon.

### VARIANTS:

A less shallow strongly weathered and eroded variant where *in situ* rock is encountered within 30 cm of the soil surface. A typifying profile for Bua soils, undulating phrase is given below.

### SIMILAR SOILS AND

### DISTINGUISHING FEATURES:

None recognised

### GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:

Analysis shows the soil to be very strongly acid and of variable charge; organic carbon is high in the topsoil (0-17cm) and low in the other horizons; nitrogen is medium in the topsoil and very low below it; TEB and CEC values are very low throughout the profile and while %BS has high values 17-109 cm this is somewhat irrelevant in view of the extremely low CEC and TEB values; exchangeable calcium, potassium and sodium are of very low values magnesium low throughout the profile; and % aluminium is most significant in the exchange complex.

The particle size family class is very fine.

The mineralogical class is ferruginous.

### LABORATORY Nos:

Q.DPI 11711 - 11714

### SOIL LIMITATIONS:

Rapid permeability; severe soil moisture deficits experienced during the dry season; severe past sheet erosion and severe sheet and rill erosion potential; very strong acidity; variable charge; aluminium toxicity; and a low nutrient reserve that would be rapidly depleted under a cropping regime.

**Bua**

## Typifying Profile

SOIL NAME: BUA soils, flat to gently undulating phase.  
PROFILE NO: NLDC 03  
SITE LOCATION: Trial area at NLDC Nasarowaqa pigeon pea project area.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Flat planar backslope position on slope of 150 cm length in a flat to gently undulating plateau surface.  
PARENT MATERIAL: Strongly weathered in *situ* rock of basic composition.  
SLOPE: 2°  
ASPECT: West  
ELEVATION: 40 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Pigeon pea (4 weeks old) crop.  
LAND USE: Intensive pigeon pea production.  
DRAINAGE: Well drained  
EROSION: Has experienced severe sheet and rill erosion in the past.  
DISTURBANCE: Cultivated  
LABORATORY NUMBERS: Q.DPI 11711-11714

### PROFILE DESCRIPTION

Ap	0-17 cm (17 cm)	Dry; dark reddish brown (5YR 3/2) and rubbed dark reddish grey (5YR 4/2) silty clay loam; moderately developed fine nut structure; friable; slightly sticky; non plastic; few fine roots, unweathered subangular iron stone gravels; sharp smooth boundary,
Bt1	17-49 cm (32 cm)	Slightly moist; red (2.5YR 4/6) gravelly clay loam; moderately developed medium blocky structure breaking to moderate medium blocky structure breaking to moderate medium crumb and nut structure; firm; slightly sticky; non plastic; no roots; many weathered subangular stones; indistinct smooth boundary,
Bt2	49-109 cm (60 cm)	Slightly moist; red (2.5YR 4/6) clay loam; weak to moderately developed fine and medium blocky structure; friable to firm; sticky; slightly plastic; no roots; distinct smooth boundary,
BC	109-149+ cm (30 cm +)	Slightly moist; yellowish red to strongly brown (5YR - 7.5YR 5/6) and rubbed yellowish red (5YR 5/6) clay loam; many medium distinct red (10R 4/6) mottles; weakly developed medium blocky structure breaking to single grain; friable; slightly sticky; non plastic; no roots; mottles suggestive of embryonic Fe/Mn pan development.

## Typifying Profile

Bua soils, undulating phrase

Ap	0-8 cm (8 cm)	Moist; reddish-brown (2.5YR 4/4) clay; moderately developed fine granular structure; very friable; few ironstone gravels especially near surface; many roots; indistinct boundary,
Bw	8-18 cm (9 cm)	Moist; reddish-brown (2.5YR 4/4) clay; weakly developed medium blocky structure breaking to weakly developed fine granular structure; very friable; few roots; few weathered stones; distinct boundary,
Bt1	18-28 cm (10 cm)	Moist; dark red (2.5 YR 3/6) clay, moderately developed fine nut structure; friable (firm <i>in situ</i> ) no roots; no stones; distinct boundary,
Bt2	28-110+ cm (82 cm +)	Moist; dark red (2.5YR 3/6) mealy clay with many black and yellow weathered friable basalt materials; weakly developed blocky structure breaking to very fine granular structure; very friable; no roots.

Note: 30 m west of the above site and under undisturbed indigenous vegetation the following surface horizon was described.

0-8 cm	moist; dark reddish-brown (2.5YR3/4) clay; moderately developed medium blocky structure breaking to strongly developed fine nut structure; friable; many roots.
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## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Bucaisau series**

REFERENCE: The Bucaisau clay (49b) defined by Twyford & Wright (1965) as a strongly mottled, moderately gleyed soil associated with latosols developed under a climate with a moderate to strong dry season.

Included with the Veisaru set.

The central concept for Bucaisau soils is retained in this survey.

#### CLASSIFICATION:

(a) Soil Taxonomy: Typic Haplaquoll, fine, kaolinitic, isohyperthermic

(b) FAO: Mollic Gleysol

(c) Twyford and Wright: Gley soil related to latosols with a moderate to strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Bucaisau soils (51)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Mapped and described for Vanua Levu only.

PARENT ROCK: Mixed rocks predominantly of basic and intermediate composition.

PARENT MATERIAL: Riverine alluvium

PHYSIOGRAPHIC POSITION/LANDFORM: Floors of tributary valleys with very low gradients within the confines of hill country.

SLOPE CLASS AND RANGE OF SLOPES: Level or near level 0-1°.

VEGETATION AND LAND USE: Where unused for cropping supports inferior sward grasses, miscellaneous weeds and reeds and sedges. Commonly used for irrigated dalo beds, or for tavioka.

RANGE OF ELEVATION: 2-10 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly and very poorly drained.

PERMEABILITY CLASS: Slow

FLOODING: With high water, very slow surface runoff due to low gradients; floods regularly, particularly in association with intensity storms.

EROSION: No erosion risk

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Thick (25-35 cm), firm dark brown clayey topsoil, with weak blocky and nut structures, sticky and plastic consistence and abundant high chroma (5YR hue) mottles. The topsoil rests on a soft dark grey B horizon with profuse high chroma mottles, sticky and plastic consistence and weak blocky structure. The C horizon normally encountered at or below 50 cm is massive otherwise is similar morphologically to the B horizon. Iron concretions typify all horizons.
DIAGNOSTIC HORIZONS:	Mollic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Veisaru soils: Bucaisau soils have a darker and deeper topsoil than Veisaru soils, are more strongly mottled below and frequently is gravelly throughout the soil profile owing to the presence of small hard Fe or Mn concretions.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Horizons are moderately acid, base saturation values are high (&gt;60%), and organic values are low to very low and decrease regularly with depth. CEC and exchangeable calcium and magnesium values are medium. Potassium is very low and sodium values medium becoming high below 50 cm.</p> <p>The mineralogical class is kaolinitic.</p> <p>The fine earth fraction is predominantly clay with sand insignificant.</p>
LABORATORY Nos:	SB9360A-C LK4A-C
SOIL LIMITATIONS:	Low pH, high water tables and poor internal drainage.

## Typifying Profile

SOIL NAME: Bucaisau soils  
PROFILE No.: LK4  
SITE LOCATION: Map I iii (Lakeba) 448780 E 114390 N Lakeba Island, Lau Group.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Linear valley bottom flood plain.  
PARENT MATERIAL: Alluvium derived from andesitic rocks  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 8 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Ground cover of poor quality grasses, weeds and sedges with odd coconut.  
LAND USE: Extensive grazing for goats.  
DRAINAGE: Poorly drained; slow permeability; very slow runoff.  
EROSION: None observed  
DISTURBANCE: Previously cultivated for dalo.  
LABORATORY Nos: LK4A-C SB9360A-C

### PROFILE DESCRIPTION

Bucaisau soils

Ap	0-28 cm	Moist; dark brown (7.5YR 3/2), rubbed dark brown (7.5YR 4/2) clay; firm sticky; plastic; primary structure of weak coarse blocky, the secondary structure of weak to moderately developed medium nut structure; abundant, medium, soft mottles (5YR 5/4); many fine iron concretions; many fine roots; many casts and relict channels; indistinct regular boundary,
Bg	28-50 cm	Moist; dark grey (7.5YR N4/0) clay; soft; sticky; plastic; weakly developed coarse blocky structure; profuse, coarse mottles (7.5YR 5/6) these also fill worm channels; abundant fine and medium iron concretions; few to many fine roots; few casts and worm channels; rare non weathered angular stones; indistinct regular boundary,
Cg	50-75 cm	Wet; dark grey (7.5YR N4/0) clay; soft; sticky; plastic; massive; many mottle zones of 7.5YR 5/6; many fine and medium iron concretions; few fine roots; few casts and worm channels; rare, non weathered angular stones.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Bureni series**

REFERENCE: Bureni clay (28c) and Bureni hill soils (28cH) defined by Twyford & Wright (1965) as developed from indurated basic tuffs on dissected plateau surfaces under a climate with little or no dry season.

Forms part of the Wainunu set.

The central concept for Bureni soils is retained in this survey.

#### CLASSIFICATION:

(a) Soil Taxonomy: Typic Kanhaplohumult, clayey, ferruginous, isohyperthermic

(b) FAO: Humic Nitosol

(c) Twyford and Wright: Humic latosol with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Bureni soils, easy rolling phase (205C)

Bureni soils, rolling phase (205D)

Bureni soils, strongly rolling phase (205E)

Bureni soils, moderately steep phase (205F)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Bureni soils develop on dissected plateau surfaces in southern Viti Levu, particularly in the Serua ranges.

PARENT TOCK: Indurated tuffaceous rocks of basic composition.

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Dissected plateaux

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°) rolling (12-15°), strongly rolling (16-20°) and moderately steep (21-25°).

VEGETATION AND LAND USE: Much under indigenous forest. Have been cleared for pasture in a few places.

RANGE OF ELEVATION: 75-200 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY CLASS: Moderately slow

FLOODING: Never floods

EROSION: Slight and moderate sheet and rill erosion potential when forest cleared and cultivated.

**Bureni**



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of yellowish red friable silty clay loam, of moderate to strong medium nut and granular structure, overlying 90 cm of red friable clay loam, of moderate medium and coarse blocky structure commonly breaking to finer aggregates, and commonly with faint clay cutans to ped faces, overlying more than 50 cm of red firm silty clay loam, of moderate platy structure with medium blocky, and with prominent red mottling aligned in a horizontal pan like fashion.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Profiles similar to those of the Batawai soils, except that the structures are stronger and the solum deeper. Mottling can also occur, indicating poor aeration.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be strongly acid; organic carbon is low in the topsoil (0-10 cm) and very low below it; nitrogen has low values 0-48 cm and very low below this depth; available phosphorus is very low throughout; % base saturation is very low in all horizons; CEC is medium; TEB is low in the topsoil and of very low values in the other horizons; exchangeable calcium and potassium have very low values throughout the profile; and magnesium is medium.</p> <p>The particle size family class is clayey.</p> <p>The mineralogical class is ferruginous.</p>
LABORATORY Nos:	KRS V105-108 (inclusive)
SOIL LIMITATIONS:	Clayey textures; moderately slow permeability; slight and moderate soil erosion hazard when cultivated on slopes > 3°; strong soil acidity; and nutrient deficiencies of nitrogen, phosphorus and potassium.

## Typifying Profile

SOIL NAME: Bureni soils, flat to gently undulating phase.  
PROFILE No.: VS02  
SITE LOCATION: 2 km south of the Navua River on the Galoa to Nuku Village road, Serua Province.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex summit of an extensive broad surface.  
PARENT MATERIAL: Strongly weathered *in situ* rock of basic and intermediate composition.  
SLOPE: 2°  
ASPECT: South-south west.  
ELEVATION: 150 m  
MICRORELIEF: Even  
SITE VEGETATION: Pasture predominantly of Koronivia grass.  
LAND USE: Cattle grazing  
DRAINAGE: Moderately well drained.  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: KRS V105-108 (inclusive)

### PROFILE DESCRIPTION

Ah	0-10 cm (10 cm)	Moist; yellowish red (5YR 4/6) silty clay loam; moderate to strongly developed medium nut structure with moderate medium granular structure; friable; slightly sticky; abundant fine and medium roots; indistinct smooth boundary,
Bt1	10-48 cm (38 cm)	Moist; red (2.5YR 4/6) clay loam; few fine distinct olive yellow (2.5Y 6/6) parent material mottles; moderately developed medium and coarse blocky structure; friable; slightly sticky; few faint red (2.5YR 4/6) clay coatings; common fine and very fine roots; diffuse smooth boundary,
Bt2	48-100 cm (52 cm)	Moist; red (2.5YR 4/6) clay loam; few medium distinct olive yellow (2.5Y 6/6) parent material mottles; moderately developed coarse blocky structure breaking to weak fine blocky structure; friable; slightly sticky; common very fine roots; indistinct smooth boundary,
Bt3	100-150cm (50 cm+)	Moist; red (2YR 4/6 and 2.5YR 4/8) silty clay loam; many coarse prominent red (2.5YR 5/8) mottles with pan like depositional layering; moderately developed medium platy structure breaking to weak medium blocky structure; firm; slightly sticky; discontinuous iron/manganese pan.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Cikobia series**

REFERENCE: The Cikobia rocky brown clay (25a) and Cikobia rocky red clay (25b) defined by Twyford & Wright (1965) as friable soils from limestone materials formed under a climate with a weak to moderate dry season.

Forms part of the Cikobia set. The distinction between 25a and 26b is solely on soil colour, for these soils are identical in all other properties.

The moisture regime has been restricted to the ustic, but in all other respects the central concept for Cikobia soils has been retained in this survey.

#### CLASSIFICATION:

(a) Soil Taxonomy: Inceptic Eustrtox, clayey, gibbsitic, isohyperthermic

(b) FAO: Rhodic Ferralsol

(c) Twyford and Wright: Latosolic soil with a moderate to strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Cikobia soils, flat to gently undulating phase (78A)

Cikobia soils, undulating phase (78B)

Cikobia soils, easy rolling phase (78C)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Cikobia soils develop on limestone materials in the Lau Group Islands and of a minor extent in Vanua Levu.

PARENT ROCK: Andesite (colluvium) over coralline limestone.

PARENT MATERIAL: The origin of the red soil material overlying hard white coralline limestone is difficult to explain. In some areas it could be inferred to be colluvia derived from volcanic flow rocks but elsewhere e.g. Futuna limestone (Vanua Balavu) where such a source is unavailable the origin of this material can only be explained by weathering of the limestone over a long period of time.

PHYSIOGRAPHIC POSITION/LANDFORM: Occurs on flattish surface towards the centre of large masses of raised coralline limestone.

SLOPE CLASS AND RANGE OF SLOPES: Flat to easy rolling (0-11°), but predominantly on slopes < 3°.

VEGETATION AND LAND USE: Support calcicole forest in their natural state but because of the good physical properties of the soil Cikobia soils are commonly cleared for coconuts and cultivation of subsistence food crops.

RANGE OF ELEVATION: 10-25 m

RAINFALL: Annual average range: 2,000-3,200 mm;  
dry season range: 600-800 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

*Cikobia*

PERMEABILITY CLASS:	Moderately rapid
FLOODING:	Never floods
EROSION:	Though the physical properties are inherently highly erodible the erosion risk is slight because of the soil occurrence on slopes less than 11°.

### **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of dark reddish brown clay loam, of moderate to strongly developed fine and very fine nut structure, with some granular, very friable, with many coral boulders, overlying 30 cm of dusky red clay, of weakly developed fine and medium nut structure breaking easily to crumb, friable with a few coralline boulders, overlying 45 cm of dusky red clay, of massive structure breaking easily to crumb, very friable, with few to many coral boulders overlying, at about 95 cm, hard white <i>in situ</i> coral limestone.
DIAGNOSTIC HORIZONS:	Ochric epipedon, oxic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Apart from minor variation in the depth to limestone (75-180 cm) profiles show little variation from that described above.
VARIANTS:	Some profiles have B horizons of firmer consistence that are sticky and plastic and have moderately developed coarse blocky structures and indications (weak clay cutans) of a greater total clay content compared to the surface horizon i.e. an argillic horizon. The deeper variants would likely classify as Paleustults and those < 100 cm to limestone as Rhodustults.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Profiles are slightly alkaline to about 50 cm becoming moderately alkaline below. Organic carbon values are medium for the surface horizon but low in the subsoil. All horizons are fully base saturated. Exchangeable calcium and magnesium values are very high in the surface horizon but drop sharply to low values in the Bw2. CEC is medium in the Au horizon, medium in the Bw1 and very low in the Bw2. Potassium is very low in all horizons. The mineralogical class is gibbsitic and clay dominates the fine earth fraction.
LABORATORY Nos:	SB9366A-C
SOIL LIMITATIONS:	Very low water holding capacities, moderately rapid permeabilities; moderate to severe soil moisture deficits during the dry season; limestone outcrops and surface and profile boulders; low nitrogen and phosphorus levels; and due to slight alkalinity likely trace element deficiencies.

## Typifying Profile

SOIL NAME: Cikobia soils, undulating phase.  
PROFILE No.: LK14  
SITE LOCATION: Map I iii (Lakeba) 446950E 119150N Lakeba Island, Lau Group.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Linear surface within limestone pinnacles.  
PARENT MATERIAL: Red weathered regolith over cemented coralline limestone.  
SLOPE: 4°  
ASPECT: South east  
ELEVATION: 55 m  
MICRORELIEF: Exposed coralline limestone pinnacles at surface.  
SITE VEGETATION: Calcicole forest  
LAND USE: Unused  
DRAINAGE: Well drained, moderately rapid permeability; medium runoff.  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: SB9366A-C

### PROFILE DESCRIPTION

Ah	0-22 cm (22 cm)	Dry; dark reddish brown (2.5YR 2/4), moist dark red (2.5YR 2/6), rubbed dusky red (10R 3/4) clay loam; very friable; non-sticky; non-plastic; moderate to strongly developed fine and very fine nut with granular structure; profuse coarse and medium roots; few casts, many coral boulders (5-15 cm) indistinct regular boundary,
Bw1	22-50 cm (28 cm)	Dry; dusky red (10R 3/3), moist, dusky red (10R 3/2) rubbed dusky red (10R 3/4) clay, friable; non-plastic; non-sticky; weakly developed fine and medium nut with crumb structure; abundant coarse roots; few casts; few large coral boulders; indistinct regular boundary,
Bw2	50-95 cm (45 cm)	Dry; dusky red (10R 3/3), moist, dusky red, (10R 3/4), rubbed dusky red (10R 3/2), clay; very friable; non-plastic; slightly sticky; massive, breaking to weakly developed medium crumb structure; few to many fine roots; few to many coral boulders (5-10 cm) porous; distinct irregular boundary,
	on	hard white (stained red) coralline limestone.



## Typifying Profile

SOIL NAME: Burenitu soils, moderately steep phase.  
PROFILE No.: DP12  
SITE LOCATION: See soil map of Dobuilevu Agricultural Research Station (McLeod & Rijkse 1985).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Midslope on side of planar ridge.  
PARENT MATERIAL: Strongly weathered andesitic tuff.  
SLOPE: 22°  
ASPECT: West  
ELEVATION: 75 m  
MICRORELIEF: Small (25 cm) terracettes.  
SITE VEGETATION: Batiki grass dominant pasture.  
LAND USE: Grazing  
DRAINAGE: Well drained  
EROSION: Moderate sheet erosion.  
DISTURBANCE: None  
LABORATORY Nos: KRS T1476-1480

### PROFILE DESCRIPTION

Ah	0-16 cm (16 cm)	Dark brown (7.5YR 3/2) clay; friable; sticky; plastic; few coarse pores; strongly developed medium and fine nut structure; many worm casts; abundant fine and medium roots; distinct smooth boundary,
Bt1	16-32 cm (16 cm)	Yellowish red (5YR 4/6) silty clay loam; many dark (7.5YR 3/4) humus coats and worm casts; firm <i>in situ</i> ; friable in hand; sticky; plastic; few coarse pores; strongly developed medium nut structure; common thin continuous clay coatings on peds; many medium roots; distinct wavy boundary,
Bt2	32-65 cm	Yellowish red (5YR 4/6) silty clay loam; firm <i>in situ</i> ; friable in hand; slightly sticky; slightly plastic; many fine and few coarse pores; moderately developed medium blocky structure; many thin broken clay coatings; many medium roots; indistinct smooth boundary,
BC	65-103 cm (38 cm)	Yellowish red (5YR 4/6) silty clay loam with many fine concentrations of yellowish brown (10YR 5/6) parent material and many fine very dark grey (10YR 3/1) augite crystals; firm <i>in situ</i> ; slightly sticky; slightly plastic; moderately developed coarse blocky structure; few medium roots.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Burenitu series**

REFERENCE: Burenitu clay and clay loam (30c) and Burenitu hill soils (30cH) defined by Twyford and Wright (1965) as somewhat degraded soils from basalts, basic andesites and basic tuffs formed under a climate with a moderate dry season.

Forms part of the Delaimatai set.

The morphological and chemical concepts for Burenitu soils are retained, but in this survey Burenitu series are restricted to the udic soil moisture regime.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Hapludalf, fine, ferruginous, isohyperthermic
- (b) FAO: Eutric Nitosol
- (c) Twyford and Wright: Humic latosol with a moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Burenitu soils, undulating phase (121B)	Burenitu soils, strongly rolling phase (121E)
Burenitu soils, easy rolling phase (121C)	Burenitu soils, moderately steep phase (121F)
Burenitu soils, rolling phase (121D)	Burenitu soils, steep phase (121G)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Burenitu soils are extensive in Ra, and in the upper Sigatoka, Sabeto and Ba river valleys.

PARENT ROCK: Tuffaceous rocks of basic and intermediate composition.

PARENT MATERIAL: Strongly weathered *in situ* tuff.

PHYSIOGRAPHIC POSITION / LANDFORM: Gently undulating ridge crests, convex and concave ridge sides to hilly land, slumped areas, and steep hillslopes.

SLOPE CLASS AND RANGE OF SLOPES: From gently undulating ( $2^\circ$ ) through all slopes to steep ( $<35^\circ$ ).

VEGETATION AND LAND USE: Mainly in pasture. Sugar cane, pulses and rainfed rice are grown on the less sloping land. Also areas in subsistence root crops.

RANGE OF ELEVATION: 25-150 m

RAINFALL: Annual average range: 2,000-3,000 mm;  
dry season range: 600-800 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual:  $25^\circ\text{C}$ .

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate to severe sheet and rill erosion potential on slopes  $>12^\circ$ . Also have a potential for debris slides on the steeper slopes.

***Burenitu***

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of dark brown friable clay, of strongly developed medium and fine nut structure overlying 50 cm of yellowish red from silty clay loam, of moderately developed medium nut or blocky structure, sticky and plastic moist, with humus and clay cutans to peds, overlying more than 40 cm of yellowish red firm silty clay loam, of moderately developed coarse blocky structure and with strongly weathered yellowish brown parent material fragments and fine augite crystals.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	<p>Burenitu series have a A, Bt1, Bt2, BC horizon sequence.</p> <p>The A horizon thickness ranges from 13 to 18 cm; its colour ranges from reddish brown (5YR 4/4) to dark brown (7.5YR 3/2); and textures are clay or clay loam.</p> <p>The Bt horizons combined thickness ranges from 49 to 71 cm; colours in the upper part that are generally yellowish red (5YR 4/6) to dark reddish brown (5YR 3/4) with textures of clay to silty clay but silt clay loam in the lower part; and structure becomes less well developed with depth.</p> <p>The BC horizon thickness ranges from 8 to 65 cm; colours are yellowish red (5YR 4/6-5/6); and structures may be weak or moderate medium or coarse blocky.</p> <p>The C horizon is normally encountered between 99 and 124+ cm depth, and ranges in colour from red (2.5YR 4/6) to strong brown (7.5YR 4/6).</p>
VARIANTS:	Deep topsoil variant.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows low to medium CEC and % base saturation but values become higher at depth reflected the presence of unweathered parent material; exchangeable cations are generally low but magnesium and calcium can be higher.</p> <p>The particle size family class is very fine or fine (dependent on slope position).</p> <p>The mineralogical class is ferruginous but tending to be kaolinitic on steepland soils where there is more influence of unweathered parent material.</p>
LABORATORY Nos:	KRS T1476-1480 (DP12) KRS T1452-1455 (DP6) KRS T1436-1440 (DP2)
SOIL LIMITATIONS:	Main limitations are slope; heavy soil textures; erosion potential on slopes >8°; dry season soil moisture deficits; and nutrient deficiencies of nitrogen, potassium and phosphorus.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Cuku series**

REFERENCE: Cuku steepland stony sandy clay (93b) defined by Twyford & Wright (1965) as a steepland soil from quartzose tuffs formed under a climate with a strong dry season.

They form part of the Vitawa set. The central concept defined for Cuku is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Ustropept, fine-silty, mixed, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Steepland soil related to or associated with red yellow podzolic soils with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Cuku soils, rolling phase (154D)	Cuku soils, steep phase (154G)
Cuku soils, strongly rolling phase (154E)	Cuku soils, very steep phase (154H)
Cuku soils, moderately steep phase (154F)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Cuku soils are very widely developed in north-eastern Vanua Levu from Labasa to Udu Point and constitute the main steepland soils of that area. They also occur widely in Nadroga in Viti Levu.

PARENT ROCK: Rhyolite, pumiceous tuff and agglomerate, ranging to acid andesite tuff and agglomerate.

PARENT MATERIAL: Shallow moderate to strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Most slope positions in moderate and strongly dissected hill country. Slopes are commonly long and planar.

SLOPE CLASS AND RANGE OF SLOPES: Rolling (12-15°), strongly rolling (16-20°), moderately steep (21-26°), steep (27-35°) and very steep (36-40°).

VEGETATION AND LAND USE: Natural vegetation of Cuku series is poor forest, mainly comprising Doi, roli and melastomaceous plants, ranging to talasiga fern and Nokonoko.

Optimum land use of these soils is probably afforestation and in Nadroga Province many have been put to this use.

RANGE OF ELEVATION: 50-300 m

RAINFALL: Annual average range: 1,800-2,000 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY CLASS: Medium

FLOODING: Never floods

EROSION: Has suffered significant past erosion. Moderate to severe sheet and rill erosion potential.

### **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES: Typically shows 12 cm of very dark greyish brown silty clay, of moderately developed fine nut structure, firm, slightly sticky and plastic moist, with fragments of weathering rock, overlying 15 cm of red and dark reddish brown faintly mottled light brownish grey silt loam, of weakly developed fine nut structure, plastic and slightly sticky moist, firm *in situ* rock, on brownish yellow and dusky red massive and friable weathering rock.

DIAGNOSTIC HORIZONS: Ochric epipedon, cambic horizon.

RANGE OF PROFILE FEATURES: Cuku series have an A, AC, C1 horizon sequence.

The Ah horizon thickness ranges from 10-15 cm; its colours include very dark grey (10YR 3/1) dark greyish brown (10YR 3/2); structures are moderate or strong, fine or medium nut; consistence varies firm, friable to firm, and friable; and textures (commonly stony) are sandy clays, fine sandy clays, silty clays or fine sandy clay loam.

The AC horizon thickness ranges from 12-20 cm; its commonly varicoloured and includes red (2.5YR 4/6, 4/8) reddish brown (5YR 4/3, 4/4) and dark reddish brown (2.5YR 3/3, 3/4); textures include silty clay, silty clay loam, clay and clay loam; faint mottles may or may not be present; and structures may be weak or moderate fine blocky or not;

on *in situ* weathering rock normally encountered by 25-30 cm depth.

VARIANTS: None recognised

SIMILAR SOILS AND DISTINGUISHING FEATURES: None recognised

GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES: Analyses show the soil to be slightly acid to 26 cm depth and of near neutral pH below this; carbon and nitrogen values are low for the A horizon (0-12 cm) but dropping to very low below this horizon; available phosphorus is very low throughout; % base saturation is high; CEC and exchangeable calcium are of medium values; both exchangeable magnesium and sodium are high; and potassium is very low.

The particle size family class is fine-silty.

The mineralogical class is mixed.

LABORATORY Nos: KRS D 143-145

SOIL LIMITATIONS: Profile shallowness; slope; low water holding capacity; very severe past erosion and moderate to severe potential for further sheet and rill erosion; nutrient deficiencies of phosphorus, potassium and nitrogen.

## Typifying Profile

SOIL NAME: Cuku soils, strongly rolling phase.  
PROFILE No.: TR36  
SITE LOCATION: Nadi Forest. About 0.5 km turning into Akuila Road from Goodlet Road in Planning Unit 3.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Midslope of long slope in strongly dissected hill country.  
PARENT MATERIAL: Moderately weathered *in situ* acid andesite.  
SLOPE: 20°  
ASPECT: North-west  
ELEVATION: 180 m  
MICRORELIEF: Generally uneven  
SITE VEGETATION: Grassland of *Pennisetum polystachyon*, *Eleusme indica*, and *Psidium guayava*.  
LAND USE: Unused  
DRAINAGE: Moderately well drained.  
EROSION: Slight sheet erosion and probably significant past erosion.  
DISTURBANCE: None observed  
LABORATORY Nos: KRS D 143-145

### PROFILE DESCRIPTION

Cuku soils, strongly rolling phase

Ah	0-12 cm (12 cm)	Dry; very dark greyish brown (10YR 3/2), moist very dark grey (10YR 3/1) silty clay; moderate to strongly developed fine nut structure; firm; slightly sticky; plastic; abundant fine and medium roots; common fine tubular pores; few fine fragments of weathering rock; diffuse wavy boundary,
AC	12-26 cm (14 cm)	Dry; moist coarsely variegated dark reddish brown (2.5YR 3/4) and red (2.5YR 5/8) silty clay; common faint diffuse light brownish grey (10YR 6/2) mottles; weakly developed fine nut structure; firm; slightly sticky; plastic; common fine fibrous roots; weathered <i>in situ</i> rock; diffuse wavy boundary,
C1	26-50 cm+ (24 cm+)	Dry; moist coarsely variegated brownish yellow (10YR 6/6) and dusky red (10R 3/4) weathering <i>in situ</i> rock; massive; friable; common fine fibrous roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Daria series**

REFERENCE: The Daria stony bouldery silt loam and clay (27a) defined by Twyford & Wright (1965) to include soils having impeded drainage, mottled subsoils, varied profile form and as being formed on colluvium derived from adjacent hill soils. Parent materials were defined as basic and intermediate rocks.

Forms part of the Sote set. In this survey this concept for Daria series is retained i.e. imperfectly drained soils with slowly permeable subsoil results in subsoil gleying.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Humitropept, fine, kaolinitic, isohyperthermic
- (b) FAO: Humic Cambisol
- (c) Twyford and Wright: Humic latosol with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Daria soils, flat to gently undulating phase (133A)      Daria soils, easy rolling phase (133C)  
Daria soils, undulating phase (133B)                      Daria soils, rolling phase (133D)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Daria soils are of minor importance on Viti Levu. They are widespread in the wetter areas of Vanua Levu and develop adjacent to and derived from Solevu, Wainunu, Nakavika and Seatura soils.

PARENT ROCK: Marine sediments of basic and intermediate composition.

PARENT MATERIAL: Colluvial toeslope debris and strongly weathered parent rock (sandstones and siltstones).

PHYSIOGRAPHIC POSITION/LANDFORM: More commonly on toeslopes of hills, but occasionally midslope benches where seepage from upslope results in wet conditions.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°); undulating (4-7°); gently rolling (8-11°); and rolling (12-15°).

VEGETATION AND LAND USE: Commonly under indigenous forest, elsewhere cleared and in grasses with Navua sedge (*Cyperus aromaticus*).

RANGE OF ELEVATION: 10-150 m

RAINFALL: Annual average range: 2,150-4,280 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic/perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Imperfectly drained

PERMEABILITY CLASS: Slow and moderate permeability.

FLOODING: Never floods

EROSION: No erosion risk.



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically Daria series are imperfectly drained soils of clayey textures with dark coloured A horizons overlying brownish, and sometimes reddish B and C horizons. A characteristic of the soils are mottles of both low and high chromas which may occur in all horizons.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Daria series have an Ag, Bg, BCg horizon sequence.  The Ag horizons range in thickness between 12-18 cm; colours are of either 10YR or 7.5YR hue; low chroma mottles vary between 5 and 10%; and high chroma mottles vary between 5 and 15%.  The Bg horizons range in thickness between 30-50 cm; colour hues vary from 10YR and 7.5YR to 2.5YR; low chroma mottles may be of either 2.5Y or 5Y hue and vary from 15 to 30%; and high chroma mottles of 7.5YR hue vary between 10 and 20%.  The Ag and Bg horizons may have either nutty or blocky structures and their consistence is either friable or firm.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Sote weakly gleyed subsoil variant: Have only reddish coloured B horizons. Pale colours on ped faces and along pores are of too high a chroma for Sote variant to be classified with an aquic subgroup or suborder.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	A clayey textured soil, strongly acid, with low and very low base saturation. Exchangeable calcium is low and very low; magnesium medium, varying to low at depth; potassium very low; and sodium medium.  The family particle size class is fine.  The clay mineralogical class is kaolinitic.
LABORATORY Nos:	KRS T1407-1410 (inclusive).
SOIL LIMITATIONS:	Soils have imperfect drainage resulting from lateral seepage of water through them from high ground. Liable to erosion on sloping land if surface bared of vegetation. The low and very low base saturations and strong acidity suggest that the fertility of these soils is limited.

## Typifying Profile

SOIL NAME: Daria soils, rolling phase.  
PROFILE No.: N78  
SITE LOCATION: Refer soil map of Naduruloulou Agricultural Research Station (Palmer & Smith, 1984) Grid Reference sheet: Viti Levu 14 (1:50 000) 604E 124N.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Slightly concave toeslope in moderately dissected hill country.  
PARENT MATERIAL: Strongly weathered marine sandstone and siltstone of intermediate composition.  
SLOPE: 13°  
ASPECT: South  
ELEVATION: 17 m  
MICRORELIEF: Low hummocks with amplitude < 30 cm.  
SITE VEGETATION: Para grass and Navua sedge.  
LAND USE: Cattle grazing  
DRAINAGE: Imperfectly drained  
EROSION: None  
DISTURBANCE: None  
LABORATORY Nos: KRS T1407-1410 (inclusive).

### PROFILE DESCRIPTION

Daria soils, rolling phase

Ag	0-15 cm (15 cm)	Brown to dark brown (10YR 4/3) clay loam with common (10%) medium distinct yellowish red (5YR 5/6) and common (10%) fine faint greyish brown (2.5Y 5/2) mottles which occur mainly towards the base of the horizon; many fine roots; distinct smooth boundary,
Bg	15-53 cm (38 cm)	Brownish yellow (10YR 6/6) clay with common (20%) fine prominent strong brown (7.5YR 5/6) mottles on ped faces and common (15%) fine distinct grey (5Y 5/1) mottles along pores and root channels; friable; sticky; plastic; weakly developed coarse blocky structure; few fine roots; indistinct wavy boundary,
BCg	53-100cm (47 cm)	Yellowish red (5YR 5/6) clay with common (10%) fine distinct light yellowish brown (2.5Y 6/4) mottles and many (30%) fine faint light bluish grey (5B 7/1) mottles along pores and root channels; firm; sticky; plastic; massive to weakly developed coarse blocky structure; few fine roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Dawasamu series**

REFERENCE: The Dawasamu sand (2a) defined by Twyford and Wright (1965) as a recent soil forming on coastal sands derived from mainly basaltic and basic andesitic coastal sands.

Forms part of the Dawasamu set.

The central concept for Dawasamu series is retained in this survey.

#### CLASSIFICATION:

(a) Soil Taxonomy: Typic Quarzipsamment, ferritic, isohyperthermic

(b) FAO: Arenosol

(c) Twyford and Wright: Recent soil from coastal sands with a weak to moderate dry season

#### INCLUDING MAPPING UNITS AND PHASES:

Dawasamu soils (14)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Of very limited occurrence along the east and north-east coast of Tailevu province, Viti Levu.

PARENT ROCK: Basic rocks (Angite basalt).

PARENT MATERIAL: Coastal sand resulting from the resorting of alluvium brought down by the Dawasamu river.

PHYSIOGRAPHIC POSITION/LANDFORM: Coastal beach strand.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-2°).

VEGETATION AND LAND USE: Originally under forest. Now cleared and mainly used for arable crops (peanuts, watermelon etc) and subsistence crops (cassava, kumala).

RANGE OF ELEVATION: 1-2 m

RAINFALL: Annual average range: 2,150-4,280 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat excessively drained.

PERMEABILITY CLASS: Rapid

FLOODING: Never floods

EROSION: Minor risk of wind erosion.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of grey brown to black sand containing many coarse augite crystals, loose and of single grain structure, on dark grey brown to black sand , loose and of single grain structure.
DIAGNOSTIC HORIZONS:	Ochric epipedon
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Not applicable
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Moderately alkaline, low organic carbon values, high base status, high iron values.  The mineralogical class is ferritic.
LABORATORY Nos:	FACL 194177
SOIL LIMITATIONS:	Excessive internal drainage, very low water holding capacities and thin topsoils. Low organic matter status, nutrient deficiencies of potassium and phosphorus and in view of alkaline pH likely trace element deficiencies.

## Typifying Profile

SOIL NAME: Dawasamu soils  
PROFILE No.: VS 36  
SITE LOCATION: 500 m south-east of Nataleira village, Dawasamu, Tailevu province.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Coastal beach strand.  
PARENT MATERIAL: Coastal sands from augite basalt.  
SLOPE: <2°  
ASPECT: Not applicable  
ELEVATION: 1-5 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Kumala and miscellaneous weeds.  
LAND USE: Kumala cropping  
DRAINAGE: Somewhat excessively drained.  
EROSION: None  
DISTURBANCE: Cultivated  
LABORATORY Nos: FACL 194177

### PROFILE DESCRIPTION

Ap	0-8 cm (8 cm)	Moist; very dark greyish brown (10YR 3/2) sandy loam; single grain; loose; abundant very fine and fine fibrous roots; sharp smooth boundary,
C1	8-30 cm (22 cm)	Moist; black (10YR 2/1) sand; single grain; loose; common fine and medium roots; sharp smooth boundary,
C2	30-120 cm (90 cm)	Moist; very dark greyish brown (10YR 3/2) sand; single grain; loose; few medium and coarse fibrous roots,
B1	30-75cm	Moist; black (2.5YR 2/6) sand; weakly developed single grain structure; moist loose; non plastic; non sticky; few small concretions; few fine roots; 70% coarse material,
B2	75-95 cm (20 cm)	Moist; black to very dark grey (2.5YR 2/0) sand; weakly developed single grain; moist loose; non plastic; non sticky; few concretions; few fine roots,
C	95 cm+	Moist; dark brown (7.5YR 3/2) sandy loam; weakly developed single grain; moist loose; non plastic; non sticky.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Delaibo series**

REFERENCE: Delaibo stony and bouldery clay (75) defined by Twyford & Wright (1965) as a steepland soil from basalts and calcareous agglomerates formed under a climate with a weak dry season. They are associated with or related to nigrescent soils. Delaibo soils have been refined in the soil survey of Wainigata Agricultural Research Station (Purdie, Laffan & Shepherd, 1985) to remove the slope class (i.e. not exclusively a steepland soil) as a definitive criteria.

In all other respects the central concept for Delaibo soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Eutropept, coarse-loamy, mixed, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Steepland soil related to or associated with nigrescent soils with a weak dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Delaibo soils, easy rolling phase (202D)	Delaibo soils, moderately steep phase (202G)
Delaibo soils, rolling phase (202E)	Delaibo soils, steep phase (202H)
Delaibo soils, strongly rolling phase (202F)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Delaibo soils are the dark coloured, shallow and stony soils of hilly land in south-eastern Vanua Levu over a altitudinal range from sea level to about 600 m.

PARENT ROCK: Calcareous basaltic tuff agglomerate.

PARENT MATERIAL: Strong weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Occurs on the midslope position of the higher hills where lateral movement of water from higher ground bring excess water at times .

SLOPE CLASS AND RANGE OF SLOPES: Gently rolling (8-11°); rolling (12-15°); strongly rolling (16-20°); moderately steep (21-25°); and steep (26-35°).

VEGETATION AND LAND USE: Mainly coconuts, indigenous forest, with tall reed grass, gasau in the proximity of villages.

RANGE OF ELEVATION: 0-600 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic/perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Moderate colluvial movement downslope; slight slip erosion.

*Delaibo*



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	The characteristic profile features of this soil are a very dark greyish brown to black A horizon, subsoils with a colour of 10YR 3-4/2-4 with 10YR 5/6 mottles, a weakly developed clay alluvial horizon (not developed enough to be an argillic horizon), and strongly weathered <i>in situ</i> basalt with rock structure preserved in the lower subsoil. Texture becomes coarser down the profile ranging from clay loam at the surface to loamy sand in the weathered rock.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Delaibo series have an A, Btg1, Btg2, C horizon sequence. The range of features within the taxonomic unit is partly related to slope, with <i>in situ</i> weathered rock occurring at shallower depths on steeper slopes. Colour hues may extend to 2.5Y in the layer above the weathered rock. Areas of stony and bouldery soils occur within the mapping unit; they are considered to be inclusions.
VARIANTS:	There are areas where mass movement has taken place and a slump variant might be recognised.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Navava series: The boundary between Delaibo series and Navava series is gradational. Navava series is distinguished by having no mottles in the subsoil, and the Bt horizon is more developed and meets the criteria for an argillic horizon.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>The pH ranges from slightly acid to slightly alkaline; organic C % in the A horizon is low to medium; %BS is very high throughout the profile; exchangeable Ca and Mg are very high; exchangeable Na is high, increasing down the profile; exchangeable K is low. Particle size increases down the profile, clay contents are 30% in the top dropping down to 5% in the saprolite.</p> <p>The mineralogical class is mixed.</p> <p>The family particle size class is coarse-loamy.</p>
LABORATORY Nos:	KRS S2008-2012 (inclusive)
SOIL LIMITATIONS:	This soil has severe limitations. Limiting factors are: slope, areas of bouldery and stony soils; limited rooting depth and erosion hazards. Exchangeable potassium is low. Trace element levels are not known.

## Typifying Profile

SOIL NAME: Delaibo soils, steep phase.  
PROFILE No.: W69  
SITE LOCATION: Refer soil map of Wainigata Agricultural Research Station (Purdie, Laffan & Shepherd, 1984).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Steep convex slope in moderately dissected hill country.  
PARENT MATERIAL: Weathered *in situ* basalt.  
SLOPE: 29°  
ASPECT: North-north east  
ELEVATION: 28 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Coconuts  
LAND USE: Coconut plantation  
DRAINAGE: Moderately well drained.  
EROSION: Downslope colluvial movement.  
DISTURBANCE: None observed  
LABORATORY Nos: KRS S2008-2012 (inclusive)

### PROFILE DESCRIPTION

Delaibo soils, steep phase

Ah	0-14 cm (14 cm)	Black (10YR 3/1) clay; friable; sticky; plastic; moderately developed medium nut structure breaking to moderately developed fine nut; common fine distinct mottles (7.5YR 5/6); abundant very fine roots; distinct irregular boundary,
Btg1	14-31 cm (17 cm)	Brown to dark brown (10YR 4/3) sandy clay; friable; sticky; slightly plastic; weakly developed fine and very fine nut structure; common medium distinct mottles (10YR 5/8); common distinct clay and organic cutans (10YR 3/2); many very fine roots; common moderately weathered subangular gravels; indistinct boundary,
Btg2	31-48 cm (17 cm)	Dark greyish brown (2.5Y 4/2) sandy clay; friable; sticky; plastic; moderately developed medium nutty plus weakly developed fine nutty structure; many fine distinct mottles (10YR 5/6); common distinct clay plus organic cutans (10YR 4/2); common very fine roots; common moderately weathered gravels; indistinct boundary,
C	48-68 cm+ (20 cm+)	In situ weathered rock; yellowish brown (10YR 5/4) coarse sand; friable; non sticky; non plastic; massive; common fine distinct mottles (10YR 5/8); few distinct clay and organic cutans (10YR 4/3); few very roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Delaimatai series**

REFERENCE: Delaimatai clay and silty clay (30b) and Delaimatai hill soils (30bH) defined by Twyford & Wright (1965) as formed from basalts, basic andesites and basic tuffs on rolling and hilly land under a climate with a moderate dry season.

In this survey the central concept is retained but Delaimatai series are restricted to the ustic soil moisture regime.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Kanhaplustult, clayey, ferruginous, isohyperthermic
- (b) FAO: Dystric Nitosol
- (c) Twyford and Wright: Humic latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Delaimatai soils, easy rolling phase (183C)	Delaimatai soils, moderately steep phase (183F)
Delaimatai soils, rolling phase (183D)	Delaimatai soils, steep phase (183G)
Delaimatai soils, strongly rolling phase (183E)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Delaimatai soils occur in Bua province in Vanua Levu although they are not very extensively developed on this island. They are of restricted area on Viti Levu where are commonly forest.

PARENT ROCK: Basalts, basic andesites and basic tuffs.

PARENT MATERIAL: Deep strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Backslopes and midslopes on rolling and hilly land.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-26°), and steep phase (26-35°).

VEGETATION AND LAND USE: Much still under indigenous forest. Elsewhere under reeds, bracken fern and scrub.

RANGE OF ELEVATION: 15-200 m

RAINFALL: Annual average range: 2,000-3,200 mm;  
dry season range: 600-800 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate to severe sheet and rill erosion potential on slopes >12°.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 6 cm of reddish brown friable clay loam of strongly developed fine nut structure, overlying 25 cm of red friable silt clay of moderately developed fine blocky and crumb structure with distinct clay cutans to peds, overlying 30 cm of red firm silty clay of moderately developed fine blocky structure and with a few weathered stones and clay cutans to peds, overlying more than 30 cm of red friable silty clay of moderately developed medium blocky structure and with a few weathered stones and clay cutans to peds.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Delaimatai series have a Ah, Bt1, Bt2, Bt3 horizon sequence.  The A horizon thickness ranges from 5-10 cm; its colours include reddish brown (5YR 4/3, 2.5YR 4/4) and dark reddish brown (5YR 3/3, 3/4 and 2.5YR 3/4); textures are silty clay loam; silty clay and clay loam; and structures are fine or medium blocky or nutty.  The Bt horizons combined thickness exceeds 80 cm; their colours include red (2.5YR 4/6, 4/8, 5/8) and reddish brown (2.5YR 4/4, 5/4, 5YR 4/4, 5/4); textures are silty clays, clay loams or clays; structures range between weak or moderate, fine, medium or coarse blocky; consistence may be friable or firm; clay cutans are common, many and profuse in abundance; and weathered stones may or may not be present.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Chemical analysis shows Delaimatai soils to be strongly acid; carbon and nitrogen values are low in the A horizon (0-6 cm) and very low below this; available phosphorus is very low and phosphorus retention medium; % base saturation is low in the A horizon and very low in the other horizons; CEC is medium in the A horizon and low below this; exchangeable potassium and calcium are very low; and magnesium is high in the A horizon and of low values in the other horizons.  The particle size family class is clayey.  The mineralogical class is ferruginous.
LABORATORY Nos:	USP ND22A-E
SOIL LIMITATIONS:	Slope where developed on slopes >15°; clayey textures; moderate soil moisture deficits during the dry season; moderate and severe sheet and rill erosion potential on slopes >12°; strong soil acidity; and nutrient deficiencies of nitrogen, potassium and phosphorus.

## Typifying Profile

SOIL NAME: Delaimatai soils, rolling phase.  
PROFILE No.: ND22  
SITE LOCATION: Masi catchment, Nadi Forest, Nadroga Province.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Flat planar backslope in strongly dissected hill country.  
PARENT MATERIAL: Strongly weathered *in situ* basaltic rock.  
SLOPE: 12°  
ASPECT: West  
ELEVATION: 450 m  
MICRORELIEF: Even  
SITE VEGETATION: Mission grass (sparse), bracken fern and karuka.  
LAND USE: Unused  
DRAINAGE: Moderately well drained.  
EROSION: Slight sheet erosion.  
DISTURBANCE: None observed  
LABORATORY Nos: USP ND22A-E

### PROFILE DESCRIPTION

Ah	0-6 cm (6 cm)	Dry; reddish brown (2.5YR 4/4) moist and red (2.5YR 4/6) rubbed clay loam; friable; slightly sticky; strongly developed fine nut structure; common fine roots; few strongly weathered subrounded stones; sharp smooth boundary,
Bt1	6-33 cm (27 cm)	Slightly moist; red (2.5YR 4/6) moist and red (2.5Yr 4/8) rubbed silty clay; friable; slightly sticky; slightly plastic; moderately developed fine crumb structure with some moderate fine blocky; many distinct red (2.5YR 4/6) clay cutans; few fine roots; few moderately weathered subrounded stones; distinct smooth boundary,
Bt2	33-62 cm (29 cm)	Slightly moist; red (2.5YR 4/6) moist and rubbed silty clay; firm; slightly sticky; slightly plastic; moderately developed fine blocky structure with some moderate fine crumb; many distinct red (2.5YR 4/6) clay cutans; few fine roots; few moderately weathered subrounded stones; distinct smooth boundary,
Bt3	62-92 cm+ (30 cm+)	Slightly moist; red (2.5YR 4/6) moist and rubbed silty clay; friable; sticky; slightly plastic; moderately developed medium blocky structure; many distinct red (2.5YR 4/6) clay cutans; few fine roots; few moderately weathered subrounded stones.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Delainacau series**

REFERENCE: Delainacau sandy clay (40a) and Delainacau hill soils (40aH) defined by Twyford & Wright (1965) as reddish soils from mixed acid and basic tuffs, on rolling and hilly land, usually forested and formed under a climate with a moderate dry season.

Forms part of the Delainacau set.

The central concept for Delainacau soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Dystropept, fine, ferruginous, isohyperthermic
- (B) FAO: Dystric Cambisol
- (c) Twyford and Wright: Red yellow podzolic soil with a weak to moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Delainacau soils, easy rolling phase (207C)

Delainacau soils, strongly rolling phase (207E)

Delainacau soils, rolling phase (207D)

Delainacau soils, moderately steep phase (207F)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Delainacau soils do not occur on Viti Levu. They develop in association with Dogotuki soils on Vanua Levu.

PARENT ROCK: Mixed composition (acid and basic) layered tuffs.

PARENT MATERIAL: Deep weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Mainly planar and convex slopes in rolling and hilly land.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°) and moderately steep (21-25°).

VEGETATION AND LAND USE: Mostly under forest but cleared in places to crop. Poor crops of cassava is followed by long periods of fallow .

RANGE OF ELEVATION: 50-500 m

RAINFALL: Annual average range: 2,000-3,200 mm;  
dry season range: 600-800 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 24.5°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate to severe sheet and rill erosion potential if forest cleared and cultivated without attention given to soil conservation measures.



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows under forest 3 cm of mixed litter and worm casts, on 12 cm of dark reddish brown slightly sandy clay, of moderate coarse granular and crumb structure and slightly sticky and plastic moist, overlying 20 cm of dusky red friable clay of weak medium blocky structure and sticky and plastic when moist, overlying 12 cm of dark red friable clay with a slightly sandy feel, overlying 25 cm of dusky red friable to firm sandy clay, of strong coarse granular structure, powdering to fine granular and crumb on brownish yellow weathered tuff.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be moderately acid 0-32 cm and strongly acid below 32 cm; organic carbon is high in the topsoil (0-12 cm), medium 12-32 cm and very low below and nitrogen follows a similar trend, i.e. high, low, very low; very low available phosphorus; % base saturation is high in the topsoil and of medium values below; exchangeable calcium and magnesium are both high in the topsoil and medium in the other horizons; and potassium is high in topsoil and very low in the other horizons.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is ferruginous.</p>
LABORATORY Nos:	KRS 436-439
SOIL LIMITATIONS:	Erosion potential hazard on slopes; slight soil moisture deficits during the dry season; soil acidity; nutrient deficiencies of phosphorus and potassium.
ADDITIONAL COMMENTS:	None

## Typifying Profile

SOIL NAME: Delainacau soils, easy rolling phase.

PROFILE No.: TW 22

SITE LOCATION: Wainikoro valley.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Convex midslope.

PARENT MATERIAL: Weathered *in situ* acid tuffs.

SLOPE: 10°

ASPECT: North-west

ELEVATION: 90 m

MICRORELIEF: Forest dimples

SITE VEGETATION: Originally forest, now talasiga.

LAND USE: Unused

DRAINAGE: Well drained

EROSION: Stable site, but serious sheet erosion in the vicinity.

DISTURBANCE: None

LABORATORY Nos: KRS D 280-283

### PROFILE DESCRIPTION

L	3-0 cm (3 cm)	Dry; mixed litter and worm casts,
Ah	0-12 cm (12 cm)	Moist; dark reddish brown (2.5YR 3/4) slightly sandy clay; moderately developed coarse granular and crumb structure; friable; slightly sticky; plastic; abundant fine and medium fibrous and woody roots; distinct smooth boundary,
Bt	12-32 cm (20 cm)	Moist; dusky red (2.5YR 3/2) clay; weakly developed medium blocky structure; friable; sticky; plastic; many fine and medium fibrous and woody roots; indistinct smooth boundary,
Bw1	32-44 cm (12 cm)	Moist; dark red (2.5YR 3/6) very slightly sandy clay; moderately developed medium blocky structure; friable; compact in place; slightly sticky; plastic; few fine and medium fibrous roots; distinct smooth boundary,
Bw2	44-69 cm (25 cm)	Moist; dusky red (2.5YR 3/2) sandy clay; strongly developed coarse granular structure powdering easily to fine granular and crumb; friable to firm; sticky; plastic; few fine fibrous roots; distinct wavy boundary,
BC	on	Brownish yellow (10YR 6/6) <i>in situ</i> weathered sandy tuff; sticky; plastic.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Deuba series**

REFERENCE: The Deuba sandy loam (52b) of Twyford & Wright (1965) defined the soil as having developed on sands brought down by the Navua and Rewa rivers derived from mainly acid rocks and containing much quartz. Found behind coastal dunes where gleying has taken place. This concept matches well Deuba series defined here, where the series develops inland from the Vunibau series where water tables come nearer to the surface and the gleyed sands of Deuba series occur.

Forms part of the Nacokula set.

CLASSIFICATION:

(a) Soil Taxonomy: Typic Tropaquept, sandy, mixed, isohyperthermic

(b) FAO: Dystric Gleysol

(c) Twyford and Wright: Gley soil related to red yellow podzolic soils with a weak or no dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Deuba soils (13)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Restricted to the areas of coastal sands in the Deuba Navua area of SSE Viti Levu.

PARENT ROCK: Rocks of acid composition.

PARENT MATERIAL: Highly quartzose sands brought down by the Navua River system, resorted and deposited mainly by marine action. Contains some pumiceous material indicative of marine deposition.

PHYSIOGRAPHIC POSITION/LANDFORM: Coastal dunes with weakly expressed ridge and swale topography.

SLOPE CLASS AND RANGE OF SLOPES: Level (0-1°)

VEGETATION AND LAND USE: Normally supports a poor vegetation of grasses, ferns and sedges.

RANGE OF ELEVATION: 0.5-2 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean Annual: 24°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly and very poorly drained.

PERMEABILITY CLASS: Rapid

FLOODING: Due to physiographic position and high water tables (at 60-90 cm) floods during periods of high intensity rainfall events.

EROSION: No erosion risk.

*Deuba*

## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

The top 50 cm is usually brown to very dark brown due to organic matter. Pronounced red mottling is common below this level in the zone of water table fluctuation and lies on grey gleyed structureless sand encountered normally at 90-100 cm. Sandy textures throughout the profile; wet consistencies are non sticky and non plastic; topsoils are friable, subsoils firm with the sands losing coherence below the water table. Topsoil structure is well developed but with weak coarse blocky structures in the subsoils.

### DIAGNOSTIC HORIZONS:

Ochric epipedon, cambic horizon.

### RANGE OF PROFILE FEATURES:

Deuba series have an Ap (Ah), Bw, Bg Bms, Cr horizon sequence.

The Ap horizon thickness ranges from 12-20 cm; its colours include very dark greyish brown (2.5Y 3/2, 10YR 3/2) and dark greyish brown (2.5Y 4/2, 10YR 4/2); textures are fine sandy or medium sandy loam.

The Bw horizon thickness ranges from 25-30 cm; its colours include strong brown (10YR 5/6, 5/8) yellowish brown (10YR 5/6, 5/8) or olive yellow (2.5Y 6/6, 6/8); and textures may be fine, medium or coarse sand; and blocky structures may be fine, medium or coarse.

The Bg horizons thickness ranges from 40-60 cm; textures may be fine, medium or coarse sand; and the red mottles may be few, common, or many.

The Cr horizon is normally encountered by 90 cm and exceeds 30 cm in thickness; textures may be fine, medium or coarse sand and the red mottles, few or many in abundance.

### VARIANTS:

None recognised

### SIMILAR SOILS AND DISTINGUISHING FEATURES:

Vunibau series: Well drained or somewhat excessively drained, and developed on recent alluvium. Water table does not fluctuate and is constant at depths from 65 to 100 cm; dark, well structured topsoil overlying deep subsoil to water table in which patches of organic matter impart a rather uneven colour. Weakly mottled.

Waikalou series: Develop on older, inland coastal sands, where water tables fluctuate greatly - within this zone of mottling the sand is weakly cemented by an iron-humus complex. This series shows more subsoil coherence.

### GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:

Deuba series are moderately to strongly acid with very low base levels and plant nutrients are very deficient. However, base saturation values are very high. The fine earth fraction is dominated in all horizons by sand (>80%) and the particle size family class is sandy.

The mineralogical class is mixed.

### LABORATORY Nos:

D058-D063 (inclusive)

### SOIL LIMITATIONS:

Susceptibility to flooding, permanent high seasonal water table; rapid permeability; low water holding capacity; may experience short periods of soil moisture deficit in the period May to October; soil acidity; and deficiencies of nitrogen, phosphorus and potassium.

## Typifying Profile

SOIL NAME: Deuba soils  
PROFILE No.: D.014  
SITE LOCATION: Run 270. Photo 67. Huntings (1969).

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Long parallel ridges and narrow swales; pit near bottom of ridge.  
PARENT MATERIAL: Marine sand.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 1.5 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Grassland, grazed; Batiki blue grass.  
LAND USE: Dairying  
DRAINAGE: Poorly drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: D058-D063 (inclusive)  
COMMENTS: Water table at 73 cm.

### PROFILE DESCRIPTION

Ap	0-18 cm (18 cm)	Moist; very dark greyish brown (10YR 3/2) fine sandy loam; moderate to strongly developed fine nut structure breaking to fine crumb structure; friable; non-sticky; non-plastic; abundant fine roots; distinct smooth boundary,
Bw	18-46 cm (28 cm)	Moist; strong brown (7.5YR 5/6) with patches of grey (10YR 5/1) medium sand; weakly developed, coarse blocky structure; very friable; non-sticky; non-plastic; many fine roots in top 15 cm with few below; distinct wavy boundary,
Bg1	46-69 cm (23 cm)	Moist; greyish brown (2.5Y 5/2) coarse sand; many coarse red (2.5YR 4/6) mottles; coarse sand; very weakly developed coarse blocky structure; firm; non-sticky; non-plastic; slightly cemented; few fine roots; diffuse smooth boundary,
Bg2	69-89 cm (20 cm)	Wet; grey (5Y 5/1) coarse sand; few coarse red (2.5YR 4/6) mottles; very weakly developed coarse blocky structure; non-sticky; non-plastic; few fine roots; distinct wavy boundary,
Bms	89-99 cm (10 cm)	Wet; dark grey to grey (5Y 4/1-5/1) coarse weakly; weakly developed coarse blocky structure; extremely firm; cemented; strongly bedded; iron staining in patches and bands; distinct smooth boundary,
Cr	99-115 cm (16 cm)	Wet; grey (2.5Y 6/0) coarse sand; few coarse red (2.5YR 4/6) mottles; single grain; non-sticky; non-plastic; slumping in pit.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Dobuilevu series**

REFERENCE: Dobuilevu clay (13a) and Dobuilevu hill soils (13aH) defined by Twyford & Wright (1965) as soils formed from basic tuffs under a climate with a moderate dry season.

Forms part of the Dobuilevu set.

The morphological and chemical concepts for Dobuilevu series are retained but in this survey Dobuilevu series are restricted to the udic soil moisture regime.

#### CLASSIFICATION:

(a) Soil Taxonomy: Typic Hapludoll, fine-loamy, smectitic, isohyperthermic

(b) FAO: Haplic phaeozem

(c) Twyford and Wright: Nigrescent soil with a weak to moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Dobuilevu soils, undulating phase (122B)

Dobuilevu soils, easy rolling phase (122C)

Dobuilevu soils, rolling phase (122D)

Dobuilevu soils, strongly rolling phase (122E)

Dobuilevu soils, moderately steep phase (122F)

Dobuilevu soils, steep phase (122G)

Dobuilevu soils, very steep phase (122H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Dobuilevu soils develop widely in Ra on Viti Levu.

PARENT ROCK: Tuffaceous rocks of andesitic composition with a high proportion of augite present.

PARENT MATERIAL: Moderately weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Easy rolling ridge crests, rolling to moderately steep convex to concave ridge sides and slumped areas.

SLOPE CLASS AND RANGE OF SLOPES: All slope classes from undulating (5°) to very steep (>35°)

VEGETATION AND LAND USE: Mainly under pasture. Some areas in sugar, pulses and subsistence root crops.

RANGE OF ELEVATION: 25-200 m

RAINFALL: Annual average range: 2,800-3,800 mm;  
dry season range: 800-1,000 mm;  
wet season range: 1,600-2,200 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Moderate sheet and rill erosion potential and severe mass movement (slumping) potential on slopes >12°.

*Dobuilevu*



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 25 cm of very dark grey friable clay, of strongly developed fine nut and crumb structure, slightly sticky and plastic moist, overlying 50 cm of dark brown friable clay (becoming sandy clay loam in the lower part), of moderately developed medium and coarse blocky structure with humus and faint clay cutans to the peds, overlying 30 cm of dark brown friable sandy clay loam with horizontal layers (1 cm thick) of clay, of massive structure breaking to crumb over a paralithic contact below which is more than 50 cm of dark brown firm loamy sand.
DIAGNOSTIC HORIZONS:	Mollic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Dobuilevu series have a Ap, Bw1, Bw2, BC, C horizon sequence.</p> <p>The A horizon thickness ranges from 20-30 cm; and its colours include very dark grey (10YR 3/1) and very dark greyish brown (10YR 3/2).</p> <p>The Bw horizons combined thickness ranges 18-70 cm; their colours include very dark greyish brown (10YR 3/1) and dark yellowish brown (10YR 4/4); texture ranges from clay to sandy clay loam; and structure can range from strong medium blocky in the upper part of the horizon to massive in the lower part.</p> <p>The BC horizon ranges 10-30 cm in thickness, and its colours range between dark brown (0YR 3/3) and dark yellowish brown (10YR 3/4).</p> <p>The C horizon ranges in colour from dark yellowish brown (10YR 4/4) to near dark greyish brown (2.5Y 4/3), with textures of clay loam through to sandy loam.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows carbon values are low decreasing to very low with depth; CEC and % base saturation are very high; exchangeable calcium and magnesium are very high, sodium medium, and potassium low.</p> <p>The particle size family class is fine loamy.</p> <p>The mineralogical class is smectitic.</p>
LABORATORY Nos:	KRS T1447-1451 (DP5) KRS T1472-1475 (DP11)
SOIL LIMITATIONS:	Main limitations are slope, erosion potential on slopes >12; soil moisture deficits during the dry season; and nutrient deficiencies of potassium and phosphorus.

## Typifying Profile

SOIL NAME: Dobuilevu soils, rolling phase.  
PROFILE No.: DP5  
SITE LOCATION: See soil map of Dobuilevu Agricultural Research Station (McLeod & Rijkse 1985).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Midslope of convex ridge in moderately dissected hill country.  
PARENT MATERIAL: Moderately weathered intermediate and loasic tuff.  
SLOPE: 15°  
ASPECT: West north-west  
ELEVATION: 67 m  
MICRORELIEF: Small terracettes  
SITE VEGETATION: Nadi blue grass dominant pasture.  
LAND USE: Grazing for cattle.  
DRAINAGE: Well drained  
EROSION: Slight sheet erosion.  
DISTURBANCE: None observed  
LABORATORY Nos: KRS T1447-1451

### PROFILE DESCRIPTION

Ap	0-23 cm (23 cm)	Very dark grey (10YR 3/1) clay; friable; slightly sticky; plastic; strongly developed fine nut and crumb structure; few fine pores; abundant fine roots; distinct wavy boundary,
Bw1	23-46 cm (23 cm)	Dark brown (10YR 3/3) clay; many dark grey (10YR 3/1) humus coatings; friable; slightly sticky; slightly plastic; strongly developed medium blocky breaking to fine blocky and crumb structure; many fine pores; few thin discontinuous clay coatings; many fine roots; indistinct wavy boundary,
Bw2	46-71 cm (25 cm)	Dark brown (10YR 3/3) sandy clay loam; many dark grey (10YR 3/1) humus coatings on peds; friable; slightly sticky; slightly plastic; moderately developed coarse blocky breaking to fine nut and crumb structure; many medium pores; few thin patchy clay coatings; many fine roots; distinct wavy boundary,
BC	71-103 cm (32 cm)	Dark brown (10YR 3/3) sandy clay loam; horizontal layers of clay (up to 1 cm thick); friable; slightly sticky; non-plastic; many coarse and medium pores; massive to medium crumb structure; few fine roots; distinct wavy boundary,
C	103-130 cm (27 cm)	Near dark brown (10YR 3/3) loamy sand; many black crystals and thin (<0.5 cm) dark greyish brown (2.5Y 4/2) veins; firm; non-sticky; non-plastic; massive; no roots.

(103 cm is a paralithic contact)



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Dogo series**

REFERENCE: Dogo clay, sandy clay, sandy loam, etc. (55b) as defined by Twyford & Wright (1965) as undrained saline soils of the marine marsh occurring in any of the lowland climatic zones of Fiji in a narrow strip along the sea shore, tidal river banks and mud islands.

Dogo series have a marked fluctuation in soil salinity and deficient aeration because of the rise and fall of the tide and are occupied by mangroves. Because of the instability of this soil, profile characteristics are variable.

CLASSIFICATION:

(a) Soil Taxonomy: Typic Sulfaquent, loamy over clayey, mixed, isohyperthermic

(b) FAO: Thionic Fluvisol

(c) Twyford and Wright: Saline soil of the marine marsh

INCLUDED MAPPING UNITS AND SYMBOLS:

Dogo soils (5)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Dogo soils are extensive at the mouths of all rivers except the Sigatoka river and many streams of Viti Levu, Vanua Levu and on many of the offshore islands.

PARENT ROCK: Various

PARENT MATERIAL: A diversity of alluvial parent materials. Deposition was due partly to a check in river current but mainly to the flocculation of the silt and clay in the lagoons, resulting in the gradual raising of the seabed to a certain height where the different mangrove species were able to colonise it.

PHYSIOGRAPHIC

POSITION/LANDFORM: Tidal margins of deltas, rivers plus offshore mud islands.

SLOPE CLASS

AND RANGE OF SLOPES: Flat to near level (0-1°).

VEGETATION AND LAND USE: Mangroves. The family *Rhizophoraceae* predominates in the number of species but the trees present may include other widely separated families. *Rhizophora mucronata*, *Bruguiera gymnorhiza*, *Bleckeria vitiensis*, are the most common.

RANGE OF ELEVATION: 0-1 m

RAINFALL: Annual average range: 1,800-4,500 mm;  
dry season range: 400-3,000 mm;  
wet season range: 1,400-3,000 mm.

TEMPERATURE: Mean annual range: 24-27°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Very poorly drained.

PERMEABILITY CLASS: Slow

FLOODING: Permanently flooded though fluctuating diurnally with the tides.

EROSION: No erosion risk.

### **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES: Typically shows 12 cm of dark brown to dark grey humic sandy clay loam, of massive structure, soft, sticky and slightly plastic, with many woody mangrove roots, overlying 50 cm of dark grey or very dark greyish brown peaty silty clay, of massive structure, soft with abundant mangrove roots, overlying more than 100 cm very dark grey or dark greyish brown fine sandy clay loam, of massive structure and soft consistence.

Water table permanently at or near the surface.

DIAGNOSTIC HORIZONS: Ochric epipedon, sulfidic materials.

RANGE OF PROFILE FEATURES: Not applicable. Only a few observations made.

VARIANTS: None recognised.

SIMILAR SOILS AND DISTINGUISHING FEATURES: None

GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES: Fresh moist samples where near neutral or slightly alkaline except for the Cu1 horizon (12-35 cm) which was strongly acid, and dried samples were extremely acid in all horizons 12-130 cm; carbon values are high for depths 12-130 cm with C/N ratios very high throughout; % base saturation high to very high (64-95%); extremely high values for CEC (>100 me.%), magnesium (>25 me.%), potassium (2.2-10.5 me.%) and sodium (>50 me.%); calcium values are high and very high.

LABORATORY Nos: KRS T2712-2719

SOIL LIMITATIONS: Permanent high water table; very high salinity; and in most situations these soils cannot be drained.

## Typifying Profile

SOIL NAME: Dogo soils  
PROFILE No.: DK27  
SITE LOCATION: Beyond the sea wall at Dreketi rice irrigation scheme, Dreketi, Vanua Levu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Saline marshland on estuarine delta.  
PARENT MATERIAL: Estuarine muds, silts and sands.  
SLOPE: Level  
ASPECT: Not applicable  
ELEVATION: 0.5 m  
MICRORELIEF: Uneven due to surface mangrove roots and crab burrows.  
SITE VEGETATION: *Rhizophora mucronata*  
LAND USE: Unused  
DRAINAGE: Very poorly drained water table (tidal fluctuating) at 70 cm (near low tide).  
EROSION: None observed other than minor surface disturbance by crabs.  
DISTURBANCE: Crab burrows.  
LABORATORY Nos: KRS T2712-2719.

### PROFILE DESCRIPTION

Ah	0-12 cm (12 cm)	Wet; dark brown (7.5YR 4/4) to dark grey (5Y 4/1) humic sandy clay loam; soft; sticky; slightly plastic; massive; many fine and coarse tiri roots; sharp smooth boundary,
Cu1	12-35 cm (23 cm)	Wet; very dark grey (5YR 3/1) peaty silty clay soft; soft; massive; abundant medium and coarse fibrous roots; indistinct smooth boundary,
Cu2	35-70 cm (35 cm)	Wet; very dark greyish brown (2.5Y 3/2) peaty silty clay; soft; massive; abundant medium and coarse roots; indistinct smooth boundary,
Cu3	70-130 cm (60 cm)	Wet; very dark greyish brown (2.5Y 3/2) fine sandy clay loam; soft; massive; abundant fine and medium roots; distinct smooth boundary,
Cu4	130-180+ cm (50 cm+)	Wet; very dark grey (5Y 3/1) very fine sandy clay loam; soft; massive; many fine and very fine roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Dogotuki series**

REFERENCE: Dogotuki fine sandy clay loam (40c) defined by Twyford and Wright (1965) as brown to yellowish red soils from extensively silicified materials, on rolling and hilly land, commonly supporting forest and formed under a climate with a moderate dry season.

Forms part of the Delainacau set.

The central concept for Dogotuki series is retained in this survey.

#### CLASSIFICATION:

(a) Soil Taxonomy: Ustic Humitropept, fine, kaolinitic, isohyperthermic

(b) FAO: Humic Cambisol

(c) Twyford and Wright: Red yellow podzolic soil with a moderate dry season

#### INCLUDING MAPPING UNITS AND PHASES:

Dogotuki soils, undulating phase (156B)

Dogotuki soils, strongly rolling phase (156E)

Dogotuki soils, easy rolling phase (156C)

Dogotuki soils, moderately steep phase (156F)

Dogotuki soils, rolling phase (156D)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: These occur to a minor extent in Viti Levu in the rolling and hill country between the upper Sigatoka and Nadi.

PARENT ROCK: Silicified marls, tuffs, sandstones and agglomerates.

PARENT MATERIAL: Strongly weathered *in-situ* rock.

#### PHYSIOGRAPHIC

POSITION/LANDFORM: Gently convex slopes in rolling and hilly land.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), and moderately steep (21-25°).

VEGETATION AND LAND USE: Much still under forest in which yaka, yasi yasi, and cuakuro are the predominant trees. Elsewhere cleared for subsistence food crops or as in the upper Sigatoka valley under grass and used for rough grazing.

RANGE OF ELEVATION: 20-600 m

RAINFALL: Annual average range: 2,000-3,000 mm;  
dry season range: 600-800 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Severe sheet and rill erosion potential where cultivated (without soil conservation measures) on slopes >7°.

**Dogotuki**



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 8 cm of dark brown friable clay loam of strong fine granular structure, overlying 25 cm of red and light red friable clay of strong fine and medium nut structure and sticky moist, overlying 50 cm or more of varicoloured massive clayey and compact strongly weathered <i>in-situ</i> parent material commonly with fragments of weathering tuffs.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows them to be moderately to strongly acid and strongly leached, low in phosphorus and very low in potassium.
LABORATORY Nos:	FACL 192047
SOIL LIMITATIONS:	Susceptibility to erosion; soil acidity and nutrient deficiencies of phosphorus and potassium.

## Typifying Profile

SOIL NAME: Dogotuki soils  
PROFILE No.: VS21  
SITE LOCATION: 300 m from Rauriko bridge on roadside towards Wainigadru, Dogotuki, Macuata..

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex shoulder slope in rolling terrain.  
PARENT MATERIAL: Strongly weathered *in-situ* acid tuffs.  
SLOPE: 10°  
ASPECT: South-east  
ELEVATION: 200 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Dryland grasses with scattered forest remnants.  
LAND USE: Original sama, velau, saurua and wild palm.  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: FACL 192047

### PROFILE DESCRIPTION

Ah	0-8 cm (8 cm)	Moist; dark brown (7.5YR 3/2) clay loam; strongly developed fine granular structure; friable; slightly sticky; slightly plastic; abundant fine roots; distinct wavy boundary,
Bw1	2-28 cm (20 cm)	Moist; red (2.5YR 4/3) and light red (2.5YR 6/8) clay; strongly developed fine nut structure; friable; sticky; non plastic; abundant fine roots; indistinct smooth boundary,
Bw2	28-33 cm (5 cm)	Moist; red (2.5YR 4/3) and weak red (10R 4/4) silty clay; weakly developed coarse nut structure; friable; very sticky; non plastic; few fine roots; sharp smooth boundary,
BC	33-83 cm+ (50 cm+)	Moist; reddish brown (2.5YR 4/4) and yellow (10YR 8/8) heavy clay of weathered parent material; massive breaking to weak coarse blocky structure; very firm; sticky; with fragments of weathered tuff.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Drasa series**

REFERENCE: Drasa clay (31b) as described by Twyford & Wright (1965) as colluvial and outwash soils on flattish land from weathered basic rocks formed under a climate with a strong dry season.

Forms part of the Drasa set.

The central concept for Drasa is retained in this survey.

#### CLASSIFICATION:

(a) Soil Taxonomy: Ultic Haplustalf, fine, ferruginous, Isohyperthermic

(b) FAO: Eutric Nitosol

(c) Twyford and Wright: Humic latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Drasa soils, flat to gently undulating phase (71A)

Drasa soils, undulating phase (71B)

Drasa soils, easy rolling phase (71C)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Drasa soils are confined to two small areas, one of 10 sq km around the old Lautoka airport and another of 4 sq km near Lomawai in Nadroga.

PARENT ROCK: Rocks of basic composition.

PARENT MATERIAL: Deep strongly weathered colluvial outwash.

PHYSIOGRAPHIC POSITION/LANDFORM: Broad low angle outwash fan.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°) and easy rolling (8-11°).

VEGETATION AND LAND USE: Primarily utilised for sugar cane.

RANGE OF ELEVATION: 10-100 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Medium

FLOODING: Floods on 2-3 occasions for short periods and on slopes <2° during the wet season following high intensity storms.

EROSION: Slight to moderate sheet and rill erosion potential on slopes >2° under cultivation regime.

## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

Typically shows 30 cm of dark reddish brown clay, of weakly developed coarse blocky structure that breaks with difficulty to fine granular, very firm, and slightly sticky and slightly plastic when moist, overlying 45 cm of reddish brown clay, of moderately developed coarse blocky structure, very firm, slightly sticky and slightly plastic when moist, with many soft black manganese nodules, overlying more than 45 cm of reddish yellow clay, of weakly developed coarse blocky structure, very firm, and very plastic and sticky when moist.

### DIAGNOSTIC HORIZONS:

Ochric epipedon, argillic horizon.

### RANGE OF PROFILE FEATURES:

Drasa series have an Ap, Bt1, Bt2 horizon sequence.

The Ap horizon thickness ranges 25-32 cm; colours are dark reddish brown (5YR 3/2, 3/3, 3/4, 2.5YR 2/4, 3/4) or reddish brown (5YR 4/3) or weak red (2.5YR 4/2); textures are either clay or clay loam; and structures may be weak or moderate coarse nut or blocky breaking to moderate or strong granular or fine nut.

The Bt1 horizon thickness ranges 40-55 cm; colours may be red (2.5YR 4/6, 4/8, 5/8) or reddish brown (5YR 4/4, 5/4); and black manganese nodules are present in variable amounts i.e. common, many or abundant.

The Bt2 horizon thickness exceeds 45 cm; colours are yellowish red (5YR 5/6, 5/8) or reddish yellow (7.5YR 6/6, 6/8); textures may be clay, clay loam, gritty clay or gritty clay loam.

### VARIANTS:

None recognised

### SIMILAR SOILS AND DISTINGUISHING FEATURES:

None recognised

### GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:

Analyses show Drasa series to be extremely acid in the surface horizon becoming moderately acid in the other horizons; carbon and nitrogen both very low and the C/N ratio is also low; available phosphorus is very low; % base saturation is low in the topsoil but high in the other horizons; CEC and exchangeable calcium have medium values throughout; magnesium is medium in the topsoil and high below this, and potassium is very low throughout.

### LABORATORY Nos:

KRS U100-102 (inclusive)

### SOIL LIMITATIONS:

Slight flooding risk on slopes < 2°; moderate to severe soil moisture deficits normally experienced during the dry season; the clayey nature of the soils in combination with coarse structures make for a poor tilth and a propensity to hardening of aggregates when the soils are dry; slight to moderate erosion risk under cultivation on slopes > 2°; and nutrient deficiencies of nitrogen, potassium and phosphorus.

## Typifying Profile

SOIL NAME: Drasa soils, flat to gently undulating phase.  
PROFILE No.: 33/1/a  
SITE LOCATION: Levee of Teidamu River near old Lautoka airstrip.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Stable levee surface.  
PARENT MATERIAL: Deep strongly weathered. Colluvial outwash from rocks of basic composition.  
SLOPE: 0°  
ASPECT: Not applicable  
ELEVATION: 15 m  
MICRORELIEF: Level and smooth.  
SITE VEGETATION: Fallow  
LAND USE: Sugar cane and pulses - intensive cropping.  
DRAINAGE: Well drained  
EROSION: Severe past sheet erosion.  
DISTURBANCE: Recently ploughed. Receives periodic NPK fertiliser.  
LABORATORY Nos: KRS U100-102 (inclusive)  
COMMENTS: Very hard when dry.

### PROFILE DESCRIPTION

Ap	0-30 cm (30cm)	Moist; dark reddish brown (5YR 3/4) clay; weakly developed very coarse blocky structure breaking with difficulty to moderate fine granular structure; very firm; slightly sticky; slightly plastic; many fine granules; few fine fibrous roots; distinct smooth boundary,
Bt1	30-75 cm (45 cm)	Moist; reddish brown (5YR 4/4) clay; moderate very coarse blocky structure; very firm; slightly sticky; slightly plastic; many soft black manganese nodules; few fine fibrous roots; diffuse smooth boundary,
Bt2	75-120 cm (45 cm)	Moist; reddish yellow (7.5YR 6/8) clay; weakly developed very coarse blocky structure; very firm; very plastic, sticky; few fine fibrous roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Dreketi series**

REFERENCE: New soil series introduced in this survey to describe recently drained saline soils of the marine marsh (i.e. Dogo series in the natural state) occurring in any of the lowland climatic zones of Fiji. The central concept for Dreketi series is low pH, but >3.5, and presence of jarosite mottles thus no true sulfuric horizon but intergrading to sulfaquepts (Tiri series). In general Dreketi series have been drained longer than Tiri series and had at least one rice crop since drainage.

Previously included with Dogo soils (56) as defined by Twyford & Wright (1965). The name is from the Dreketi River.

#### CLASSIFICATION:

(a) Soil Taxonomy: Sulfic Tropaquept, clayey, mixed, isohyperthermic

(b) FAO: Thionic Fluvisol

(c) Twyford and Wright: Saline soil of the marine marsh

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Dreketi soils (4)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Dreketi soils are associated with Dogo soils and are extensive at the mouths of all rivers except the Sigatoka river and many streams of Viti Levu and Vanua Levu.

PARENT ROCK: Various

PARENT MATERIAL: Diverse alluvia deposited partly by a slowing in river current but mainly to the flocculation of silt and lay in the lagoons resulting in the gradual raising of the sea bed to a certain height, where the different mangrove species were able to colonise it.

PHYSIOGRAPHIC POSITION/LANDFORM: Behind sea walls (and protected from marine tides) in recently drained sites on the delta and river margins.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-1°).

VEGETATION AND LAND USE: Normally in irrigated rice (first or second crop following drainage) or fallowed between rice crops.

RANGE OF ELEVATION: 0-2 m

RAINFALL: Annual average range: 1,800-4,500 mm;  
dry season range: 400-3,000 mm;  
wet season range: 1,400-3,000 mm.

TEMPERATURE: Mean annual range: 24-27°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Very poorly drained.

PERMEABILITY CLASS: Slow

FLOODING: In a normal wet season experiences 4 to 5 floods of short duration. Have been artificially drained and water table maintained at 60-70 cm.

*Dreketi*



EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC  
PROFILE FEATURES:

Typically shows 15 of black mottled yellowish brown (jarosite) peaty silty clay, of moderately developed crumb structure, and friable, overlying 20 cm of greyish brown mottled yellowish brown (jarosite) clay, of massive structure, very firm and plastic and sticky moist, overlying 25 cm of greyish brown mottled yellow (jarosite) clay, of massive structure, firm, and plastic and sticky moist, overlying more than 50 cm of dark brown or dark grey clay or silty clay loam, friable and sticky and plastic when moist. All horizons have dead woody mangrove roots and gypsum crystals are commonly found in horizons below 100 cm.

DIAGNOSTIC HORIZONS:

Orchic epipedon, cambic horizon, sulfidic materials.

RANGE OF PROFILE FEATURES:

Dreketi series have a Ahg, Bg1, Bg2, Cr1, Cr2 etc. horizon sequence.

The A horizon thickness ranges 10-20 cm; colours are black (either 2.5Y, 10YR or 7.5YR hues); textures are peaty and either silt loams, clay loams or silty clays; and structures may be either fine nutty, granular or crumb.

The Bg horizons range from 35 to 45 cm thickness; colours are either greyish brown (10YR or 2.5Y 5/2) or dark greyish brown (10YR or 2.5Y 4/2); mottles may be many or profuse.

The Cr horizons exceed 75 cm in thickness; colours are dark brown (10YR 3/3, 7.5YR 4/2) or dark grey (2.5Y 4/0, 10YR 4/1 and 7.5YR 4/0); textures vary between clays, silts, fine sands, silty clays, clay loams, and sandy clays; and gypsum crystals may or not be present.

VARIANTS:

None recognised

SIMILAR SOILS AND

DISTINGUISHING FEATURES:

None recognised

GENERAL CHEMICAL, PHYSICAL &  
MINERALOGICAL PROPERTIES:

pH determination on fresh moist samples gave strongly or extremely acid values (but >3.5) to 100 cm depth soil reaction becoming slightly acid below this depth; % base saturation is low in the A horizon but high in other horizons; CEC values are very high throughout; exchangeable calcium values increased with depth from medium in the A horizon to very high values below 100 cm; potassium and magnesium follow a similar trend with depth; exchangeable sodium is extremely high in all horizons; C/N ratios are very high in all horizons except the A where the ratio is medium to high; available phosphorus is low.

LABORATORY Nos:

KRS T2683-2688. USP DK21A-F

SOIL LIMITATIONS:

Soil acidity, poor internal drainage, high sodium values reflecting marine tidal influences on the ground water and the water table fluctuations; low phosphorus status.

## Typifying Profile

SOIL NAME: Dreketi soils  
PROFILE No.: DK21  
SITE LOCATION: Dreketi rice irrigation scheme.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar surface on estuarine delta.  
PARENT MATERIAL: Estuarine alluvia from rocks of diverse lithologies.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 1 m  
MICRORELIEF: Smooth  
SITE VEGETATION: In fallow  
LAND USE: Being prepared for intensive rice cultivation. Recently artificially drained.  
DRAINAGE: Very poorly drained.  
EROSION: None  
DISTURBANCE: Cultivated  
LABORATORY Nos: KRS T2683-2688. USP DK21A-F

### PROFILE DESCRIPTION

Ahg	0-14 cm (14 cm)	Wet; black (2.5Y 2/0) peaty silty clay; few medium distinct yellowish brown (10YR 5/8) mottles; moderately developed medium crumb structure; friable; slightly sticky; non plastic; abundant fine dead roots (kuta); distinct irregular boundary,
Bg1	14-32 cm (18 cm)	Very moist; greyish brown (10YR 5/2) clay; many fine to medium distinct yellowish brown (10YR 5/8) mottles along root channels; massive; slightly sticky; very plastic; very firm; many fine and very fine dead roots (kuta); distinct smooth boundary,
Bg2	32-58 cm (26 cm)	Very moist; greyish brown (2.5Y 5/2) clay; profuse medium to coarse prominent yellow (10YR 7/8) to yellowish brown (10YR 5/8) mottles; massive; firm; slightly sticky; plastic; many very fine and fine dead (kuta) roots; sharp smooth boundary,
Cr1	58-72 cm (14 cm)	Wet; dark brown (10YR 3/3) clay; massive; firm; slightly sticky; plastic; common very fine and fine dead roots (kuta); distinct wavy boundary,
Cr2	72-95 cm (23 cm)	Very moist; dark grey (7.5YR 4/0) silty clay; massive; friable; very sticky; slightly plastic; many very fine and medium dead roots (vadra); distinct wavy boundary,
Cr3	95-141 cm (46 cm)	Very moist; dark brown (7.5YR 4/2) silty clay loam; many medium distinct very pale brown (10YR 7/4) mottles (weathered shell fragments); friable; very sticky; non plastic; many very fine to medium dead roots (vadra); many gypsum crystals (mainly along root channels; distinct wavy boundary,

141 cm+

Wet; very dark grey (5Y 3/1) loamy fine sand; single grain; slightly sticky; loose; few very fine and fine dead roots (vadra).

Note: Gypsum crystals reach maximum size at 125 cm.  
High chroma mottles are jarosite.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Driti series**

REFERENCE: Driti sandy clay and sandy lay loam (37b) and Driti hill soils (37bH) defined by Twyford & Wright (1965) as formed from dacite and quartz rich tuffs, on rolling and especially hilly land under a climate with little or no dry season.

Forms part of the Lutu set.

The central concept for Driti soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Inceptic Eutroperox, clayey, ferruginous, isohyperthermic
- (b) FAO: Xanthic Ferralsol
- (c) Twyford and Wright: Red yellow podzolic soil with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Driti soils, undulating phase (137B)

Driti soils, rolling phase (137D)

Driti soils, easy rolling phase (137C)

Driti soils, strongly rolling phase (137E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lutu soils develop in the very wet centre and east centre of Viti Levu and in a number of restricted locations in the interior of Vanua Levu where they are almost entirely forested.

PARENT ROCK: Dacite and quartz rich tuffs.

PARENT MATERIAL: Shallow strongly weathered *in situ* in situ rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Gently convex and planar surfaces on easy rolling and flattish topography.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Mainly under tall rain forest in which daku salusalu is dominant.

RANGE OF ELEVATION: 100-600 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Moderate to severe sheet and rill erosion potential when forest cleared.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 2 cm of decaying litter overlying 10 cm of dark brown friable silt loam of developed medium nut structure breaking to crumb and fine blocky, overlying 25 cm of dark brown friable silty clay loam of moderate medium nut breaking to fine locky, overlying 15 cm of reddish brown firm clay loam, of moderate medium nut breaking to fine blocky, commonly stony, on weathered tuff
DIAGNOSTIC HORIZONS:	Ochric epipedon, oxic horizon.
RANGE OF PROFILE FEATURES:	<p>Driti series have an Ah, Bw, BC, C horizon sequence.</p> <p>The Ah horizon ranges in thickness from 8 to 15 cm; its colours include dark brown (7.5YR 4/2) dark reddish brown (5YR 3/2, 3/3) and dark grey (5YR 4/1); textures are clay, sandy clay, silt loam and loam; and structures moderate or strong medium nut.</p> <p>The Bw horizon ranges in thickness from 15 to 25 cm; its colours include dark brown (7.5YR 4/4), yellowish red (5YR 4/6, 5/6) and reddish brown (5YR 4/4, 5/4); textures are silty clay loam, clay loam and clay; and structures are moderate or strong fine or medium nut or blocky.</p> <p>The BC horizon ranges in thickness from 15 to 25 cm; its colours include reddish brown (5YR 4/4) brown (7.5YR 5/4), yellowish red (5YR 4/6, 5/6); textures are clay or clay loam; and structures are weak, moderate or strong fine or medium blocky or nut.</p> <p>The BC horizon of weathering tuff may be encountered between 25 and 50 cm depth.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be moderately acid; organic carbon values are high in the topsoil (0-8 cm), low 8-30 cm and very low below these; % base saturation is medium; CEC is medium in the topsoil and low in the other horizons; and available phosphorus is very low.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is ferruginous.</p>
LABORATORY Nos:	USP SP15/1896-1899
SOIL LIMITATIONS:	Profile shallowness; moderately rapid permeability; moderate to severe erosion potential when forest cleared; moderate soil acidity; and nutrient deficiencies of phosphorus and potassium.

## Typifying Profile

SOIL NAME: Driti soils, easy rolling phase.  
PROFILE No.: SP15  
SITE LOCATION: Northwest slopes of Mt Ulu-i-dali, Bua Province, Vanua Levu.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar midslope on flattish land.  
PARENT MATERIAL: Basic tuff  
SLOPE: 10°  
ASPECT: North-west  
ELEVATION: 350 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Dakua (*Agathis vitiensis*).  
LAND USE: Indigenous forest. Unused.  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: USP SP15/1896-1899

### PROFILE DESCRIPTION

L	2-0 cm	Dead and decaying leaves of <i>Agathis vitiensis</i> ,
Ah	0-8 cm (8 cm)	Moist; dark brown (7.5YR 4/2) silt loam; friable, moderately developed medium nut structure breaking to moderate fine crumb and blocky structure; few fine angular stones; common roots; diffuse boundary,
Bw	8-30 cm (22 cm)	Moist; dark brown (7.5YR 4/4) silty clay loam; friable; moderately developed medium nut structure breaking to strong fine blocky structure; few roots; few stones; distinct boundary,
BC	30-45 cm (15 cm)	Moist; reddish brown (5YR 4/4) clay loam; firm; moderately developed medium nut structure breaking to weak to moderate fine blocky structure; few roots; few large stones.
	on	weathering tuff.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Dulevi series**

REFERENCE: Dulevi loam (23g) and Dulevi hill soils (23gH) defined by Twyford & Wright (1965) as latosolic soils from very young volcanic ash and formed under a climate with a weak dry season.

Forms part of the Waiqere set.

The central concept for Dulevi series is retained in this survey.

#### CLASSIFICATION:

(a) Soil Taxonomy: Hydric Hapludand, medial, isohyperthermic

(b) FAO: Ochric Andosol

(c) Twyford and Wright: Latosolic soil with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Dulevi soils, flat to gently undulating phase (90A)	Dulevi soils, rolling phase (90D)
Dulevi soils, undulating phase (90B)	Dulevi soils, strongly rolling phase (90E)
Dulevi soils, easy rolling phase (90C)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Central upland plateau of Koro Island, and of very limited occurrence on Taveuni Island.

PARENT ROCK: Basalt

PARENT MATERIAL: Thick weakly weathered volcanic ash over older lava flows.

PHYSIOGRAPHIC POSITION/LANDFORM: Convex crests and ridges, and broad rolling plateau surfaces.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Mostly under forest but patches used productively for food gardens and yaqona.

RANGE OF ELEVATION: 0-600 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-3,000 mm;  
wet season range: 2,000-3,200 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat excessively drained.

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Severe sheet and rill erosion potential on slopes >3° if forest cleared and cultivated in the absence of soil conservation measures.



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 18 cm of black very friable clay loam, of strong fine and very fine nut structure, and slightly sticky and plastic, overlying 25 cm of dark yellowish brown very friable very fine sandy loam of weak medium nut and crumb structure, overlying 60 cm of dark brown very friable sandy clay, of moderate coarse blocky structure with crumb, sticky and plastic moist and with faint clay cutans on 20 cm or more of dark yellowish brown gravelly clay loam, of moderate coarse blocky structure with crumbs, and again with faint clay cutans.  Most profiles have a few weakly weathered stones and gravels.
DIAGNOSTIC HORIZONS:	Mollic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Not analysed in this survey but considered to be moderately acid in the topsoil and slightly acid in the other horizons; of low base status and low or very low exchangeable calcium, magnesium and potassium and available phosphorus; and with very high phosphate retention properties.
LABORATORY Nos:	Not sampled
SOIL LIMITATIONS:	Moderately rapid soil permeability; erosion hazard on slopes $>3^\circ$ ; nutrient deficiencies of potassium and phosphorus; and high phosphate retention properties.

## Typifying Profile

SOIL NAME: Dulevi series  
PROFILE No.: T73  
SITE LOCATION: Tutu Estate, Taveuni Island.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Ash cover platform formed by basalt lava flows.  
PARENT MATERIAL: Thick weakly weathered basaltic ash.  
SLOPE: 4°  
ASPECT: West north-west  
ELEVATION: 110 m  
MICRORELIEF: Forest dimpled  
SITE VEGETATION: Coconuts, Vaivaioa, and ground weeds.  
LAND USE: Unused. Previously used for food gardens.  
DRAINAGE: Well drained  
EROSION: Slight soil creep.  
DISTURBANCE: Previously cultivated  
LABORATORY Nos: Not sampled

### PROFILE DESCRIPTION

Ap	0-18 cm (18 cm)	Moist; black (10YR 2/1) clay loam; strongly developed fine and very fine nut structure; very friable; slightly sticky; plastic; common fine fibrous roots; common weakly weathered subrounded basalt stones; distinct smooth boundary,
Bw	18-42 cm (24 cm)	Moist; dark yellowish brown (10YR 4/4) very fine sandy loam; weakly developed medium nut structure breaking to very fine crumb; very friable; slightly plastic; common fine fibrous roots; common weakly weathered subrounded basalt stones; distinct smooth boundary,
Bt1	42-108 (64 cm)	Moist; dark brown (10YR 3/3) sandy clay; moderately developed coarse blocky structure breaking to weak very fine crumb; very friable; sticky; plastic; few faint dark brown (10YR 3/3) clay cutans; few fine fibrous roots; few weakly weathered subrounded basalt stones; distinct smooth boundary,
Bt2	108-120 cm (112 cm)	Moist; dark yellowish brown (10YR 4/4) gravelly clay loam; moderately developed coarse blocky structure breaking to weak very fine crumb; friable; slightly sticky; plastic; few faint dark brown (10YR 3/3) clay cutans; few weakly weathered subrounded basalt stones.

Note NaF reaction. Strong reaction for all 4 horizons.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Ekubu series**

REFERENCE: Ekubu clay (10b) and Ekubu clay, mottled phase (10c) defined by Twyford & Wright (1965) as colluvial soils from crystalline limestone formed under a climate with a moderate dry season.

Forms part of the Korotuku set.

The central concept for Ekubu soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Lithic Haplustoll, fine, smectitic, isohyperthermic
- (b) FAO: Haplic Kastanozem
- (c) Twyford and Wright: Nigrescent soil with a moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Ekubu soils (83)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Of very limited occurrence and restricted to Vatulele island.

PARENT ROCK: Limestone and basic rocks.

PARENT MATERIAL: Moderately weathered colluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Flats and hollows between the coastal beach strand proper and low raised coral reef terraces.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: Mainly under coconuts with underplanting of food gardens and bananas.

RANGE OF ELEVATION: 1-3 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: No erosion risk.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 3 cm of weathering pumice grits, overlying 15 cm of very dark brown firm gravelly slightly gritty clay with colourless fine shining quartz crystals, of weak coarse blocky structure breaking to strong granular, overlying 20 cm of dark yellowish brown friable gravelly clay of weak coarse blocky structure over coral rock
DIAGNOSTIC HORIZONS:	Mollic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions made.
VARIANTS:	Unnamed mottled variant that occurs in hollows where subsoil waters cannot easily seep away. Typically shows 12-20 cm of very dark grey brown faintly mottled dark grey clay of strong coarse blocky structure overlying 38 cm of dark grey, mottled pale grey, blue, green and dusky red clay.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Chemical analysis shows it to be slightly alkaline, of very high base status, with very high exchangeable calcium, magnesium and potash, and very high available phosphorus.</p> <p>The family particle size class is fine.</p> <p>The mineralogy class is smectitic.</p>
LABORATORY Nos:	KRS 748-749 (inclusive)
SOIL LIMITATIONS:	Profile shallowness; dry season soil moisture deficits; and some subsoil waterlogging during the wet season in the mottled variant.

## Typifying Profile

SOIL NAME: Ekubu soil  
PROFILE No.: TW 52  
SITE LOCATION: 150 m west of Ekubu village.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar surface behind coastal sands (Yasawa soils).  
PARENT MATERIAL: Collurium with pumice grits and limestone fragments.  
SLOPE: Level surface  
ASPECT: Not applicable  
ELEVATION: 4 m  
MICRORELIEF: Cultivated ridges  
SITE VEGETATION: Coconut over food garden of dalo, bele, banana.  
LAND USE: Gardening  
DRAINAGE: Well drained  
EROSION: No evidence of erosion.  
DISTURBANCE: Non-mechanical cultivation.  
LABORATORY Nos: KRS 748-749

### PROFILE DESCRIPTION

Ekubu soils

	0-3 cm (3 cm)	Surface layer of dry weathering pumice grits, distinct boundary,
Ap	3-18 cm (15 cm)	Moist; very dark brown (10YR 2/2) gravelly slightly gritty clay; weakly developed coarse blocky structure breaking to strong medium blocky and then to strongly developed granular; firm; slightly sticky; slightly plastic; few colourless fine shining quartz crystals; many fine fibrous roots; distinct smooth boundary,
Bw	18-38 cm (20 cm)	Moist; dark yellowish brown (10YR 4/4) gravelly clay; weakly developed coarse blocky structure; friable; sticky; plastic; many yellowish brown (10YR 5/6) weathering pumice fragments; few white coral limestone fragments; common fine fibrous roots; sharp wavy boundary,
R	on	Hard coralline limestone.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Emuri series**

REFERENCE: Emuri clay (17b) defined by Twyford & Wright (1965) as the colluvial derivative of Dakadaka stony clay (17a) and formed under a climate with a strong dry season. In this survey the parent material range has been extended to include base rich tuffs, siltstones and sandstones.

Forms part of the Dakadaka set.

The central concept for Emuri soils described by Twyford & Wright (1965) is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Udic Haplustert, fine, smectitic, isohyperthermic
- (b) FAO: Pellic Vertisol
- (c) Twyford and Wright: Nigrescent soil with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Emuri soils, flat to gently undulating phase (118A)
- Emuri soils, undulating phase (118B)
- Emuri soils, easy rolling phase (118C)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Emuri soils occur mainly in south-western Viti Levu on the coastal lowlands between the Sigatoka and Nadi rivers.

PARENT ROCK: Marine sedimentary rocks of basic and intermediate composition.

PARENT MATERIAL: Deep strongly weathered colluvium.

PHYSIOGRAPHIC POSITION / LANDFORM: Toeslopes and valley floors of underfit valleys.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), and easy rolling (8-11°).

VEGETATION AND LAND USE: Rainfed rice and sugar or rough grazing outside of the cane belt proper.

RANGE OF ELEVATION: 10-100 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Slow

FLOODING: May experience short duration flooding in association with high intensity storms on 3-4 occasions each wet season.

EROSION: No erosion risk.



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of black firm clay, of strongly developed very coarse blocky structure, sticky and plastic moist, and with slicken sides to the peds, overlying 40 cm of black very firm clay, of moderate to strongly developed very coarse blocky structure (aggregates tilted 20-60°), sticky and plastic moist, and with slicken sides to peds, overlying more than 50 cm of black and dark brown faintly mottled reddish brown and yellowish red firm clay, of massive tending columnar structure, with slicken sides, and with common subrounded gravels.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon, vertic features.
RANGE OF PROFILE FEATURES:	Not applicable. Apart from slight differences in horizon thicknesses profiles show little variation in profile features from that described above.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Chemical analysis show Emuri series to be moderately acid in the A horizon (0-20 cm), slightly acid 20-60 cm, and slightly alkaline below; carbon and nitrogen have medium values in the A horizon with very low values in the other horizons, and C/N ratios are medium; CEC and % base saturation are very high; exchangeable calcium is very high, magnesium extremely high, sodium medium to high, and potassium high in the A horizon but very low in the other horizons; and available phosphorus very low throughout.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is smectitic.</p>
LABORATORY Nos:	USP NWC1A-C
SOIL LIMITATIONS:	Clayey textures; montmorillonitic clays with their shrink/swell properties that give rise to the soils vertic properties; subsoil waterlogging on slopes <3° during the wet season; severe soil moisture deficits in the dry season; and nutrient deficiencies of phosphorus, nitrogen and potassium.

## Typifying Profile

SOIL NAME: Emuri soils, flat to gently undulating phase.

PROFILE No.: NWC1

SITE LOCATION: Fiji Pine Commission trial site, Nawaicoba.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Concave toeslope on valley surface (underfit) in rolling country.

PARENT MATERIAL: Colluvium derived from sedimentary rocks of intermediate composition.

SLOPE: 3°

ASPECT: North-east

ELEVATION: 35 m

MICRORELIEF: Gilgai features

SITE VEGETATION: Wire grasses and miscellaneous weeds.

LAND USE: Exotic forestry with under-grazing by goats.

DRAINAGE: Poorly drained

EROSION: None recognised

DISTURBANCE: Previously ploughed

LABORATORY Nos: USP NWC1A-C

### PROFILE DESCRIPTION

Ap	0-20 cm	Dry; black (5YR 2/1) clay; strongly developed very coarse blocky structure, with strong fine blocky structure in upper 3 cm; sticky; plastic; firm; common faint black (5YR 2/1) slicken sides to peds; fine and medium live roots; common weakly weathered sub-rounded fine grits; indistinct smooth boundary,
Bw	20-60 cm	Moist; black (5YR 2/1) clay; moderate to strongly developed very coarse blocky structure; sticky; plastic; very firm; common distinct black (5YR 2/1) slicken sides and polished surfaces; structural aggregates tilted at 20-60°; few fine and medium roots; common weakly weathered subrounded very fine gravels; indistinct smooth boundary,
BC	60-110 cm	Moist; black (5YR 2/1) and dark brown (10YR 3/3) clay; few fine faint reddish brown (5YR 4/4) and yellowish red (5YR 5/6) mottles; massive to weak coarse columnar structure; plastic; firm; common distinct black (5YR 2/1) slicken sides and polished surfaces; common weakly weathered subrounded very fine gravels.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Gaigai series**

REFERENCE: Gaigai steepland rocky clay loam (90b) defined by Twyford & Wright (1965) as a steepland soil from dacite and quartz-rich tuffs formed under a climate with no dry season.

Forms part of the Narayawa set.

The central concept for Gaigai soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Kanhaplohumult, clayey, ferruginous, isohyperthermic
- (b) FAO: Humic Nitosol
- (c) Twyford and Wright: Steepland soils related to or associated with red yellow podzolic soils with no dry season.

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Gaigai soils, rolling phase (136D)

Gaigai soils, moderately steep phase (136F)

Gaigai soils, strongly rolling phase (136E)

Gaigai soils; steep phase (136G)

### Environmental Factors

#### GEOGRAPHICAL

##### DISTRIBUTION:

Gaigai soils are developed in Vanua Levu inland from Wainunu and Dawara in a region of dacite peaks.

##### PARENT ROCK:

Dacite and tuffs of acidic composition.

##### PARENT MATERIAL:

Deep strongly weathered *in situ* rock.

##### PHYSIOGRAPHIC

##### POSITION / LANDFORM:

Predominantly convex and planar backslopes and midslopes in strongly dissected hill country.

##### SLOPE CLASS

##### AND RANGE OF SLOPES:

Rolling (12-15°), strongly rolling (16-20°), moderately steep (21-26°), and steep (27-35°).

##### VEGETATION AND LAND USE:

Indigenous forest (damanu, sacau, roci).

##### RANGE OF ELEVATION:

100-600 m

##### RAINFALL:

Annual average range: 3,200-4,800 mm;  
dry season range: 800-600 mm;  
wet season range: 1,800-2,800 mm.

##### TEMPERATURE:

Mean annual: 24°C.

##### SOIL MOISTURE REGIME:

Udic (perudic)

##### SOIL TEMPERATURE REGIME:

Isohyperthermic

##### SOIL DRAINAGE CLASS:

Well drained

##### PERMEABILITY CLASS:

Medium

##### FLOODING:

Never floods

##### EROSION:

Moderate to severe sheet and rill erosion if forest removed from slopes >11°.

## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

Typically shows 25 cm of dark brown firm clay loam, of strongly developed medium granular structure, overlying 30 cm of reddish brown firm clay loam, of moderately developed medium granular structure, overlying 40 cm of yellowish red friable fine sandy loam, of massive tending weak columnar structure over more than 100 cm of varicoloured (light grey, yellowish brown, reddish yellow, dark red) friable fine sandy loam of massive structure with many strongly weathered subrounded boulders.

### DIAGNOSTIC HORIZONS:

Ochric epipedon, argillic horizon.

### RANGE OF PROFILE FEATURES:

Gaigai series have a Ah, Bt, Bw, C horizon sequence.

The Ah horizon thickness ranges from 12-28 cm; its colours include dark brown (7.5YR 3/2, 4/2, 4/4) and very dark grey (7.5YR N3/0); textures may be sandy clay, sandy clay loam, silty clay loam or clay loam; structures may be moderate or strong, fine or medium, not or granular; and consistence friable or firm.

The Bt horizon thickness ranges from 25-40 cm; its colours include dark brown (7.5YR 4/2, 4/4) and reddish brown (5YR 4/3, 4/4, 5/3); textures are sandy clay, silty clay, clay or clay loam; and structures are moderate medium nut or granular.

The Bw horizon thickness ranges from 15 to 40 cm; its colours include yellowish red (5YR 4/6, 5/6, 5/8) and brown (7.5YR 5/4); textures are fine sandy loam, sandy clay loam, and sandy clay; and structures are massive, or weak coarse blocky or columnar.

### VARIANTS:

None recognised

### SIMILAR SOILS AND DISTINGUISHING FEATURES:

None recognised

### GENERAL CHEMICAL, PHYSICAL AND MINERALOGICAL PROPERTIES:

Analysis show the profile to be strongly acid throughout; organic carbon is low in the A horizon (0-25 cm) and very low below; nitrogen is medium in the A horizon and very low in the other horizons; very low available phosphorus throughout; % base saturation is high 0-25 cm, medium 25-55 cm and very low below 55 cm depth; CEC is low; exchangeable calcium is low 0-25 cm and very low below; magnesium is medium 0-55 cm and low below this, potassium is medium; and aluminium is significant in the exchange complex.

The particle size family class is fine.

The mineralogical class is ferruginous.

### LABORATORY Nos:

KRS U469-472

### SOIL LIMITATIONS:

Physical limitations of slope and moderate to severe erosion potential if forest removed from slopes; strong soil acidity; possible aluminium toxicity; and nutrient deficiencies of nitrogen and phosphorus.

## Typifying Profile

SOIL NAME: Gaigai soils, steep phase.  
PROFILE No.: TEA008  
SITE LOCATION: Wainunu tea project, Bua Province.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Concave crest in steepland.  
PARENT MATERIAL: Shallow colluvium derived from rocks of acid composition overlying *in situ* rock of the same composition.  
SLOPE: 35° length 70 m.  
ASPECT: North-west  
ELEVATION: 425 m  
MICRORELIEF: Forest dimples  
SITE VEGETATION: Indigenous forest (damanu, sacau, roci).  
LAND USE: Unused  
DRAINAGE: Well drained  
EROSION: None  
DISTURBANCE: None  
LABORATORY Nos: KRS U469-472

### PROFILE DESCRIPTION

Ah	0-25 cm (25 cm)	Dry; dark brown (7.5YR 4/4) moist and rubbed clay loam; firm; strongly developed medium granular structure; common fine roots; distinct irregular boundary,
Bt	25-55 cm (30 cm)	Slightly moist; reddish brown (5YR 4/3) moist and rubbed clay loam; firm; slightly plastic; moderately developed medium granular structure; common fine roots; diffuse irregular boundary,
Bw	55-92 cm (37 cm)	Moist; yellowish red (5YR 5/6) moist and strong brown (7.5YR 5/6) rubbed fine sandy loam; friable; slightly sticky; massive tending weakly developed coarse columnar structure; common fine roots; diffuse irregular boundary,
C	92-200 cm (108 cm+)	Moist; colour variegated light grey (10YR 7/2) yellowish brown (10YR 5/4) reddish yellow (5YR 6/8) and dark red (10R 3/6) fine sandy loam; friable; slightly sticky; massive; many strongly weathered subrounded boulders.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Galoa series**

REFERENCE: Galoa gritty clay (33) and Galoa hill soils (33H) defined by Twyford & Wright (1965) as talasiga soils from basic rocks on rolling and undulating land under fern and scrub and formed under a climate with a weak dry season.

Forms the Galoa set.

The central concept for Galoa soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Rhodudult, clayey, ferruginous, isohyperthermic
- (b) FAO: Dystric Nitosol
- (c) Twyford and Wright: Ferruginous latoso with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Galoa soils, undulating phase (175B)  
Galoa soils, easy rolling phase (175C)

Galoa soils, rolling phase (175D)  
Galoa soils, strongly rolling phase (175E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Centre and northern end of Galoa Island, and Gau Island.

PARENT ROCK: Basalt

PARENT MATERIAL: Strongly weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Planar and broad convex slopes in rolling country.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Generally and due to repeated severe past burning, carry a vegetation of sparse fern, nuqaneqa, nokoko, stunted gasau etc. Sometimes used for a single cassava crop but followed by more than 20 years of fallow.

RANGE OF ELEVATION: 20-600 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,000 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Very severe sheet and rill erosion potential. Have experienced repeated burning over the years and serious topsoil losses.



## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 12 cm of dusky red friable to firm clay, fairly sticky and plastic when moist, of strong very fine nut structure on about 30 cm of weak red firm rather compact clay of massive structure overlying about 60 cm of red, streaked with grey, clay, very compact in place but friable in the hand, of massive structure breaking to strong fine blocky. Strongly weathered rock common through the profile.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Not analysed but considered to be very acid, low in phosphate and bases and probably even in trace elements.
LABORATORY Nos:	Not sampled
SOIL LIMITATIONS:	Clayey textures; very severe erosion hazard and past thermal degradation; nutrient deficiencies of phosphorus, nitrogen and potassium; strong soil acidity; and possible aluminium toxicity.

## Typifying Profile

SOIL NAME: Galoa soils, undulating phase.  
PROFILE No.: TW 22  
SITE LOCATION: 500 m south-west of Lekanai village, NE Gau Island.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Concave midslope in hilly land.  
PARENT MATERIAL: Deeply weathered *in situ* basalt rock.  
SLOPE: 6°  
ASPECT: North-west  
ELEVATION: 120 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Nokonoko, gasau and scattered fern.  
LAND USE: Unused  
DRAINAGE: Well drained  
EROSION: Severe sheet erosion.  
DISTURBANCE: Past erosion  
LABORATORY Nos: Not sampled

### PROFILE DESCRIPTION

Galoa soils, easy rolling phase

Ah	0-12 cm (12 cm)	Moist; dusky red (10R 3/2) clay; strongly developed very fine nut structure; friable to firm; sticky; plastic; common fine fibrous roots; distinct smooth boundary.
Bw	12-42 cm (30 cm)	Moist; dusky red (10R 3/4) clay; massive structure; firm; sticky; plastic; compact; few fine fibrous roots; distinct smooth boundary,
Bt	42-103 cm (61 cm)	Moist; dusky red (10R 3/6) clay; grey (2.5YR N5/0) streaks; massive breaking to strong fine nut structure; very compact in place; friable; sticky; plastic; few fine fibrous roots; common strongly weathered stones.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Gau series**

REFERENCE: Gau clay and clay loam (29a) defined by Twyford & Wright (1965) as colluvial soils from mainly basic rocks and formed under a climate with a weak dry season.

Forms part of the Lomaiviti set.

The central concept for Gau soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Hapludalf, fine, kaolinitic, isohyperthermic
- (b) FAO: Eutric Nitosol
- (c) Twyford and Wright: Humic latosol with a weak dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Gau soils, flat to gently undulating phase (169A)	Gau soils, easy rolling phase (169C)
Gau soils, undulating phase (169B)	Gau soils, rolling phase (169D)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Gau soils, colluvial derivatives of Lomaiviti and Lodon soils, are of very minor extent in Viti Levu and Vanua Levu. They are of greatest extent (5 km sq) in Gau Island, Lomaiviti Group.

PARENT ROCK: Basic rocks

PARENT MATERIAL: Deep strongly weathered colluvium.

PHYSIOGRAPHIC POSITION / LANDFORM: Underfit valley floors and concave/planar toeslopes.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), easy rolling (8-11°), and rolling (12-15°).

VEGETATION AND LAND USE: Originally under forest is now used extensively for food gardens, yagona, bananas and coconuts.

RANGE OF ELEVATION: 10-250 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: May experience short duration (24 hours) flooding on flatter sites associated with high intensity storms during the summer months.

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 9 cm of reddish brown friable clay loam, of strong medium nut with crumb structure overlying 30 cm of dark reddish brown friable clay loam of weak coarse blocky structure breaking to fine and medium nut with few strongly weathered stones overlying 60 cm or more of dark reddish brown friable gritty clay of weak fine blocky structure tending massive with single grain.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be moderately acid; organic carbon is low in the topsoil (0-9 cm) and of very low value below 9 cm; very low available phosphorus; % base saturation is medium 0-40 cm and very high below, CEC values are medium throughout; exchangeable calcium is low, magnesium very high and potassium very low throughout.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is kaolinitic.</p>
LABORATORY Nos:	SB9396A-C
SOIL LIMITATIONS:	Flooding of very short duration on slopes $< 2^\circ$ ; very slight erosion hazard on slopes $> 3^\circ$ ; and nutrient deficiencies of phosphorus and potassium.

## Typifying Profile

SOIL NAME: Gau series, undulating phase.  
PROFILE No.: LK17  
SITE LOCATION: Lakeba island. 452670E 114740N

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Concave toeslope in rolling country.  
PARENT MATERIAL: Strongly weathered colluvium from basic andesite.  
SLOPE: 5°  
ASPECT: West  
ELEVATION: 45 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Reed (*M. floridulus*)  
LAND USE: Unused  
DRAINAGE: Well drained  
EROSION: None  
DISTURBANCE: None  
LABORATORY Nos: SB9396A-C

### PROFILE DESCRIPTION

Gau soils, undulating phase

Ah	0-9 cm (9 cm)	Moist; reddish brown (5YR 4/3) clay loam; strongly developed medium nut with crumb structure; friable; firm <i>in situ</i> ; slightly sticky; abundant fine and medium fibrous roots; abundant casts; few fine strongly weathered gravels; indistinct smooth boundary,
bAh	9-40 cm (31 cm)	Moist; dark reddish brown (5YR 3/2) clay loam; weakly developed coarse blocky structure breaking to moderate to strongly developed fine and medium nut structure; friable firm <i>in situ</i> ; slightly sticky; thin clay cutans to worm channels; many casts; many fine and medium fibrous roots; few strongly weathered stones; indistinct smooth boundary,
bBt	40-100cm (60 cm)	Moist; dark reddish brown (5YR 3/4) gritty clay; weakly developed fine blocky tending massive structure breaking to single grain; very friable; slightly sticky; thin clay cutans to relict root channels; abundant fine fibrous roots; few casts; many strongly weathered stones.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Hafhafu series**

REFERENCE: New soil series introduced in the soil survey of Rotuma Island (Laffan & Smith, 1986) and defined as somewhat excessively drained soils formed from basaltic aa lavas and minor basaltic ash on the volcanic ringplains.

Profiles have stony sandy loam A horizons with abundant stones/boulders overlying stony loamy sand B horizons with abundant to profuse stones and boulders.

Name derived from the Rotuman word for extremely stony soils with some fine material.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Udic Vitric Hapludand, ashy-skeletal, isohyperthermic
- (b) FAO: Vitric Andosol
- (c) Twyford and Wright: Latosolic soil with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Hafhafu soils, undulating phase (100B)  
Hafhafu soils, easy rolling phase (100C)  
Hafhafu soils, rolling phase (100D)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs extensively in the far western end, and in the eastern half of Rotuma Island.

PARENT ROCK: Basalt

PARENT MATERIAL: Weakly weathered *in situ* aa lavas and minor ash.

PHYSIOGRAPHIC POSITION/LANDFORM: Volcanic ringplains surrounding volcanic cones.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°) and rolling (12-15°).

VEGETATION AND LAND USE: Originally in indigenous forest, much of which has been cleared for coconut plantations. Some areas of undisturbed forest and in bush fallow. Minor areas utilised for food crops.

RANGE OF ELEVATION: 10-150 m

RAINFALL: Annual average range: 2,766-4,356 mm. Average 3,560 mm.

TEMPERATURE: Mean annual: 27°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat excessively drained.

PERMEABILITY CLASS: Rapid

FLOODING: Never floods

EROSION: No erosion risk.



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Profiles have moderately thick (15-20 cm), very dark grey, extremely stony and/or bouldery sandy loam A horizons that overlie dark brown extremely stony/bouldery loamy sand Bw horizons. Stones and boulders increase down the profile from abundant (35-75%) in A horizons to abundant to profuse (>75%) in Bw horizons.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	<p>Ututu series. Excessively drained, extremely stony and bouldery soils formed from basaltic aa lavas. Stones and boulders are profuse (&gt;75%) and generally comprise &gt;90% by volume. Negligible fine material (&lt;2 mm) throughout the profile (Laffan &amp; Smith, 1986).</p> <p>Kirikiri series. Somewhat excessive drained soils from aa lavas and basaltic ash. Stones and boulders are abundant (35-75%) in the control section.</p>
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Slightly acid soil with high phosphorus values but having very high P retention. Organic carbon and nitrogen values are high for the topsoil but drop progressively to low values below 60 cm. % base saturation is high in the topsoil but low in underlying horizons. The CEC is very high in the topsoil and drops progressively to medium values in the Bw2 horizon. Exchangeable calcium and magnesium are very high in the topsoil but medium to low at depth. The topsoil potassium values are low with very low values measured below 15 cm. Tamms oxalate extractable aluminium, iron and silica values are high.</p> <p>The particle size class is ashy-skeletal and the fine earth fraction is dominated by amorphous materials.</p>
LABORATORY Nos:	SB9715A-C
SOIL LIMITATIONS:	Severe to very severe physical limitations of shallow root depth, stoniness and low available water holding capacity. Like Kirikiri series likely to have nutrient deficiencies of nitrogen, phosphorus, potassium and sulphur.

## Typifying Profile

SOIL NAME: Hafhafu soils, flat to gently undulating phase.  
PROFILE No.: R30  
SITE LOCATION: Refer soil map of Rotuma (Laffan & Smith 1986). About 500 m SW of Oinafa Village and 50 m S of Oinafa-Hoa Road.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Volcanic ringplain surrounding volcanic cones. Mound surface - easy rolling country.  
PARENT MATERIAL: Basaltic aa lava and minor basaltic ash.  
SLOPE: 3°  
ASPECT: North-west  
ELEVATION: 10 m  
MICRORELIEF: Very uneven, with protruding boulders and stones.  
SITE VEGETATION: Coconuts and some citrus with ground creepers.  
LAND USE: Coconut plantation and minor citrus.  
DRAINAGE: Somewhat excessively drained.  
EROSION: None observed  
DISTURBANCE: Negligible  
LABORATORY Nos: SB9715A-C

### PROFILE DESCRIPTION

Ap	0-15 cm (15 cm)	Very dark grey (7.5YR 3/1) stony loam; moderately developed very fine and fine nut structure; non-sticky, non-plastic, very friable, uncemented, stiff consistence; abundant fine and medium roots; abundant weakly weathered subangular basalt stones; indistinct wavy boundary,
Bw1	15-58 cm (43 cm)	Dark brown (7.5YR 3/2) stony loam; moderately developed very fine and fine nut structure; non-sticky; non-plastic, very friable, uncemented, very stiff consistence; many fine and medium roots; abundant weakly weathered subangular basalt gravels, stones and boulders; diffuse boundary,
Bw2	58-100+ cm (42 cm+)	Dark brown (7.5YR 4/4) stony loamy sand; very weakly developed fine crumb structure breaking to single grain; non-sticky, non-plastic, loose, uncemented, very stiff consistence; few fine roots; abundant to profuse weakly weathered subangular gravels, stones and boulders.

NOTES: Reaction to NaF: Very strong and rapid in all horizons.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Kavula series**

REFERENCE: Kavula steepland bouldery clay(86a) and Kavula steepland bouldery brown clay (86b) defined by Twyford and Wright(1965) as formed from basalt, basic andesites, andesites and andesitic tuffs under forest and under a climate with a strong dry season.

Forms part of the Kavula set.

The central concept for Kavula soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Ustic Dystrypept, fine, kaolinitic, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Steepland soil related to or associated with humic latosols with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Kavula soils, strongly rolling phase (186E)
- Kavula soils, moderately steep phase (186F)
- Kavula soils, steep phase (186G)
- Kavula soils, very steep phase (186H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: They are found mainly in Macuata and the northern part of Bua province and are in the main forested. Kavula soils are of minor significance in Viti Levu.

PARENT ROCK: Basalt, basic andesite, andesite, and andesitic tuffs

PARENT MATERIAL: Strongly weathered *in-situ* rock

PHYSIOGRAPHIC POSITION/LANDFORM: Predominantly planar surfaces in all slope positions in strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Strongly rolling (16-20°), moderately steep (21 - 25°), steep (26 - 35°), and very steep (35 - 40°).

VEGETATION AND LAND USE: Originally under forest. Used for subsistence crops and good crops of yam and dalo are produced in the first year, then kumala and cassava for two to three years after that. They are then allowed to revert under fallow but forest doesn't regenerate easily and much of these soils is gradually being replaced in its cover by reeds used for extensive forestry and in some areas planted out in *pinus caribaea*.

RANGE OF ELEVATION: 20-600m

RAINFALL: Annual average range: 1,800-2,800mm;  
dry season range: 400-600 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY:	Moderate
FLOODING:	Never floods
EROSION:	Severe sheet and rill erosion potential.

### **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 25cm of dark reddish brown friable clay loam, of moderate fine and medium nut structure overlying 60cm of yellowish red friable silty clay, of fine blocky structure and commonly with stones and boulders on at least 20cm of yellowish red firm gravelly silty clay, of massive structure and with stones and boulders.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Kavula series have a A, Bw, (Bt), BC horizon sequence. The A horizon thickness ranges from 15 to 30cm; its colours include dark greyish brown (10YR4/2) dark brown(7.5 YR4/2), very dark grey (5YR2/1) and dark reddish brown (5YR8/2); textures are clay, clay loam or stony clay; consistence friable or firm; and structures moderate or strong medium; fine or coarse blocky or nut.</p> <p>The Bw horizon thickness ranges from 15 to 60cm; its colours include yellowish red (5YR 4/8,5/8), dark reddish grey(5YR 4/2) and (7.5YR5/4); textures are clay, clay loam or silty clay and commonly stony; consistence may be friable or firm; and structures are weak, moderate or strong fine or medium blocky.</p> <p>The BC horizon may be encountered between 50 and 100cm; its colours include yellowish red (5YR 5/8,4/8), red (2.5 YR 4/8,5/8) or light brown(7.5YR 6/4) and commonly vari coloured; and textures are stony, gravelly or rubbly clay, clay loam or silty clay.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be moderately acid in the topsoil (0 - 37cm) and strongly acid in the horizon below it; organic carbon is low 0-14cm and very low below 14cm; nitrogen is low 0-37cm and very low below 37cm; very low available phosphorous and medium phosphate retention values; % base saturation is medium 0 -37cm and low in the other horizon; CEC is medium 0-14cm and medium below 14cm; exchangeable calcium is medium 0 -14cm, low 14 - 37cm, and very low below 37cm; magnesium is very high 0 -63cm and remains high below 63cm; and potassium is high 0 -14cm, medium 14-37cm and below 37cm depth.</p> <p>The family particle size class is fine clayey.</p> <p>The mineralogy class is kaolinitic.</p>
LABORATORY NOS:	USP ND 20A - E
SOIL LIMITATIONS:	Generally shallow profiles; slope; severe erosion hazard; severe soil moisture deficits in the dry season; soil acidity; and nutrient deficiencies of phosphorous and nitrogen.

## Typifying Profile

SOIL NAME: Kavula soils, steep phase.  
PROFILE NO: ND 20  
SITE LOCATION: Masi catchment, Nadi Forest.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar backslope in strongly dissected hill country.  
SLOPE: 29°  
ASPECT: West  
ELEVATION:  
MICRORELIEF: Uneven  
SITE VEGETATION: Dense mission grass, karuka fern and *P. Caribaea*.  
LAND USE: Exotic forestry  
DRAINAGE: Well drained  
EROSION: None  
DISTURBANCE: None  
LABORATORY Nos.: USP ND 20A - E

### PROFILE DESCRIPTION

Kavula soils, steep phase

Ah1	0-14cm (14 cm)	Moist; dark reddish brown(5YR 3/2) clay loam; moderately developed fine and medium nut structure; friable; many fine fibrous roots; distinct smooth boundary,
Ah2	14 - 37cm (23 cm)	Moist; dark reddish brown(5YR 3/4) clay loam; moderately developed fine nut with weak fine blocky structure; friable; many moderately weathered subangular stones; many fine fibrous roots; distinct smooth boundary,
Bw	37 - 63cm (26 cm)	Moist, yellowish red (5YR 5/8) silty clay; weakly developed fine blocky structure; friable; slightly sticky; slightly plastic; common strongly weathered subrounded stones; common fine fibrous roots; indistinct smooth boundary,
Bt	63 - 93cm (30 cm)	Moist; yellowish red (5YR 4/8) silty clay; strongly developed fine blocky structure; friable; slightly sticky; slightly plastic; common fine yellowish red (5YR 4/6) clay cutans, few fine fibrous roots; few strongly weathered subrounded stones; distinct smooth boundary,
BC	93 - 111cm (18 cm)	Moist; yellowish (5YR 4/8) gravelly silty clay; massive structure; firm; slightly sticky; slightly plastic; many weakly weathered subrounded stones; few fine fibrous roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Kedra series**

REFERENCE: Kedra sandy clay loam (53a) defined by Twyford & Wright (1965) as a moderately mottled, weakly gleyed soil formed on alluvium of high quartz content derived from acid rocks under a climate with a strong to moderate dry season.

Forms part of the Kedra set.

The central concept for Kedra soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Aerlic Tropaquept, fine, kaolinitic, isohyperthermic
- (b) FAO: Destric Gleysol
- (c) Twyford and Wright: Gley soil related to red yellow podzolic soils with a strong to moderate dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Kedra soils (65)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Northern eastern Vanua Levu and to a limited extent in Kadavu Island.

PARENT ROCK: Acid rocks

PARENT MATERIAL: Deep moderately weathered alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Alluvial bottom lands.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-1°).

VEGETATION AND LAND USE: Formerly supported high forest with abundant vusavusa and cibicibi (*Pterocarpus indicus*) but are now largely cleared and used for dalo gardens and rice with scattered coconuts. Sugar cane is grown.

RANGE OF ELEVATION: 2-10 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Slow

FLOODING: One in 20 year return period for floods depositing alluvium. Two in one year return period for other floods. Water table high in the profile during the wet season.

EROSION: No erosion risk.



## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 23 cm of very dark brown friable sandy clay loam, of strong medium nut structure overlying 18 cm of very dark brown firm to friable sandy clay of moderate coarse and medium blocky structure and slightly mottled dark grey on 50 cm or more of dark reddish brown firm clay of massive structure when wet and weak coarse blocky when dry and strongly mottled yellowish red and dark grey.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Not analysed but considered to have a moderately acid reaction and of low to moderate base status. Available phosphorus is expected to be low.
LABORATORY Nos:	Not sampled for analysis.
SOIL LIMITATIONS:	High seasonal water table; clayey textures; slow permeability; poor internal drainage; frequency of flooding; soil moisture deficits during the dry season; and nutrient deficiency of phosphorus.

## Typifying Profile

SOIL NAME: Kedra soils  
PROFILE No.: DK43  
SITE LOCATION: 5 km northeast of Labasa.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar valley floor.  
PARENT MATERIAL: Moderately weathered alluvium from acidic rocks.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 2 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Fallow after rainfed rice.  
LAND USE: Rice cultivation  
DRAINAGE: Poorly drained. Water table at 65 cm.  
EROSION: None observed  
DISTURBANCE: Cultivated  
LABORATORY Nos: Not sampled

### PROFILE DESCRIPTION

Ap	0-23 cm (23 cm)	Moist; very dark brown (10YR 2/2) sandy clay loam; strongly developed medium nut structure; friable; slightly sticky; common fine fibrous roots; indistinct smooth boundary,
Apg	23-40 cm (17 cm)	Moist; very dark brown (10YR 2/2) sandy clay; few fine dark grey (10YR 4/1) mottles; moderately developed medium and coarse blocky structure; firm to friable; sticky; plastic; few fine fibrous roots; distinct smooth boundary,
BCr	40-90 cm (50 cm+)	Wet; dark reddish brown (5YR 3/4) clay; abundant distinct yellowish red (5YR 5/6) and dark grey (10YR 4/1) mottles; massive; soft; sticky; very plastic.



# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Keiyasi series**

REFERENCE: Keiyasi steepland stony and bouldery clay (69) defined by Twyford & Wright (1965) as developed from marls and calcareous tuffs under a climate with a moderate dry season.

The defined physical and chemical properties are retained in this survey as the central concept for Keiyasi series but the climate under which these soils occur is now restricted to the ustic moisture regime.

### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Haplustoll, fine, smectitic, isohyperthermic
- (b) FAO: Haplic Kastanozem
- (c) Twyford and Wright: Nigrescent soil with a strong dry season

### INCLUDED MAPPING UNITS AND SYMBOLS:

Keiyasi soils, easy rolling phase (113C)	Keiyasi soils, moderately steep phase (113F)
Keiyasi soils, rolling phase (113D)	Keiyasi soils, steep phase (113G)
Keiyasi soils, strongly rolling phase (113E)	Keiyasi soils, very steep phase (113H)

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Keiyasi soils are very widely developed in Ra, Nadroga and Novosa areas of Viti Levu.

PARENT ROCK: Calcareous tuffs and marls.

PARENT MATERIAL: Weak to moderately weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Convex and planar hill slopes in moderate and strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling through all slope classes to very steep (8-38°).

VEGETATION AND LAND USE: Used for subsistence root crops followed by 5 years grass fallow; areas have been planted out in *Pinus caribaea*; and elsewhere mainly rough grazing

RANGE OF ELEVATION: 30-450 m

RAINFALL: Annual average range: 1,800-28,00 mm;  
dry season range: 400-600 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean Annual: 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Moderate and severe rill and sheet erosion potential. Also slight to moderate soil slip and shallow debris slide potential.

## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

Typically shows 20 cm of black friable silty clay loam of moderate fine nut and granular structure and commonly with a few weathered stones, overlying 15 cm of dark greyish brown friable silty clay loam, of moderate nut and granular structure which overlies 30 cm light olive brown mottled strong brown firm clay loam, of massive structure breaking to weak coarse blocky and commonly with clay /organic cutans to ped faces, overlying more than 30 cm of yellowish brown mottled strong brown firm sandy clay loam, massive and with rock structures preserved.

### DIAGNOSTIC HORIZONS:

Mollic epipedon, cambic horizon.

### RANGE OF PROFILE FEATURES:

Keiyasi series have an Ap(Ah), Bt(Bw), BC horizon sequence.

The Ap1(Ah) horizon thickness ranges from 10-25 cm; its colours include black (10YR 2/1), very dark brown (10YR 2/2) very dark grey (10YR 3/1), very dark greyish brown (10YR 3/2) and dark brown (10YR 3/3); textures are clay, clay loam or silty clay loam; and structures are moderate or strong, fine or medium nut or blocky.

The Ap2 horizon thickness ranges from 10-20 cm; its colours include those described for the A1; textures are clay, clay loam or silty clay loam; and structures are weak or moderate, fine or medium nut or blocky.

The Bt or BW horizon thickness ranges from 20-35 cm; its colours include light olive brown (2.5Y 5/4, 5/6) dark yellowish brown (10YR 3/4, 4/4), brown (10YR 4/3, 5/3) and dark greyish brown (10YR 4/2); textures are clay, clay loam or silty clay loam; and structures are massive breaking to weak or moderate, fine or medium, blocky or nut; and there may be weak cutans present or not. Stones may be few, common or many in all horizons.

### VARIANTS:

None recognised

### SIMILAR SOILS AND

### DISTINGUISHING FEATURES:

None recognised

### GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:

Analysis shows the soil to be strongly acid in the topsoil (0-20 cm) and moderately acid in the other horizons; organic carbon and nitrogen are low in the topsoil and of low values below this; very low available phosphorus; CEC values are high throughout; % base saturation is high 0-37 cm and very high in the other horizons; exchangeable calcium is high; magnesium extremely high and potassium very low.

The particle size family class is fine.

The mineralogical class is smectitic.

### LABORATORY Nos:

KRS V179-182

### SOIL LIMITATIONS:

Profile shallowness; slope; moderate to severe soil moisture deficits experienced during the dry season; potential soil erosion risk; soil acidity; and nutrient deficiencies of potassium, phosphorus and nitrogen.

## Typifying Profile

SOIL NAME: Keiyasi soils, moderately steep phase.

PROFILE No.: AP03

SITE LOCATION: Yalavou cattle range, Nadroga Province.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar backslope in strongly rolling country.

PARENT MATERIAL: Moderate weathered in situ tuffaceous rocks of basic or intermediate composition.

SLOPE: 26°

ASPECT: West

ELEVATION: 120 m

MICRORELIEF: Even

SITE VEGETATION: Mission grass and Desmodium pasture with scattered shrubs (Drala) plus miscellaneous weeds (Blue ratstail, Japanese tea, goat weed).

LAND USE: Cattle grazing

DRAINAGE: Well drained

EROSION: None

DISTURBANCE: None

LABORATORY Nos: KRS V179-182

### PROFILE DESCRIPTION

Ap1	0-20 cm (20 cm)	Slightly moist; black (10YR 2/1) silty clay loam; moderately developed fine nut structure plus moderate fine granular structure; friable; slightly sticky; slightly plastic; many very fine and fine roots; few strongly weathered subrounded stones; indistinct smooth boundary,
Ap2	20-37 cm (17 cm)	Slightly moist; 60% very dark greyish brown (10YR 3/2) and 40% dark greyish brown (2.5Y 4/2) silty clay loam; weak to moderately developed fine and medium nut structure plus weak medium granular structure; friable; slightly sticky; slightly plastic; common fine and very fine roots; common fine and very fine roots; common strongly weathered subrounded stones; distinct smooth boundary,
Bw	37-65 cm (28 cm)	Moist, light olive brown (2.5Y 5/4) clay loam; common fine distinct strong brown (7.5YR 5/8) mottles; massive breaking to weakly developed coarse blocky structure; firm; sticky; plastic; few faint dark greyish brown (10YR 4/2) clay/organic coatings; few very fine roots; sharp wavy boundary,
BC	65-100 cm (35 cm)	Slightly moist; yellowish brown (10YR 5/6) sandy clay loam; many medium distinct strong brown (7.5YR 5/8) mottles; massive with rock structure preserved; firm.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Kelikoso series**

REFERENCE: Kelikoso clay and gravelly clay (41a) defined by Twyford & Wright (1965) as colluvial soils forming under a climate with a strong dry season on flattish land with a parent material derived from quartzose tuffs.

Forms part of the Kelikoso set and is a colluvial derivative of Wainikoro clay and sandy clay (42b).

The central concept for Kelikoso soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Kandic Paleustalf, fine, ferruginous, isohyperthermic
- (b) FAO: Eutric Planosol
- (c) Twyford and Wright: Red yellow podzolic with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Kelikoso soils, flat to gently undulating phase (145A)
- Kelikoso soils, undulating phase (145B)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Kelikoso soils are confined to small patches in western Viti Levu. They are more extensive in Vanua Levu where they occur in association with Wainikoro soils on adjacent land of flattish to undulating relief.

PARENT ROCK: Tuffaceous rocks of acidic composition.

PARENT MATERIAL: Strongly weathered colluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Planar valley bottoms, coalescing fans and toeslopes in rolling to flattish land.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°) and undulating (4-7°).

VEGETATION AND LAND USE: Sugar cane, some areas in pulses and rainfed rice. A small area under light forest.

RANGE OF ELEVATION: 15-150 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Slight to moderate sheet and rill erosion, under cultivation and slopes >2°.



## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of dusky red clay loam, of strongly developed fine nut and granular structure, and very friable, overlying 10 cm of reddish brown clay, of moderately developed medium blocky structure, friable, slightly sticky when moist, with dark reddish brown organic coatings to peds, overlying 50 cm of red clay, of moderately developed coarse blocky structure, firm, and with clay cutans to peds, overlying more than 30 cm of dark red clay, of weakly developed coarse blocky structure, friable, and slightly sticky.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analyses show moderately acid pH; carbon and nitrogen with low values in the surface horizon and very low below; available phosphorus is very low; % base saturation is very high throughout the profile; CEC and exchangeable calcium are medium 0-28 cm and very low below; exchangeable magnesium is high and potassium very low throughout the profile.
LABORATORY Nos:	USP NB5A-D
SOIL LIMITATIONS:	Severe soil moisture deficits during the dry season; slight to moderate sheet and rill erosion potential on slopes $>2^\circ$ under cultivation; moderate acidity and nutrient deficiencies of phosphorus, nitrogen and potassium.

## Typifying Profile

SOIL NAME: Kelikoso soils, undulating phase.  
PROFILE No.: NB5  
SITE LOCATION: P74/II/16 Nabou Forest, Nadroga Province.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar valley bottom surface in moderately dissected hill country. Narrow long and sinuous underfit valley.

PARENT MATERIAL: Colluvium with some 'old' alluvium derived from rocks predominantly of acid composition.

SLOPE: 4°, length 200 m

ASPECT: East

ELEVATION: 120 m

MICRORELIEF: Flat

SITE VEGETATION: Ground cover of guava (2 m), mission grass and Tobacco weed under 8 year old *Pinus caribaea*.

LAND USE: Exotic forestry

DRAINAGE: Moderately well drained.

EROSION: Slight sheet erosion.

DISTURBANCE: None

LABORATORY Nos: USP NB5A-D

### PROFILE DESCRIPTION

Kelikoso soils, undulating phase

Ah	0-17 cm (17 cm)	Slightly moist; moist and rubbed, dusky red (2.5YR 3/2) clay loam; strongly developed fine nut structure with strong fine granular structure; very friable; non-sticky; non-plastic; common medium and coarse roots; indistinct smooth boundary,
AB	17-28 cm (11 cm)	Slightly moist; moist; reddish-brown (5YR 4/4) and rubbed dark reddish brown (5YR 3/3) clay; moderately developed medium blocky structure plus some strong fine granular structure; friable; slightly sticky; non-plastic; many faint dark reddish-brown (5YR 3/4) organic coatings; few fine roots; indistinct smooth boundary,
Bt	28-78 cm (50 cm)	Slightly moist; moist red (2.5YR 4/6) and rubbed, dark red (2.5YR 3/6) clay; moderately developed coarse blocky structure; firm; slightly sticky; non-plastic; many distinct yellowish red (5YR 4/6) clay skins; few medium roots; diffuse smooth boundary,
Bw	78-108 cm+ (30 cm+)	Slightly moist; moist and rubbed dark red (2.5YR 3/6) clay; massive breaking to weakly developed coarse; blocky structure; friable; slightly sticky; non-plastic; abundant charcoal flecks; few medium roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Kirikiri series**

REFERENCE: New soil series introduced in the soil survey of Rotuma Island (Laffan and Smith, 1986) and defined as somewhat excessively drained soils formed from basaltic aa lavas and basaltic ash. Profiles have stony loam textures throughout, with stones/boulders increasing with depth from common or many in A horizons to abundant in B horizons.

Name derived from the Rotuman word for stony soils with appreciable fine material.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Hydric Hapludand, hydrous-skeletal, isohyperthermic
- (b) FAO: Ochric Andosol
- (c) Twyford and Wright: Latosolic soil with no dry season.

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Kirikiri soils, flat to gently undulating phase (99A)  
Kirikiri soils, undulating phase (99B)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs mainly in the northern parts of Rotuma Island.

PARENT ROCK: Basalt

PARENT MATERIAL: Weakly weathered *in situ* aa lava and ash.

PHYSIOGRAPHIC POSITION/LANDFORM: Volcanic ringplains surrounding the volcanic cones.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°) and undulating (4-7°).

VEGETATION AND LAND USE: Originally indigenous forest which has been cleared for food and cash crops, including coconuts, dalo, cassava, bananas and minor citrus. Some areas bush fallow.

RANGE OF ELEVATION: 10-150 m

RAINFALL: Annual average range: 2,766-4,356 mm; average 3,560 mm

TEMPERATURE: Mean annual: 27°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat excessively drained.

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: No erosion

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	A relatively thick (20-25 cm) dark brown, very friable, stony or bouldery loam A horizon overlies brown, very stony or bouldery loam or sandy loam B horizons. Stones (boulders) increase down the profile from common (5-15%) or many (15-35%) in A horizons to abundant (35-75%) in subsoils.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Kirikiri series have a Ap, Bw1, Bw2, horizon sequence.</p> <p>The A horizon thickness ranges 12-25 cm; colours are dark brown (10YR 3/3, 7.5YR 3/2), black (7.5YR 2/0), very dark grey (10YR 3/1) and very dark greyish brown (10YR 3/2); textures may be gravelly loam, stony silt loam, loam, or stony fine sandy loam; stones may be many or common; and structures nutty or granular.</p> <p>The Bw1 horizon thickness ranges 10-78 cm; colours are dark yellowish brown (10YR 3/4, 4/4), dark brown (7.5YR 3/2, 4/4, 3/3) or rarely red (2.5YR 4/6); textures may be loam, stony loam, stony fine sandy loam, or stony sandy loam; and stones many common, many or abundant.</p> <p>The Bw2 horizon thickness ranges 35-75 cm; colours are dark yellowish brown (10YR 3/4, 3/6) or strong brown (7.5YR 4/6-5/6); textures may be stony or bouldery loams, fine sandy loam, or bouldery sandy loam; blocky structure are either weak or moderately developed; and stones are either many or abundant.</p>
VARIANTS:	Kirikiri series, moderately deep variant. Profiles have relatively massive basalt at depths between 50-100 cm.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	<p>Hafhafu series: Somewhat excessively drained soils formed from basaltic aa lavas and minor basaltic ash, have higher stone/boulder content (profuse stones in subsoil) and fine minerals (&lt;2 mm) are coarser (sandy loams, loamy sands).</p> <p>Sumi series: Well drained soils formed from basaltic ash and basaltic aa lavas, have common to many (5-35%) basalt stones/boulders throughout the profile (Laffan &amp; Smith, 1986).</p>
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Slightly acid soils having neutral soil reaction in the subsoils. Organic carbon values are high in the A horizons, medium in the Bw1 and low below 50 cm. Phosphorus values are very high but P retention is extremely high. The CEC values are very high with % base saturation high in the A horizons and low in the other horizons (40-50%). Exchangeable calcium and magnesium values are very high in the top 50 cm and high below this. Potassium is medium in the A but very low values in all other horizons. The profile size class is thixotropic-skeletal and the fine earth fraction dominated by amorphous materials.
LABORATORY Nos:	SB9710A-E
SOIL LIMITATIONS:	Moderate to severe physical limitations of stoniness and low available water holding capacity. Glasshouse pot trials indicate moderate to severe deficiency of nitrogen and phosphorus and slight deficiency of potassium and sulphur.

## Typifying Profile

SOIL NAME: Kirikiri soils, flat to gently undulating phase.  
PROFILE No.: R3  
SITE LOCATION: Refer soil map of Rotuma (Laffan & Smith 1986). North-central part of Rotuma (Malhaha District) between airstrip and Solhefu peak.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Volcanic ring plain surrounding volcanic cones. Easy rolling surface. Few medium surface boulders.  
PARENT MATERIAL: Weakly weathered basalt fragments and boulders and some basaltic volcanic ash.  
SLOPE: Level  
ASPECT: Not applicable  
ELEVATION: 30 m  
MICRORELIEF: Slightly uneven with protruding stones and boulders.  
SITE VEGETATION: Bush, Vau (hibiscus) and fern, i.e. regenerating forest species.  
LAND USE: Bush fallow  
DRAINAGE: Somewhat excessively drained.  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: SB9710A-E  
COMMENTS: Reaction to NaF. Moderate in Ap; strong in Bw1 and Bw2 horizons.

### PROFILE DESCRIPTION

Kirikiri soils, flat to gently undulating phase

Ap	0-22 cm (22 cm)	Dark brown (7.5YR 3/2) stony silt loam; moderately developed very fine to fine nutty structure breaking to weakly developed very fine crumb structure; slightly sticky, slightly plastic, very friable, moderately firm, semi-deformable, uncemented, soft consistence; many weakly weathered angular basalt stones; abundant fine and medium roots; distinct wavy boundary,
Bw1	22-50 cm (28 cm)	Dark yellowish brown (10YR 3/4) stony loam; moderately developed fine blocky structure breaking to weakly developed very fine crumb structure; non-sticky, non-plastic, very friable, semi-deformable, uncemented, soft consistence; abundant weakly weathered angular basalt stones and boulders; many fine and medium roots; diffuse boundary,
Bw2	50-122+ cm (72 cm+)	Dark yellowish brown (10YR 3/4) bouldery sandy loam; moderately developed fine blocky structure breaking to weakly developed very fine crumb structure; non-sticky, non-plastic, very friable, semi-deformable, uncemented, soft consistence; abundant weakly weathered angular basalt stones and boulders; few fine and medium roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Koro series**

REFERENCE: Koro steepland stony and bouldery clay (80c) defined by Twyford & Wright (1965) as a latosolic soil from 'slightly older olivine basalt flows' formed under a climate with a weak dry season.

Forms part of the Ravilevu set.

The central concept of Koro soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Eutropept, fine-silty, halloysitic, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Steepland soil related to or associated with latosolic soils with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Koro soils, steep phase (94G)
- Koro soils, very steep phase(94H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occur on the west coast of Taveuni Island in close association with Taveuni soils from Nasinu Estate in the south to Mua Estate in the north, and in many areas fringing the central plateau on Koro Island.

PARENT ROCK: Olivine basalt

PARENT MATERIAL: Moderately weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: On steeper terrain of the lava surfaces fringing the volcanic centre of Taveuni.

SLOPE CLASS AND RANGE OF SLOPES: Steep (26-35°) and very steep (>35°).

VEGETATION AND LAND USE: Areas used for coconuts but majority under forest. Small areas cleared for subsistence crops and cocoa.

RANGE OF ELEVATION: 0-600 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean Annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Severe sheet and rill erosion potential for forest cleared and soil bared or intensively cultivated .



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 12 cm of very dark brown very friable silty clay of strong fine and medium nut structure overlying 15 to 20 cm of dark brown friable silt loam of moderate fine and medium nut structure commonly with subangular basalt stones overlying 70 cm or more of weathered fine grained and jointed basalt on hard basalt at about 100 cm depth.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Koro series have an Ah, Bw, C horizon sequence.</p> <p>The Ah horizon thickness ranges from 12 to 35 cm; its colours include very dark brown (10YR 2/2) and very dark greyish brown (10YR 3/2); textures are silty clay or clay; consistence friable or very friable; structures are strong fine or medium nut; and there may be none, few or common stones.</p> <p>The Bw horizon thickness ranges from 15 to 40 cm; its colours include dark yellowish brown (10YR 3/4, 4/4) and dark brown (10YR 3/3, 7/5YR 3/2); consistence friable or very friable; textures include silt loam, silty clay or clay (commonly all stony); and structures are moderate or strong fine or medium nut or blocky.</p> <p>On greyish or/and reddish, brown weathering basalt.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be moderately acid in the topsoil (0-13 cm) and near neutral below this; organic carbon and nitrogen have medium values in the topsoil and very low values below it; C/N ratios are medium; % base saturation is medium; CEC and TEB have high values in the topsoil and are medium below; calcium and magnesium have high values in the topsoil and medium values below; and potassium is very high in the topsoil and very low below this.</p> <p>The particle size family class is fine-silty.</p> <p>The mineralogical class is halloysitic.</p>
LABORATORY Nos:	ORSTOM TAV47A-B
SOIL LIMITATIONS:	Slope; susceptibility to erosion when forest cleared; moderately rapid permeability; nutrient deficiencies of potassium and nitrogen and possibly phosphorus.

## Typifying Profile

SOIL NAME: Koro soils, steep phase.  
PROFILE No.: TAV47  
SITE LOCATION: 1 km inland from (due east) of Somosomo Village, Taveuni Island.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar midslope (length 200 m) in weakly dissected steep land.  
PARENT MATERIAL: Moderately weathered *in situ* basalt.  
SLOPE: 28°  
ASPECT: West  
ELEVATION: 300 m  
MICRORELIEF: Uneven. 20% boulders on surface.  
SITE VEGETATION: Indigenous forest comprising Damanu, Yasiyasi, Mali, Vesi and Yaro.  
LAND USE: Unused (natural state)  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: ORSTOM TAV47A-B

### PROFILE DESCRIPTION

Ah	0-13 cm (13 cm)	Moist; very dark brown (10YR 2/2) silty clay; strongly developed fine and medium nut structure; very friable; plastic; many fine and medium fibrous roots; distinct smooth boundary,
Bw	13-30 cm (17 cm)	Moist; dark brown (7.5YR 3/2) silt loam; moderately developed fine and medium nut structure; friable; slightly sticky; plastic; common subangular basalt stones; common fine and medium coarse roots; distinct irregular boundary,
C	30-100 cm (70 cm)	Dry; grey weathered <i>in situ</i> fine grained basalt rock; jointed.
	on	Hard basalt.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Korokadi series**

REFERENCE: New soil series introduced in this survey to include strongly weathered colluvial soils derived from basic rocks developed on toeslope and underfit broad valley floors on plateaux with a talasiga vegetation under a climate with a strong dry season.

Previously included with Namosau soils(36) as defined by Twyford and Wright (1965). Named from Korokadi settlement, Bua Province, Vanua Levu.

CLASSIFICATION:

- (a) Soil Taxonomy: Anionic Acrustox, clayey, ferruginous, isohyperthermic
- (b) FAO: Rhodic Ferralsol
- (c) Twyford and Wright: Ferruginous latoso, with a strong dry season

INCLUDED MAPPING UNITS AND PHASES:

- Korokadi soils, flat to gently undulating phase (42A)
- Korokadi soils, undulating phase (42B)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Korokadi soils occur in association with Namosau soils on high terrace remnants behind Nadi, Lautoka and Ba in Viti Levu. They are of limited area in Vanua Levu.

PARENT ROCK: Basalts and basic andesites.

PARENT MATERIAL: Deep strongly weathered colluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Gently concave broad valley floors and planar toeslopes in gently undulating and rolling weakly dissected plateaux.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0 -3<sup>o</sup>) and undulating (4 - 7<sup>o</sup>).

VEGETATION AND LAND USE: Normally supports a talasiga vegetation of ferns and nokonoko. With fertilizer inputs are used for sugarcane, rainfed rice and pulses.

RANGE OF ELEVATION: 20-200 m

RAINFALL: Annual average range: 1,500-2,000 mm;  
dry season range: 400-500 mm;  
wet season range: 1,200-1,600 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY: Moderately rapid

FLOODING: In normal years may flood up to 3 - 4 days on 4-5 occasions during the wet season and associated with high intensity storms.

EROSION: Accumulating site

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 25cm of very dark greyish brown friable gravelly silt loam of moderate fine nut and crumb structure, with many subangular ironstone gravels, overlying 55cm of light olive brown firm gravelly clay loam, of weak medium blocky breaking to crumb, and again with many subangular ironstone gravels, overlying 50cm of yellowish brown friable clay loam, of weak fine blocky structure breaking to single grain on 30cm or more of yellowish brown firm mottled red gritty clay loam, of weak medium blocky structure with iron concretions and a discontinuous iron pan.
DIAGNOSTIC HORIZONS:	Mollic epipedon, oxic horizon.
TYPIFYING PROFILE:	NLDC01
RANGE OF PROFILE FEATURES:	Not applicable. Only three profile descriptions made (including the described variant).
VARIANTS:	Well drained variant without an iron pan at depth (though still red mottled) with redder hues occurs on lower midslope position.  (Profile description attached - NLDC 02 Q - DPI 11707 - 11710)
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be very strongly acid in the topsoil (0 - 27cm) strongly acid below 27cm depth and of variable charge; organic carbon values are high in the topsoil and below it; Total phosphorous values are high throughout; TEB and CEC values are very low in all horizons as are all the bases; the high % base saturation values are irrelevant in view of the extremely low CEC; and % aluminium saturation is significant in the exchange complex.
LABORATORY NOS:	Q.DPI 11703 - 11706
SOIL LIMITATIONS:	Moderately rapid permeability; short duration flooding during the wet season; severe soil moisture deficits experienced during the dry season; strong soil acidity; variable charge; aluminium toxicity; and a very low nutrient reserve that would rapidly be depleted under a cropping regime.

## Typifying Profile

NAME: Korokadi soils  
PROFILE NO: NLDC 01  
LABORATORY NO: QPI 11703-11706  
SITE LOCATION: NLDC pigeon pea estate, Nasarowaqa, Bua Province, Vanua Levu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Concave-planar toeslope on a slope of 100m length in a weakly dissected plateau.  
PARENT MATERIAL: Deep strongly weathered colluvium of basic composition.  
SLOPE: 2°  
ASPECT: South  
ELEVATION: 45 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Pigeon pea (4 weeks old).  
LAND USE: Intensive mechanised pigeon pea cultivation.  
DRAINAGE: Moderately well drained (water ponds during the wet season).  
EROSION: Accumulating site  
DISTURBANCE: Cultivated  
COMMENTS: Abundant surface iron/manganese concretions and nodules.  
LABORATORY Nos: Q.DOI 11703 - 11706

### PROFILE DESCRIPTION

Ap	0-27 (27cm)	Dry; very dark greyish brown (10 YR 3/2) gravelly silt loam; moderately developed fine nut structure with moderate fine crumb structure; friable; slightly sticky; non-plastic; few, fine roots; many unweathered subangular ironstone gravels; sharp smooth boundary,
Bw1	27-82cm (55cm)	Slightly moist; light olive brown (2.5Y 5/6) and rubbed olive brown (2.5 Y 4/4) gravelly clay loam; weakly developed medium blocky structure breaking to moderately developed fine crumb structure; firm; slightly sticky; non plastic; no roots; many, unweathered subangular ironstone gravels; diffuse smooth boundary,
Bw2	82-129cm (47cm)	Slightly moist; yellowish brown (10YR 5/6) clay loam; weakly developed fine blocky structure breaking to single grain; friable; slightly sticky; non-plastic; no roots; indistinct smooth boundary,
BC	129-159cm+ (30+cm)	Slightly moist; yellowish brown (10 YR 5/8) gritty clay loam; many, medium and coarse prominent red (10 R 4/6) iron mottles; weakly developed medium blocky structure; firm; sticky; non-plastic; discontinuous iron/manganese pan; no roots; horizon includes both soft Fe/Mn mottles plus hardened (concretions) mottles.

## Typifying Profile

NAME: Korokadi, variant  
PROFILE NO: NLDC 02  
LABORATORY NO. Q.DOI 11707 - 11710  
SITE LOCATION: NLDC pigeon pea estate, Nasarowaqa, Bua Province, Vanua Levu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar lower midslope position on 150m slope on a weakly dissected plateau.  
PARENT MATERIAL: Strongly weathered colluvium of basic composition.  
SLOPE: 3°  
ASPECT: South  
ELEVATION: 42 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Pigeon pea (4 weeks old).  
LAND USE: Intensive mechanised pigeon pea cropping.  
DRAINAGE: Well drained  
EROSION: Past sheet erosion.  
DISTURBANCE: Cultivated  
LABORATORY Nos: Q.DPI 11707 - 11710

### PROFILE DESCRIPTION

Ap	0-30cm (30cm)	Dry; black(10YR 2/1) gritty silt loam; strongly developed fine crumb structure with moderate fine nut structure; very friable; non-sticky; non-plastic; few fine roots; common weakly weathered subangular gravels; distinct, smooth boundary,
Bw1	30-61cm (31cm)	Slightly moist; dark yellowish brown (10 YR 4/4) and rubbed yellowish brown (10YR 5/6) gritty fine sandy clay; weakly developed fine blocky structure breaking to moderate fine crumb structure; friable; slightly sticky; non plastic; no roots; few weakly weathered subangular gravels; diffuse smooth boundary,
Bw2	61-134cm (73cm)	Slightly moist; strong brown to yellowish brown (7.5YR to 10 YR 5/6) and rubbed yellowish brown (10 YR5/6) gravelly silt loam; weakly developed fine blocky structure breaking to weak fine crumb structure; friable to firm; slightly sticky; non-plastic; no roots; many weakly weathered subangular gravels; indistinct smooth boundary,
BC	134-149+ cm (15+cm)	Slightly moist; yellowish-red to strong brown (5 YR to .5YR 5/6) and rubbed yellowish red (5 YR 5/8) gritty silt clay loam; many medium prominent red 2.5 YR 4/6 mottles; weakly developed medium blocky structure breaking to weak fine crumb structure; firm; slightly sticky; non plastic; no roots.

**Korokadi**

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Koromavu series**

REFERENCE: The Koromavu steepland gritty sandy clay (73) and Koromavu steepland gritty sandy clay, moderately steep phase (73M) defined by Twyford and Wright (1965) as shallow soils developed from silicified marls under a climate with a strong dry season. The name Koromavu series is retained in this survey for steepland soils with AC profiles (Entisols).

They form part of the Vanuavou set. The central concept for Koromavu soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Lithic Ustorthent, loamy-skeletal, mixed, isohyperthermic
- (b) FAO: Eutric Regosol
- (c) Twyford and Wright: Steepland soil related to or associated with nigrescent soils with a strong dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Koromavu soils, rolling phase (112D)	Koromavu soils, steep phase (112G)
Koromavu soils, strongly rolling phase (112E)	Koromavu soils, very steep phase (112H)
Koromavu soils, moderately steep phase (112F)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Koromavu soils develop in the strong dry season zone and are found in the Momi area of western Viti Levu.

PARENT ROCK: Silicified marls and sandstones.

PARENT MATERIAL: Weakly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Convex planar slopes in strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°), and very steep (>35°).

VEGETATION AND LAND USE: Where grazed and in improved pasture: nadi blue grass, wire grass, mission grass and desmodium. Where not grazed: inferior grasses, guava and scattered forest remnants.

RANGE OF ELEVATION: 20 to 750 m

RAINFALL: Annual average range: 1,500-2,000 mm;  
dry season range: 400-500 mm;  
wet season range: 1,200-1,600 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Rapid

FLOODING: Never floods



EROSION: Terracettes, some sheet erosion and shallow soil slips and debris slides.  
Severe soil creep, sheet, shallow soil slip and debris slide erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES: Dominantly shallow soils, with no B horizon and *in situ* rock is within 25 cm of the ground surface.

Thin (12 cm) dark topsoil with silt loam texture and with moderate to strong fine blocky structures.

Thin (20 cm) BC horizon with sandy textures and stony with weak to moderately weathered *in situ* rock (some profiles may have a paralithic contact).

DIAGNOSTIC HORIZONS: Ochric epipedon

RANGE OF PROFILE FEATURES: Koromavu series have Ah, C, R1, R2 horizon sequence.

The A horizon thickness ranges from 8 to 15 cm; its colours include very dark grey (10YR 3/1), very dark greyish brown (10YR 3/2) and dark brown (10YR 3/3); and structures are moderate medium nut or blocky.

The C horizon thickness ranges from 10 to 25 cm; its colours include olive brown (2.5Y 4/3, 4/4), light yellowish brown (2.5Y 6/4) and pale yellow (2.5Y 7/4); textures may be silt loam, fine sandy loam, medium sand or coarse sand; and stoniness is variable.

VARIANTS: None recognised

SIMILAR SOILS AND DISTINGUISHING FEATURES: Olo series - on flat ridge crest sites; profiles more stony, have paralithic or lithic contact, otherwise similar in most profile features (Leslie, 1984).

GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES: Slightly acid with very high base status; extremely high values for calcium and magnesium in all horizons; very high values for sodium; potassium and organic carbon are low in topsoils and very low in the C horizon.

The particle size family class is loamy-skeletal.

The mineralogical class is mixed.

LABORATORY Nos KRS R2671-72

SOIL LIMITATIONS: Profile shallowness; slope; very severe soil moisture deficits experienced during the dry season; severe potential erosion risk; and nutrient deficiencies of phosphorus, potassium and nitrogen.

## Typifying Profile

SOIL NAME: Koromavu soils, steep phase.  
PROFILE No.: N8  
SITE LOCATION: Refer soil map of Nawaicoba Agricultural Research Station (Leslie, 1984).

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Convex shoulder site on hill side in strongly dissected hill country.  
PARENT MATERIAL: Weak to moderately weathered *in situ* sandstone.  
SLOPE: 28°  
ASPECT: North-east  
ELEVATION: 230 m  
MICRORELIEF: Terracettes with 35 cm steps and 30 cm in width.  
SITE VEGETATION: Nadi blue grass and wire grass.  
LAND USE: Grazing for beef cattle.  
DRAINAGE: Moderately well drained.  
EROSION: Terracettes due to cattle grazing with small soil slips in some places.  
DISTURBANCE: None observed  
LABORATORY Nos: KRS R2671-2672

### PROFILE DESCRIPTION

Ah	0-10 cm (10 cm)	Dry; very dark greyish brown (10YR 3/2) silt loam; strongly developed fine blocky structure breaking to strong fine nut structure; slightly sticky; slightly plastic; very friable; uncemented; stiff penetration; common fine and very fine roots; few weakly weathered subangular gravels; distinct wavy boundary,
C	10-20 cm (10 cm)	Dry; variegated colours dominated by light yellowish brown (2.5Y 6/4), rubbed olive brown (2.5Y 4/4) coarse sandy loam; massive breaking to single grain; non-sticky; non-plastic; loose; uncemented; stiff penetration; common very fine roots; few moderately weathered subangular gravels; indistinct smooth boundary,
R1	20-40 cm (20 cm)	Dry; light yellowish brown (2.5Y 6/4) and olive brown (2.5Y 4/4) stony coarse sand; few very fine roots; profuse moderately weathered angular stones and gravels (fractured <i>in situ</i> rock); sharp boundary (lithic contact),
R2	on	Extremely hard, massive weakly weathered rock.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Koroniqala series**

REFERENCE: Koroniqala sandy clay (40d) and Koroniqala hill soils (40dH) defined by Twyford and Wright (1965) as formed from silicified materials on rolling and hilly land under talasiga vegetation.

Forms part of the Delainacau set.

The central concept for Koroniqala soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Haplustult, clayey, kaolinitic, isohyperthermic
- (b) FAO: Orthic Acrisol
- (c) Twyford and Wright: Red yellow podzolic soil with a moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Koroniqala soils, undulating phase (157B)

Koroniqala soils, rolling phase (157D)

Koroniqala soils, easy rolling phase (157C)

Koroniqala soils, strongly rolling phase (157E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Koroniqala soils are of restricted distribution, found mainly in the Kadavu group and the basins of the Waisali, Qalinabulu, Nadrou and Sabeto Rivers in North-west Viti Levu.

PARENT ROCK: Silicified marls, tufts, andesite etc.

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Gently convex slopes in rolling and hilly land

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Grassland of mission grass, reeds and fern but now widely under pine forests.

RANGE OF ELEVATION: 200-600 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY: Moderate

FLOODING: New floods

EROSION: Have experienced severe past erosion (are considered to be derived from Dogotuki soils by burning and erosion). Severe sheet and rill erosion potential.

**Koroniqala**

## **Morphological and Chemical Properties**

**CHARACTERISTIC  
PROFILE FEATURES:**

They are somewhat sandy in texture and often severely eroded so the compact, plastic, weak red subsoil often occurs near the soil surface. Tracks commonly show a thin layer of fine quartz sand.

Typically shows 10 cm of reddish brown friable clay (containing fine sand) of weak medium and fine blocky structure breaking to crumb, overlying 10 cm of weak red firm clay and hard to dig, overlying 40 cm of light reddish brown clay, very hard to dig of massive structure on varicoloured compact and very plastic clay, mainly light reddish brown and pink. Horizons have plastic and slightly sticky consistence when moist.

**DIAGNOSTIC HORIZONS:**

Ochric epipedon, argillic horizon.

**TYPIFYING PROFILE:**

TW62

**RANGE OF PROFILE FEATURES:**

Not applicable

**VARIANTS:**

None recognised

**SIMILAR SOILS AND  
DISTINGUISHING FEATURES:**

None recognised

**GENERAL CHEMICAL, PHYSICAL &  
MINERALOGICAL PROPERTIES:**

Analysis shows them to be moderately to strongly acid and strongly leached of plant nutrients, low in phosphorus and very low in exchangeable potassium.

**LABORATORY NOS:**

Not sampled for analysis.

**SOIL LIMITATIONS:**

Severe past erosion and very severe potential erosion; soil acidity; and nutrient deficiencies of nitrogen, phosphorus and potassium.

## Typifying Profile

SOIL NAME: Koroniqala soils, easy rolling phase.

PROFILE NO: TW62

SITE LOCATION: Kadavu Island

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex mid-slope in easy rolling hilly country.

PARENT MATERIAL: Strongly weathered *in situ* silicified tuft.

SLOPE: 13 - 15°

ASPECT: North

ELEVATION: 50 m

MICRORELIEF: Uneven

SITE VEGETATION: Grassland, ferns, nokonoko

LAND USE: Grazing, pine plantation.

DRAINAGE : Well drained

EROSION: Significant topsoil through sheet erosion.

DISTURBANCE: Burning

LABORATORY Nos.: Not sampled for analysis.

### PROFILE DESCRIPTION

Ah	0-10cm (10 cm)	Moist; reddish brown (2.5YR 4/4) slightly sandy clay; weakly developed medium and fine blocky structure breaking to very fine blocky and granular; friable; slightly sticky; moderately plastic; distinct smooth boundary,
Bt1	10-20cm (10 cm)	Moist; weak red (10R 4/4) clay; weak coarse blocky structure (tending massive) breaking easily to very fine blocky and crumb; firm; slightly sticky; moderately plastic; distinct smooth boundary,
Bt2	20-60 cm (40 cm)	Moist; light reddish brown (2.5YR 6/4) clay; massive; firm; slightly sticky; strongly plastic; very hard to dig; diffuse smooth boundary,
BC	on	Varicoloured compact light reddish brown (2.5YR 6/4) and pink (5YR 7/3) very plastic clay.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Koronivia series**

REFERENCE: The Koronivia sandy loam (38) defined by Twyford and Wright (1965) as a yellow brown soil from rhyolitic outwash and tuffaceous material, mainly on dissected plateau remnants under a climate with little or no dry season.

The central concept for Koronivia soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Kandihumult, clayey, kaolinitic, isohyperthermic
- (b) FAO: Humic Nitosol
- (c) Twyford and Wright: Red yellow podzolic soil with very weak or no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Koronivia soils, flat to gently undulating phase (44A)
- Koronivia soils, undulating phase (44B)
- Koronivia soils, easy rolling phase (44C)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Plateau surfaces that have a distribution from 5 km south of Koronivia Agricultural Research Station to 20 km north, in the coastal hill margins of SE Viti Levu.

PARENT ROCK: Rhyolite and tuffaceous rocks of acidic composition.

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Dissected plateau remnants, the surfaces of which are uniformly flat.

SLOPE CLASS AND RANGE OF SLOPES: Level to near level (0-3°), undulating (4-7°), and easy rolling (8-11°).

VEGETATION AND LAND USE: Mainly in improved pasture (Para grass) with Navua sedge, Tarweed and Yellow primrose. Dairying and beef cattle grazing.

RANGE OF ELEVATION: 15-50 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Imperfectly drained

PERMEABILITY CLASS: Slow

FLOODING: Not subject to flooding but water may pond at the surface for short periods during the wet season.

EROSION: No erosion risk.



## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically are deep strongly weathered profiles with thick (>25 cm) surface horizons and clay rich subsoils (>50 cm). There is a textural gradient from topsoil (silt loam) to argillic horizon (clay loam) to subsoil below 90 cm (silty clay loam). The argillic B horizon is yellowish-brown firm with dark red mottles (10YR 3/6) and well expressed clay coatings to peds. Mottling generally extends to the basal layer of the surface horizon.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	<p>Koronivia series have a Ap, Ag, Bt, Bts, BC horizon sequence.</p> <p>The A horizon thickness ranges from 12-22 cm; its colours include very dark greyish brown (10YR 3/2), dark yellowish brown (10YR 3/4) and dark brown (10YR 3/3); textures are silty clay loam, silt loam and fine sandy loam; and structures weak or moderate, fine, very fine or medium nut.</p> <p>The Ag horizon thickness ranges from 10-25 cm; its colours include olive brown (2.5Y 4/4) and light olive brown (2.5Y 5/4); textures are silt loam and silty clay loam; consistence friable or firm; and structures are either weak or moderate, very fine, fine or medium nut.</p> <p>The Bt horizon thickness ranges 25-40 cm; colours are yellowish brown (10YR 5/4, 5/6); textures clay or clay loam; mottles range from few to profuse; and structures are weak or moderate fine, medium or coarse blocky.</p> <p>The Bts horizon thickness ranges 20-30 cm; textures are clay or clay loam; and structures are medium or coarse blocky.</p> <p>The BC horizon exceeds 50 cm; its colours include pale brown (10YR 6/3) and very pale brown (10YR 7/3) and textures are silty clay loam or clay loam.</p>
VARIANTS:	Koronivia series, sandy topsoil variant (typifying profile attached).
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Naqavoka series: steep slopes (>25°); thinner argillic horizon; more friable consistence and in general less compact; have more clay in topsoils, which are mottled to the surface.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Moderately acid topsoils becoming slightly acid in subsurface horizons. % base saturation is high in topsoils but becomes very low below this. Organic carbon values are low to very low. The CEC values are low in all horizons. Exchangeable calcium decreases downwards from medium topsoil values while both magnesium and sodium go from low to very low with depth. Potassium values are very low. Phosphorus values are medium for topsoils and low in subsoils.</p> <p>Percentage clay increases from 30% in the topsoil to &gt;65% in the Bt horizon, while sand &gt;40% in the surface horizon drops to low values below 40 cm depth.</p> <p>The mineralogy glass is kaolinitic.</p> <p>The particle size family class is clayey.</p>
LABORATORY Nos:	SB 9604A-E
SOIL LIMITATIONS:	Imperfect internal drainage; tendency for water to pond at times during the wet season due to clayey textures, flat surfaces and slow permeability; poor trafficability during the wet season; soil acidity; nutrient deficiencies of phosphorus, nitrogen and potassium; and difficulty of attaining a fine tilth when cultivated.

*Koronivia*

## Typifying Profile

SOIL NAME: Koronivia soils, flat to gently undulating phase.  
PROFILE No.: KN30  
SITE LOCATION: Refer soil map of Koronivia Agricultural Research Station (scale 1:3000), Leslie (1983).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar surface on moderately dissected terrace.  
PARENT MATERIAL: Strongly weathered *in situ* acid tuff.  
SLOPE: 0°  
ASPECT: Not applicable  
ELEVATION: 18 m  
MICRORELIEF: Uniformly planar  
SITE VEGETATION: Para grass with some Navua sedge.  
LAND USE: Improved pasture for dairying.  
DRAINAGE: Imperfectly drained  
EROSION: None observed  
DISTURBANCE: Has been ploughed. Experiences surface pugging by cattle when the soil is saturated.  
LABORATORY Nos: SB9604A-E

### PROFILE DESCRIPTION

Ap	0-18 cm (18 cm)	Slightly moist; dark brown (10YR 3/3) both ped face and rubbed silt loam; humic staining along root channels; weakly developed fine and very fine nut with granular structure; friable to firm; non-sticky; non plastic; uncemented; soft penetration; many fine roots; indistinct smooth boundary,
Ag	18-41 cm (23 cm)	Slightly moist; olive brown (2.5Y 4/4) ped face yellowish brown (10YR 5/8) rubbed; silt loam; common medium distinct yellowish red (5YR 4/6) mottles; weakly developed very fine nut and granular structure; friable; non-sticky; non-plastic; uncemented; soft penetration; common fine roots; sharp wavy boundary,
Bt	41-73 cm (32 cm)	Moist; yellowish brown (10YR 5/8) both ped face and rubbed; clay loam; few medium prominent dark red (10R 3/6) mottles; weakly developed coarse nut structure breaking to weak very fine blocky structure; firm; sticky; slightly plastic; uncemented; firm penetration; few faint dark yellowish brown (10YR 4.5/6) clay skins; few very fine roots; indistinct smooth boundary,
Bts	73-100 cm (27 cm)	Moist; 75% yellowish brown (10YR 5/8) with 15% very pale brown (10YR 7/3); clay loam; profuse coarse prominent dark red (10R 3/6) mottles; weakly developed coarse nut structure breaking to weak medium blocky structure; firm; sticky; slightly plastic; uncemented; firm penetration; common faint strong brown (7.5YR 5/6) clay skins; no roots; indistinct smooth boundary,

BC 100-130 cm (30 cm) Moist; very pale brown (10YR 7/3) silty clay loam; massive; firm; slightly sticky; non-plastic; uncemented; stiff penetration; few, faint yellowish brown (10YR 5/8) clay skins; no roots; *in situ* strongly weathered rock.

### Typifying Profile

SOIL NAME: Koronivia soils, sandy topsoil variant.  
PROFILE No.: KN22  
SITE LOCATION: Refer soil map of Koronivia Agricultural Research Station (scale 1:3000).

#### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Surface on moderately dissected terrace.  
PARENT MATERIAL: Strongly weathered *in situ* tuffaceous rock.  
SLOPE: Level site  
ASPECT: Not applicable  
ELEVATION: 20 m  
LANDFORM: Terrace, probably marine planted.  
TOPOGRAPHY: Flat  
MICRORELIEF: Uniformly planar  
SITE VEGETATION: Navua sedge, mile a minute, para grass, yellow primrose, tar weed.  
LAND USE: Improved pasture for dairying.  
DRAINAGE: Moderately well drained.  
EROSION: None observed  
DISTURBANCE: Ploughed more than once. May experience topsoil pugging by cattle when soil saturated.  
LABORATORY Nos: SB9601A-E

#### PROFILE DESCRIPTION

Ap 0-9 cm (9 cm) Slightly moist; dark greyish brown (2.5Y 4/3) ped face, dark brown (10YR 3/3) rubbed; fine sandy clay; few fine, faint reddish brown (5YR 4/4) mottles; weakly developed fine and very fine nut with granular structure; friable; non-sticky; non-plastic; uncemented; firm penetration; humic staining (root channels); many, fine roots; indistinct, smooth boundary,  
Ag 9-26 cm (17 cm) Slightly moist; olive brown (2.5Y 4/4) ped face, dark yellowish brown (10YR 4/4) rubbed; fine sandy clay loam; many, fine, distinct reddish brown (5YR 4/4) mottles; weakly developed fine nut and granular structure; friable; non-sticky; non-plastic; uncemented; firm penetration; humic staining (root channels); many fine roots; indistinct, smooth boundary,  
AB 26-42 cm (16 cm) Slightly moist; olive brown (2.5Y 4/4) ped face, yellowish brown (10YR 5/4) rubbed; silty clay loam; many, fine, distinct reddish brown (5YR 4/4) mottles; weakly developed fine nut and granular structure; friable; non-sticky; non-plastic; uncemented; soft penetration; moderate faunal activity; few, very fine roots; distinct, smooth boundary,

*Koronivia*

Bt	42-68 cm (26 cm)	Moist; strong brown (7.5YR 5/6) ped face and rubbed; clay loam; few, medium, faint reddish brown (5YR 4/4) mottles; weakly developed, coarse blocky structure breaking to weak fine blocky structure; firm; slightly sticky; slightly plastic; uncemented; stiff penetration; common yellowish brown (10YR 5/4) clay/organic cutans; few, very fine roots; indistinct, wavy boundary,
Btg	68-113 cm (45 cm+)	Moist; light yellowish grey (2.5Y 6/2) ped face, strong brown (10YR 5/6) rubbed; clay loam; many, medium, distinct yellowish red (5YR 4/6) mottles; massive breaking to weak, fine blocky structure; friable; slightly sticky; slightly plastic; uncemented; firm penetration; common yellowish brown (10YR 5/4) organic cutans; common strong brown (7.5YR 5/6) clay cutans; no roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Korotuku series**

REFERENCE: Korotuku clay (10a) defined by Twyford & Wright (1965) as formed from basic tuff with enrichment from crystalline limestone under a climate with a moderate dry season.

Forms part of the Korotuku set.

In this survey these soils are restricted to the ustic soil moisture regime, otherwise the central concept for Korotuku soils is retained.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Argiustoll, very fine, smectitic, isohyperthermic
- (b) FAO: Luvic Phaeozem
- (c) Twyford and Wright: Humic latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Korotuku soils, flat to gently undulating phase (206A)
- Korotuku soils, undulating phase (206B)
- Korotuku soils, easy rolling phase (206C)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Of very restricted occurrence on Cikobia island.

PARENT ROCK: Basaltic rocks (with minor limestone in solution).

PARENT MATERIAL: Deep strongly weathered basic tuff.

#### PHYSIOGRAPHIC

POSITION/LANDFORM: Planar and convex undulating slopes.

#### SLOPE CLASS

AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), and easy rolling (8-11°).

VEGETATION AND LAND USE: Almost all planted continuously in the wide range of subsistence food crops.

RANGE OF ELEVATION: 10-100 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-600 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat excessively drained.

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Slight to moderate sheet and rill erosion potential on slopes >3° if soil conservation measures not adopted.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 38 cm of reddish black friable clay loam, of strong very fine nut structure and slightly sticky and slightly plastic moist, overlying 70 cm of dusky red friable to firm clay of very strong coarse granular structure and slightly sticky and plastic moist, on 30 cm or more of dark reddish brown firm slightly gritty heavy clay of massive structure breaking to moderate medium blocky and granular and sticky and plastic when moist.
DIAGNOSTIC HORIZONS:	Mollic epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only one profile description made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be near neutral; organic carbon and nitrogen have medium values in the topsoil (0-38 cm) with respectively very low and low values below this; % base saturation is very high in the topsoil, high 38-107 cm and medium below 107 cm; CEC is very high 0-107 cm and medium below; exchangeable calcium and magnesium have very high values 0-107 cm and high values below that depth; potassium is low in the topsoil and very low below; available phosphorus is likely to be high but phosphorus retention also high.</p> <p>The family particle size class is very fine.</p> <p>The mineralogical class is smectitic.</p>
LABORATORY Nos:	ORSTOM K21-K23 (inclusive)
SOIL LIMITATIONS:	Moderately rapid permeability; soil moisture deficits experienced during the dry season; moderate erosion hazard where intensively cultivated on slopes >7°; nutrient deficiencies of nitrogen and potassium, and high phosphate retention.

## Typifying Profile

SOIL NAME: Korotuku series, undulating phase.  
PROFILE No.: K2  
SITE LOCATION: 0.5km west of Delaioloi, Kabara Island.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Broad planar toeslope.  
PARENT MATERIAL: Strongly weathered colluvium from basic tuff with some limestone enrichment.  
SLOPE: 5°  
ASPECT: West  
ELEVATION: 60 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Fallow following root crops.  
LAND USE: Intensive cropping for subsistence food crops.  
DRAINAGE: Well drained  
EROSION: None  
DISTURBANCE: Cultivated  
LABORATORY Nos: ORSTOM K21-K23 (inclusive)

### PROFILE DESCRIPTION

Korotuku soils, undulating phase

Ap	0-38 cm (38 cm)	Moist; reddish black (10YR 2/1) clay loam; strongly developed very fine nut structure; friable to very friable; slightly sticky; slightly plastic; many fine fibrous roots; indistinct smooth boundary,
Bt1	38-107cm (69 cm)	Moist; dusky red (10R 2/2) clay; very strongly developed coarse granular structure; friable to firm; slightly sticky; plastic; common clay coatings to peds; common fine fibrous roots; distinct smooth boundary,
Bt2	107-137cm+ (30 cm+)	Dark reddish brown (2.5YR 3/4) slightly gritty heavy clay massive, breaking to moderate medium blocky with granular structure; firm; sticky; plastic; common clay coatings to peds.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Korovuli series**

REFERENCE: New soil series introduced in the detailed soil survey of Seaqaqa Agricultural Research Station (Laffan, Purdie & Shepherd 1985) to include well drained soils formed from alluvium derived from andesitic rocks on stream terraces. Profiles have argillic horizons.

Korovuli series cannot be easily correlated with any of the established series defined by Twyford & Wright (1965) but probably would have been included with Nasou clay (31a).

Named after Korovuli Village, 2 km to the south of Seaqaqa Agricultural Research Station.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Paleustult, clayey, ferruginous, isohyperthermic
- (b) FAO: Dystric Nitosol
- (c) Twyford and Wright: Humic latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Korovuli soils (37)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Korovuli soils are common in association with Tabia soils in the Macuata and Bua provinces of Vanua Levu. They are common in the dry zone of Viti Levu, particularly Ra and Ba provinces.

PARENT ROCK: Andesite

PARENT MATERIAL: Older fine textured stream alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Intermediate terraces adjacent to stream margins

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: Grassland species with grazing, coconuts, exotic forestry, horticultural crops, and sugar cane in some areas.

RANGE OF ELEVATION: 15-125 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate to moderately slow.

FLOODING: Nil - out of reach of flooding.

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Deep, heavy-textured (silty clay) soils with strongly developed blocky and nut structures in subsoils. Distinct dark reddish brown clay cutans commonly occur in lower subsoils. Subsoil colours are generally reddish brown (5YR 4/4) or dark reddish brown (2.5YR 3/4). Few or many distinct yellowish brown mottles occur at depths below 70-80 cm.
DIAGNOSTIC HORIZONS:	Mollic epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	<p>Korovuli series have an Ap, Bw, Bt1, Bt2, Bt3, horizon sequence.</p> <p>The Ap horizon thickness ranges from 16 to 25 cm; colours vary between dark reddish brown (5YR 3/2) and very dark greyish brown (10YR 3/2); and textures are silty clays or clays.</p> <p>The Bw horizon thickness averages 25 cm; colours are always dark reddish brown (2.5YR 3/4); and textures are silty clays or clays.</p> <p>The Bt1 horizon thickness ranges from 27-34 cm; colours vary between reddish brown (2.5YR 3/4) and reddish brown (5YR 4/4); textures are either silty clays or clays; and clay cutans may be few or common.</p> <p>The Bt2 horizon thickness ranges from 20-30 cm; and textures are either silty clays or clays.</p> <p>The Bt3 horizon exceeds 20 cm; textures are silty clays or silty clay loams; and there may be distinct yellowish brown mottles.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>pH moderately acid throughout profile; organic C % low in A horizon and very low in B horizon; % base saturation high in A horizon, medium in B horizon above 1 m depth, and low at depths below 1 m. Exchangeable calcium high and magnesium very high in A horizon, calcium low to medium and magnesium high in B horizons. Exchangeable potassium very low throughout profile.</p> <p>The mineralogy class is ferruginous.</p> <p>The particle size family class is very fine.</p>
LABORATORY Nos:	KRS S1955-1960 (inclusive)
SOIL LIMITATIONS:	Major soil physical limitations of severe seasonal soil moisture deficit and clayey textures. Severe nutrient deficiencies (nitrogen, potassium, and phosphorus) and low pH.

## Typifying Profile

SOIL NAME: Korovuli soils  
PROFILE No.: S1  
SITE LOCATION: Refer soil map of Seaqaqa Agricultural Research Station (Laffan, Purdie & Smith 1984).

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Terrace surface  
PARENT MATERIAL: Older stream alluvium derived from strongly weathered andesite.  
SLOPE: 0°  
ASPECT: Not applicable  
ELEVATION: 115 m  
MICRORELIEF: Slight alluvial ridge and swale.  
SITE VEGETATION: Grassland species  
LAND USE: Extensive grazing  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: Probably previously cultivated.  
LABORATORY Nos: KRS S1955-1960 (inclusive)

### PROFILE DESCRIPTION

Ap	0-28 cm	Dark reddish brown (5YR 3/2) silty clay; friable; sticky; very plastic; strongly developed coarse and medium nut structure; many very fine roots; indistinct boundary,
Bw1	28-53 cm	Dark reddish brown (2.5YR 3/4) silty clay; common fine distinct red (2.5YR 4/6) mottles; friable; sticky; very plastic; strongly developed medium and coarse nut structure; common very fine roots; diffuse boundary,
Bt1	53-80 cm	Dark reddish brown (2.5YR 3/4) silty clay; firm; slightly sticky; plastic; strongly developed medium nut structure and moderately developed coarse blocky structure; common faint dark reddish brown (5YR 3/3) clay cutans; few very fine roots; diffuse boundary,
Bt2	80-103 cm	Reddish brown (5YR 4/4) silty clay; common fine distinct dark yellowish brown (10YR 4/6) mottles; firm; slightly sticky; plastic; moderately developed medium blocky and nut structure; common distinct dark reddish brown (5YR 3/3) clay cutans; few very fine roots; diffuse boundary,
Bt3	103+ cm	Reddish brown (5YR 4/4) silty clay; common medium distinct yellowish brown (10YR 5/4) mottles; friable; slightly sticky; plastic; moderately developed coarse blocky structure breaking to very fine nut structure; common faint dark reddish brown (5YR 3/3) clay cutans.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Kubuna series**

REFERENCE: Kubuna clay and gravelly clay (34a) defined by Twyford & Wright (1965) as colluvial 'talasiga' soils, related to Tuva soils (34b), having parent materials of basic and intermediate composition and formed under a climate with a moderate dry season.

Forms part of the Tuva set.

In this survey Kubuna soils are restricted to the ustic soil moisture regime, otherwise the central concept for Kubuna soils are retained.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Ustic Dystrypept, fine, ferruginous, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Ferruginous latosol with a moderate to strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Kubuna soils, undulating phase (190B)	Kubuna soils, rolling phase (190D)
Kubuna soils, easy rolling phase (190C)	Kubuna soils, strongly rolling phase (190E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Kubuna soils are confined in Viti Levu to a few small valleys drawing terrain carrying Tuva soils, particularly in the valley of the Kubuna river in Nadroga.

PARENT ROCK: Basalts and andesites.

PARENT MATERIAL: Strongly weathered deep colluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Long planar surface or short concave toeslopes in flattish to rolling land.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°), and strongly rolling (16-20°).

VEGETATION AND LAND USE: Sugar cane, exotic forestry and unused (extensive rough grazing).

RANGE OF ELEVATION: 10-200 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate to severe sheet and rill erosion potential on cultivated slopes >7°.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically show 15 cm of dark reddish brown friable clay loam, of strongly developed fine nut and granular structure, commonly with some ironstone nodules, overlying 15 cm of red firm clay of moderately developed medium blocky with granular structure, with peds commonly humus coated dusky red, overlying 50 cm of red firm clay, of massive or weak coarse blocky structure.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be strongly acid; organic carbon and nitrogen have low values in the topsoil (0-14 cm) and very low values below this horizon; available phosphorus is very low and phosphorus retention is medium; % base saturation is medium; CEC is low; exchangeable calcium and sodium are low; magnesium medium; and potassium very low.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is ferruginous.</p>
LABORATORY Nos:	USP NB04A-E
SOIL LIMITATIONS:	Clayey textures; severe soil moisture deficits experienced in the dry season; moderate to severe sheet and rill erosion potential on slopes >7°; strong soil acidity; and severe nutrient deficiencies of phosphorus, nitrogen and potassium.

## Typifying Profile

SOIL NAME: Kubuna soils, undulating phase.

PROFILE No.: NB04

SITE LOCATION: P74/III/14 Nabou Forest

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar midslope on long angle 'fan like' surface in rolling country.

PARENT MATERIAL: Colluvium derived from basic rocks.

SLOPE: 4° length 200 m

ASPECT: East south-east

ELEVATION: 25 m

MICRORELIEF: Flat

SITE VEGETATION: Ground cover of Guava, Mimosa, Qatima and Mission grass under 8 year old *Pinus caribaea*.

LAND USE: Exotic forestry

DRAINAGE: Moderately well drained

EROSION: None observed

DISTURBANCE: None

LABORATORY Nos: USP NB04A-E

### PROFILE DESCRIPTION

Ah	0-14 cm (14 cm)	Slightly moist; moist dark reddish brown (5YR 3/2), rubbed dark reddish brown (5YR 3/4) clay loam; strongly developed fine nut structure with strong fine granular; friable; non sticky; non plastic; many fine and medium roots; distinct smooth boundary,
AB	14-29 cm (15 cm)	Slightly moist; moist 50% red (2.5YR 4/6) and 50% dusky red (2.5YR 3/2) rubbed reddish-brown (2.5YR 4/4) clay; moderately developed medium blocky structure with strong fine granular structure; firm; slightly sticky; non plastic; common distinct dusky red (2.5YR 3/2) organic coatings; moderate faunal activity; common coarse roots; indistinct smooth boundary,
Bt1	29-49 cm (20 cm)	Slightly moist; moist red (2.5YR 5/8) rubbed red (2.5YR 4/6) clay; weakly developed very coarse blocky structure; firm; slightly sticky; non plastic; common distinct dusky red (2.5YR 3/2) organic coatings; few fine roots; diffuse smooth boundary,
Bt2	49-79 cm (30 cm)	Slightly moist; moist red (2.5YR 5/8) with parent material flecks of white (5Y 8/2) rubbed red (2.5YR 5/6) clay; massive breaking to weak crumb structure; firm; slightly sticky; non plastic; few fine roots; diffuse smooth boundary,
BC	79-109+ cm (30 cm+)	Slightly moist; moist red (2.5YR 4/8) with flecks of white (5Y 8/2) clay; massive breaking to crumb structure; friable; slightly sticky; non plastic; few fine roots.





# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Kurukuru series**

REFERENCE: Kurukuru sandy clay (41c) defined by Twyford & Wright (1965) as a colluvial soil developed on flattish land (mainly colluvial derivatives of Nukudamu soils (42c)) and formed under a climate with a strong dry season. Parent materials are acid and quartz rich tuffs.

Forms part of the Kelikoso set.

The central concept for Kurukuru soils is retained in this survey.

### CLASSIFICATION:

- (a) Soil Taxonomy: Rhodic Kandiuustox, clayey, ferruginous, isohyperthermic
- (b) FAO: Rhodic Ferralsol
- (c) Twyford and Wright: Red yellow podzolic soil with a strong dry season

### INCLUDED MAPPING UNITS AND SYMBOLS:

Kurukuru soils, flat to gently undulating phase (144A)      Kurukuru soils, easy rolling phase (144C)  
Kurukuru soils, undulating phase (144B)                      Kurukuru soils, rolling phase (144D)

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Kurukuru soils are confined to Vanua Levu where they develop as colluvial accumulation from Nukudamu, Koroniqala and Dogotuki soils.

PARENT ROCK: Acid and quartz rich tuffs.

PARENT MATERIAL: Deep strongly weathered colluvium (and some alluvium).

PHYSIOGRAPHIC POSITION/LANDFORM: Coalescing fans, toeslopes and midslopes in flattish and gently rolling country.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), easy rolling (8-11°) and rolling (12-15°).

VEGETATION AND LAND USE: Sugar cane and rainfed rice. In traditional agricultural used for root crops (kumala, cassava) with some years for fallow.

RANGE OF ELEVATION: 20-90 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthrmic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: 1 in 15 year return period for major floods depositing 'fresh' colluvia and restricted to slopes of < 3°. Elsewhere never floods.

EROSION: Slight to moderate sheet and rill erosion risk under cultivation on slopes >2°.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of dark red clay loam, of weakly developed nut and granular structure, friable to firm, and slightly sticky moist, overlying 40 cm of red fine sandy clay loam, of fine crumb structure with single grain, and very friable, overlying a paleosol of 10 cm of red and very dusky red silty clay loam, of weak fine nut and crumb structure, and very friable, overlying more than 40 cm of dark red silty clay loam, of weakly developed fine nut and crumb structure, and very friable.
DIAGNOSTIC HORIZONS:	Ochric epipedon, oxic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analyses show extremely acid pH; carbon (low to very low values) decreases irregularly with increasing depth due to paleosols; available phosphorus very low; % base saturation low; CEC on the low side of medium; magnesium is medium; and exchangeable calcium and potassium are very low throughout the profile.
LABORATORY Nos:	USP SQ61A-D
SOIL LIMITATIONS:	Infrequent flooding risk on slopes $<3^\circ$ ; moderate sheet and rill erosion potential, when cultivated on slopes $>2^\circ$ ; moderate to severe soil moisture deficits during the dry season; extreme acidity; low base status; and very low available phosphorus and potassium reserves.

## Typifying Profile

SOIL NAME: Kurukuru soils, undulating phase.  
PROFILE No.: SQ61  
SITE LOCATION: Seaqaqa Forest - 1961 planting area.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar midslope position in rolling country.  
PARENT MATERIAL: Strongly weathered colluvium derived from sedimentary rocks of acid composition.  
SLOPE: 4°, length 300 m  
ASPECT: East  
ELEVATION: 30 m  
MICRORELIEF: Flat  
SITE VEGETATION: *P. caribaea* (planted in 1961) with ground cover of ferns and Costa's curse.  
LAND USE: Exotic forestry  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: USP SQ61A-D

### PROFILE DESCRIPTION

Kurukuru soils, undulating phase

Ah	0-10 cm (10 cm)	Moist; moist and rubbed dark red (2.5YR 3/6) clay loam; weakly developed medium nut, plus weak fine granular structure; slightly sticky; non-plastic; friable to firm; common fine medium and coarse roots; distinct smooth boundary,
Bw	10-50 cm (40 cm)	Moist; moist and rubbed red (2.5YR 4/6) fine sandy clay loam; weakly developed fine crumb structure plus single grain; non-sticky; non-plastic; very friable; common fine medium and coarse roots; distinct smooth boundary,
bAh	50-60 cm (10 cm)	Very moist; moist red (2.5YR 4/6) and very dusky red (10R 2/2) rubbed dark reddish brown (2.5YR 3/4) silty clay loam; weakly developed fine nut plus weak fine crumb structure; non-sticky; non-plastic; very friable; few fine and medium roots; distinct smooth boundary,
bBw	60-106+ cm (45 cm+)	Very moist; moist and rubbed dark red (2.5YR 3/6) silty clay loam; weakly developed fine nut breaking to weak fine crumb structure; non-sticky; non-plastic; very friable; few very fine roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Kuta series**

REFERENCE: Kuta peat (63a) defined by Twyford & Wright (1965) as an upland organic soil developed from giant kuta reeds (*Eleocharis articulata*) around the crater in upland Taveuni.

The central concept for Kuta soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Hydric Tropofibrist, dysic, isothermic
- (b) FAO: Dystric Histosol
- (c) Twyford and Wright: Upland organic soil

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Kuta soils (209)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs extensively around the crater lake (Lake Tagimaucia) in upland Taveuni Island

PARENT ROCK: Not Applicable

PARENT MATERIAL: Weakly decomposed peat from the decomposition of the giant kuta (*Eleocharis articulata*).

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Peat bog and floating islands of peat.

#### SLOPE CLASS

AND RANGE OF SLOPES: Flat

VEGETATION AND LAND USE: Unused (in natural state of kuta reed).

RANGE OF ELEVATION: At 800 m

RAINFALL: Annual average range: 3,000-6,400 mm;  
dry season range: 2,000-3,200 mm;  
wet season range: 800-3,000 mm.

TEMPERATURE: Mean annual: 18°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Very poorly drained.

PERMEABILITY CLASS: Rapid

FLOODING: Permanently flooded

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of very dark greyish brown massive and soft weakly decomposed fibrous peat overlying 250 cm or more of very dark greyish brown to dark yellowish brown soft and massive weakly decomposed peat with the fibrous character diminishing with depth overlying 10 cm of buried tephra comprising dark brown peaty loamy fine sand over black organic lake deposits. Algal jelly commonly associated with surface horizon.
DIAGNOSTIC HORIZONS:	Histic epipedon
RANGE OF PROFILE FEATURES:	Not applicable. Only one profile description made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be strongly acid; organic carbon is extremely high (>42%); CEC is very high; % base saturation very low; calcium is low, sodium high, potassium very low and magnesium high throughout; and Tamms aluminium extract values are extremely high.
LABORATORY Nos:	USP TAV116A-B
SOIL LIMITATIONS:	Permanent high water table; unable to be drained; and general low nutrient status

## Typifying Profile

SOIL NAME: Kuta soils  
PROFILE No.: TAV116  
SITE LOCATION: Edge of Tagimaucea Lake central upland Taveuni Island.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Flat upland peat bog.  
PARENT MATERIAL: Weakly decomposed peat derived mainly from *Lepironia articulata* sedges.  
SLOPE: Flat  
ASPECT: Not Applicable  
ELEVATION: 800 m  
MICRORELIEF: Uneven (hummocky)  
SITE VEGETATION: *Lepironia articulata* with some *Eleocharis articulata* near the lake edge.  
LAND USE: Unused (in natural state).  
DRAINAGE: Very poorly drained.  
EROSION: None  
DISTURBANCE: None  
LABORATORY Nos: USP TAV116A-B  
COMMENTS: Water table at or near the surface at most times.

### PROFILE DESCRIPTION

Of1	0-10 cm (10 cm)	Wet; very dark greyish brown (10YR 3/2) weakly decomposed fibrous peat with dark brown (10YR 3/3) algal jelly; massive; soft; slightly sticky; few fibrous roots; diffuse smooth boundary,
Of2	10-270 cm (260 cm)	Wet; very dark greyish brown (10YR 3/2) to dark yellowish brown (10YR 3/4) weakly decomposed fibrous peat; massive; soft; no roots; fibrous character diminishes gradually with depth; distinct smooth boundary,
2bC	270-280 cm (10 cm)	Wet; very dark greyish brown (10YR 3/2) to dark brown (10YR 3/3) peaty loamy fine sand (with patches of fibrous peat); single grain though tending to be massive due to compaction of overlying peat; buried volcanic ash; distinct smooth boundary,
3bC	280 cm+	Wet; black (10YR 3/0) organic lake deposit (not a sedge peat as in the upper horizons).





# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Labasa series**

REFERENCE: New soil series introduced in this survey to describe some of the 'oldest' drained saline soils of the marine marsh (i.e. Soso series in the natural state) occurring in any of the lowland climatic zones of Fiji. The central concept for Labasa series is a very poorly drained soil with a permanent water table (fluctuating) in the lower part of the profile that is influenced by saline waters, but considerable oxidation has occurred in the upper profile combined with some leaching of sodium salts.

Previously included with Soso clay, sandy clay etc. (55a) as defined by Twyford & Wright (1965).

Name derived from Labasa River, Vanua Levu.

### CLASSIFICATION:

- (a) Soil Taxonomy: Aeris Tropaquept, clayey over sandy, mixed, isohyperthermic
- (b) FAO: Dystric Gleysol
- (c) Twyford and Wright: Saline soil of the marine marsh

### INCLUDED MAPPING UNITS AND SYMBOLS:

Labasa soils (1)

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Labasa soils form in the marine marsh with Soso soils where the surface level is above high water mark and these areas are mangrove-free. They occur in all climate zones.

PARENT ROCK: Variable rocks of mixed lithologies

PARENT MATERIAL: Diverse alluvia deposited partly by a slowing of river currents but mainly to the flocculation of silt and lay in the lagoons resulting in the gradual raising of the sea bed to a certain height resulting in the gradual raising of the sea bed to a certain height where mangrove species made initial colonisation to be followed by salt tolerant grasses as the elevation inversed and the mangrove swamps extended seaward.

PHYSIOGRAPHIC POSITION / LANDFORM: Predominantly on deltas and river edges inland of the mangrove swamps proper.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-1°).

VEGETATION AND LAND USE: In natural state salt tolerant grasses and weeds. Used for rainfed and irrigated rice.

RANGE OF ELEVATION: 0-2.5 m

RAINFALL: Annual average range: 1,800-5,000 mm;  
dry season range: 400-3,000 mm;  
wet season range: 1,400-3,000 mm.

TEMPERATURE: Mean annual range: 24-26°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Slow

FLOODING: Watertable controlled by tidal fluctuations. Floods 4 to 5 times during the period November to April with water ponding on the surface for up to 10 to 12 days at each event.

EROSION: No erosion risk.

### **Morphological And Chemical Properties**

CHARACTERISTIC PROFILE FEATURES: Typically shows 16 cm of dark yellowish brown weakly mottled yellowish red silty clay, of weakly developed crumb structure, friable, sticky with many dead mangrove roots, overlying 25 cm of very dark greyish brown mottled strong brown and reddish yellow silty clay, of massive structure and friable, overlying 90 cm of very dark grey sandy loam, single grain, very friable, slightly sticky, with many dead mangrove roots, overlying more than 25 cm of black very fine sandy loam, single grain, very friable, slightly sticky, many dead mangrove roots, and commonly a few unweathered subrounded boulders. The water table normally fluctuates between 20 and 70 cm.

DIAGNOSTIC HORIZONS: Ochric epipedon, cambic horizon.

RANGE OF PROFILE FEATURES: Labasa series have a Ah, Bg1, Bg2, Cr1, Cr2 horizon sequence.

The Ah horizon ranges between 12 and 20 cm in thickness; colours are either dark brown (10YR 3/3) or dark yellowish brown (10YR 3/4); and textures range from silt loams to silty clays to clay loams.

The Bt horizons range between 20 and 50 cm in thickness; colours are either dark brown (10YR 3/3) or very dark greyish brown (10YR 3/2, 2.5Y 3/2); textures vary silt loams, silty clays and clay loams; mottles may be many, abundant, or profuse; stones and boulders may be present or not.

The Cr1 horizon ranges between 70 and 100 cm in thickness; colours range between black (2.5Y 3/0) and dark olive grey (5Y 3/2); textures are either loamy sands, very fine sandy loams, medium sandy loams, or medium sandy silts; and boulders and stones may be present or not.

VARIANTS: None recognised

SIMILAR SOILS AND DISTINGUISHING FEATURES: None recognised

GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES: Typically moderately acid to 40-50 cm becoming moderately alkaline below this depth; nitrogen values are very low and carbon while low maintains significant levels to depth - the C/N ratios are very high; % base saturation is very high increasing to 100% below 40 cm depth; CEC follows similar trends; exchangeable potassium and magnesium values are very high, sodium extremely high and increasing with depth, while calcium goes from high to very high below 40 cm depth; and available phosphorus is very low.

LABORATORY Nos: KRS T2694-2698. USP DK23A-E

SOIL LIMITATIONS: Frequency of flooding; permanent high tidal fluctuating water tables; salt water (as indicated by very high sodium figures) influencing subsoil chemistry; because of low gradients and water table being controlled by sea level very difficult to drain; and nutrient deficiencies (nitrogen, phosphorus).

**Labasa**

## Typifying Profile

SOIL NAME: Labasa soils  
PROFILE No.: DK23  
SITE LOCATION: Dreketi rice irrigation scheme.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar surface on estuarine delta.  
PARENT MATERIAL: Estuarine alluvia from rocks of diverse lithology.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 1.25 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Rice  
LAND USE: Intensive irrigated rice production.  
DRAINAGE: Poorly drained  
EROSION: None  
DISTURBANCE: Cultivated  
LABORATORY Nos: KRS T2694-2698. USP DK23A-E

### PROFILE DESCRIPTION

Ah	0-16 cm (16 cm)	Moist; dark yellowish brown (10YR 3/4) silty clay; common yellowish red (5YR 4/8) mottles along root channels, weakly developed fine to medium crumb structure; friable; sticky; non-plastic; many very fine and fine roots; former 'tiri/dogo' vegetation burnt (some black (2.5Y 2/0) patches); indistinct smooth boundary,
Bg1	16-27 cm (11 cm)	Moist; very dark greyish brown (10YR 3/2) silty clay; many distinct strong brown (7.5YR 5/8) to reddish yellow (7.5YR 7/8) mottles; massive; friable; slightly sticky; slightly plastic; common very fine and fine roots; distinct wavy boundary,
Bg2	27-40 cm (13 cm)	Moist; dark brown (10YR 3/3) to yellowish brown (10YR 5/6) silty clay; many strong brown to reddish yellow (7.5YR 5/8 to 6/8) mottles; massive; friable; many very fine and fine roots; few unweathered subrounded stones and boulders; distinct wavy boundary,
Cr1	40-128 cm (88 cm)	Moist; very dark grey (5Y 3/1) sandy loam; single grain; very friable; slightly sticky; common fine and medium dead roots ('tiri'); few unweathered subrounded boulders; indistinct wavy boundary,
Cr2	128-140+ cm (12 cm+)	Wet; black (2.5Y 3/0) very fine sandy loam; single grain; very friable; slightly sticky; few very fine and fine dead roots ('tiri'); few unweathered subrounded boulders.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lagilagi series**

REFERENCE: Lagilagi loamy sand (9b) and Lagilagi sandy clay (9c) defined by Twyford and Wright (1965) as formed from alluvium of high quartz content under a climate with a strong to moderate dry season.

Forms part of the Lato set.

In this survey the sandy clay or gritty clay type is the most extensive and is taken as the central concept for the series, with the loamy sand profile as a variant for it develops in association and can not be separated as a mappable unit.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Ustoxic Dystrypept, fine, kaolinitic, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Recent soil from alluvium with a strong to moderate dry season

#### INCLUDING MAPPING UNITS AND PHASES:

Lagilagi soils (63)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: They occur mainly in north-east Vanua Levu in the valley bottoms of rivers draining landscapes carved in rhyolites and in some narrow valleys in the Nadi area of Viti Levu.

PARENT ROCK: Silicified rocks and rhyolites.

PARENT MATERIAL: Deep weakly weathered alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Low terraces and valley floors.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-1°).

VEGETATION AND LAND USE: Extensively used for sugarcane and wet season rice.

RANGE OF ELEVATION: 2-10 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY CLASS: Moderate to slow.

FLOODING: For soil formed in the narrow valleys a one in two year return period for floods; elsewhere (larger valleys) a one in ten year return period for major floods.

EROSION: No erosion risk.

*Lagilagi*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of dark brown very friable gritty clay, of weak fine and medium nut with granular structure, and slightly sticky and plastic when moist; overlying 40 cm of dark brown friable mottled brown gritty clay, of moderate fine and medium nut structure, and slightly sticky and plastic when moist overlying 30 cm of dark greyish brown friable mottled dark yellowish brown, of weak medium blocky structure breaking to fine nut and crumb and sticky and plastic when moist; over 30 cm or more of greyish brown strongly mottled strong brown and yellowish red firm gritty clay, of weak medium blocky structure.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions made.
VARIANTS:	Loamy sand variant — better drained and less mottled in the upper horizons but otherwise morphologically similar.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Lagilagi soils are considered to be fertile soils with only a slight acidity and a high base status including high levels of potash.
LABORATORY Nos:	Not sampled for analysis.
SOIL LIMITATIONS:	Frequency of flooding and seasonal soil moisture deficits.

## Typifying Profile

SOIL NAME: Lagilagi soils  
PROFILE No.: DL45  
SITE LOCATION: Wainikoro River, Vanua Levu.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Alluvial terrace  
PARENT MATERIAL: Deep alluvium from acidic rocks.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 3.5 m  
MICRORELIEF: Smooth  
SITE VEGETATION: In fallow, recently ploughed.  
LAND USE: Intensive sugar cane cultivation.  
DRAINAGE: Moderately well drained. Water table at 75 cm (during wet season).  
EROSION: None  
DISTURBANCE: Ploughed  
LABORATORY Nos: Not sampled for analysis.

### PROFILE DESCRIPTION

Ap1	0-17 cm (17 cm)	Slightly moist; dark brown (10YR 3/3) gritty clay; weakly developed fine and medium nut structure with moderate fine granular structure; very friable; slightly sticky; plastic; few fine dead roots; diffuse smooth boundary,
Ap2	17-57 cm (40 cm)	Moist; dark brown (10YR 3/3) gritty clay; common medium faint brown (10YR 4/3) mottles; moderately developed fine and medium nut structure; friable slightly sticky; plastic; few fine dead roots; diffuse smooth boundary,
Bw1	57-86 cm (29 cm)	Moist; dark greyish brown (2.5Y 4/2) gritty clay; common fine distinct dark yellowish brown (10YR 4/4) mottles; weakly developed medium blocky breaking to weak fine nut and crumb structure; friable; sticky; plastic; distinct smooth boundary,
Bw2	86-116 cm+ (30 cm+)	Moist; greyish brown (2.5YR 5/2) gritty clay; profuse coarse distinct strong brown (7.5YR 5/6) and few fine distinct yellowish red (5YR 4/6) mottles; weakly developed medium blocky structure; firm; slightly sticky; plastic.





# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Lakeba series**

REFERENCE: Lakeba steepland stony and gravelly clay (87a) defined by Twyford and Wright (1965) as a moderately degraded soil from basic parent materials under poor grasses and scrub and formed under a climate with a moderate dry season. In this survey the climatic definition has been extended to include a strong dry season.

Forms part of the Lakeba set.

The central concept for Lakeba soils is retained in this survey.

### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Dystrypept, very-fine, kaolinitic, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Steepland soils related to or associated with ferruginous latosols with a moderate to strong dry season

### INCLUDED MAPPING UNITS AND SYMBOLS:

Lakeba soils, rolling phase (180D)	Lakeba soils, steep phase (180G)
Lakeba soils, strongly rolling phase (180E)	Lakeba soils, very steep phase (180H)
Lakeba soils, moderately steep phase (180F)	

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lakeba soils develop in Viti Levu in the Ba hills behind Natunuku, in a number of islands in the Lau and Lomaiviti Groups, and in a minor extent in Vanua Levu where they are thought to derive from Vuya soils through extensive burning.

PARENT ROCK: Andesites and less commonly basalts.

PARENT MATERIAL: Shallow strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Linear or convex backslopes and concave midslopes in very strongly moderately dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°) and very steep (>35°).

VEGETATION AND LAND USE: Mainly unused. Short rough grasses, stunted gasau, vasa, blue rat-tail, mimosa etc. i.e. not true talasiga vegetation but very poor plant associations.

Used for afforestation (*P. caribaea*) on Lakeba Island.

RANGE OF ELEVATION: 7-250 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-600 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

**Lakeba**

FLOODING:	Never floods
EROSION:	Sheet erosion and wind erosion where surface has been bared. Dependent on the nature of surface cover can be severely eroded by rilling.

### **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 25 cm of dark red friable gritty clay of moderately developed medium blocky structure with peds that become very hard when dry, plastic and sticky moist, and with a few weathered stones, overlying 25 cm of dark red firm clay of medium prismatic structure breaking to blocky, sticky and plastic moist and with a few weak clay cutans. The underlying strongly weathered rock is of variable colour (red and yellow hues), compact, firm, massive and sticky and plastic moist.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Profiles are moderately acid with very low phosphorus and organic carbon values. % base saturation values are at the low end of medium while the CEC values are high though dropping with depth. Exchangeable calcium is very low and exchangeable magnesium extremely high. Sodium is medium and potassium values very low.</p> <p>The fine earth fraction is dominated by clay (&gt;75%) with sand &lt;5% in all horizons.</p> <p>The mineralogical class is kaolinitic.</p> <p>The particle size family class is very fine.</p>
LABORATORY Nos:	SB9365A-E
SOIL LIMITATIONS:	Slope, profile shallowness, clayey textures, severe soil moisture deficits during the dry season; severe sheet and rill erosion potential, moderate soil acidity, and nutrient deficiencies of phosphorus, nitrogen and potassium.

## Typifying Profile

SOIL NAME: Lakeba soils, moderately steep phase.  
PROFILE No.: LK13  
SITE LOCATION: Map I III (Lakeba) 454600 E 117400 N. Lakeba Island, Lau Group.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Linear-concave midslope.  
PARENT MATERIAL: Thin colluvium derived from andesitic rocks over *in situ* andesite.  
SLOPE: 24°  
ASPECT: South  
ELEVATION: 30 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Fern dominated (*P. equisetum* and *D. linearis*) savanna with scattered *P. caribaea*..  
LAND USE: Exotic forestry  
DRAINAGE: Moderately well drained; moderate permeability; medium runoff.  
EROSION: Some sheet erosion.  
DISTURBANCE: None observed  
LABORATORY Nos: SB9365A-C

### PROFILE DESCRIPTION

Ah	0-27 cm (27 cm)	Dry; dusky red (2.5YR 3/2), moist; dark red (2.5YR 3/6) and rubbed dark reddish brown to dark red (2.5YR 3/5) slightly gritty clay; friable, firm <i>in situ</i> ; sticky; plastic; weakly developed fine prismatic with moderately developed secondary structure of medium blocky with crumb; abundant fine and medium roots; few casts; few strongly weathered stones (<2 cm); indistinct regular boundary,
Bw	27-52 cm (25 cm)	Dry; red (2.5YR 4/6), moist; dark red (2.5YR 3/6) and rubbed dark red (2.5YR 3/6) clay; firm; sticky; plastic; primary structure of moderately developed medium prismatic with a weakly developed secondary structure of coarse blocky; few faint discontinuous thin cutans; few roots restricted to vertical partings; few strongly weathered stones (<2 cm); charcoal flakes; distinct wavy boundary,
Cu1	52-66 cm (14 cm)	Moist; dark red (10R 3/6) and reddish yellow (7.5YR 6/6) clay; firm; sticky; plastic; massive breaking to single grain structure; shiny ped faces; rare fine root; strongly weathered <i>in situ</i> rock; distinct regular boundary,
Cu2	66-74 cm (9 cm)	Moist; red (10R 4/8) and brownish yellow (10YR 6/6) gritty clay; firm; sticky; plastic; massive breaking to single grain; shiny ped faces; strongly weathered <i>in situ</i> rock; distinct regular boundary,
Cu3	74-80 cm (6 cm)	Moist; brownish yellow (10YR 6/6) clay; firm; sticky; plastic; massive breaking to single grain; shiny structural faces; strongly weathered <i>in situ</i> rock.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lami series**

REFERENCE: Lami steepland rocky clay (82) defined by Twyford and Wright (1965) as formed from limestone materials under a climate with no dry season.

The central concept for Lami soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Lithic Eutropept, clayey-skeletal, smectitic, isohyperthermic
- (b) FAO: Eutric (Lithic) Cambisol
- (c) Twyford and Wright: Steepland soil related to or associated with latosolic soils with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Lami soils, strongly rolling phase (75E)
- Lami soils, moderately steep phase (75F)
- Lami soils, steep phase (75G)
- Lami soils, very steep phase (75H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs in a small area in the Lami district west of Suva city.

PARENT ROCK: Raised indurated coral limestone.

PARENT MATERIAL: Weakly weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION/LANDFORM: Convex to planar backslope and midslopes in strongly dissected hilly land.

SLOPE CLASS AND RANGE OF SLOPES: Strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°), and very steep (>35°).

VEGETATION AND LAND USE: Mostly under forest but occasionally used for subsistence food gardens followed by a long fallow period.

RANGE OF ELEVATION: 10 - 150 m

RAINFALL: Annual average range: 3,000-5,000 mm;  
dry season range: 800-1800 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY: Moderate

FLOODING: Never floods

EROSION: Severe sheet and rill erosion potential if forest cleared. Shallow landslides common.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 6 to 10 cm of very dark greyish brown firm clay loam of weak medium nut structure, and slightly sticky and slightly plastic when moist, overlying 20 cm of dark yellowish brown firm clay of weak medium nut structure, sticky and slightly plastic on very strongly cemented <i>in situ</i> limestone.  The upper horizons contain common to many angular boulders.
DIAGNOSTIC HORIZONS:	Umbric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions made.
VARIANTS:	Unnamed variant that occurs in isolated pockets. Deep profiles with redder hues typically show 12 cm of dark reddish brown firm clay of strong medium and fine blocky structure and sticky and plastic moist on 50 cm of red clay, of moderate coarse blocky structure and very sticky and very plastic when moist.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	This soil likely to be alkaline, of high base status with high exchangeable calcium but low exchangeable magnesium and potash.  The particle size family class is clayey-skeletal.  The mineralogy class is smectitic.
LABORATORY NOS:	Not sampled for analysis.
SOIL LIMITATIONS:	Shallow profile, surface and profile boulders, low potassium and organic matter reserves, and due to slight alkalinity likely trace elements deficiencies and imbalances.

## Typifying Profile

SOIL NAME: Lami soils, steep phase.  
PROFILE NO: VS 31  
SITE LOCATION: Kalekana Road, Draunibota, Suva; 70m from the coastline.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Convex hillslope in weakly dissected hill country.  
SLOPE: 30°  
ASPECT: South-west  
ELEVATION: 30 m  
MICRORELIEF: Disturbed seriously by micro landslips.  
SITE VEGETATION: Light forest (natural state).  
LAND USE: Housing and home gardening.  
DRAINAGE: Well drained  
EROSION: Shallow landslips  
DISTURBANCE: Subsistence gardens

### PROFILE DESCRIPTION

Ap	0-6 cm (6 cm)	Moist; very dark greyish brown (10YR 3/2) clay loam; weakly developed medium nut structure; firm; slightly sticky; slightly plastic; abundant fine and medium fibrous roots; common weakly weathered angular boulders; indistinct wavy boundary,
Bw	6-25 cm (19 cm)	Moist; dark yellowish brown (10YR 4/4) clay; weakly developed medium nut structure; firm; sticky; slightly plastic; abundant fine and medium roots; common weakly weathered angular boulders; distinct irregular boundary (lithic contact),
R	25-125 cm (100 cm)	Moist; very pale brown (10YR 8/4) very strongly cemented <i>in situ</i> rocks.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lato series**

REFERENCE: Lato stony sand (9a) defined by Twyford & Wright (1965) as formed from alluvium of high quartz content (from acidic rocks) under a climate with a strong to moderate dry season.

Forms part of the Lato set.

The central concept for Lato soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Fluventic Dystropept, sandy, mixed, isohyperthermic
- (b) FAO: Dystric Fluvisol
- (c) Twyford and Wright: Recent soil from alluvium with a strong to moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Lato soils (62)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Very restricted occurrence in the valley of Lato Creek and in one or two adjacent creeks which drain into the upper Sigatoka River.

PARENT ROCK: Highly silicified basaltic rocks.

PARENT MATERIAL: Weakly weathered sandy (quartz) alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Planar contemporary floodplains.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-1°).

VEGETATION AND LAND USE: Due to flood frequency remains in rough pasture with odd coconuts and scattered wild guava .

RANGE OF ELEVATION: 25-100 m

RAINFALL: Annual average range: 3,000-3,200 mm;  
dry season range: 600-800 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Excessively drained.

PERMEABILITY CLASS: Rapid

FLOODING: 1 in 2 year return period for floods depositing alluvium. 3 in 1 year return period for other floods.

EROSION: No erosion hazard.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically the profile has large pieces of quartz and comprises 90 cm or more of dark brown stony sand, of weak blocky structure easily breaking to single grain. The soil is neither plastic nor sticky when moist.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only one description available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Likely to be a fertile soil with only slight acidity and of high base status.  The mineralogy class is mixed.  The particle size family class is sandy.
LABORATORY Nos:	Not sampled for analysis.
SOIL LIMITATIONS:	Coarse textures; high frequency of flooding; seasonal soil moisture deficits; strong soil acidity; and nutrient deficiencies of phosphorus and nitrogen.

## Typifying Profile

SOIL NAME: Lato soils  
PROFILE No.: TW 21  
SITE LOCATION: Lato Creek, Sigatoka Valley, South West Viti Levu.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar floodplain surface.  
PARENT MATERIAL: Alluvium from acidic parent material.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 35 m  
MICRORELIEF: Level surface  
SITE VEGETATION: Miscellaneous weeds and grasses.  
LAND USE: Rough grazing  
DRAINAGE: Very well drained.  
EROSION: None. A depositional site.  
DISTURBANCE: None  
LABORATORY Nos: Not sampled for analysis.

### PROFILE DESCRIPTION

Ah	0-7 cm (7 cm)	Moist; dark greyish brown (10YR 4/2) sandy clay loam; fragile; weakly developed medium nut structure; many fine and medium roots; few unweathered medium gravels; indistinct boundary.
Bw	7-137 cm (130 cm)	Moist; dark brown (10YR 3/3) stony sand; very friable; weakly developed blocky structure breaking to single grain; non-plastic; non-sticky; many rounded fine and medium gravels; few fine fibrous roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lau series**

REFERENCE: The Lau gravelly clay (34c) and Lau hill soils (34cH) defined by Twyford & Wright (1965) as a talasiga soils on rolling and hilly land under fern and scrub (some nokonoko) from basic rocks under a climate with a strong dry season.

Forms part of the Tuva set.

This central concept for Lau soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Kandiuustox, clayey, kaolinitic, isohyperthermic
- (b) FAO: Rhodic Ferralsol
- (c) Twyford and Wright: Ferruginous latosol with a moderate to strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Lau soils, undulating phase (182B)
- Lau soils, easy rolling phase (182C)
- Lau soils, rolling phase (182D)
- Lau soils, strongly rolling phase (182E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lau soils are developed only in a few small areas of Viti Levu. They occur extensively on talasiga landscapes throughout the Lau group.

PARENT ROCK: Andesites and basalts.

PARENT MATERIAL: Deep strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Can develop on all slope positions but more commonly occurs in convex interfluvial and backslope positions.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Normally the vegetative cover comprises fern, molau, vasa and nokonoko.

RANGE OF ELEVATION: 50-200 m

RAINFALL: Annual average range: 1,800-2,800 mm;  
dry season range: 400-700 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate to severe sheet erosion and in some areas rilling (can be severe) particularly sites that have experienced repeated burning and have a depleted vegetative cover.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	The profile typically shows 25 cm of black or dusky red very friable silty clay loam of strongly developed fine nut or granular structure and often powdery when dry. This overlies 50 to 70 cm of dusky red or dark brown friable silt loam of moderately developed blocky structure and commonly with manganese concretions overlying massive varicoloured friable strongly weathered <i>in situ</i> rock with manganese veining. This horizon is normally encountered between a depth of 90 and 120 cm.
DIAGNOSTIC HORIZONS:	Ochric epipedon, oxic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Moderately acid surface horizon but becoming strongly acid below 30 cm depth. Both % base saturation and the CEC are high for the topsoil but drop off sharply to low values in horizons below 30 cm. Organic carbon values are medium for the topsoil and very low in the other horizons. Exchangeable calcium values are high in the topsoil and very low below; magnesium is very high in topsoil, high in B horizons and medium in the BC; and potassium while medium in topsoils drops to very low values below. Tamm's oxalate extractable aluminium is high and iron very high in the surface horizons dropping progressively to be medium in the C1.</p> <p>The particle size family class is clayey.</p> <p>The mineralogical class is kaolinitic.</p>
LABORATORY Nos:	SB9414A-E
SOIL LIMITATIONS:	Moderate permeability; severe sheet and rill erosion potential on slopes >2°; severe soil moisture deficits experienced during the dry season; moderate soil acidity; and nutrient deficiencies of nitrogen, phosphorus and potassium.

## Typifying Profile

SOIL NAME: Lau soils, strong rolling phase.  
PROFILE No.: VB16  
SITE LOCATION: Map 143 (Vanua Balavu) 178° 56' 37" E, 17° 17' 90" N. Vanua Balavu Island, Lau Group.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex interfluve  
PARENT MATERIAL: Colluvium derived from andesitic rocks overlying *in situ* andesite.  
SLOPE: 16°  
ASPECT: South-east  
ELEVATION: 150 m  
MICRORELIEF: Minor flattish (terrace-like but not continuous) elongate narrow surfaces.  
SITE VEGETATION: Reed dominated savanna with short Cyperaceous shrubs.  
LAND USE: Unused  
DRAINAGE: Well drained; moderate permeability; medium to rapid runoff.  
EROSION: Moderate sheet erosion.  
DISTURBANCE: Burning  
LABORATORY Nos: SB9414A-E

### PROFILE DESCRIPTION

Ah1	0-8 cm (8 cm)	Moist and dry black (5YR 2/1) rubbed dark reddish brown (5YR 2/2) silty clay loam; very friable; non sticky; non plastic; very strongly developed fine and medium nut with cast granular structure; abundant roots; many casts; indistinct regular boundary,
Ah2	8-27 cm (19 cm)	Moist and dry black (5YR 2/1) rubbed dark reddish brown (5YR 3/2) powdery silty clay loam; very friable; non sticky; non plastic; moderately developed fine nut with considerable crumb and some cast granular structure; abundant roots; many casts; indistinct regular boundary,
Bw1	27-74 cm (47 cm)	Moist dry and rubbed dark brown (7.5YR 3/2) silt loam; friable; non sticky; non plastic; primary structure of moderately developed coarse blocky with secondary structure of moderately developed medium nut and crumb structure; many roots; few to many casts; odd manganese concretions; indistinct regular boundary,
Bw2	74-95 cm (21 cm)	Moist dry and rubbed dark brown (7.5YR 4/4 and 3/2) silt loam; very friable non-sticky; non-plastic; massive breaking to weak to moderately developed fine nut with crumb structure; few roots; distinct regular boundary,
BC	95-110 cm (15 cm+)	Moist dark brown (7.5YR 4/4) and dark red (10R 3/6) yellowish brown (10YR 5/8) fine sandy loam; friable; firm <i>in situ</i> ; non-sticky; non-plastic; massive; few fine roots; manganese-rich bands; strongly weathered <i>in situ</i> rock.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Laucala series**

REFERENCE: Laucala gravelly loam (23c) and Laucala hill soils (23cH) defined by Twyford & Wright (1965) as latosolic soils from young basic scoria and formed under a climate with a weak dry season.

Forms part of the Waiqere set.

The central concept for Laucala soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Vitric Hapludand, medial, isohyperthermic
- (b) FAO: Ochric Andosol
- (c) Twyford and Wright: Latosolic soil with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Laucala soils, undulating phase (92B)
- Laucala soils, easy rolling phase (92C)
- Laucala soils, rolling phase (92D)
- Laucala soils, strongly rolling phase (92E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Eastern Laucala Island and in small patches on the plateau of Koro Island.

PARENT ROCK: Basalt

PARENT MATERIAL: Weakly weathered mixed ash and scoria.

#### PHYSIOGRAPHIC

POSITION/LANDFORM: Rolling land on the volcanic ring plains.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Coconuts, bananas and other subsistence food crops.

RANGE OF ELEVATION: 0-100 m

RAINFALL: Annual average range: 3,000-4,500 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,600-2,600 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Have experienced sheet erosion on the steeper slopes. Severe sheet and rill erosion potential on slopes >7°.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of dusky red to dark reddish brown friable stony and gravelly loam (sometimes heavier, to clay), of strong fine and very fine blocky, and slightly sticky moist, overlying 60 cm of reddish brown to yellowish red faintly mottled very dark grey brown friable gravelly loam, of massive structure and slightly plastic moist on reddish grey and black weathering scoria.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	Unnamed variant (Twyford & Wright 1965) with clayey textures and higher plasticity. Typically shows 25 cm of dark reddish brown friable stony clay, of strong fine and very fine blocky and nut structure, and moderately plastic moist, overlying 22 cm of dark reddish brown very friable stony gritty clay, of massive structure, and slightly sticky and strongly plastic moist, on dark reddish brown, reddish yellow and black weathering scoria.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Not analysed in this survey but chemical analysis in Twyford & Wright (1965) show Laucala soils to be slightly acid and of high base status with moderate acid soluble phosphate and high contents of exchangeable calcium, magnesium and potash. Undoubtedly have high phosphate retention properties.
LABORATORY Nos:	Not analysed
SOIL LIMITATIONS:	Moderately rapid permeability; high friability that gives an erosion hazard if intensively cultivated in the absence of soil conservation measures; and nutrient deficiencies of nitrogen, and high phosphate retention properties.

## Typifying Profile

SOIL NAME: Laucala soils  
PROFILE No.: TW 40  
SITE LOCATION: North coast 100 m inland of coastal sand strip (Nuku soils).

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar mid-slope position.  
PARENT MATERIAL: Weakly weathered *in situ* basaltic ash and scoria.  
SLOPE: 6°  
ASPECT: North  
ELEVATION: 25 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Coconuts with ground cover of miscellaneous weeds.  
LAND USE: Coconut plantation and food crops (bananas, dalo, yaqona).  
DRAINAGE: Well drained  
EROSION: Sheet erosion  
DISTURBANCE: Non-mechanical cultivation.  
LABORATORY Nos: Not sampled for analysis.

### PROFILE DESCRIPTION

Ah	0-15 cm (15 cm)	Moist; dusky red (2.5YR 3/2) to dark reddish brown (2.5YR 3/4) stony and gravelly loam; strongly developed fine and very fine blocky structure; friable; slightly sticky; many fine and medium fibrous roots; distinct smooth boundary,
Bw	15-75 cm (60 cm)	Moist; reddish brown (5YR 5/4) to yellowish red (5YR 5/6) gravelly loam; few faint very dark greyish brown (10YR 3/2) mottles; massive structure breaking to fine granules; friable; plastic; distinct smooth boundary,
BC	75-125 cm (50 cm+)	Reddish grey (5YR 5/2) and black (5YR 2/1) weathering scoria.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lautoka series**

REFERENCE: The Lautoka clay (48a) defined by Twyford & Wright (1965) as a weak to moderately mottled gley soil associated with latosols and formed under a climate with a moderate to strong dry season.

The central concept for Lautoka soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Udic Argiustoll, very fine, kaolinitic, isohyperthermic
- (b) FAO: Luvic Phaeozem
- (c) Twyford and Wright: Humic latosol with a moderate to strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Lautoka soils (73)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lautoka soils occur along the west coast of Viti Levu between Nadi and Drasa.

PARENT ROCK: Andesite

PARENT MATERIAL: Strongly weathered mixed outwash colluvial (some alluvia).

PHYSIOGRAPHIC POSITION/LANDFORM: Broad outwash coalescing fans and low terraces.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: Intensive sugar cane production with smaller areas in pulse crops and rainfed rice.

RANGE OF ELEVATION: 3-20 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained to imperfectly drained.

PERMEABILITY CLASS: Moderately slow

FLOODING: Return period of 1 in 5 years.

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 25 cm of very dark greyish brown faintly mottled yellowish red clay loam, of weakly developed fine nut and granular structure, and firm, overlying 50 cm of very dark grey mottled reddish brown clay loam, of weakly developed medium blocky structure, and firm, overlying more than 50 cm of reddish brown clay, of massive structure breaking to weakly developed very fine blocky, very firm and with dark greyish brown clay coatings to ped faces.
DIAGNOSTIC HORIZONS:	Mollic epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 3 profile observations made.
VARIANTS:	Lautoka gleyed subsoil variant: Imperfectly drained soils with grey mottles (chroma 2) in subsoils (Soil Taxonomy classification is Aquic Argiustoll, very fine, kaolinitic).
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Organic C % is low in A horizons and very low in B horizons. %BS high in A horizon and medium to high in B. Exchangeable Ca very high in A, high in B horizons; Mg high in A and high to very high in B horizons; K low in A and very low in B horizons. CEC high throughout profile. %BS &gt;35 below 1 m depth and assumed to be 35-50% at 1.8 m below surface.</p> <p>The particle size family class is very fine.</p> <p>The mineralogy class is kaolinitic.</p>
LABORATORY Nos:	SB9658A-C KRS R2701-2703 (Inclusive)
SOIL LIMITATIONS:	Heavy soil textures; seasonal (wet season) wetness; dry season soil moisture deficits; and potassium deficiencies.

## Typifying Profile

SOIL NAME: Lautoka soils  
PROFILE No.: L74  
SITE LOCATION: Refer soil map of Legalega Agricultural Research Station (Laffan, 1988).

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Low terrace adjacent to streams.  
PARENT MATERIAL: Strongly weathered colluvium.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 5 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Grass species and weeds.  
LAND USE: Extensive grazing (cattle and goats).  
DRAINAGE: Moderately well drained to imperfectly drained.  
EROSION: None observed  
DISTURBANCE: None observed  
LABORATORY Nos: K2701-2703 (inclusive)  
SB9658A-C

### PROFILE DESCRIPTION

Lautoka soils

Ap	0-25 cm (25 cm)	Slightly moist; very dark greyish brown (10YR 3/2) (moist, ped face and rubbed colours) clay loam; few fine distinct yellowish red (5YR 4/6) mottles; firm; non-sticky; non-plastic; weakly developed very fine nut structure and weakly developed fine granular structure; common very fine roots; indistinct smooth boundary,
Bwg	25-75 cm (50 cm)	Slightly moist; very dark grey (10YR 3/1) (moist, ped face and rubbed colours) clay loam; common fine faint reddish brown (5YR 4/4) mottles; firm; weakly developed medium blocky structure; non-sticky; non-plastic; distinct smooth boundary,
Bt	75-120+ cm (45 cm+)	Slightly moist; reddish brown (moist, ped face and rubbed colours) clay; very firm; non-sticky; non-plastic; massive breaking to weakly developed very fine blocky structure; common distinct dark greyish brown (2.5Y 4/2) clay cutans.





# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Lawai series**

REFERENCE: New soil series introduced in the detailed soil survey of Sigatoka Agricultural Research Station (Rijkse, 1990) to include soils formed on the crested levee surface which are subjected to 'fresh' accretions of sediment and therefore have paleosols prominent in most profiles. Textures are coarser than for Sigatoka series in which Lawai series was previously included in the soil survey of Fiji (Twyford & Wright, 1965).

Name derived from Lawai village 4 km south of Sigatoka Agricultural Research Station.

### CLASSIFICATION:

- (a) Soil Taxonomy: Fluventic Ustropept, loamy, mixed, isohyperthermic
- (b) FAO: Eutric Fluvisol
- (c) Twyford and Wright: Recent soil from alluvium with a moderate to strong dry season

### INCLUDED MAPPING UNITS AND SYMBOLS:

Lawai soils, flat to gently undulating phase (23A)  
Lawai soils, undulating phase (23B)

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Restricted to the intermediate terraces of the Sigatoka River system.

PARENT ROCK: Includes argillite, sandstone, andesite, probably basalts and hydrothermally altered rocks of basic and intermediate composition.

PARENT MATERIAL: Deeply weakly weathered riverine alluvium.

### PHYSIOGRAPHIC

POSITION/LANDFORM: Narrow intermediate terrace surface.

### SLOPE CLASS

AND RANGE OF SLOPES: Flat to gently undulating (0-3°), and undulating (4-7°).

VEGETATION AND LAND USE: Palms and tree crops with grass ground cover, and in places root crops (taro, cassava).

RANGE OF ELEVATION: 3-18 m

RAINFALL: Annual average range: 2,000-3,200 mm;  
dry season range: 400-600 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthrmic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Rapid

FLOODING: Infrequent (1 in 5 year return period) for floods depositing sediment. Water may pond for 2-5 days following each event.

EROSION: Moderate bank corrosion in places adjacent to the Sigatoka River.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically show 30 cm of friable dark brown silt loam, of weakly developed nut structure, overlying 15 cm of dark brown to very dark greyish brown friable silt loam to fine sandy loam, of weakly developed fine nut structure, overlying olive brown sandy loam subsoils of weakly developed structures and containing paleosols. The deep topsoils are indicative of infrequent flooding.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Nasau series: Flood frequently, have coarser textures (sandy loam to sand) and occur on the lower terrace surface of rivers and major streams.  Sigatoka series: Rarely flood; have heavier textures (clay loam to clay); the paleosols, if present, are not well expressed; and occur on the higher terrace surface of rivers and major streams.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	High base saturation and the soil is near neutral to slightly acid. Profiles have high exchangeable calcium and magnesium, exchangeable potassium is high in the upper 30 cm but drops to very low from 35 to 65 cm depth and low to medium below that depth. Exchangeable sodium is low in the upper 10 cm and medium to low beneath that depth.
LABORATORY Nos:	USP SIG2 A-G
SOIL LIMITATIONS:	Due to coarse subsoil textures the water holding capacity may be too low to sustain shallow rooting plants during the dry season; organic matter status is low and deficient in nitrogen and potassium (below 20 cm depth).

## Typifying Profile

SOIL NAME: Lawai soils  
PROFILE No.: SIG2  
SITE LOCATION: Refer to soil map of Sigatoka Agricultural Research Station (Rijkse, 1990).  
Grid reference - Sheet: Viti Levu 16 (1:50 000) 987E 576N.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: River terrace  
PARENT MATERIAL: Alluvium derived from basic and intermediate rocks.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 6 m  
MICRORELIEF: Uniformly even  
SITE VEGETATION: Palms with grass cover.  
LAND USE: Rough grazing, some vegetables (dalo, cassava).  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None observed  
LABORATORY Nos: USP SIG2 A-G

### PROFILE DESCRIPTION

Ap1	0-19 cm (19 cm)	Dark brown (10YR 3/3) sandy loam; friable; non-sticky non-plastic; moderately developed fine and medium nut structure; many fine and medium roots; indistinct smooth boundary,
Ap2	19-33 cm (14 cm)	Dark brown (10YR 3/3) sandy loam; friable; non-sticky; non-plastic; weakly developed fine and medium nut structure; many fine and medium roots; indistinct smooth boundary,
Ap3	33-49 cm (16 cm)	Very dark greyish brown (10YR 3/2) and 20% yellowish brown (10YR 5/4) loam; few; faint dark reddish brown (2.5YR 3/4) mottles; friable; non-sticky; non-plastic; weakly developed fine nut structure; common fine and medium roots; indistinct smooth boundary,
C	49-70 cm (21 cm)	Olive brown (2.5Y 4/4) with 10% very dark greyish brown (10YR 3/2) worm casts; fine sandy loam; friable; non-sticky; non-plastic; single grain to very weakly developed cast granular structure; common fine and medium roots; distinct smooth boundary,
bAh1	70-91 cm (21 cm)	Very dark greyish brown (10YR 3/2) loam; friable; non-sticky; non-plastic; weakly developed fine and medium nut structure; common medium roots; indistinct smooth boundary,
bAh2	91-111 cm (20 cm)	Very dark greyish brown (2.5Y 3/2) loam; friable; non-sticky; non-plastic; weakly developed fine crumb structure; common medium roots; indistinct smooth boundary,

bC

111-141 cm  
(30 cm+)

Dark brown (10YR 3/3) fine sandy loam; loose; non-plastic; non-sticky;  
single grain; few medium roots.

# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Ledrutua series**

REFERENCE: Ledrutua steepland stony silty clay (70) defined by Twyford & Wright (1965) as steepland soils related to and associated with nigrescent soils developed from silicified marls, andesites and basalts under a climate with a moderate dry season.

The physical and chemical properties as described by Twyford & Wright (1965) for the central concept for Ledrutua series are retained in this survey but the climate under which the series forms is now confined to the ustic moisture regime.

### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Haplustoll, fine over loamy-skeletal, smectitic, isohyperthermic
- (b) FAO: Haplic Kastanozem
- (c) Twyford and Wright: Nigrescent soils with a strong dry season

### INCLUDED MAPPING UNITS AND SYMBOLS:

Ledrutua soils, easy rolling phase (208C)	Ledrutua soils, moderately steep phase (208F)
Ledrutua soils, rolling phase (208D)	Ledrutua soils, steep phase (208G)
Ledrutua soils, strongly rolling phase (208E)	Ledrutua soils, very steep phase (208H)

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Ledrutua soils are a widespread soil in south-western Viti Levu. They occur extensively, stretching inland from Korolevu to the mouth of the Sigatoka river. Ledrutua soils also occur on the west side of the Sigatoka river inland from the coast where the climate is not too dry. They are also mapped in the upper Sigatoka near Vunatoto.

PARENT ROCK: Solicified basalts, andesites, tufts and marls.

PARENT MATERIAL: Weakly weathered *in situ* boulders and gravel deposits.

PHYSIOGRAPHIC POSITION / LANDFORM: Rolling ridges and shoulders, convex backslopes and planar midslopes in moderately dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°) and very steep (>35°).

VEGETATION AND LAND USE: In their natural state they are mainly covered in guava, gasau and in places nokonoko. Elsewhere (e.g. Yalavou cattle station), they have been put into improved grasses for grazing.

RANGE OF ELEVATION: 30 - 600 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-600 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

**Ledrutua**

EROSION: Slight to moderate sheet and rill erosion potential.

### **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES: Typically shows 20 cm of black slightly stony silt loam, of moderate to strongly developed nut with granular structure, and friable, overlying 15-20 cm of black stony silty clay loam, of moderately developed medium blocky structure, friable, and containing many weakly weathered stones, overlying 30 cm of varicoloured (yellow, yellow brown, and very pale brown) bouldery and sandy silt loam, of massive breaking to weak blocky structure, firm, and containing abundant stones and boulders, on very bouldery fine sand (*in situ* gravel formation).

DIAGNOSTIC HORIZONS: Mollic epipedon, cambic horizon.

RANGE OF PROFILE FEATURES: Not applicable. Apart from some differences in horizon thickness most profiles show little variation for that described above.

VARIANTS: None recognised

SIMILAR SOILS AND DISTINGUISHING FEATURES: None recognised

GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES: Analyses show moderately acid pH to 38 cm depth becoming near neutral below this; carbon and nitrogen have medium values to a depth of 38 cm; available phosphorus is very low; % base saturation is very high throughout the profile; CEC values are high to very high; and exchangeable calcium is high becoming very high below 38 cm; magnesium is very high, sodium high and potassium very low.

The particle size family class is fine over loamy-skeletal.

The mineralogical class is smectitic.

LABORATORY Nos: KRS V 189-191 (inclusive)

SOIL LIMITATIONS: Shallowness and stoniness of profiles; very severe soil moisture deficits experienced during the dry season; soil erosion risk on slopes and low available phosphorus and potassium.

## Typifying Profile

SOIL NAME: Ledrutua soils, moderately steep phase.

PROFILE No.: AP06

SITE LOCATION: Yalavou

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Convex backslope in strongly rolling hill country.

PARENT MATERIAL: Bouldery and gravelly comprising rocks of mixed (granite, diorite, some basalt etc) lithologies.

SLOPE: 20°

ASPECT: South

ELEVATION: 75 m

MICRORELIEF: Smooth

SITE VEGETATION: Mission grass and desmodium.

LAND USE: Grazing for cattle.

DRAINAGE: Well drained

EROSION: None observed

DISTURBANCE: None observed

LABORATORY Nos: KRS V 189-191 (inclusive)

### PROFILE DESCRIPTION

Ap1	0-20 cm (20 cm)	Slightly moist; black (10YR 2/1) silt loam; moderate to strongly developed nut and granular structure; friable; many very fine and fine roots; few weakly weathered subangular stones; indistinct smooth boundary,
Ap2	20-38 cm (18 cm)	Slightly moist; black (10YR 2/1) stony silty clay loam; weak to moderately developed medium blocky structure with moderate medium granular; friable; many fine and very fine roots; many weakly weathered subangular stones; distinct smooth boundary,
Bw	38-68 cm (30 cm)	Slightly moist; variable colours of yellowish brown (10YR 5/6), very pale brown (10YR 7/3), yellow (10YR 7/6) bouldery sandy silt loam; massive breaking to weakly developed medium blocky structure; firm; few very fine roots; abundant weak to moderately weathered rounded and subrounded stones and boulders; diffuse smooth boundary,
C	68-200 cm (cm)	Slightly moist; variable colours; very bouldery fine sand; massive breaking to single grain; firm; profuse moderately weathered rounded and subrounded boulders and stones.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lekutu series**

REFERENCE: Lekutu gravelly silt loam (35b) and Lekutu hill soils (35bH) defined by Twyford & Wright (1965) as strongly degraded soils under reeds and fern, etc. from basic rocks on rolling and hilly land and formed under a climate with a strong dry season.

Forms part of the Raviravi set.

The central concept for Lekutu soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Ustorthent, fine-loamy, kaolinitic, isohyperthermic
- (b) FAO: Dystric Regosol
- (c) Twyford and Wright: Ferruginous latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Lekutu soils, easy rolling phase (194C)

Lekutu soils, strongly rolling phase (194E)

Lekutu soils, rolling phase (194D)

Lekutu soils, moderately steep phase (194F)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lekutu soils occur mainly in Vanua Levu and in a few locations in Viti Levu where they are associated with shallow unweathered basalt flows.

PARENT ROCK: Basalt

PARENT MATERIAL: Very strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Broad planar gently undulating slopes on plateau 'like' surface becoming convex and steeper toward the edges of the surface.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°) and moderately steep (21-25°).

VEGETATION AND LAND USE: More commonly support 'talasiga' vegetation. Some areas have been planted out in *Pinus caribaea*. Where profiles are deeper cassava may be grown but always followed by long bush fallow.

RANGE OF ELEVATION: 25-200 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-600 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Have experienced severe topsoil losses in the past as a result of repeated burning. Very severe sheet and rill erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically show 10 cm of brown very friable silt loam, of strongly developed fine nut structure overlying more than 70 cm of firm varicoloured (pinkish grey, light reddish brown and reddish yellow) massive and strongly weathered <i>in situ</i> rock, of firm consistence breaking easily to single grains of fine sandy loam texture. Strongly weathered basalt boulders are common throughout the profile as are ironstone nodular surface erosion pavements on the more gentle slopes.  Profiles are of high friability but neither sticky or plastic.
DIAGNOSTIC HORIZONS:	Ochric epipedon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 3 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be strongly acid; nitrogen and organic carbon values are low in the topsoil (0-8 cm) and extremely low below this horizon; very low available phosphorus; % base saturation is very low; CEC is medium; exchangeable calcium is very low, sodium medium, potassium very low, and magnesium medium in the topsoil and very low below it; they have high exchange acidity and aluminium is significant in the exchange complex.  The particle size family class is fine loamy.  The mineralogical class is kaolinitic..
LABORATORY Nos:	USP LOL3A-B
SOIL LIMITATIONS:	Profile shallowness; severe soil moisture deficits experienced in the dry season; severe past erosion and very severe potential for sheet and rill erosion; strong soil acidity; nutrient deficiencies of nitrogen, phosphorus and potassium and aluminium toxicity.

## Typifying Profile

SOIL NAME: Lekutu soils, easy rolling phase.  
PROFILE No.: LOL3  
SITE LOCATION: P70/II/1 Lololo Forest, Ba Province.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar toeslope position on edge of plateau like surface in easy rolling land.  
PARENT MATERIAL: Strongly weathered *in situ* basic agglomerate.  
SLOPE: 11°  
ASPECT: North-west  
ELEVATION: 150 m  
MICRORELIEF: Very uneven. Surface nodular ironstones and boulders.  
SITE VEGETATION: Sparse mission grass and kawaka under 13 year old *Pinus caribaea*.  
LAND USE: Exotic forestry  
DRAINAGE: Well drained  
EROSION: Severe past erosion. 'Badland' landscape.  
DISTURBANCE: Past erosion  
LABORATORY Nos: USP LOL3A-B

### PROFILE DESCRIPTION

Ah	0-8 cm (8 cm)	Dry; moist brown (7.5YR 5/4) and dry light brown (7.5YR 6/4) silt loam; strongly developed fine nut structure; very friable; slightly sticky; non-plastic; common ironstone nodules; abundant fine medium and coarse roots; sharp; smooth boundary,
C	8-100 cm+ (92 cm+)	Dry; moist colour variegated 80% pinkish grey (7.5YR 7/2) 10% light reddish brown (5YR 6/4) and 10% reddish yellow (7.5YR 6/8) very fine plastic; many strongly weathered varicoloured boulders and stones; few fine roots; strongly weathered <i>in situ</i> rock.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lewa series**

REFERENCE: Lewa red and brown clays (61) defined by Twyford & Wright (1965) as upland soils from basic parent materials on rolling land supporting talasiga vegetation and formed under a climate with a moderate to weak dry season. In this survey Lewa series are restricted to the udic soil moisture regime otherwise the central concept for Lewa soils is retained.

CLASSIFICATION:

- (a) Soil Taxonomy: Oxic Dystropept, fine, kaolinitic, isothermic
- (b) FAO: Dystric Cambisol
- © Twyford and Wright: Upland ferruginous latosol with a weak dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Lewa soils, flat to gently undulating phase (221A)	Lewa soils, strongly rolling phase (221E)
Lewa soils, undulating phase (221B)	Lewa soils, moderately steep phase (221F)
Lewa soils, easy rolling phase (221C)	Lewa soils, steep phase (221G)
Lewa soils, rolling phase (221D)	Lewa soils, very steep phase (221H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lewa soils are mainly found along terraces along the Nukunuku stream and around Lewa village and also on the Nausori highlands in Viti Levu.

PARENT ROCK: Basic rocks

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Rolling and undulating country in the uplands.

SLOPE CLASS AND RANGE OF SLOPES: All slope classes from flat to gently undulating (0-3°) to very steep (>35°)

VEGETATION AND LAND USE: Talasiga vegetation. Some places planted in exotic forest species (Lewa soils lie close to the boundary between forest and gasau country). Are used for subsistence root crops (mainly cassava) followed by 15 to 20 years of fallow.

RANGE OF ELEVATION: 900-1050 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 600-800 mm;  
wet season range: 2,000-2,800 mm.

TEMPERATURE: Mean annual:

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Very severe erosion potential if cultivated (without soil conservation measures) on slopes >7°.

## **Morphological and Chemical Properties**

<b>CHARACTERISTIC PROFILE FEATURES:</b>	Typically shows 30 cm of dark brown friable clay loam of strong fine granular structure with common ironstone nodules overlying 35 cm of dark reddish brown firm clay of weak coarse nut structure and commonly with weathered rocks on 5 cm of varicoloured firm and massive clay.
<b>DIAGNOSTIC HORIZONS:</b>	Ochric epipedon, cambic horizon.
<b>RANGE OF PROFILE FEATURES:</b>	Not applicable. Only 2 profile descriptions made.
<b>VARIANTS:</b>	Unnamed variant of redder hues. Typically shows 15 cm of reddish brown very friable clay with a strong fine nut and very fine granular structure, on 25 cm of red friable clay, of strong medium and fine blocky structure breaking easily to very fine fragments, very hard to dig, on red friable clay with moderate coarse blocky structure breaking easily to fine angular fragments and very hard to dig.
<b>SIMILAR SOILS AND DISTINGUISHING FEATURES:</b>	None recognised
<b>GENERAL CHEMICAL, PHYSICAL &amp; MINERALOGICAL PROPERTIES:</b>	Analysis shows the soil to be strongly acid; organic carbon and nitrogen values are low in the topsoil (0-30 cm) and of very low values below it; very low available phosphorus; % base saturation values are very low; CEC values are low throughout; exchange calcium, magnesium and potassium values are very low in all horizons
<b>LABORATORY Nos:</b>	KRS V690-692 (inclusive)
<b>SOIL LIMITATIONS:</b>	Severe erosion potential; soil acidity; and nutrient deficiencies nitrogen, phosphorus and potassium .

## Typifying Profile

SOIL NAME: Lewa soils, undulating phase.  
PROFILE No.: VS112  
SITE LOCATION: Lewa valley, Nadarivatu, 2500 m west of Nadrenituka trig station.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Convex toeslope in gently rolling land.  
PARENT MATERIAL: Strongly weathered *in situ* basic rock.  
SLOPE: 5°  
ASPECT: West  
ELEVATION: 620 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Just harvested for *Pinus caribaea* crop. Remaining vegetation includes guava, prickly solanum, reeds, mission grass, and blue rats tail.  
LAND USE: Exotic forest  
DRAINAGE: Well drained  
EROSION: Some past sheet erosion.  
DISTURBANCE: None  
LABORATORY Nos: KRS V690-692 (inclusive)

### PROFILE DESCRIPTION

Lewa soils, undulating phase

Ap	0-30 cm (30 cm)	Moist, dark brown (7.5YR 3/4) clay loam; strongly developed fine granular structure; friable; non-sticky; common fine ironstone nodules; common large pores; common fine fibrous roots; distinct smooth boundary,
Bw	30-65 cm (35 cm)	Moist; dark reddish brown (5YR 3/4) clay; weakly developed coarse nut structure; firm; slightly sticky; common weathered large rocks; few fine pores; few fine fibrous roots; diffuse smooth boundary,
BC	65-120cm (55 cm)	Moist; varicoloured dark yellowish brown (10YR 4/6) yellowish red (5YR 5/8) dark grey (5Y 4/1) clay; massive; firm; sticky; common weathered large rocks; few fine pores; few fine roots.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lobau series**

REFERENCE: Lobau steepland clay (83f) as described by Twyford & Wright (1965) as a steepland soil from andesitic tuffs and marls formed under a climate with no dry season.

Forms part of the Visa set. The central concept for Lobau soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Dystropept, fine, ferruginous, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Steepland soil related to or associated with humic latosols with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Lobau soils, easy rolling phase (124C)	Lobau soils, moderately steep phase (124F)
Lobau soils, rolling phase (124D)	Lobau soils, steep phase (124G)
Lobau soils, strongly rolling phase (124E)	Lobau soils, very steep phase (124H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lobau soils are widespread in Viti Levu. They occur in areas west of the Suva peninsula in the hills of the upper Waimanu and up Wainibuka valleys. Lobau soils are common in Berata and near Korovou, Tailevu province.

PARENT ROCK: Andesitic tuffs and marls.

PARENT MATERIAL: Strongly weathered colluvium over *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Concave and planar hillsides of moderate and strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-26°), steep (27-35°), and very steep (>35°).

VEGETATION AND LAND USE: Majority under forest. Where cleared used for subsistence root crops followed by bush fallow, or dairying particularly in Tailevu/Nataisiri Provinces.

RANGE OF ELEVATION: 20-350 m

RAINFALL: Annual average range: 3,000-5,000 mm;  
dry season range: 800-1,800 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Medium

FLOODING: Never floods

EROSION: Severe sheet, rill and debris slide erosion potential where forest removed.

## Morphological And Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of yellowish red friable silty clay, of weakly developed fine and medium nut structure, overlying 30 cm of red friable clay of weak coarse blocky structure, and sticky and plastic moist, overlying 90 cm of red very friable stony silty clay with rock structures preserved, massive and with prominent manganese cutans to the stones. Strongly weathered stones are present in most horizons.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Lobau series have a Ah, Bt, Bw, BC horizon sequence.  The A horizon thickness ranges from 15-22 cm; colours include yellowish red (5YR 4/6, 4/8) and reddish brown (5YR 4/3, 4/4); textures are clay, clay loam or silty clay loam; structures may be moderate or strong, very fine, fine or medium nut or blocky; and consistence may be friable or friable to firm.  The Bt horizon thickness ranges from 30 to 45 cm; its colours are red (2.5YR 4/6, 4/8, 5/6); structures may be weak or moderate, medium or coarse blocky commonly breaking to finer structures; and faint clay cutans may or may not be present.  The Bw horizon thickness ranges from 50 to 75 cm; its colours are red (2.5YR 4/6, 4/8, 5/6); textures include silty clay, clay loam and clay; structures may be massive or weak coarse or medium blocky; consistence is either friable or very friable; strongly weathered stones range in abundance from many to profuse and rock structures are commonly preserved.  The BC horizon thickness ranges from 30 to 200 cm; colours are red (2.5YR 4/6, 4/8, 5/6 and 10R 4/6, 4/8, 5/6); textures are silty clay, clay loam and clay and always stony (strongly weathered manganese coated); and consistence is either very friable or friable.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis show the soil to be strongly acid; organic carbon and nitrogen values are low in the topsoil (0-18 cm) and of very low values in the other horizons; the C/N ratios are very low; available phosphorus is extremely low throughout the profile; CEC is medium; % base saturation is low in the topsoil and very low in the other horizons; sodium is medium, potassium very low, calcium low in the topsoil and very low below this horizon; and magnesium is medium in the topsoil and of low values below this horizon.  The particle size family class is fine.  The mineralogical class is ferruginous.
LABORATORY Nos:	KRS V155-158
SOIL LIMITATIONS:	Slope; very severe soil erosion potential on all slopes when forest cover removed; strong soil acidity; and severe nutrient deficiencies of nitrogen, potassium and phosphorus.

## Typifying Profile

SOIL NAME: Lobau soils, moderately steep phase.  
PROFILE No.: VS13  
SITE LOCATION: 1.5 km inland from Mau Village on the Namosi Road.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar lower midslope in strongly rolling and steep hill country.  
PARENT MATERIAL: Strongly weathered colluvium from andesitic tuffs and marls over *in situ* rock.  
SLOPE: 25°  
ASPECT: North-east  
ELEVATION: 45 m  
MICRORELIEF: Terracettes  
SITE VEGETATION: Batiki blue grass and ferns.  
LAND USE: Dairying  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: KRS V155-158

### PROFILE DESCRIPTION

Ah	0-18 cm (18 cm)	Moist; yellowish red (5YR 4/6) silty clay; moderately developed fine and medium nut structure plus weak fine crumb structure; friable; slightly sticky; slightly plastic; common very fine and fine roots; few strongly weathered subangular stones; distinct smooth boundary,
Bt	18-50 cm (32 cm)	Moist; red (2.5YR 4/6) clay; weakly developed coarse blocky structure breaking to weak fine blocky structure; friable; sticky; plastic; few very fine roots; few strongly weathered subangular stones; distinct smooth boundary,
Bw	50-110 cm (60 cm)	Moist; red (2.5YR 4/8) stony silty clay; massive with rock structure preserved; very friable; sticky; slightly plastic; many prominent black (2.5YR N2/0) manganese coatings to stones; no roots; profuse strongly weathered angular stones and gravels; indistinct smooth boundary,
BC	110-140 cm (30 cm+)	Moist, red (10R 4/8) stony silty clay; massive with rock structure preserved; very friable; sticky; slightly plastic; many prominent black (2.5YR N2/0) manganese coatings to stones; no roots; profuse strongly weathered angular stones and gravels.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lodoni series**

REFERENCE: Lodoni clay (29d) and Lodoni hill soils (29dH) defined by Twyford & Wright (1965) as formed from basalt, basic andesite and basic tuffs under a climate with a weak dry season.

Forms part of the Lomaiviti set.

The central concept for Lodoni series is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Humic Hapludult, clayey, ferruginous, isohyperthermic
- (b) FAO: Orthic Acrisol
- (c) Twyford and Wright: Humic latosol, with weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Lodoni soils, undulating phase (168B)	Lodoni soils, moderately steep phase (168F)
Lodoni soils, easy rolling phase (168C)	Lodoni soils, steep phase (168G)
Lodoni soils, rolling phase (168D)	Lodoni soils, very steep phase (168H)
Lodoni soils, strongly rolling phase (168E)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lodoni soils occur in the Lodoni, upper Sigatoka and upper Ba areas of Viti Levu.

PARENT ROCK: Basalt and basic andesite.

PARENT MATERIAL: Strongly weathered colluvium over weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION/LANDFORM: All slope position on rolling country.

#### SLOPE CLASS

AND RANGE OF SLOPES: All slope classes from undulating phase (4-7°) through to very steep (>35°)

VEGETATION AND LAND USE: Scrub and gasau. Some still under virgin forest. Used for subsistence root crops.

RANGE OF ELEVATION: 30-200 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Medium

FLOODING: Never floods

EROSION: Moderate sheet and rill erosion potential when forest cleared and cultivated. Potential for soil slips and small debris slides on slopes > 15°.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of dark reddish brown friable clay loam, of strongly developed medium nut structure, overlying 35 cm of dark red friable (tending firm) clay of weakly developed coarse prismatic structure breaking to blocky, sticky and plastic moist, and with clay cutans to ped faces, overlying 50 cm of red firm clay of prismatic structure breaking to medium blocky, sticky and plastic moist, and with clay cutans to ped faces on more than 50 cm of yellowish red firm silty clay, of massive structure breaking to single grain, with clay cutans and common weathered boulders.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Lodoni series have an A, Bt1, Bt2, C horizon sequence.  The A horizon thickness ranges from 15-20 cm; its colours include dark reddish brown (5YR 3/3, 3/4), dark brown (7.5YR 4/4, 10YR 4/3) and yellowish brown (10YR 5/4); textures are clay or clay loam; and structures are moderate or strong, fine or medium, nut or granular.  The Bt1 horizon thickness ranges from 30-40 cm; its colours include yellowish red (5YR 4/6, 5/6) reddish yellow (5YR 6/6, 6/8), dark red (2.5YR 3/6) and red (2.5YR 4/6, 4/8, 5/8); structures include coarse prismatic breaking to moderate fine, medium and coarse nut or blocky.  The Bt2 horizon thickness ranges from 30-50 cm; its colours are as described for the Bt1; and structures are weak or moderate fine or medium nut or blocky.  The C horizon colours include yellowish red (5YR 4/6, 5/6) and reddish yellow (5YR 6/6, 6/8); textures are silt loam, silty clay or silty clay loam with few, common or many strongly weathered boulders, and with or without alumina nodules.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be extremely acid; organic carbon and nitrogen have medium values in the topsoil (0-16 cm) and very low below this; available phosphorus is very low; CEC is medium; % base saturation is very low; exchangeable calcium is low in the topsoil and of very low values in the other horizons; magnesium is medium in the topsoil and low below; sodium is low; and potassium very low.  The particle size family class is clayey.  The mineralogical class is ferruginous.
LABORATORY Nos:	KRS V144-147 (inclusive)
SOIL LIMITATIONS:	Clayey textures; moderate sheet and rill erosion potential on slopes > 3° when forest cleared and cultivated; extremely acid pH; and nutrient deficiencies of potassium, nitrogen and phosphorus.

## Typifying Profile

SOIL NAME: Lodoni soils, undulating phase  
PROFILE No.: VS10  
SITE LOCATION: Adjacent Navua River 2 km downstream from Saliadrau Village, Namosi District.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex backslope on domed ridge in strongly rolling hill country.  
PARENT MATERIAL: Very strongly weathered colluvium from Navua mudstone formation of intermediate and basic composition.  
SLOPE: 5°  
ASPECT: East  
ELEVATION: 120 m  
MICRORELIEF: Smooth, even  
SITE VEGETATION: Indigenous forest species.  
LAND USE: Unused  
DRAINAGE: Well drained  
EROSION: None  
DISTURBANCE: None  
LABORATORY Nos: KRS V144-147 (inclusive)

### PROFILE DESCRIPTION

Ah	0-16 cm (16 cm)	Moist; dark reddish brown (5YR 3/3) clay loam; moderate to strongly developed medium nut structure; friable; slightly sticky; slightly plastic; abundant fine, medium and coarse roots; distinct smooth boundary,
Bt1	16-52 cm (36 cm)	Moist; dark red (2.5YR 3/6) clay; weakly developed coarse prismatic structure (dry) breaking to moderate medium and coarse blocky structure; friable to firm; sticky; plastic; common distinct reddish brown (5YR 4/3) organic coatings in the upper 10 cm with common distinct yellowish red (2.5YR 4/6) clay coatings throughout; few medium roots; diffuse smooth boundary,
Bt2	52-100 cm (48 cm)	Moist; red (2.5YR 4/6) clay; weakly developed coarse prismatic structure, breaking to moderate medium blocky structure; friable to firm; sticky; plastic; many distinct red (2.5YR 4/6) clay coatings; few very fine roots; distinct smooth boundary,
C1	100-150cm (50 cm+)	Moist; yellowish red (5YR 4/6) silty clay with 20% yellow (2.5Y 7/6) strongly weathered parent material boulders; massive breaking to single grain plus weakly developed fine blocky structure; firm; slightly sticky; slightly plastic; few distinct yellowish red (5YR 4/6) clay coatings to pores and root channels; no roots.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lomaiviti series**

REFERENCE: Lomaiviti clay (29c) and Lomaiviti hill soils (29cH) defined by Twyford & Wright (1965) as forming on rolling and hilly land from basalt, basic andesite and basic tuffs under a climate with a weak dry season.

Forms part of the Lomaiviti set.

The central concept for Lomaiviti soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Eutropept, fine, ferruginous, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Humic latosol with a very weak or no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Lomaiviti soils, easy rolling phase (176C)  
Lomaiviti soils, rolling phase (176D)

Lomaiviti soils, strongly rolling phase (176E)  
Lomaiviti soils, moderately steep phase (176F)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lomaiviti soils are not common in Viti Levu and are confined to a few small areas near Lodonu. They occur along the southern coast of Vanua Levu, particularly at the eastern end of the island on the Natewa peninsula, and throughout the Lomaiviti Group.

PARENT ROCK: Basalt, basic andesite, and basic tuffs.

PARENT MATERIAL: Strongly red weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: On crests and sides of narrow ridges (crest shoulder and side slopes all have similar depths of soil over *in situ* rock.)

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), and moderately steep (21-25°).

VEGETATION AND LAND USE: Some areas still under forest. Used for subsistence gardens, yagona, bananas and coconuts and in a few places cocoa.

RANGE OF ELEVATION: 10-150 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24.5°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate sheet and rill erosion potential when cultivated.

## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

The soil has hues redder than 10YR throughout the profile with high chromas in the subsoil (e.g. 2.5YR 4/8) and no mottles. There are clay cutans in the B horizon but the clay accumulation is insufficient to define an argillic horizon. Strongly weathered basalt with residual rock structure (saprolite) is present in the lower part of the profile.

Typically shows 10 cm of dark reddish brown firm clay, of moderately developed coarse blocky structure, sticky and plastic moist, overlying 75 cm of red firm clay, of moderately developed fine and medium blocky structure, sticky and plastic moist, and with clay cutans to ped faces, over more than 30 cm of yellowish red firm coarse sandy clay loam, of massive structure breaking to blocky, with clay cutans.

### DIAGNOSTIC HORIZONS:

Ochric epipedon, cambic horizon.

### RANGE OF PROFILE FEATURES:

Not applicable. Only 2 profile descriptions made.

### VARIANTS:

None recognised

### SIMILAR SOILS AND

### DISTINGUISHING FEATURES:

None recognised

### GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:

The soil is moderately acid, the strongly weathered basalt (saprolite) is slightly acid; organic C% is medium to low in the A horizon; %BS is high in the upper part of the profile grading up to very high in the lower part; exchangeable Ca is medium decreasing to low down the profile; exchangeable Mg is very high increasing from 10 me.% in the topsoil to 42 me.% in the saprolite; exchangeable Na is high to very high; exchangeable K is medium.

The particle size family class is fine.

The mineralogy given for taxonomy is ferruginous (marginal to kaolinitic).

### LABORATORY Nos:

KRS S2024-2028 (inclusive)

### SOIL LIMITATIONS:

Slope; erosion potential on slopes when cultivated; moderate soil acidity; and nutrient deficiency of phosphorus.

## Typifying Profile

SOIL NAME: Lomaiviti soils, moderately steep phase.  
PROFILE No.: W16  
SITE LOCATION: Refer soil map of Wainigata Agricultural Research Station (Purdie, 1986).

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Backslope on hillside in hill country.  
PARENT MATERIAL: Very strongly weathered *in situ* augite andesite.  
SLOPE: 24°  
ASPECT: South  
ELEVATION: 25 m  
MICRORELIEF: Planar  
SITE VEGETATION: *Pinus caribaea*  
LAND USE: Exotic forestry  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None observed  
LABORATORY Nos: KRS S2024-2028 (inclusive)

### PROFILE DESCRIPTION

Ah	0-12 cm (12 cm)	Moist; dark reddish brown (5YR 3/3) clay; friable to firm; sticky; plastic; moderately developed coarse blocky structure breaking to moderately developed very fine nut; no mottles; many fine and medium roots; indistinct wavy boundary,
Bw1	12-39 cm (26 cm)	Moist; red (2.5YR 4/8) clay; firm; sticky; plastic; moderately to strongly developed fine and medium blocky structure breaking to moderately developed very fine nut; no mottles; common distinct red (2.5YR 4/6) clay cutans; many fine and medium roots; indistinct wavy boundary,
Bw2	38-85 cm (47 cm)	Moist; red (2.5YR 4/8) clay; firm; sticky; plastic; moderately developed fine and medium blocky structure breaking to weakly developed very fine nut; no mottles; common distinct red (2.5YR 4/6) clay cutans; common fine roots; few soft strongly weathered subangular stone (andesite); indistinct wavy boundary,
BC	85-120 cm (35 cm)	Moist; weathered <i>in situ</i> rock; yellowish red (5YR 5/8) coarse sandy clay loam; firm to very firm; slightly sticky, slightly plastic, massive breaking to moderately developed medium blocky structure; no mottles; common prominent red (2.5YR 4/6) clay cutans; few very fine roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lomaje series**

REFERENCE: Lomaje loam (23d) and Lomaje hill soils (23dH) as defined by Twyford & Wright (1965) as latosolic soils from young andesitic ash under a climate with a weak dry season.

Forms part of the Waiqere set.

The central concept for Lomaje soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Pachic Vitric Melanud and, medial, isohyperthermic
- (b) FAO: Humic Andosol
- (c) Twyford and Wright: Latosolic soil with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Lomaje soils, undulating phase (84B)
- Lomaje soils, easy rolling phase (84C)
- Lomaje soils, rolling phase (84D)
- Lomaje soils, strongly rolling phase (84E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Of limited occurrence at the western extremity of Kadavu Island centred about the mountain of Nabukelevu.

PARENT ROCK: Andesite

PARENT MATERIAL: Moderately deep weakly weathered volcanic ash.

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Planar and gently convex slopes in undulating and strongly rolling country.

SLOPE CLASS AND RANGE OF SLOPES: Undulating phase (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Heavily cropped for a wide range of vegetables.

RANGE OF ELEVATION: 0-500 m

RAINFALL: Annual average range: 3,200-4,500 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.:

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Severe sheet and rill erosion potential on slopes >7° if soil conservation measures not implemented.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically show 55 cm of black very friable slightly sandy loam, of strong fine nut structure and very slightly sticky and slightly plastic moist, overlying 25 cm of very dark reddish brown friable loam, on 30 cm of yellow brown very friable loam, on strong brown firm sandy clay, sticky and very plastic when moist.
DIAGNOSTIC HORIZONS:	Mollic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only one profile description available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Lomaje soils, by chemical analysis (Twyford & Wright 1965) are very slightly acid, with a high base saturation in the topsoils but fairly low in the subsoil. Acid soluble phosphate and exchangeable potash are both high in the topsoil and the exchange capacity of the clay is likewise high.
LABORATORY Nos:	KRS 677-678
SOIL LIMITATIONS:	Erosion hazard on slopes $>7^\circ$ ; and rapid soil permeability.

## Typifying Profile

SOIL NAME: Lomaje soils, undulating phase  
PROFILE No.: TW 31  
SITE LOCATION: Not available

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar toeslope in hilly land.  
PARENT MATERIAL: Weathered *in situ* andesitic ash.  
SLOPE: 6°  
ASPECT: North  
ELEVATION: 200 m  
MICRORELIEF: Smooth surface  
SITE VEGETATION: Secondary forest (in fallow).  
LAND USE: Food gardens (dalo, yams, bananas).  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: Non-mechanical cultivation.  
LABORATORY Nos: KRS 677-678

### PROFILE DESCRIPTION

Ah	0-55 cm (55 cm)	Moist; black (5YR 2/1) slightly sandy loam; strongly developed fine nut structure; very friable; slightly sticky; slightly plastic; abundant fine and medium fibrous roots; distinct smooth boundary,
Bw1	55-80 cm (25 cm)	Moist; dark reddish brown (5YR 3/4) loam; moderately developed fine and medium nut structure; friable; sticky; slightly plastic; many fine and very fine fibrous roots; distinct smooth boundary,
Bw2	80-110 cm (30 cm)	Moist; yellowish brown (10YR 5/6) loam; weakly developed fine granular structure; very friable; sticky; plastic; few fine and very fine fibrous roots; distinct smooth boundary,
Bc	110-130 cm (10 cm+)	Moist; strong brown (7.5YR 5/6) sandy clay; massive structure; firm; sticky; very plastic.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Losa series**

REFERENCE: New soil series introduced in the soil survey of Rotuma Island (Laffan & Smith 1983) and defined as somewhat excessively drained soils formed from basaltic pahoehoe lavas and minor basaltic ash on the volcanic ringplains.

Profiles are shallow stony/bouldery loams with abundant stones/boulders overlying massive basalt at depths <50 cm.

Named after Losa village, at the western end of Rotuma Island.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Lithic Hapludand, ashy-skeletal, isohyperthermic
- (b) FAO: Humic Andosol
- (c) Twyford and Wright: Latosolic soil with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Losa soils, undulating phase (86B)
- Losa soils, easy rolling phase (86C)
- Losa soils, rolling phase (86D)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs mainly at western end of Rotuma Island near Losa village, but probably also occurs elsewhere associated with Hafhafu and Ututu soils.

PARENT ROCK: Basalt

PARENT MATERIAL: Weakly weathered *in situ* pahoehoe lava and minor ash.

PHYSIOGRAPHIC POSITION / LANDFORM: Volcanic ring plains surrounding the volcanic cones.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°); easy rolling (8-11°) and rolling 12-15°).

VEGETATION AND LAND USE: Mainly indigenous forest with minor area under coconut plantations with enclosed pig run off areas.

RANGE OF ELEVATION: 10-60 m

RAINFALL: Annual average range: 2,766-4,356 mm; average 3,560 mm.

TEMPERATURE: Mean annual: 27°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat excessively drained.

PERMEABILITY CLASS: Rapid

FLOODING: Never floods

EROSION: Some very slight sheet erosion.

## Morphological And Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Dark brown bouldery loams with abundant (35-75%) boulders and stones overlying massive pahoehoe basalt at depths <50 cm.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon, lithic contact.
RANGE OF PROFILE FEATURES:	Not applicable, only one description made.
VARIANTS:	Unnamed very shallow variant: Profiles have abundant stones and boulders overlying massive pahoehoe basalt at depths <30 cm.  Rock outcrops are a very common association with Losa series.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Hafhafu series: Somewhat excessively drained, deep soils (>1 m) formed from basaltic aa lavas and minor basaltic ash. Profiles have abundant to profuse stones/boulders with sandy loam and loamy sand textures.  Kirikiri series: Somewhat excessively drained, deep soils (>1 m) formed from basaltic aa lavas and basaltic ash. Profiles have stony/bouldery loam textures with abundant stones/boulders in subsoils.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Not sampled for analysis. Likely to be slightly acid soils with high phosphorus values and very high P retention, i.e. similar to Kirikiri series.  Particle size class is ashy-skeletal and the fine earth fraction would be dominated by amorphous materials.
LABORATORY Nos:	Not sampled
SOIL LIMITATIONS:	Severe to very severe physical limitations of very shallow rooting depth, stoniness, and low available water holding capacity.  Likely to have severe nutrient deficiencies.

## Typifying Profile

SOIL NAME: Losa soils, undulating phase.  
PROFILE No.: R15  
SITE LOCATION: Refer soil map of Rotuma (Laffan & Smith 1983). About 600 m north of Losa Village, at western end of Rotuma.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Volcanic ringplain surrounding volcanic cones. Planar surface.  
PARENT MATERIAL: Basaltic pahoehoe lava and minor basalt ash.  
SLOPE: 5°  
ASPECT: North west  
ELEVATION: 20 m  
MICRORELIEF: Uneven with protruding boulders and rock outcrops.  
SITE VEGETATION: Mainly undisturbed indigenous forest.  
LAND USE: Pig farming  
DRAINAGE: Somewhat excessively drained.  
EROSION: Slight sheet erosion.  
DISTURBANCE: Pig rooting  
LABORATORY Nos: Not sampled for analysis.  
COMMENTS: Reaction to NaF. Very strong and rapid in A horizon.

### PROFILE DESCRIPTION

Losa soils, undulating phase

Ah	0-22 cm (22 cm)	Dark brown (7.5YR 3/2) bouldery loam; strongly developed fine nut structure; slightly sticky, slightly plastic, very friable, moderately weak, uncemented, soft consistence; abundant fine and medium roots; abundant weakly weathered subangular boulders; sharp wavy boundary (lithic contact)
R	on	Massive basaltic pahoehoe lava.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lovonivia series**

REFERENCE: Lovonivia loamy sand (42e) defined by Twyford and Wright (1965) as a grey soil on flattish quartzose outwash fans and terraces supporting talasiga vegetation in the natural state, and formed under a climate with a strong dry season.

Forms part of the Wainikoro set.

The central concept for Lovonivia soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Ultic Haplorthod, sandy over clayey, siliceous, isohyperthermic
- (b) FAO: Orthic Podzol
- (c) Twyford and Wright: Red yellow podzolic soil with a strong dry season

#### INCLUDING MAPPING UNITS AND PHASES:

- Lovonivia soils, flat to gently undulating phase (45A)
- Lovonivia soils, undulating phase (45B)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lovonivia soils are of limited distribution - less than 1 sq km - occurring only in Vanua Levu.

PARENT ROCK: Rocks of acidic composition.

PARENT MATERIAL: Strongly weathered and leached riverine alluvia (and to a lesser extent colluvia on fans).

PHYSIOGRAPHIC POSITION / LANDFORM: Mainly relict high terraces and a small area of colluvial fans.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), and undulating (4-7°).

VEGETATION AND LAND USE: Rough grazing and scrub. Some areas used for vegetable but requires continual watering in dry season plus high fertiliser inputs.

RANGE OF ELEVATION: 6-20 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Slow

FLOODING: Never floods

EROSION: Slight sheet erosion potential for topsoil on slopes > 3°.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of dark greyish brown very friable fine sandy loam, of weak fine nut structure with crumb, overlying 10 cm of light brownish grey mottled dark yellowish brown firm loamy very fine sand, of massive structure, overlying 35 cm of light brownish grey extremely firm and massive loamy sand, overlying 12 cm of dark greyish brown friable loamy very fine sand, of weak coarse blocky structure breaking to single grain and with common organic cutans, overlying 15 cm of brownish yellow mottled dark yellowish brown firm gritty clay, of weak medium platy structure, and with a discontinuous iron-humus pan and organic cutans, overlying 20 cm brownish yellow mottled strong brown friable gritty clay, of massive structure breaking to weak coarse blocky and with both clay and organic cutans, overlying 30 cm or more of pale yellow strong mottled yellow very friable clay, of massive structure breaking to weak medium blocky with a few organic and clay cutans.
DIAGNOSTIC HORIZONS:	Ochric epipedon, an albic horizon, spodic horizon and a argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows this soil to be very strongly acid and very poor in plant nutrients, very low CEC values with base saturation low to moderate.  Mineralogy class is  Particle size family class is
LABORATORY Nos:	SB/T 446 A-G
SOIL LIMITATIONS:	Seasonal moisture deficits, slow subsoil permeability. Soil acidity and nutrient deficiencies.
ADDITIONAL COMMENTS:	Seasonal soil moisture deficits, sandy textures, trace element and nutrient deficiencies and susceptibility to erosion.

## Typifying Profile

SOIL NAME: Lovonivia soils, flat to gently undulating phase.  
PROFILE No.: LOV1  
SITE LOCATION: Relict higher surface adjacent to the Wainikoro River, Vanua Levu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: High terrace remnant.  
PARENT MATERIAL: Strongly weathered riverine alluvia of acidic composition.  
SLOPE: 2°  
ASPECT: South-west  
ELEVATION: 10 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Ground cover of carpet grass with scattered shrubs of Hibiscus burr.  
LAND USE: Rough grazing  
DRAINAGE: Poorly drained  
EROSION: None  
DISTURBANCE: Previously cultivated  
LABORATORY Nos: SB/T 446 A-G  
COMMENTS: Quartz grains on ground surface.

### PROFILE DESCRIPTION

Ap1	0-22 cm (22 cm)	Dry; dark greyish brown (2.5YR 4/2) sandy loam; few fine faint dark brown (10YR 3/3) mottles; weakly developed fine nut structure with weak fine crumbs; very friable; few fine and very fine roots; sharp smooth boundary,
Ap2	22-31 cm (9 cm)	Dry; 95% light brownish grey (2.5YR 6/2) and 5% dark greyish brown (2.5Y 7/2) loamy sand; common fine distinct dark yellowish brown (10YR 4/4) fine reticulate mottling; massive; very weakly cemented; firm; indistinct wavy boundary,
Ea1	31-64 cm (33 cm)	Dry; light brownish grey (2.5Y 6/2) loamy sand; massive; extremely firm; very weakly cemented; indistinct wavy boundary,
Ea2/Bs1	64-76 cm (12 cm)	Moist; 80% dark greyish brown (10YR 4/2) and 20% light brownish grey (2.5YR 6/2) sandy clay loam; weakly developed coarse blocky structure breaking to single grain; friable; slightly sticky; common distinct dark greyish brown (10YR 4/2) organic cutans; sharp smooth boundary,
Bs2	76-92 cm (16 cm)	Moist; brownish yellow (10YR 6/8) loamy clay; many medium and coarse dark yellowish brown (10YR 4/4) mottles (layered horizontally); weakly developed medium platy structure breaking to single grain; firm; very weakly cemented; discontinuous reddish brown (5YR 4/4) embryonic iron/manganese humus pan; few distinct dark yellowish brown (10YR 4/4) organic coatings; distinct smooth boundary,



Bt	92-111 cm (19 cm)	Moist; brownish yellow (10YR 6/6) loamy clay; few fine and medium faint strong brown (7.5YR 5/8) mottles; massive breaking to weakly developed coarse blocky structure; friable; slightly plastic; common faint brownish yellow (10YR 6/8) and common distinct strong brown (7.5YR 5/8) clay cutans; few distinct smooth boundary,
Bw	111-141 cm (30 cm+)	Moist; 50% pale yellow (5Y 8/3) sandy clay loam; 50% profuse medium and coarse prominent yellow (10YR 7/8) mottles; massive breaking to weakly developed medium blocky structure; very friable; slightly plastic; few faint brownish yellow (10YR 6/8) clay cutans; few distinct yellowish brown (10YR 5/4) organic cutans.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Lutu series**

REFERENCE: Lutu sandy clay (37a) and Lutu hill soils (37aH) defined by Twyford & Wright (1965) as reddish brown soils from silicified tufts, granite, quartzite or quartz porphyry on rested rolling and especially hilly land, under a climate with little or no dry season.

The central concept for Lutu soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Kandihumult, fine, kaolinitic, isohyperthermic
- (b) FAO: Humic Nitosol
- (c) Twyford and Wright: Red yellow podzolic soil with little or no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Lutu soils, easy rolling phase (148C)
- Lutu soils, rolling phase (148D)
- Lutu soils, strongly rolling phase (148E)
- Lutu soils, moderately steep phase (148F)
- Lutu soils, steep phase (148G)
- Lutu soils, very steep phase (148H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Lutu soils are of restricted extent; they occur in the very wet centre and east centre of Viti Levu.

PARENT ROCK: Predominantly intrusive rocks but all of acidic composition.

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Rolling ridges (domed) and convex backslopes and midslopes.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°) and rolling (12-15°).

VEGETATION AND LAND USE: Generally under forest and where cleared have regenerated to guava and gasau.

RANGE OF ELEVATION: 30-200 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY CLASS: Medium

FLOODING: Never floods

EROSION: Moderate to severe sheet, rill and debris slide erosion potential if forest removed, particularly from slopes >7°.

**Lutu**

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of brown friable gritty clay loam, of moderately developed fine and medium nut structure, overlying 15 cm of strong brown and brown friable loam, of weak fine nut and granular structure, plastic moist, with humus cutans to ped faces and commonly many quartz grits, overlying 40 cm of yellowish red firm clay of weak blocky structure, very sticky, with faint clay cutans to ped faces, over more than 100 cm of dark red or red massive silty clay loam commonly with clay cutans to peds.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile observations made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis show the soil to be strongly acid; carbon and nitrogen values are very low throughout; available phosphorus is extremely low; CEC is low 0-20 cm and medium in the other horizons; total bases are very low; % base saturation is low 0-20 cm and of very low values below this depth; exchangeable calcium is very low, potassium extremely low, magnesium and sodium low.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is kaolinitic.</p>
LABORATORY Nos:	KRS V124-128
SOIL LIMITATIONS:	Moderate to severe sheet, rill and massive movement erosion potential; strong soil acidity; and severe nutrient deficiencies of nitrogen, phosphorus and potassium

## Typifying Profile

SOIL NAME: Lutu soils, undulating phase  
PROFILE No.: VS06  
SITE LOCATION: Adjacent Biausevu village, inland from Korolevu Bay, south west Viti Levu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar summit interfluvium in strongly rolling hill country.  
PARENT MATERIAL: Strongly weathered *in situ* agglomerate of acidic composition.  
SLOPE: 5°  
ASPECT: West  
ELEVATION: 140 m  
MICRORELIEF: Even  
SITE VEGETATION: Open talasiga vegetation comprising pandanus, ground fern and scattered tall palms with miscellaneous short shrubs.  
LAND USE: Unused  
DRAINAGE: Moderately well drained.  
EROSION: Soil slips in vicinity and past topsoil losses.  
DISTURBANCE: Past erosion  
LABORATORY Nos: KRS V124-128

### PROFILE DESCRIPTION

Ah	0-7 cm (7 cm)	Moist; brown (10YR 5/3) gritty clay loam; moderately developed fine and medium nut structure; friable; sticky; slightly plastic; many fine and very fine roots; few unweathered rounded quartz gravels and grits; distinct smooth boundary,
Bw	7-20 cm (13 cm)	Moist; 80% strong brown (7.5YR 5/6) and 20% brown (10YR 5/3) loam; weakly developed fine nut and granular structure; friable; plastic; common distinct dark brown (10YR 4/3) organic coatings; few very fine roots; many quartz grits; distinct smooth boundary,
Bt	20-55 cm (35 cm)	Moist; 80% yellowish red (5YR 4/6) and strong brown (7.5YR 5/6) clay; weakly developed medium blocky breaking to single grain; friable to firm; very sticky; few faint yellowish red (5YR 5/6) clay coatings; no roots; distinct smooth boundary,
BC	55-150 cm (145 cm)	Moist; dark red (10R 3/6) and red (10R 4/6) silty clay loam; massive breaking to single grain with some weakly developed coarse blocky structure; friable to firm; plastic; few faint red (2.5YR 4/6) clay coatings; no roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Macuata series**

REFERENCE: The Macuata steepland stony, and gritty clay (88) defined by Twyford & Wright (1965) as 'talasiga' soils derived from basic parent materials (basalts, andesites and tuffs). They are normally severely eroded with iron coated fragments from rock outcrops over the ground surface and have very shallow profiles with the strongly weathered parent material normally encountered at 20 cm from the surface.

The central concept for Macuata soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Ustorthert, fine-loamy, kaolinitic, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Ferruginous latosol with a strong dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Macuata soils, easy rolling phase (200C)	Macuata soils, moderately steep phase (200F)
Macuata soils, rolling phase (200D)	Macuata soils, steep phase (200G)
Macuata soils, strongly rolling phase (200E)	Macuata soils, very steep phase (200H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Macuata soils are found to some extent in the so called 'Ba Closed Area' on Viti Levu. They are extensively developed in Macuata and in northern Bua province in Vanua Levu.

PARENT ROCK: Basalts and andesites.

PARENT MATERIAL: Very strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Convex and planar midslopes and backslopes in dissected (commonly 'badland') strong rolling to hilly country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strong rolling (16-20°), moderately steep (21-25°), steep (26-35°) and very steep (>35°).

VEGETATION AND LAND USE: Talasiga vegetation, mostly fern such as qatomose (*Dicranopteris linearis*) and nokonoko (*Casuarina equisetifolia*) though it was originally a poor forest of sea, buabua and yasiyasi.

RANGE OF ELEVATION: 20-300 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Has suffered significant past erosion (sheet, rill) and retains a moderate to severe erosion potential.

**Macuata**

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of dark yellowish brown gritty clay loam, of moderately developed fine and medium nut structure breaking to single grain, very friable, slightly sticky moist, and with common weakly weathered stones overlying more than 80 cm of grey strongly weathered <i>in situ</i> rock (gritty fine sandy loam) of massive structure breaking easily to single grain, very firm and with organic and manganese coatings to rock fissures.
DIAGNOSTIC HORIZONS:	Ochric epipedon.
RANGE OF PROFILE FEATURES:	Macuata series have an A, C horizon sequence.  The A horizon thickness ranges 8-18 cm; colours include dark yellowish brown (10YR 4/4), dark brown (7.5YR 3/2, 4/4) and dark reddish brown (5YR 3/3, 3/4); textures vary gritty clay loam, gritty clay and clay; and there may or may not be grey fine mottling.  The C horizon exceeds 80 cm; varicoloured pinkish white (5YR 8/2), light grey (5YR 7/1), grey (5YR 5/1), and weak red (2.5YR 4/2, 5/2); textures vary from clay, clay loam, silty clay loam to very fine sandy loam -all commonly gritty; and few to many humus and/or manganese coatings to fissures on the weathering <i>in situ</i> rock.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analyses show strongly acid pH; very low values for carbon and nitrogen; very low available phosphorus with high phosphorus retention; CEC is medium; % base saturation is low in the A horizon dropping to very low with depth; exchangeable calcium and potassium are very low; magnesium is high in the topsoil but drops with depth to low values; and aluminium is most significant in the exchange complex.  The particle size family class is fine loamy.  The mineralogical class is kaolinitic.
LABORATORY Nos:	USP LOL9A-B
SOIL LIMITATIONS:	Slope; uneven ground surface because of past erosion; severe potential for sheet and rill erosion; very severe soil moisture deficits during the dry season; aluminium toxicity; and nutrient deficiencies of nitrogen, potassium and phosphorus.

## Typifying Profile

SOIL NAME: Macuata soils, rolling phase.

PROFILE No.: LOL9

SITE LOCATION: Lololo Forest PSP 71/III/23.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Lower convex midslope in 'badland' eroded landscape.

PARENT MATERIAL: Strongly weathered and chemically degraded *in situ* basic rock.

SLOPE: 14°

ASPECT: West

ELEVATION: 150 m

MICRORELIEF: Abundant laterite stones and boulders on the ground surface.

SITE VEGETATION: Moderately dense Mission grass under 12 year old *Pinus Caribaea*.

LAND USE: Exotic forestry

DRAINAGE: Well drained

EROSION: Severe past sheet and rill erosion.

DISTURBANCE: Eroded

LABORATORY Nos: USP LOL9A-B

### PROFILE DESCRIPTION

Macuata soils, rolling phase

Ap	0-15 cm (15 cm)	Dry; moist, dark yellowish brown (10YR 3/4) and dry, brown (10YR 4/3) gritty clay loam; moderately developed fine and medium nut structure breaking to single grain; very friable; slightly sticky; non-plastic; abundant fine and medium roots; common weakly weathered subangular stones; distinct wavy boundary,
C	15-100+ (85 cm+)	Dry; moist, grey (2.5YR N5/0) and dry, light grey (5YR 7/1) gritty very fine sandy loam; massive breaking to single grain; very firm ( <i>in situ</i> ); non-sticky; non-plastic; no roots; strongly weathered <i>in situ</i> rock; humus and iron/manganese coatings to rock fissures.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Mafua series**

REFERENCE: New soil series introduced in the soil survey of Rotuma Island (Laffan & Smith 1983) and defined as well drained soils formed from basaltic ash over weakly weathered basaltic scoria. Profiles have loam to clay loam A horizons overlying slightly stony loamy AB or B horizons. At depths below 35-70 cm horizons are stony loamy sand, with abundant stones.

The name is derived from Solmafua hill in the central part of Rotuma Island.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Eutric Fulvudand, ashy-skeletal, isohyperthermic
- (b) FAO: Mollic Andosol
- (c) Twyford and Wright: Latosolic soil with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Mafua soils, rolling phase (108D)
- Mafua soils, strongly rolling phase (108E)
- Mafua soils, moderately steep phase (108F)
- Mafua soils, steep phase (108G)
- Mafua soils, very steep phase (108H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs on most of the volcanic cones throughout Rotuma.

PARENT ROCK: Basalt

PARENT MATERIAL: Volcanic ash over weakly weathered in situ scoria.

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Sides and crests of the volcanic cones.

SLOPE CLASS AND RANGE OF SLOPES: Rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°) and very steep (>35°).

VEGETATION AND LAND USE: Originally indigenous forest, part of which has been cleared for coconut plantations and food crops. Small areas of bush fallow.

RANGE OF ELEVATION: 15-250 m

RAINFALL: Annual average range: 2,766-4,356 mm;  
average: 3,560 mm.

TEMPERATURE: Mean annual: 27°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Slight to moderate sheet erosion in places.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Dark brown, friable, loamy to clay loam A horizons with few or many stones overlying dark brown stony loam or stony sandy loam B horizons with many stones. Abundant gravels, stones or boulders are encountered below about 35-50 cm. Textures of the fine earth (<2 mm) in the upper 35-50 cm are heavier than for soils of the volcanic ringplain formed from volcanic ash.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Mafua series have a A, AB, Bw, C horizon sequence.  The A horizon thickness ranges 15-24 cm; colours are dark brown (10YR 3/3, 7.5YR 3/2); textures may be stony heavy loam, stony fine sandy loam, or heavy loam; stones are few or many; and structures are granular or nutty.  The AB horizon thickness ranges 10-12 cm; colours are dark brown (7.5YR 3/3, 4/5); textures are either heavy loam or fine sandy loam; and stones may be few or many.  The Bw horizon thickness ranges 13-80 cm; colours are dark brown (7.5YR 4/2, 3/2, 4/4, 4/5) or dark reddish brown (5YR 3/4); stony textures are either sandy loam, heavy loam, or loamy sand; structures are weak and may be blocky, nutty or crumb.  The C horizon are yellowish brown or reddish brown, of loose consistence and stones may be abundant or profuse.
VARIANTS:	Unnamed variant: Profiles with >60% coarse fragments (>2 mm) in the lower control section. The particle size class is medial over pumiceous.  Unnamed variant: Profiles with <35% coarse fragments in the control section. The particle size class is medial.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Vaka series: Somewhat excessively drained soils with coarser textures throughout the profile (medial-pumiceous particle size class).  Hefu series: Well drained soils formed from volcanic ash over basaltic scoria. Have reddish hues throughout the profile due to red colour of the scoria parent material.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Near neutral becoming slightly alkaline below 50 cm. Phosphorus values are high, doubling in value with depth but P retention is high. The CEC is very high with exchangeable calcium, magnesium and potassium also very high except for the latter which has very low values below 50 cm. Tamm's oxalate extractable aluminium, iron and silica values are high for all horizons. Organic carbon values are medium in the upper 25 cm.  The particle size class is ashy-skeletal with the fine earth fraction dominated by amorphous materials.
LABORATORY Nos:	SB9721A-F
SOIL LIMITATIONS:	Severe physical limitations of slope, shallow rooting depth, stoniness, low available water holding capacity and erosion risk under cultivation. Moderate to severe nutrient deficiencies of nitrogen and phosphorus, and moderate deficiency of sulphur.

## Typifying Profile

SOIL NAME: Mafua soils, steep phase.  
PROFILE No.: R113  
SITE LOCATION: Refer soil map of Rotuma Island (Laffan & Smith, 1983). Side of Solmafua Hill in the centre of the island.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Midslope of volcanic scoria cone.  
PARENT MATERIAL: Basaltic ash over weakly weathered basaltic scoria.  
SLOPE: 33°  
ASPECT: South west  
ELEVATION: 170 m  
MICRORELIEF: Few small surface stones. Smooth overall.  
SITE VEGETATION: Coconuts and ground creepers.  
LAND USE: Coconut plantation and bush fallow.  
DRAINAGE: Well drained  
EROSION: Negligible sheet erosion  
DISTURBANCE: Periodically cultivated  
LABORATORY Nos: SB9721A-F  
COMMENTS: Reaction to NaF. Very weak in A; weak in AB; very strong in Bw and strong in C horizons.

### PROFILE DESCRIPTION

Ap	0-24 cm (24 cm)	Dark brown (10YR 3/3) clay loam; moderately developed medium nut structure and moderately developed fine granular structure; sticky, plastic, friable, uncemented, firm; common fine roots; few moderately and strongly weathered subrounded gravels; distinct wavy boundary,
AB	24-35cm (11 cm)	Strong brown (7.5YR 4/5) clay loam; moderately developed medium nut structure and moderately developed fine granular structure; sticky, plastic, friable, uncemented, firm; common fine roots; few moderately to strongly weathered subrounded gravels; indistinct wavy boundary,
Bw	35-70cm (35 cm)	Dark reddish brown (5YR 3/4) stony sandy loam; weakly developed fine blocky structure breaking to weakly developed fine crumb structure; non-sticky, non-plastic, very friable, uncemented, stiff; common fine roots; abundant moderately weathered subangular gravels and stones; diffuse boundary,
C1	70-97cm (27 cm)	Reddish brown (5YR 4/4) and yellowish brown (10YR 5/6) stony very coarse sand; single grain; non-sticky, non-plastic, loose, moderately firm, uncemented, very stiff consistence; common fine roots; abundant moderately weathered subangular gravels, stones and boulders; distinct wavy boundary,

C2

97-120+cm  
(23 cm+)

Very dark greyish brown (10YR 3/2) and yellowish brown (10YR 5/6) and reddish brown (5YR 4/5) stony very coarse sand; single grain; non-sticky, non-plastic, loose, moderately firm, very weakly cemented, hard; few fine roots; profuse moderately weathered subangular gravels and stones.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SERIES NAME: **Makomako series**

REFERENCE: Makomako Clay (32a) defined by Twyford and Wright (1965) as formed from basic parent materials under forest on rolling and hilly land under a climate with a strong dry season

Forms part of the Makomako set.

The central concept for Makomako soils is retained in this survey

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Haplustult, clayey, kaolinitic, isohyperthermic.
- (b) FAO: Orthic Acrisol
- © Twyford & Wright: Humic latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Makomako soils, undulating phase (188B)

Makomako soils, rolling phase (188D)

Makomako soils, easy rolling phase (188C)

Makomako soils, strongly rolling phase (188E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Makomako soils are well developed near Namakomako village and elsewhere in the region extending southward to the Seaqaqa River in Vanua Levu but of limited occurrence in Viti Levu.

PARENT MATERIAL: Basic and basic andesites (tufts, agglomerates and flowrocks).

PARENT ROCK: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LAND FORM: Convex, concave and planar surfaces in all slope positions in rolling land.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4 - 7°), easy rolling (8 - 11°), rolling 12 - 15°) and strongly rolling (16 - 20°).

VEGETATION AND LAND USE: Original cover was forest and much is still in forest. Soils burnt or cleared for shifting cultivation have reverted to scrub and fern. Used for sugar cane in the Seaqaqa basin.

RANGE OF ELEVATION: 40 - 400 m

RAINFALL: Annual average range: 1,800 - 2,400 mm;  
dry season range: 400 - 500 mm;  
wet season range: 1,400 - 1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Severe sheet and rill potential.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of yellowish red friable clay, of moderate to strong fine and medium nut and granular structure, and slightly sticky and slightly plastic when moist, overlying 30 cm of red very friable clay, of weak to moderate blocky structure breaking to crumb and slightly sticky and slightly plastic when moist, overlying 40 cm of red friable clay, of weak coarse blocky structure breaking to fine blocky, slightly sticky and slightly plastic when moist and with faint clay cutans, overlying 30 cm of dark red friable to form clay, of massive structure breaking to weak fine blocky on 40 cm or more of yellowish red friable clay loam of massive structure breaking to weak fine blocky, and with strongly weathered stones.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Makomako series have a A, Bw, Bt, BC horizon sequence.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Makomako soils by chemical analysis, are low to moderate base status and are moderately acid. They are low in exchangeable bases including potash and are also low in available phosphate.</p> <p>Mineralogy class in kaolinitic.</p> <p>Particle size family class is clayey.</p>
LABORATORY NOS:	FACL Koronivia 192047.
SOIL LIMITATIONS:	Low fertility, acidity, and seasonal moisture deficits.

## Typifying Profile

SOIL NAME: Makomako series, rolling phase  
PROFILE NO: LAB 1  
SITE LOCATION: Bucalevu access road about 9km from the main Labasa Seaqaqa highway.

### SITE INFORMATION

LANDFORM: Mid slope position.  
SLOPE: 12°  
ASPECT: North  
ELEVATION: 100m  
MICRORELIEF: Even  
PARENT MATERIAL: Basic and intermediate composition(igneous rocks) material and colluvia.  
SITE VEGETATION: Mission grassland with mint weed, bracken, male, sa and yaro.  
LAND USE: Logging and shifting cultivation  
DRAINAGE: Good  
EROSION: Slight sheet erosion  
DISTURBANCE: None  
LABORATORY NOS: FACL, Koronivia 192047

### PROFILE DESCRIPTION

Makomako soils

Ap	0 -16cm (16 cm)	Moist; dark brown (10YR 4/3) clay; strongly developed blocky structure; slightly sticky; slightly plastic; common fine pores; common fine, medium and coarse woody roots; distinct wavy boundary.
B	16 - 58cm (42 cm)	Moist; red yellowish(5YR 4/6) clay; weak to moderately developed blocky structure; slightly plastic; some weathered parent material; many fine pores; common medium roots; distinct smooth boundary.
BC	58 - 190cm ( 132 cm)	Mixed red (5YR 4/6), light yellowish brown (2.5Y 6/4), light olive brown(2.5Y5/4) clay; weakly developed subangular blocky structure; much weathered parent material.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Malolo series**

REFERENCE: Malolo steepland stony clay loam (93d) and moderately steep phase (93dH) defined by Twyford & Wright (1965) from quartz porphyry and quartzite rocks under a climate with a strong dry season.

Forms part of the Vitawa set.

The central concept for Malolo soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Ustipsamment, mixed, non-acid, isohyperthermic
- (b) FAO: Dystric Regosol
- © Twyford and Wright: Red yellow podzolic soil with a strong dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

- Malolo soils, rolling phase (149D)
- Malolo soils, strongly rolling phase (149E)
- Malolo soils, moderately steep phase (149F)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Malolo soils are of limited area and are restricted to Malolo Island west of Viti Levu.

PARENT ROCK: Quartz porphyry and quartzite.

PARENT MATERIAL: Weakly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Planar and convex midslopes and backslopes in strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Rolling (12-15°), strongly rolling (16-20°) and moderately steep (21-26°).

VEGETATION AND LAND USE: Unused, primarily due to severe erosion and slope factors.

RANGE OF ELEVATION: 10-100 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Rapid

FLOODING: Never floods

EROSION: Due to repeated burning soils have experienced serious topsoil losses by severe sheet erosion.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 11 cm of dark yellowish brown stony fine sand, of weakly developed fine nut and crumb structure with single grain, very friable, with many weakly weathered stones overlying 60 cm of yellow and reddish yellow stony loamy fine sand, of massive structure and single grain, friable, with weathered stones, overlying at a lithic contact yellow and reddish yellow massive extremely firm <i>in situ</i> rock, of gritty coarse sand.
DIAGNOSTIC HORIZONS:	Ochric epipedon
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analyses show the topsoil (0-11 cm) to be strongly acid with slightly acid pH below; carbon and nitrogen values are very low as is the C/N ratio; available phosphorus is very low; % base saturation is high in the topsoil and very high in the underlying horizons; CEC is low in all horizons; and exchangeable sodium is medium, potassium is very low, magnesium is medium in the topsoil and very high below, and calcium is low in the topsoil and very low and all other horizons.</p> <p>Particle size family class: Psamment soil order.</p> <p>Mineralogical class is mixed.</p>
LABORATORY Nos:	USP NB21A-C
SOIL LIMITATIONS:	Slope, sandy textures, profile shallowness, rapid permeability, and low water holding capacities all in combination result in very severe soil moisture deficits experienced during the dry season; severe past soil erosion; severe sheet and rill erosion potential; soil acidity; and nutrient deficiencies of nitrogen, potassium and phosphorus.

## Typifying Profile

SOIL NAME: Malolo soils, rolling phase.  
PROFILE No.: NB21  
SITE LOCATION: PSP P74/1/16 Nabou Forest, Nadroga Province.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex shoulder slope in strongly dissected hill country.  
PARENT MATERIAL: Colluvium over *in situ* rock of acid composition.  
SLOPE: 15°, length 150 m  
ASPECT: South  
ELEVATION: 75 m  
MICRORELIEF: Flat  
SITE VEGETATION: Bracken, karuka fern, nokonoko, pandanus under 8 year old *Pinus caribaea*.  
LAND USE: Exotic forestry  
DRAINAGE: Well drained  
EROSION: Past severe topsoil loss by sheet erosion.  
DISTURBANCE: Past erosion  
LABORATORY Nos: USP NB21A-C

### PROFILE DESCRIPTION

Malolo soils, rolling phase

Ah	11 cm	Dry; moist and rubbed dark yellowish brown (10YR 4/4) stony fine sand; weakly developed fine nut and crumb structure with single grain very friable; non-sticky; non-plastic; abundant fine and medium roots; common weakly weathered subangular stones; indistinct smooth boundary,
C	59 cm	Dry; moist, 50% reddish yellow (7.5YR 6/8) and 50% yellow (2.5Y 8/6) stony loamy fine sand; massive breaking to single grain; friable; non-sticky; non-plastic; common fine and medium roots in upper 10 cm; many strongly weathered subangular stones; distinct smooth boundary (lithic contact),
R	30 cm+	Dry; moist 50% yellow (2.5Y 8/6) and 50% reddish yellow (7.5YR 6/8) gritty coarse sand; massive; extremely firm; <i>in situ</i> rock.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Manuka series**

REFERENCE: Manuka stony clay (58d) and Manuka stony hill soils (58dH) defined by Twyford & Wright (1965) as upland latosolic soils from olivine basalt flows 'older than those of the Naitata soils' formed under a climate with no dry season.

Forms part of the Naitata set.

In this survey the central concept for Manuka soils is that described for 58dH by Twyford & Wright rather than the more reddish hues described for 58d.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Acrudoxic Hydric Fluvudand, medial, isothermic
- (b) FAO: Humic Andosol
- (c) Twyford and Wright: Upland latosolic soil with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Manuka soils, rolling phase (215D)  
Manuka soils, strongly rolling phase (215E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Manuka soils occur on the uplands east of the axial divide of Taveuni island.

PARENT ROCK: Olivine basalt

PARENT MATERIAL: Moderately weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Broken and uneven rolling terrain.

#### SLOPE CLASS

AND RANGE OF SLOPES: Rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Unused (tall rain forest).

RANGE OF ELEVATION: 600-1000 m

RAINFALL: Annual average range: 4,000-6,400 mm;  
dry season range: 1,000-3,000 mm;  
wet season range: 2,000-3,200 mm.

TEMPERATURE: Mean annual: 18°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Moderate sheet and rill erosion potential if the forest were cleared and these soils were intensively cultivated.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of very dark brown and very dark greyish brown friable stony silt loam of moderate fine and medium granular structure overlying 60 cm of dark brown firm silt loam grading to sandy loam with depth, of massive structure breaking to weak coarse blocky or columnar, commonly with volcanic grits and stones toward the base of the horizon over varicoloured weathered <i>in situ</i> basalt that is normally encountered by 90 cm depth.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be strongly acid 0-20 cm and moderately acid in the other horizons; organic carbon is very high 0-20 cm, medium 20-70 cm and very low below 70 cm depth; phosphorus retention is very high for all horizons; % base saturation is very low; CEC is high or very high except for 70-85 cm where it is low; TEB values are very low; calcium is very low; magnesium medium 0-20 cm and very low below 20 cm; potassium is low 0-20 cm and very low in the other horizons; and Tamms aluminium extract is high to very high.
LABORATORY Nos:	USP TAV104A-E
SOIL LIMITATIONS:	Rock outcrops and surface boulders; uneven surface; moderately rapid permeability; nutrient deficiencies of nitrogen and potassium; soil acidity; and very high phosphate fixation properties.

## Typifying Profile

SOIL NAME: Manuka soils, rolling phase.  
PROFILE No.: TAV104  
SITE LOCATION: West Taveuni Island, 4 km up Des Veoux Peak Road from Wairaki Mission and 10 m on the south side of the road.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Slightly convex midslope position.  
PARENT MATERIAL: Moderately weathered *in situ* basaltic flow rock.  
SLOPE: 15°  
ASPECT: North  
ELEVATION: 700 m  
MICRORELIEF: Gently undulating. Basalt outcrops on the surface.  
SITE VEGETATION: Rainforest with low canopy of ferns, *Clidemia sp.*, *Alphitonia sp.*, *Parasponia andersonii*.  
LAND USE: Unused (natural state).  
DRAINAGE: Well drained © horizon impediment to drainage and root movement).  
EROSION: None observed  
DISTURBANCE: None observed  
LABORATORY Nos: USP TAV104A-E  
COMMENTS: NaF reaction. Strong positive for all horizons described below.

### PROFILE DESCRIPTION

L	1-0 cm	Partly decomposed litter.
Ah1	0-2 cm (2 cm)	Moist; very dark greyish brown (10YR 3/2) stony silt loam; weak to moderately developed fine and medium granular structure; friable to firm; slightly plastic; profuse fine and medium roots; diffuse wavy boundary,
Ah2	2-20 cm (18 cm)	Moist; very dark brown (10YR 2/2) stony silt loam; moderately developed medium granular structure; friable; slightly sticky; plastic; many fine and medium roots; distinct wavy boundary,
Bw1	20-70 cm (50 cm)	Moist; dark brown (10YR 3/3) silt loam; massive breaking to very coarse blocky structure; very firm; plastic; slightly sticky; few fine and medium roots; distinct smooth boundary,
Bw2	70-85 cm (15 cm)	Moist; dark brown (10YR 3/3) medium sandy loam; weakly developed coarse columnar breaking to medium prismatic structure; firm; slightly sticky; plastic; many grits and fragments of weathered basalt; few fine roots; diffuse smooth boundary,
C	85+ cm	Moist; varicoloured yellowish (5YR 5/6), dark brown (10YR 3/3) and yellowish brown (10YR 5/6) <i>in situ</i> weathered basalt (laminated appearance).





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Matawailevu series**

REFERENCE: Matawailevu clay and stony clay (13b) and Matawailevu hill soils (13bH) defined by Twyford & Wright (1965) as degraded soils formed from basic tuffs under a climate with a moderate dry season.

The morphological and chemical concepts for Matawailevu series are retained but in this survey Matawailevu series are restricted to the udic soil moisture regime.

Forms part of the Dobuilevu set.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Argiudoll, very fine, kaolinitic, isohyperthermic
- (b) FAO: Orthic Luvisol
- (c) Twyford and Wright: Nigrescent soil with a weak to moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Matawailevu soils, flat to gently undulating phase (123A)

Matawailevu soils, undulating phase (123B)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Matawailevu soils are developed widely in association with Dobuilevu soils in Ra province of Viti Levu.

PARENT ROCK: Tuffaceous rocks of intermediate and basic composition.

PARENT MATERIAL: Strongly weathered *in situ* rock with a thin irregular cover of alluvium.

PHYSIOGRAPHIC POSITION / LANDFORM: Low, gently undulating hills surrounded by alluvial soils of the high terrace on which Wainibuka series occur.

SLOPE CLASS AND RANGE OF SLOPES: Flat to undulating (0-5°).

VEGETATION AND LAND USE: Pasture, cocoa, bananas, subsistence root crops and rainfed rice.

RANGE OF ELEVATION: 30-80 m

RAINFALL: Annual average range: 2,800-3,500 mm;  
dry season range: 700-1,200 mm;  
wet season range: 1,400-2,500 mm.

TEMPERATURE: Mean annual: 24.5°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Slow

FLOODING: 1 in 15 year return period for floods.

EROSION: Very slight sheet and rill erosion potential on slopes >2°.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of very dark grey friable clay loam, sticky and plastic moist, of strongly developed fine and medium nut structure with clay cutans to peds and with occasional gravels, overlying 15 cm of very dark grey friable clay, sticky and plastic moist, of strongly developed fine and medium nut structure overlying 50 cm of strong brown friable clay, sticky and plastic moist, of moderately developed medium blocky structure breaking to crumb, and with thin clay cutans to peds on more than 40 cm of dark yellowish brown friable clay with yellow mottles and iron and humus stains.
DIAGNOSTIC HORIZONS:	Mollic epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Matawailevu series have a Ap1, Ap2, Bt, Bw horizon sequence.  The Ap horizons combined thickness ranges 30-40 cm; their colours include very dark grey (10YR 3/1) and very dark greyish brown (10YR 3/2); and textures are clay loam or clay.  The Bt horizon thickness ranges from 25 to 60 cm; its colours range from dark yellowish brown (10YR 3/4) to yellowish red (5YR 4/6); and structures may be massive breaking to moderate or strong medium or coarse blocky.  The Bw horizon thickness ranges from 30-60 cm; its colours include dark yellowish brown (10YR 4/6) and strong brown (7.5YR 4/4); and structures are either weak medium or coarse blocky or massive breaking to fine blocky.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows organic carbon values are low in the topsoil decreasing to very low in the subsoil; % base saturation is high; CEC is medium; exchangeable calcium and sodium have medium values throughout the profile, magnesium is high, and potassium is very high in the topsoil dropping to medium in the subsoil.  The particle size family class is very fine clayey.  The mineralogical class is kaolinitic.
LABORATORY Nos:	KRS T1441-1446.
SOIL LIMITATIONS:	Limitations include: heavy texture and slow subsoil permeability; soil moisture deficits during the dry season; and nutrient deficiencies of phosphorus and nitrogen.

## Typifying Profile

SOIL NAME: Matawailevu soils, flat to gently undulating phase.  
PROFILE No.: DP4  
SITE LOCATION: See soil map of Dobuilevu Agricultural Research Station (McLeod, 1992).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Near crest of low broad ridge surrounded by alluvial deposits.  
PARENT MATERIAL: Strongly weathered intermediate and basic tuff with thin mantle of alluvium derived from rocks of mixed mineralogy.  
SLOPE: 0°  
ASPECT: Not applicable  
ELEVATION: 58 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Para grass  
LAND USE: Grazing  
DRAINAGE: Well drained  
EROSION: None  
DISTURBANCE: Cultivated  
LABORATORY Nos: KRS T1441-1446

### PROFILE DESCRIPTION

Ap1	0-22 cm (22 cm)	Very dark grey (10YR 3/1) clay loam; friable; sticky; plastic; strongly developed medium and fine nut structure; many thin discontinuous clayskins on ped faces; occasional gravels; many fine roots; indistinct irregular boundary,
Ap2	22-37 cm (15 cm)	Very dark grey (10YR 3/1) clay; friable; sticky; plastic; few fine and coarse pores; strongly developed medium and fine nut structure; thin discontinuous clayskins on ped faces; occasional gravels; many fine and few coarse roots; indistinct wavy boundary,
Bt	37-85 cm (48 cm)	Strong brown (7.5YR 4/6) clay with very dark grey (10YR 3/1) humus concentrations mainly along old root channels; friable to firm; sticky; plastic; moderately developed medium blocky breaking to crumb structure; thin discontinuous clayskins on ped faces; occasional gravels; few medium and fine roots; indistinct smooth boundary,
Bw	85-127 cm (42 cm)	Dark yellowish brown (10YR 4/6) clay with few fine indistinct yellow (10YR 7/6) concentrations, also few indistinct strong brown (7.5YR 5/6) iron coatings on peds; common dark grey (10YR 4/1) humus stains frequently along old root channels; friable; sticky; plastic; weakly developed medium blocky structure; few medium cocoa roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Matana series**

REFERENCE: Matana peaty silty clay loam (58c) and Matana hill soils (58cH) defined by Twyford & Wright (1965) as upland latosolic soils from young olivine basalt ash, on rolling and hilly land formed under a climate with no dry season.

Forms part of the Naitata set.

The central concept for Matana soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Acrudoxic Hydric Fluvudand, thixotropic, isothermic
- (b) FAO: Humic Andosol
- (c) Twyford and Wright: Upland latosolic soil with no dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Matana soils, rolling phase (218D)

Matana soils, strongly rolling phase (218E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Matana soils occur throughout the central uplands of Taveuni where they form on surfaces fringing the volcanic cones.

PARENT ROCK: Olivine basalt

PARENT MATERIAL: Moderately weathered ash overlying *in situ* flow rocks at depth.

PHYSIOGRAPHIC POSITION / LANDFORM: Broad planar surfaces on rolling land.

SLOPE CLASS AND RANGE OF SLOPES: Rolling (12-15°) and strong rolling (16-20°).

VEGETATION AND LAND USE: Unused (natural state of tall rain forest).

RANGE OF ELEVATION: 600-1000 m

RAINFALL: Annual average range: 4,000-6,000 mm;  
dry season range: 1,000-3,000 mm;  
wet season range: 2,000-3,200 mm.

TEMPERATURE: Mean annual: 18°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Moderate sheet and rill erosion potential if the forest were cleared and these soils were intensively cultivated.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	<p>A very deep volcanic ash soil typically showing a thin very dark greyish brown to dark brown very friable loamy topsoil of moderate to strong nut structure overlying a dark brown friable fine loamy to fine clayey subsoil of weak coarse blocky or nut structure.</p> <p>A paleosol and an underlying Bt horizon may or may not be present.</p>
DIAGNOSTIC HORIZONS:	Umbric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Matana series have an Ah, Bw, (bAh), bBw, (bBt), C horizon sequence.</p> <p>The Ah horizon thickness ranges from 8 to 44 cm; its colours include dark reddish brown (5YR 3/3, 3/4), dark brown (7.5YR 3/2, 4/2) and very dark greyish brown (10YR 3/2); textures are clay loams or silty clay loams; and structures are moderate or strong fine or medium nut.</p> <p>The Bw horizon thickness ranges from 13 to 26 cm; its colours include reddish brown (5YR 4/3, 4/4, 5/4) or dark brown (10YR 3/3, 7.5YR 3/2); textures are clay loams or silty clay loam; and structures are weak medium or fine nut.</p> <p>The bAh horizon thickness (if present) ranges from 12 to 33 cm; its colours include very dark greyish brown (10YR 3/2) or very dark brown (10YR 2/2); textures are silty clay loams or silty clays; and structures are weak or moderate coarse or fine nut.</p> <p>The bBw horizon thickness ranges from 27 to 83 cm; its colours include dark yellowish brown (10YR 4/4), dark brown (10YR 3/8) or reddish brown (5YR 4/3, 4/4, 5/4); textures range between sandy clay loams and clay loams; structures are weak or moderate coarse blocky; and there may be few or common gravels and stones.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be strongly acid in the topsoil (0-28 cm) and moderately acid in the other horizons; organic carbon is high in the topsoil, medium in the Bw and bAh horizons and very low in the other horizons; nitrogen is high in the topsoil, low in the Bw and bAh horizons and very low in the other horizons; phosphorus retention is very high throughout; % base saturation and TEB is very low throughout the profile; CEC is high in the topsoil and low in all other horizons; calcium, magnesium and potassium are very low throughout the profile.
LABORATORY Nos:	KRS S2968-2973; SBT286A-C; and M4A-D
SOIL LIMITATIONS:	Moderately rapid permeability; susceptibility for erosion after forest clearance; strong soil acidity; very high phosphate fixation properties; and nutrient deficiencies of potassium and nitrogen.

## Typifying Profile

SOIL NAME: Matana soils, rolling phase.  
PROFILE No.: T41  
SITE LOCATION: West Taveuni Island, south and adjacent to Des Veoux Peaks Road 2.45 km ESE of Tutu Chapel.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex sideslope in rolling country.  
PARENT MATERIAL: Moderately weathered basaltic ash overlying *in situ* basaltic flow rocks at depth.  
SLOPE: 12°  
ASPECT: West south-west  
ELEVATION: 610 m  
MICRORELIEF: Gently undulating  
SITE VEGETATION: Rainforest with low canopy of ferns, *Clidemia sp.*, *Alphitonia sp.*, *Parasponia andersonii*.  
LAND USE: Forest  
DRAINAGE: Well drained  
EROSION: None  
DISTURBANCE: None  
LABORATORY Nos: KRS S2968-2973  
SBT286A-C  
M4A-D  
COMMENTS: NaF reaction. Moderate; strong; strong; strong for the 4 horizons described below.

### PROFILE DESCRIPTION

Ah	0-28 cm (28 cm)	Very moist; very dark greyish brown (10YR 3/2) clay loam; very friable; slightly sticky; plastic; moderately developed medium nut breaking to moderately developed fine nut structure; many very fine roots; distinct irregular boundary,
Bw	28-54 cm (26 cm)	Moist; dark brown (10YR 3/3) silty clay loam; friable; slightly sticky; plastic; weakly developed medium nut breaking to weakly developed fine nut structure; common very fine roots; few moderately weathered subrounded basalt stones; distinct wavy boundary,
bAh	54-76 cm (22cm)	Moist; very dark greyish brown (10YR 3/2) silty clay loam; friable; very sticky; very plastic; weakly developed coarse blocky breaking to weakly developed fine nut structure; few faint dark brown (10YR 3/3) organic cutans; common very fine roots; distinct irregular boundary,
bBw	76-102 cm	Moist; dark brown (10YR 3/3) clay loam; friable; slightly sticky; plastic; weakly developed coarse blocky breaking to weakly developed fine blocky structure; few distinct dark brown (10YR 3/3) organic cutans; few very fine roots; few moderately weathered subrounded basalt stones.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Matavelo series**

REFERENCE: Matavelo clay (50a) as described by Twyford & Wright (1965) as a strongly mottled, moderately to strongly gleyed soil developed in valley bottoms and low-lying depressions under a climate with a moderate to strong dry season; and related to humic latosols.

Forms part of the Matavelo set.

This concept for Matavelo soils has been retained for this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Aerlic Tropaquept, fine, kaolinitic, isohyperthermic
- (b) FAO: Dystric Gleysol
- (c) Twyford and Wright: Gley soil related to latosols with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Matavelo soils (52)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Matavelo soils are widely distributed in valley bottoms and low-lying depressions in the south-west, west and north of Viti Levu. On Vanua Levu they are widespread in gentle depressions on a rolling or undulating landscapes and low terraces in the dry zone.

PARENT ROCK: Variable rocks of basic and intermediate composition.

PARENT MATERIAL: Deep weathered alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Valley floors and depressions.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-2°).

VEGETATION AND LAND USE: Intensively used for sugar cane and rainfed rice.

RANGE OF ELEVATION: 3-30 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Slow in summer months. Medium to moderately rapid in winter months.

FLOODING: Flooding occurs on 2-3 occasions in the period November to April with water ponding for up to 5 days at each event. Water table can be as high as 60 cm in the profile for up to 60 days in the wet season.

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of yellowish brown mottled reddish yellow clay, of coarse blocky structure, very hard when dry and sticky when moist; with common black manganese concretions; overlying 15 cm of dark brown mottled reddish yellow clay, of coarse nutty structure and firm; overlying 25 cm of very dark greyish brown mottled reddish yellow clay of strongly developed very coarse blocky structure (tending prismatic when dry), very firm and sticky and plastic when moist; overlying more than 60 cm of yellow mottled grey silty clay, very firm, of massive structure.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Matavelo series have an Ap1, Ap2, AB, Bw horizon sequence.  The Ap horizon thickness varies from 15-20 cm; colours range from yellowish brown (10YR 5/4) to greyish brown (10YR 5/2); and structures may be medium or coarse blocky.  The AB horizons range from 30 to 45 cm in thickness; colours vary between dark brown (10YR 3/3) very dark greyish brown (10YR 3/2), dark grey (10YR 3/1 and 4/1) and grey (10YR 5/1); and structures may be strong medium prismatic or strong coarse and very coarse blocky.  The Bw horizon exceeds 50 cm in thickness; colours range from yellow (10YR 8/8, 7/6) to white (10YR 8/2); mottle colours are highly variable but commonly grey (2.5YR hue) or reddish (2.5YR and 5YR hues) and can show reticulate patterns; humus may or may not be present; and textures range between silty clays and sandy clays.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Moderately acid. High cation exchange capacity with the exchange complex dominated by calcium and magnesium that also have high values. Exchangeable potassium, however, is very low. Available phosphorus is very low and nitrogen is low below 20 cm depth.  The particle size family class is fine.  The mineralogy class is kaolinitic.
LABORATORY Nos:	KRS U103-105 (inclusive)
SOIL LIMITATIONS:	Soil moisture deficits sometime during the period May to October, poor internal drainage (when moist), high seasonal water table in part of the summer, due to montmorillonitic clay mineralogy and winter drying soil aggregates become extremely hard as does the compact subsoil, and nutrient deficiencies (potassium and phosphorus).

## Typifying Profile

SOIL NAME: Matavelo soils  
PROFILE No.: 33/1/b  
SITE LOCATION: Located between the main road and Drasa timber mill, and about 50 m east of connecting road.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: A concave basin; possibly an old abandoned river bed progressively in-filled with outwash materials.  
PARENT MATERIAL: Deep alluvium derived from rocks of basic composition.  
SLOPE: Level  
ASPECT: Not applicable  
ELEVATION: 10 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Sugar cane  
LAND USE: Intensive sugar cane cropping.  
DRAINAGE: Poorly drained. Water table at 150 cm.  
EROSION: None observed  
DISTURBANCE: Cultivated  
LABORATORY Nos: KRS U103-105 (inclusive)

### PROFILE DESCRIPTION

Matavelo soils

Ap1	0-20 cm (20 cm)	Moist; yellowish brown (10YR 5/4) and mottled reddish yellow (7.5YR 6/8) clay; common black (10YR 2/1) manganese nodules; weakly developed coarse blocky structure; friable; slightly sticky; non-plastic; many fine fibrous roots; diffuse smooth boundary,
Ap2	20-35 cm (15 cm)	Moist; dark brown (10YR 3/3) clay; common fine faint reddish yellow (7.5YR 5/6) mottles; weakly developed coarse nut structure; firm; slightly sticky; few fine fibrous roots; diffuse smooth boundary,
AB	35-60 cm (25 cm)	Moist; very dark greyish brown (10YR 3/2) clay; common small distinct reddish yellow (7.5YR 6/8) mottles; strongly developed very coarse blocky (tending prismatic when dry) structure; very firm; slightly sticky; slightly plastic; few fine fibrous roots; diffuse smooth boundary,
Bw	60-120cm+ (60 cm+)	Moist; yellow (10YR 5/8) silty clay; common medium distinct grey (2.5YR 7/0) mottles; massive; very firm; very plastic.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Melimeli series**

REFERENCE: Melimeli peat (54b) as defined by Twyford & Wright (1965) for soils formed in the organic deposits on the floodplains of the Rewa and Navua river systems. From Twyford and Wright descriptions the central concept of Melimeli is a Tropofibrist i.e. a weakly decomposed peat, and the type name is applied to those organic soils in the perudic soil moisture regime that correlate to this classification. Twyford and Wright describe Melimeli peat as comprising 25 cm of brown humified peat on 30 cm of dark gelatinous brown peat (with many fibrous roots) over 30 cm of strongly decomposed peat on greyish sand with the depth of peat varying from 1.5 m to 3 m.

CLASSIFICATION:

- (a) Soil Taxonomy: Hydric Tropofibrist, dysic, isohyperthermic
- (b) FAO: Dystric Histosol
- (c) Twyford and Wright: Organic soil

INCLUDED MAPPING UNITS AND SYMBOLS:

Melimeli soils (32)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs as the dominant soil in the peat bogs of the Rewa, Deuba, Navua, Melimeli districts in SSE and ESE Viti Levu.

PARENT ROCK: Not applicable

PARENT MATERIAL: Weakly decomposed sedges and grasses (*Eleocharis laxiflora*, *Nephrolepis exaltata*, *Cyclosorus gongyloide*) with commonly thin, sometimes thick, buried alluvial horizons derived from basic and intermediate rocks.

PHYSIOGRAPHIC POSITION/LANDFORM: Comprises the largest area of the often domed peat bogs where it develops in a concentric part in association with other Histosols not mappable at 1:50 000 scale.

SLOPE CLASS AND RANGE OF SLOPES: Level or near level, 0-1°.

VEGETATION AND LAND USE: Unused. Para grass, Mimosa, Yellow Primrose, Jungle rice, sedges, Kuta and Desmodium with scattered Pandanus trees.

RANGE OF ELEVATION: 1-5 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24.5°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Ponded. Water table at or near surface in most seasons.

PERMEABILITY CLASS: Moderate

FLOODING: Continual flooding, due to high water table.

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Predominantly an organic soil with no mineral horizon <i>per se</i> other than the mineral content of the thick (25-35 cm) peaty clay surface horizon. The profile below this comprises alternating horizons of dark yellowish brown and dark brown weakly decomposed peat. The peats are massive, soft and friable.
DIAGNOSTIC HORIZONS:	Histic epipedon
RANGE OF PROFILE FEATURES:	Not applicable. Profiles show little differences in physical features to that described above other than some variation in horizon thicknesses.
VARIANTS:	Within the Melimeli mapping unit the following soil series are recognised as inclusions: Barebasaga, Waidamu, and Waitovu (Leslie, 1984).
SIMILAR SOILS AND DISTINGUISHING FEATURES:	(Refer soil map of Koronivia Agricultural Research Station (Leslie, 1984): Waitovu series: Has a black, peaty loam topsoil with two or more mottled and massive clayey mineral horizons, with a weakly decomposed buried peat horizon of 30-50 cm thickness.  Laumoli series: Has a surface layer of structureless mucky silt otherwise similar in all other features to Waitovu series.  Waidamu series: Has one or more thin mineral horizons, and the peaty layers are strongly decomposed.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Strongly acid profiles with very high organic carbon values.
LABORATORY Nos:	KRS D217-223 (inclusive)
SOIL LIMITATIONS:	Permanent high water table; inability to drain; strong soil acidity; and deficiencies of potassium.

## Typifying Profile

SOIL NAME: Melimeli soils  
PROFILE No.: TR17  
SITE LOCATION: Refer soil map of Koronivia Agricultural Research Station. South-east corner of the Station 45 m south of the southern end of the main Station road.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Outer margin of Rewa peat bog.  
PARENT MATERIAL: Weakly decomposed peat derived from ferns and sedges.  
SLOPE: Level  
ASPECT: Not applicable  
ELEVATION: 4 m  
MICRORELIEF: Uniformly planar.  
SITE VEGETATION: Ferns, Mimosa, Desmodium, Viovoi, reeds and sedges.  
LAND USE: Unused, in near natural state.  
DRAINAGE: Very poorly drained. Water table at 30 cm.  
EROSION: Nil. Subject to flooding  
DISTURBANCE: Has experienced fires in the past.  
LABORATORY Nos: KRS D217-223 (inclusive)

### PROFILE DESCRIPTION

Melimeli soils

Of	0-30 cm (30 cm)	Wet; black (10YR 2/1) fibrous peat; no colour change when squeezed; fibres (7.5YR 5/4) comprise 60% of mass; many woody roots; material does not squeeze through fingers or disintegrate when rubbed; non-sticky; indistinct smooth boundary,
Ah	30-53 cm (23 cm)	Wet; brown (7.5YR 5/4) fibrous peat; fibres comprise 80% of mass; pieces of pandanus fruit; material does not squeeze through fingers or disintegrate when rubbed; non-sticky; distinct smooth boundary,
bOf1	53-76 cm (23 cm)	Wet; brown (7.5YR 5/4) fibrous peat; turns very dark greyish brown (10YR 3/2) after squeezing; liquid squeezed dark, but not colloidal; material does not squeeze through fingers or disintegrate when rubbed; non-sticky; distinct smooth boundary,
bOf2	76-99 cm (23 cm)	Wet; very dark brown (10YR 2/2) mucky fibrous peat; material turns dark yellowish brown (10YR 3/4) after squeezing; fibres comprise 80% of mass and are homogeneous in size; 25% of fibres disintegrate on rubbing and squeeze between fingers; indistinct boundary,
bOm1	99-122 cm (23 cm)	Wet; very dark brown (10YR 2/2) muck; no colour change on squeezing; fibres comprise less than 30% of mass and disintegrate on rubbing; almost all material squeezed through fingers; liquid very turbid; indistinct boundary,



bOm2	122-154 cm (32 cm)	Wet; black (10YR 2/1) muck; no colour change when squeezed; fibres less than 10%; some peaty lumps disintegrate on rubbing all material squeezes through fingers,
bAh	154-168 cm (34 cm)	Wet; black (10YR 2/1) clayey muck; no colour change on squeezing, material more clayey with depth; slightly sticky; slightly plastic; all material squeezes through fingers.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Molamolau series**

REFERENCE: Molamolau clay (48b) defined by Twyford and Wright (1965) as a weakly to moderately mottled gley soil related to latosols.

Forms part of the Lautoka set.

The central concept for Molamolau soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Ustic Dystropept, fine, mixed, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Gley soil related to latosols with a moderate to strong dry season

#### INCLUDING MAPPING UNITS AND SYMBOLS:

Molamolau soils (72)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Confined to some level flood plain systems between the Qawa and Nasarowaqa rivers in north Vanua Levu dry zone.

PARENT ROCK: Basic rocks

PARENT MATERIAL: Strongly weathered alluvium.

PHYSIOGRAPHIC POSITION / LANDFORM: Stable floodplains and low terraces.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: Originally supported tall forest but only remnants remain. Used for sugar cane, rice and dalo.

RANGE OF ELEVATION: 2-15 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat poorly drained.

PERMEABILITY CLASS: Moderately slow

FLOODING: One in 25 year return period for flood events depositing sediment. For other floods, one in 5 year return period.

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 8 cm of very dusky red firm clay, of strong fine nut structure overlying 15 cm of dark reddish brown friable clay of moderate medium blocky structure, overlying 30 cm of reddish brown firm to friable clay of weak to medium blocky structure commonly slightly mottled strong brown or dark brown on compact, firm varicoloured dark red and weak red and brown clay of fine granular structure.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
TYPIFYING PROFILE:	DK 42
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile description available.
VARIANTS:	Unnamed variant (previously Wailevu clay of Twyford and Wright, 1965) with more impeded drainage and more strongly mottled subsoil.  Typically shows 23 cm of brown clay on 12 cm of reddish brown clay slightly mottled yellowish red, on 5 cm of yellowish red strongly mottled clay resting on yellowish red very compact clay, weakly to moderately mottled.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Thought to be strongly acid and of low base status, low in available phosphate and in all exchangeable bases except potassium.
LABORATORY Nos:	Not sampled for analysis.
SOIL LIMITATIONS:	Occasional flooding hazard; water table within 1 m of the surface sometime during the wet season; moderate to severe soil moisture deficits during the dry season; nutrient deficiencies of phosphorus and nitrogen; and strong soil acidity.

## Typifying Profile

SOIL NAME: Molamolau soils  
PROFILE No.: DK 42  
SITE LOCATION: Dreketi irrigation scheme.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Floodplain  
PARENT MATERIAL: Strongly weathered outwash alluvium from basic rocks.  
SLOPE: 1°  
ASPECT: North  
ELEVATION: 5 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Rice  
LAND USE: Rice cultivation  
DRAINAGE: Poorly drained  
EROSION: None  
DISTURBANCE: Cultivated

### PROFILE DESCRIPTION

Ap	0-8 cm (8 cm)	Moist; very dusky red (2.5YR 2/2) clay; strongly developed fine nut structure breaking to fine crumb; friable to firm; slightly sticky; slightly plastic; distinct smooth boundary,
Bw1	8-23 cm (15 cm)	Moist; dark reddish brown (5YR 3/3) clay; moderately developed medium blocky structure breaking to fine blocky with crumb structure; friable; sticky; plastic; diffuse smooth boundary,
Bw2	23-53 cm	Moist; reddish brown (5YR 4/4) clay; faint strong brown (7.5YR 5/6) and dark brown (7.5YR 4/4) mottling; weakly developed medium blocky structure breaking to strongly developed fine granular structure; firm; compact in place; sticky; plastic; diffuse smooth boundary,
C	on	Moist; varicoloured dark red (2.5YR 3/6), weak red (10R 5/4) and brown (7.5YR 5/4) clay; weakly developed fine granular structure; firm; compact in place; slightly sticky; slightly plastic.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Momi series**

REFERENCE: Momi clay (16c) and Momi hill soils (16cH) defined by Twyford & Wright (1965) as developed on undulating and rolling topography from marls and calcareous tuffs under a climate with a strong dry season.

Forms part of Moto set.

The central concept as defined for Momi series is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Ustropept, fine, smectitic, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Nigrescent soil with a strong dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Momi soils, undulating phase (115B)	Momi soils, moderately steep phase (115F)
Momi soils, easy rolling phase (115C)	Momi soils, steep phase (115G)
Momi soils, rolling phase (115D)	Momi soils, very steep phase (115H)
Momi soils, strongly rolling phase (115E)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Momi soils are widespread in western and south-western Viti Levu where they are in association with Yako soils.

PARENT ROCK: Marls and calcareous tuffs and andesitic tuffs.

PARENT MATERIAL: Weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Ridge crests and shoulders and convex backslopes and midslopes in strongly rolling hill country.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°), and very steep (>35°).

VEGETATION AND LAND USE: Used only for rough grazing in the natural state and on steeper slopes. Increasingly developed for sugar cane, cassava, maize and pulse crops.

RANGE OF ELEVATION: 20-150 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Medium

FLOODING: Never floods

EROSION: Moderate and severe sheet and rill erosion potential on slopes >11°.

*Momi*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of very dark grayish brown very firm clay of strongly developed medium nut structure, sticky and plastic when moist, overlying 80 cm of reddish yellow firm clay, of strongly developed coarse blocky structure on reddish brown weathered tuff.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be slightly acid; organic carbon and nitrogen values are low in the topsoil (0-20 cm), very low below it and C/N ratios are medium; available phosphorus very low; % base saturation, TEB and CEC values are very high throughout; exchangeable magnesium, calcium and sodium are very high in all horizons; and potassium is high in the topsoil and very low below it.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is smectitic.</p>
LABORATORY Nos:	KRS U238-239
SOIL LIMITATIONS:	Clayey textures; severe soil moisture deficits experienced during the dry seasons; moderate and severe sheet and rill erosion potential; and nutrient deficiencies of phosphorus and potassium.

## Typifying Profile

SOIL NAME: Momi soils, rolling phase.  
PROFILE No.: 37/8/b  
SITE LOCATION: At Nawai, near Nadi. Just east of the junction of Old Momi Road and new highway (100 m along Nawai back road).

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Concave midslope  
PARENT MATERIAL: Weathered *in situ* andesitic tuff.  
SLOPE: 15°  
ASPECT: North-east  
ELEVATION: 25 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Wire grass, guava, japanese tea, desmodium.  
LAND USE: Rough grazing  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: KRS U238-239

### PROFILE DESCRIPTION

Ah	0-20 cm (20 cm)	Moist; very dark greyish brown (10YR 3/2) clay; strongly developed medium nut structure; very firm; sticky; plastic; common fine fibrous roots; diffuse irregular boundary,
Bw	20-100 cm (80 cm)	Moist; reddish yellow (7.5YR 6/6) clay; strongly developed coarse blocky structure; firm; sticky; plastic; few fine woody roots, irregular wavy boundary,
C	on	Reddish brown weathered tuff.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Monasavu series**

REFERENCE: The Monasavu set defined by Twyford & Wright (1965) includes Monasavu steepland clay (95a) from andesitic tuffs; Monasavu steepland bouldery red brown clay (95b) from olivine basalt; Monasavu steepland bouldery brown clay (95c) from andesite; and Monasavu steepland bouldery peaty and sandy clay (95d) from granodiorite and silicified basalts etc., all upland soils developed under a climate with no dry season. 95b is taken as the central concept for Monasavu series in this survey. 95a and 95c now constitute the Nabouwaqa series and 95d the Kabasese series.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Oxic Humitropept, fine, kaolinitic, isothermic
- (b) FAO: Humic Cambisol
- (c) Twyford and Wright: Upland steepland soil related to or associated with humic latosols with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Monasavu soils, rolling phase (223D)	Monasavu soils, steep phase (223G)
Monasavu soils, strongly rolling phase (223E)	Monasavu soils, very steep phase (223H)
Monasavu soils, moderately steep phase (223F)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Monasavu soils develop in the uplands of Viti Levu on steep slopes above 600 m under a climate with continuous rainfall and no dry season.

PARENT ROCK: Olivine basalt

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Mainly planar and convex surfaces occupying most slope positions in steep country.

SLOPE CLASS AND RANGE OF SLOPES: Rolling phase (12-15°), strongly rolling phase (16-20°), moderately steep (21-25°), steep (26-35°), and very steep (>35°).

VEGETATION AND LAND USE: Almost entirely under dense forest, only very occasionally used for subsistence cropping.

RANGE OF ELEVATION: 600-1500 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 600-800 mm;  
wet season range: 2,000-2,800 mm.

TEMPERATURE: Mean annual: 18°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Very severe sheet, rill and mass movement erosion potential if forest cleared.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 25 cm of dark brown very friable clay loam of very strongly developed granular structure, commonly with a few boulders and smeary consistence, overlying 40 cm of dark reddish brown firm clay of weak coarse nut structure, commonly with a few boulders and smeary consistence on 50 cm or more of yellowish red very firm clay, of massive structure and lightly sticky consistence, moist.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Monasavu series have an Ah, Bw, BC horizon sequence.  The Ah horizon thickness ranges from 12 to 30 cm; its colours include reddish brown (5YR 4/3, 4/4) and dark brown (7.5YR 3/2, 4/4, 4/2); textures are clay or clay loam; consistence friable or very friable; and structures may be moderate, strong or very strong fine blocky or fine or medium granular.  The Bw horizon thickness ranges from 35 to 45 cm; its colours include dark reddish brown (5YR 3/4), reddish brown (5YR 4/4, 5/4) and yellowish red (5YR 4/6, 5/6); structures may be moderate or strong nut or blocky; consistence friable or firm; and with or without boulders.  The BC horizon thickness ranges from 25 to 60 cm; its colours include yellowish red (5YR 4/6, 4/8, 5/6 and 5/8); consistence may be firm or friable; and structures massive or weak fine blocky or nutty.
VARIANTS:	Unnamed colluvial variant (Pedon VS121) profile description attached. Develops in toeslope positions and is of limited areal extent. KRS V712-713 (inclusive).
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be strongly acid throughout; organic carbon and nitrogen have medium values in the topsoil (0-25 cm) and very low values below it; very low available phosphorus; % base saturation values are low throughout; CEC is medium in the topsoil and low below it; exchangeable calcium is low in the topsoil and very low in the other horizons; magnesium is medium in the topsoil and very low below it; and potassium values are very low in all horizons.
LABORATORY Nos:	KRS V680-682 (inclusive)
SOIL LIMITATIONS:	Slope; very severe erosion potential; soil acidity; and nutrient deficiencies of potassium, phosphorus and nitrogen.

## Typifying Profile

SOIL NAME: Monasavu soils, steep phase.  
PROFILE No.: VS108  
SITE LOCATION: On road to Lewa village 5 km from junction at Nadarivatu Forestry Station.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Concave lower midslope in steepland.  
PARENT MATERIAL: Strongly weathered *in situ* olivine basalt.  
SLOPE: 30°  
ASPECT: West  
ELEVATION: 830 m  
MICRORELIEF: Uneven  
SITE VEGETATION: *Pinus caribaea* with ground cover of lantana, mission grass, reeds and goatweed .  
LAND USE: Exotic forestry  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: KRS V680-682 (inclusive)

### PROFILE DESCRIPTION

#### Monasavu soils, steep phase

Ah	0-25 cm (25 cm)	Moist; dark brown (7.5YR 4/4) clay loam; very strongly developed fine granular structure; very friable; somewhat smeary; firm medium boulders; common large pores; many fine fibrous and common large woody roots; distinct smooth boundary,
Bw	25-65 cm (40 cm)	Moist; dark reddish brown (5YR 3/4) clay; moderately developed coarse nut structure; firm; somewhat smeary; few medium subrounded boulders; few large pores; common fine fibrous roots; diffuse smooth boundary,
BC	65-120 cm (55 cm)	Moist; yellowish red (5YR 4/6) clay; massive; firm; slightly sticky; many fine roots; no boulders.

#### Variant of Monasavu soils

Ah	0-25 cm (95 cm)	Moist; brown to dark brown (7.5YR 4/4) clay; weakly developed coarse blocky structure tending to be massive; firm; very sticky; slightly plastic; few strongly weathered olive brown (2.5Y 5/6) stones and boulders; common fine fibrous roots.
Bw	25-120 cm (95 cm)	Moist; dark red (2.5YR 3/6) clay; weakly developed coarse blocky structure tending to be massive; firm; very sticky; slightly plastic; few strongly weathered olive brown (2.5Y 5/6) stones and boulders; common fine fibrous roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Muainase series**

REFERENCE: New soil series introduced in the soil survey of Naduruloulou Agricultural Research Station (Palmer & Smith 1985) to include coarser textured well drained alluvial soils with a cambic horizon that do not receive 'fresh' accretions of alluvium. The series were previously included with Rewa sandy clay loam (4b) as defined by Twyford and Wright (1965). Adoption of Soil Taxonomy requires separation of the original Rewa set (4) into new series. The coarser textured members of the set are included with Muana, Toga and Muainase series. Muana and Toga have no cambic horizon and the former has in addition a high water table.

The name is derived from the site of Navuso Agricultural College on the south bank of the Rewa River, opposite Naduruloulou Agricultural Research Station.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Eutropept, coarse loamy, mixed, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Recent soil from alluvium with a very weak or no dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Muainase soils (21)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Muainase soils develop on well drained sites adjacent to the Rewa River and its tributaries in ESE Viti Levu.

PARENT ROCK: Rocks of basic and intermediate composition.

PARENT MATERIAL: Recent, moderately weathered riverine alluvium.

PHYSIOGRAPHIC POSITION / LANDFORM: Crests of levees adjacent to rivers and streams that are subject to periodic flooding but not additions of 'fresh' alluvium.

SLOPE CLASS AND RANGE OF SLOPES: Level

VEGETATION AND LAND USE: Grazing, horticultural and root crops.

RANGE OF ELEVATION: 3-12 m

RAINFALL: Annual average range: 3,200 - 4,800 mm;  
dry season range: 800 - 1,600 mm;  
wet season range: 1,800 - 2,800.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: One in five year return period for floods depositing minor amounts of fresh sediment.

EROSION: No erosion risk.

*Muainase*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows a dark topsoil overlying a dark brown weakly structured cambic B horizon that overlies a dark brown C horizon. Textures vary in the profile from clay loam through sandy clay to loam to sandy loam, but are predominantly of coarse loamy particle size class.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	<p>Toga series: have no B horizon. A and C horizons are however similar. May be found in a similar position to Muainase series but occurs where flooding has deposited alluvium more recently.</p> <p>Rewa series: Occur off crestal levee areas further from the river.</p> <p>Textures are finer and soils less well drained, having ochrous mottles in subsoil horizons.</p>
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Slightly acid soils of very high base status. Exchangeable calcium and magnesium values are mostly high in all horizons. Exchangeable sodium is medium. A noticeable feature is the very low exchangeable potassium. Organic carbon percentages decrease regularly with depth. Particle size analyses show marked variations in texture down the profile.</p> <p>The particle size family class is coarse-loamy.</p> <p>The mineralogical class is mixed.</p>
LABORATORY Nos:	KRS T1420-1424
SOIL LIMITATIONS:	Liable to flooding; moderate permeability and coarse textures give low water holding capacity and soil moisture deficits may be experienced for short periods during the period May to October and nutrient deficiencies of nitrogen and potassium.

## Typifying Profile

SOIL NAME: Muainase soils  
PROFILE No.: N101  
SITE LOCATION: See soil map of Naduruloulou Agricultural Research Station (Palmer, 1992).  
Sheet Viti Levu 14 (1:50 000) 603 E, 121 N.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Crest of levee.  
PARENT MATERIAL: Moderately weathered alluvium derived from basic and intermediate rocks.  
SLOPE: 0°  
ASPECT: Not applicable  
ELEVATION: 10 m  
MICRORELIEF: Uniformly planar  
SITE VEGETATION: Inferior sward grasses and miscellaneous weeds.  
LAND USE: Cattle grazing  
DRAINAGE: Well drained  
EROSION: None  
DISTURBANCE: None observed  
LABORATORY Nos: KRS T1420-1424

### PROFILE DESCRIPTION

Ap	0-22 cm (22 cm)	Dark greyish brown (10YR 4/2) sandy clay loam; friable; slightly sticky; plastic; weakly developed fine blocky structure; many fine roots; diffuse boundary,
Bw	22-52 cm (30 cm)	Brown to dark brown (10YR 4/3) clay loam; friable; slightly sticky; plastic; weakly developed coarse blocky structure; many fine roots; indistinct boundary,
C	52-100 cm (48 cm+)	Brown to dark brown (10YR 4/3) sandy loam; friable; non-sticky; non-plastic; massive; few fine roots.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nabeka series**

REFERENCE: Nabeka clay (23f) and Nabeka hill soils (23fH) defined by Twyford & Wright (1965) as latosolic soils from olivine basalt flows 'somewhat other than the Taveuni clay loam basalts' and formed under a climate with a weak dry season.

Forms part of the Waiqere set.

The central concept for Nabeka soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Hapludult, clayey, halloysitic, isohyperthermic
- (b) FAO: Dystric Nitosol
- (c) Twyford and Wright: Latosolic soil with a weak dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Nabeka soils, easy rolling phase (101C)

Nabeka soils, rolling phase (101D)

Nabeka soils, strongly rolling phase (101E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Patchy distribution in the Qeleni area in north-east Taveuni and in places along the east coast from Somosomo Village in the south to Mua Estate in the north .

PARENT ROCK: Basalt

PARENT MATERIAL: Moderately weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Planar and convex slopes on undulating to easy rolling country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Much under coconut (estates) with undergrazing by beef cattle. Some areas in cocoa, elsewhere widely used for subsistence food crops.

RANGE OF ELEVATION: 0-600 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-2,000 mm;  
wet season range: 1,800-3,000 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Slight to moderate sheet and rill erosion potential where forest or tree crops cleared and intensively cultivated .

*Nabeka*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of dark brown very friable silty clay of strong fine nut structure overlying 10 cm of dark greyish brown friable silty clay overlying 60 cm of dark brown to brown friable to firm clay loam of moderate coarse blocky structure and sticky with plastic when moist, on 100 cm or more of brown firm clay loam of massive structure breaking to weak peds and commonly with a few weathered stones. Commonly overlies strongly weathered basalt boulders
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Nabeka series have an Ah, AB, Bt1, Bt2 horizon sequence.  The Ah horizon thickness ranges from 8 to 15 cm; its colours include dark brown (10YR 3/3, 7.5YR 3/2) and dark reddish brown (5YR 3/3, 3/4); textures are silty clay, clay loam or clay; and structures are weak, moderate or strong, fine or medium nut or blocky.  The AB horizon thickness ranges from 5 to 12 cm; its colours include dark greyish brown (10YR 4/2), dark brown (7.5YR 4/2) and dark reddish grey (5YR 4/2); textures are silty clay, clay loam, or clay; and structures are weak or moderate fine or medium nut or granular.  The Bt horizons thickness exceeds 100 cm; their colours include dark brown (10YR 4/3, 7.5YR 4/2, 4/4) dark reddish brown (5YR 3/4) and reddish brown (2.5YR 4/4, 5YR 4/4, 5/4); textures are clay or clay loam; structures are massive breaking to weak or moderate coarse blocky; and clay/humus cutans may be few, common or many.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be strongly acid in the topsoil (0-9 cm) and moderately acid in the other horizons; organic carbon is medium in the topsoil, low 9-20 cm, and very low below; nitrogen is high in the topsoil and low 9-80 cm; CEC and TEB are high in the topsoil and medium in the other horizons; % base saturation is medium 0-9 cm, low 9-20 cm and medium 20-200 cm; magnesium is high in the topsoil and very low values for the other horizons.  The particle size family class is clayey.  The mineralogical class is halloysitic.
LABORATORY Nos:	ORSTOM TAV19A-D
SOIL LIMITATIONS:	Susceptibility to erosion when forest cleared on slopes >11°; strong soil acidity; potassium deficiency and possible low available phosphorus.

## Typifying Profile

SOIL NAME: Nabeka soils, easy rolling phase.  
PROFILE No.: TAV19  
SITE LOCATION: Nasau district, northeast Taveuni Island.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar lower midslope in weakly dissected volcanic terrain.  
PARENT MATERIAL: Moderately weathered *in situ* basalt.  
SLOPE: 9°  
ASPECT: North-east  
ELEVATION: 200 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Coconuts with ground cover of miscellaneous weeds and grasses.  
LAND USE: Coconut (copra) production.  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: ORSTOM TAV19A-D

### PROFILE DESCRIPTION

Ah	0-9 cm (9 cm)	Moist; dark brown (10YR 3/3) silty clay; strongly developed fine nut structure; very friable; slightly sticky; slightly plastic; many fine fibrous roots; considerable biological activity; distinct smooth boundary,
AB	9-20 cm (11 cm)	Moist; dark greyish brown (10YR 4/2) silty clay; moderately developed medium nut structure; friable; slightly sticky; slightly plastic; aggregates very porous; many fine and medium fibrous roots; distinct smooth boundary,
Bt1	20-80 cm (60 cm)	Moist; dark brown to brown (10YR 4/3) clay loam; moderately developed coarse blocky structure; friable to firm; sticky; slightly plastic; moderate clay/humus cutans to ped faces; many fine fibrous roots; indistinct smooth boundary,
Bt2	80-200 cm	Moist; brown (7.5YR 5/4) clay loam; massive breaking to weakly developed coarse blocky structure; firm; sticky; slightly plastic; few weathered basalt stones; weak thin clay/humus cutans to ped faces; no roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nabiti series**

REFERENCE: Nabiti clay and gravelly clay (35e) and Nabiti hill soils (35eH) defined by Twyford & Wright (1965) as soils formed under a climate with a strong dry season from highly weathered basic rocks on undulating land under secondary forest.

Forms part of the Raviravi set.

The central concept for Nabiti soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Ustic Dystropept, very-fine, mixed, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Ferruginous latosol with a strong dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Nabiti soils, undulating phase (193B)  
Nabiti soils, easy rolling phase (193C)

Nabiti soils, rolling phase (193D)  
Nabiti soils, strongly rolling phase (193E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nabiti soils are of limited extent in Viti Levu. They are typically developed on flattish to gently undulating plateau surfaces in the region between Naravuka and Lekutu in the dry zone of Vanua Levu.

PARENT ROCK: Predominantly basalts

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Flattish to gently undulating plateau surfaces.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Partly under forest (qumu, yasiyasi, buabua, belebele, baukiwaqa, sea, vesi) or talasiga forest.

RANGE OF ELEVATION: 30-200 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean Annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Areas under 'talasiga' forest have experienced severe past topsoil losses. Have a moderate to severe sheet and rill erosion potential on slopes >11°.

**Nabiti**

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 30 cm of red very friable silty clay loam, of weakly developed nut and crumb structure and single grain, overlying 25 cm of red friable clay loam, of moderate medium blocky structure, with clay cutans to ped faces, overlying 25 cm of red friable silty clay, of weak blocky structure breaking to single grain on strongly weathered <i>in situ</i> rock with prominent manganese coatings to rock fissures.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be extremely to strong acid; organic carbon is low in the topsoil (0-18 cm) and very low below; nitrogen is high in the topsoil; available phosphorus is very low; % base saturation is low; CEC is medium; exchangeable calcium is low in the topsoil and very low in the other horizons; magnesium is high; potassium very low; and aluminium is significant in the exchange complex.</p> <p>The particle size family class is very-fine.</p> <p>The mineralogical class is mixed.</p>
LABORATORY Nos:	USP SQ67A-E
SOIL LIMITATIONS:	Moderately rapid permeability; severe soil moisture deficits experienced during part of the dry season; past erosion and moderate to severe rill and sheet erosion potential on slopes $>7^\circ$ ; strong soil acidity; probable aluminium toxicity; and nutrient deficiencies of phosphorus and potassium.

## Typifying Profile

SOIL NAME: Nabiti soils, undulating phase.

PROFILE No.: SQ67

SITE LOCATION: Seaqaqa Forest, Bua Province.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar backslope in weakly dissected hill country.

PARENT MATERIAL: Strongly weathered *in situ* rock of basic composition.

SLOPE: 4° (length 300 m)

ASPECT: South

ELEVATION: 80 m

MICRORELIEF: Flat

SITE VEGETATION: *Pinus caribaea* (planted 1967) with ground cover of fern and koster's curse.

LAND USE: Exotic forestry

DRAINAGE: Well drained

EROSION: None observed

DISTURBANCE: None

LABORATORY Nos: USP SQ67A-E

### PROFILE DESCRIPTION

Ah	0-18 cm (18 cm)	Moist; moist and rubbed red (2.5YR 4/6) silty clay loam; weakly developed very fine crumb structure plus single grain; very friable; non-sticky; non-plastic; many fine and medium roots; indistinct smooth boundary,
Bw1	18-31 cm (13 cm)	Slightly moist; moist and rubbed red (2.5YR 4/6) silty clay loam; weakly developed fine nut structure breaking to single grain; very friable; non-sticky; non-plastic; many fine and very fine roots; indistinct smooth boundary,
Bw2	31-56 cm (25 cm)	Slightly moist; moist and rubbed red (10R 4/6) clay loam; moderately developed medium blocky structure; friable; non-sticky; non-plastic; few faint red (10R 4/6) clay coatings; few very fine roots; indistinct smooth boundary,
BC	56-81 cm (25 cm)	Slightly moist; moist and rubbed red (2.5YR 4/6) silty clay loam; weakly developed medium blocky structure breaking to single grain; friable; non-sticky; non-plastic; few very fine roots; distinct smooth boundary,
C	81-111 cm (30 cm)	Slightly moist; moist and rubbed red (10R 4/6) silty clay loam; massive; non-sticky; non-plastic; friable to firm; common prominent reddish black (10R 2/1) manganese coatings to fissures; no roots; very strongly weathered <i>in situ</i> rock.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nabuesa series**

REFERENCE: Nabuesa clay (59b) defined by Twyford & Wright (1965) as an upland soil from olivine basalts on rolling and hilly land formed under a climate with no dry season.

Forms part of Waibici set. The central concept for Nabuesa soils is retained in this survey.

#### CLASSIFICATION:

(a) Soil Taxonomy: Oxic Humitropept, fine, kaolinitic, isothermic

(b) FAO: Humic Cambisol

(c) Twyford and Wright: Upland humic latosol with no dry season.

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nabuesa soils, undulating phase (226B)

Nabuesa soils, easy rolling phase (226C)

Nabuesa soils, rolling phase (226D)

Nabuesa soils, strongly rolling phase (226E)

Nabuesa soils, moderately steep phase (226F)

Nabuesa soils, steep phase (226G)

Nabuesa soils, very steep phase (226H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nabuesa soils develop on hilly land about Nadarivatu and Navai on the uplands of Viti Levu.

PARENT ROCK: Olivine basalt

PARENT MATERIAL: Strongly weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION/LANDFORM: Rolling and undulating terrain of the weakly dissected uplands.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°), and very steep (>35°).

VEGETATION AND LAND USE: Support a heavy forest of dakua (*Agathis vitiensis*) and mixed broadleaf species. Some areas have been burnt in the past and have reverted to *Dicranopteris* fern and scrub. Planted in exotic forest species in a few places.

RANGE OF ELEVATION: 800-1150 m

RAINFALL: Annual average range: 3,200-2,400 mm;  
dry season range: 600-800 mm;  
wet season range: 2,000-2,800 mm.

TEMPERATURE: Mean annual: 18°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate to severe sheet and erosion potential if forest cleared and cultivated (without conservation measures) on slopes >7°.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 22 cm of dark yellowish brown very friable clay loam of strong fine granular structure overlying 100 cm or more of yellowish red very friable clay loam of weak fine granular or nut structure tending to be massive and compact and having common weakly weathered basalt boulders.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Nabuesa series have an Ah, Bw BC horizon sequence.  The Ah horizon thickness ranges from 12 to 25 cm; its colours include dark yellowish brown (10YR 3/4), dark brown (10YR 3/3, 7.5YR, 3/2, 4/4) and brown (10YR 4/3, 7.5YR 5/2); textures are clay or clay loam; and structures are moderate or strong fine blocky and fine and very fine granular. The Bw horizon thickness ranges from 25 to 100 cm; its colours include yellowish red (5YR 4/6, 4/8, 5/6); textures are clay or clay loam; structures are weak to strong fine and very fine nut or granular; and with or without boulders.  The BC horizon thickness exceeds 25 cm; its colours include yellowish red (5YR 4/6, 4/8, 5/6); textures are clay, clay loam or silty clay; and structures are massive breaking to fine blocky.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be strongly acid; organic carbon and nitrogen values are medium in the topsoil (0-22 cm) and of very low values below it; very low available phosphorus; % base saturation is low in the topsoil and of very low values below it; CEC is medium for the topsoil and low in the other horizons; exchangeable calcium is low in the topsoil and very low below it; magnesium is medium 0-22 cm and of low values in the other horizons; and potassium is very low throughout.
LABORATORY Nos:	KRS V693-694 (inclusive)
SOIL LIMITATIONS:	Moderate to severe erosion potential on slopes >7°; soil acidity; and nutrient deficiencies of nitrogen, potassium and phosphorus.

## Typifying Profile

SOIL NAME: Nabuesa soils, rolling phase.  
PROFILE No.: VS113  
SITE LOCATION: Main *Eucalyptus deglupta* forestry plot, east of main road following Nadala Creek 2.8 km from Nadarivatu Forestry Station.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Midslope in dissected hill land.  
PARENT MATERIAL: Strongly weathered *in situ* basalt.  
SLOPE: 14°  
ASPECT: North  
ELEVATION: 1000 m  
MICRORELIEF: Uneven. Few basalt boulders on surface in vicinity of site.  
SITE VEGETATION: Vava, lantana, koster's curse, wild lemon, mission grass and goatweed.  
LAND USE: Exotic forestry (*Eucalyptus* species).  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: KRS V693-694 (inclusive)

### PROFILE DESCRIPTION

Nabuesa soils, rolling phase

Ah	0-22 cm (22 cm)	Moist; dark yellowish brown (10YR 3/4) clay loam; strongly developed very fine granular structure; very friable; non-sticky; non-plastic; common large pores; common medium fibrous roots; diffuse smooth boundary,
Bw	22-120cm+ (98 cm+)	Yellowish red (5YR 4/6) clay loam; weakly developed fine granular structure tending to massive; very friable; non-sticky; common large weakly weathered boulders; few fine pores; common fine fibrous and medium woody roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nabuono series**

REFERENCE: Nabuono steepland gravelly sandy clay (93c) defined by Twyford and Wright (1965) as red soils from acid and quartz rich tufts formed under a climate with a strong dry season.

Forms part of the Vitawa set.

The central concept for Nabuono soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Ustic Dystropept, fine, kaolinitic, isohyperthermic
- (A) FAO: Dystric Cambisol
- (c) Twyford and Wright: Steepland soil related to or associated with red yellow podzolic soils with a strong dry season.

#### INCLUDING MAPPING UNITS AND SYMBOLS:

- Nabuono soils, moderately steep phase (155F)
- Nabuono soils, steep phase (155G)
- Nabuono soils, very steep phase (155H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Restricted to the dry savanna lands of Vanua Levu, seems to be absent in Viti Levu.

PARENT ROCK: Acid and quartz rich tufts.

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Long mainly planar slopes in strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Moderately steep (21-25°), steep (26-35°), and very steep (36-40°).

VEGETATION AND LAND USE: Commonly in a depleted state in which nokonoko, usi and pandanus predominate with a ground cover of bracken. Rarely used for agriculture.

RANGE OF ELEVATION: 30-500 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Very severe sheet and rill erosion potential. Have experienced past erosion.

*Nabuono*

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 18 cm dark brown very firm gravelly clay loam of strong nut structure on 42 cm red firm gritty clay of moderate blocky structure, on 40 cm of yellowish red firm clay.
DIAGNOSTIC HORIZONS:	Orchic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only have three profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Moderately to strongly acid and of low to very low base status.
LABORATORY Nos:	FACL: 9211146-48
SOIL LIMITATIONS:	Slope; profile shallowness; severed erosion potential; severe soil moisture deficits in the dry season; soil acidity; and nutrient deficiencies of nitrogen, potassium and phosphorus.

## Typifying Profile

SOIL NAME: Nabuono soils  
PROFILE No.: MAC 14  
SITE LOCATION: Road cut 40 m North-east of Nalagi and 200 m west of Nasasa Fijian School, Macuata.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Undulating toe slope.  
PARENT MATERIAL: Weathered siliceous tuffs.  
SLOPE: 10°  
ASPECT: North  
ELEVATION: 50 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Open savanna woodland with nokonoko, usi and pandanus predominant species.  
LAND USE: Grazing  
DRAINAGE: Well drained  
EROSION: Evidence of severe past sheet erosion.  
DISTURBANCE: None  
LABORATORY Nos: FACL: 9211146-48

### PROFILE DESCRIPTION

Nabuono soils

Ap	0-18 cm (18 cm)	Dry; dark brown (10YR 3/3) gritty clay loam; very firm; strongly developed nutty structure; very good drainage; many pores; many to few fine woody roots; many pores; gravel; distinct boundary,
Bw1	18-60 cm (42 cm)	Dry; red (2.5YR 4/6) red gritty clay; moderately developed blocky structure; firm; slightly sticky; slightly plastic; many pores; many fibrous roots; wavy boundary,
Bw2	60-100 cm (40 cm)	Dry; yellowish red (5YR 5/8) clay; weakly developed blocky structure; firm; slightly sticky; slightly plastic; few fine roots.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nacamaki series**

REFERENCE: Nacamaki clay loam (24) and Nacamaki hill soils (24H) defined by Twyford & Wright (1965) as latosolic soils from young olivine basalt flows and formed under a climate with a moderate dry season.

They form the Nacamaki set.

The central concept for Nacamaki soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Eutric Thaptic Hapludand, medial-skeletal over ashy-skeletal, isohyperthermic
- (b) FAO: Humic Andosol
- (c) Twyford and Wright: Latosolic soil with a moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nacamaki soils, undulating phase (96B)  
Nacamaki soils, easy rolling phase (96C)

Nacamaki soils, rolling phase (96D)  
Nacamaki soils, strongly rolling phase (96E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: North and west districts of Koro Island. The lower slopes of Delaioloi, Kabara Island, and of very limited occurrence on Taveuni Island.

PARENT ROCK: Olivine basalt

PARENT MATERIAL: Weakly weathered *in situ* lava flows commonly with a very thin volcanic ash cover.

PHYSIOGRAPHIC POSITION/LANDFORM: Convex hillsides in moderately dissected hill country and on ridges in rolling country.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Much used for subsistence food gardens and coconuts.

RANGE OF ELEVATION: 0-250 m

RAINFALL: Annual average range: 2,500-3,600 mm;  
dry season range: 600-900 mm;  
wet season range: 1,400-2,200 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat excessively drained.

PERMEABILITY CLASS: Rapid

FLOODING: Never floods

EROSION: Have experienced sheet erosion in some places. Severe sheet and rill erosion potential on slopes >7°.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of very dark grey friable slightly sandy clay loam of strongly developed fine nut or blocky structure and commonly with stones, overlying 25 cm or more very dark greyish brown friable fine sandy loam with stones and of fine and very fine nut or blocky structure on massive friable very dark greyish brown gravelly fine sand
DIAGNOSTIC HORIZONS:	Mollic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Nacamaki series have an Ah, Bw, C horizon sequence.</p> <p>The Ah horizon ranges in thickness from 29-37 cm; colours may be either black ( YR 2/1) or very dark grey (5YR 3/1); textures may be clay loams or gravelly fine sandy clay loams; structures are either strong fine and very fine nut or blocky; and there may be few, many or abundant stones and boulders.</p> <p>The Bw horizon ranges in thickness from 16 to 48 cm; its colours are either dark brown (7.5YR 3/2, 10YR 3/3) or very dark grey (10YR 3/1, 7.5YR N3/0); textures may be fine sandy loam, fine sandy clay loam, or clay loam; and structures are either crumb or weak very fine and fine nut or blocky.</p> <p>The C horizon varies in colour from very dark greyish brown (10YR 3/2) to very dark grey (10YR 3/1) to dark yellowish brown (10YR 3/4, 4/4), and textures are either fine or coarse sands or sandy loams and commonly gravelly.</p>
VARIANTS:	Unnamed variant of finer textures and greater stickiness and plasticity. Typically shows 15 cm of very dark grey brown friable clay loam, slightly sticky and plastic when moist, of strong very fine blocky structure, overlying 25 cm of dark brown firm to friable clay, sticky and very plastic when moist, compact in place, with a very strong very fine blocky and granular structure on massive dark yellowish brown friable clay, that is sticky and very plastic when moist.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be near neutral in the topsoil and slightly acid in the subsoil; organic carbon is medium in the topsoil and Bw horizon and very low below these; nitrogen is high in the topsoil and very low in the C horizon; high available phosphorus and very high phosphate retention; exchangeable calcium and magnesium are high in the topsoils, medium in the Bw and low in the C horizon; potassium is low in the topsoil and very low in the underlying horizons; % base saturation and CEC decrease down the profile from high values in the topsoil to low in the C horizon.
LABORATORY Nos:	KRS S2952-2956; SB T290A-D; M9A-E
SOIL LIMITATIONS:	Slope; commonly surface boulders; severe erosion hazard; profile stoniness; rapid soil permeability; seasonal soil moisture deficits; nutrient deficiency of potassium; and very high phosphate retention properties.

## Typifying Profile

SOIL NAME: Nacamaki soils, strongly rolling phase.

PROFILE No.: T69

SITE LOCATION: Tutu Estate, Taveuni Island.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex hill slope in moderately dissected hill country.

PARENT MATERIAL: Weakly weathered *in situ* basalt lava flow with a very thin cover of volcanic ash.

SLOPE: 19°

ASPECT: North-west

ELEVATION: 40 m

MICRORELIEF: Hummocky

SITE VEGETATION: Scrub and grasses with ground vines.

LAND USE: Previously in food gardens, presently unused.

DRAINAGE: Somewhat excessively drained.

EROSION: Slight soil creep.

DISTURBANCE: Cultivated in the past.

LABORATORY Nos: KRS S2952-2956;  
SB T290A-D;  
M9A-E

### PROFILE DESCRIPTION

Ah1	0-15 cm (15 cm)	Moist; very dark grey (5YR 3/1) gravelly fine sandy clay loam; strongly developed fine and very fine nut structure; very friable; slightly sticky; plastic; many fine fibrous roots; many weakly weathered basalt stones; distinct wavy boundary,
Ah2	15-29 cm (14 cm)	Moist; very dark grey (5YR 3/1) gravelly fine sandy clay loam; strongly developed very fine nut and very fine granular structure; very friable; slightly sticky; plastic; many fine fibrous roots; many weakly weathered subangular basalt stones; distinct wavy boundary,
Bw1	29-49 cm (20 cm)	Moist; very dark grey (10YR 3/1) fine sandy loam; weakly developed fine nut with crumb structure; very friable; slightly plastic; many very fine fibrous roots; many weakly weathered subangular basalt stones; distinct irregular boundary,
Bw2	49-77 cm (28 cm)	Moist; very dark greyish brown (10YR 3/2) gravelly fine sandy loam; weakly developed very fine nut with crumb structure; very friable; slightly plastic; many fine fibrous roots; many weakly weathered subangular basalt stone; distinct irregular boundary,
C1	77-106 cm (29 cm)	Moist; very dark greyish brown (2.5Y 3/2) gravelly fine sand; single grain; loose; common very fine fibrous roots; abundant weakly weathered subangular basalt stones; indistinct wavy boundary,

C2	106-116cm (10 cm)	Moist; very dark grey (10YR 3/1) gravelly coarse sand; single grain; loose; few very fine fibrous roots; profuse weakly weathered subangular basalt boulders.
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Note: NaF reaction: moderately strong; moderately strong; strong; strong; moderately strong; and strong for the above six horizons.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nacaugai series**

REFERENCE: Nacaugai steepland stony and gravelly clay (80b) defined by Twyford & Wright (1965) as latosolic soils from young basic scoriae formed under a climate with a weak dry season.

Forms part of the Ravilevu set.

The central concept for Nacaugai soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Mollic Hapludand, medial-skeletal, isohyperthermic
- (b) FAO: Humic Andosol
- (c) Twyford and Wright: Steepland soil related to or associated with latosolic soils with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Nacaugai soils, steep phase (106G)
- Nacaugai soils, very steep phase (106H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Restricted to the scoriae cones (that form the axis of Taveuni Island) of the lowlands at the north end of the island and in a few small areas on the west coast of Taveuni and on Laucala Island.

PARENT ROCK: Basalt

PARENT MATERIAL: Weakly weathered *in situ* ash and scoria.

PHYSIOGRAPHIC POSITION/LANDFORM: Steep planar slopes of scoriae cones.

SLOPE CLASS AND RANGE OF SLOPES: Steep (26-35°) and very steep (>35°).

VEGETATION AND LAND USE: Mainly under coconuts and also used for subsistence root crops.

RANGE OF ELEVATION: 10-600 m

RAINFALL: Annual average range: 3,000-6,000 mm;  
dry season range: 800-3,000 mm;  
wet season range: 2,000-3,200 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Moderate to severe sheet, rill and debris slide erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 30 cm of dark brown very friable gritty and stony silty clay loam of weak coarse blocky breaking to moderate granular structure, overlying 100 cm of dark brown very friable stony and bouldery silty clay of weak coarse blocky breaking to fine granular structure, over more than 30 cm of dark brown very friable gritty silty clay loam of moderate coarse and medium nut and blocky structure. Moist consistence slightly sticky and smeary.  Commonly overlies black or dark reddish brown scoria at depth.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Nacaugai series have an Ah, Bw1, Bw2 horizon sequence.  The Ah horizon thickness ranges from 25 to 35 cm; its colours include dark brown (10YR 3/3, 7.5YR 3/2) and dark reddish brown (5YR 3/3, 3/4); textures are gritty and/or stony silty clay loams, clay loams or clays; and structures are granular or fine blocky or fine nut.  The Bw1 horizon thickness ranges from 15 to 100 cm; its colours include reddish brown (5YR 4/3, 4/4, 5/4) and dark brown (7.5YR 3/2, 10YR 3/3); textures are stony and or bouldery silty clay loams, clay loams or clays; and structures include strong or moderate fine or very fine blocky and granular.  The Bw2 horizon thickness ranges from 20 to 100 cm; its colours include dark brown (7.5YR 3/4) strong brown (7.5YR 5/6) and yellowish red (5YR 4/6, 4/8, 5/6, 5/8); textures may be bouldery, stony, gravelly or gritty sandy clays, silty clays and silty clay loams and structures are massive, coarse blocky or medium nut.
VARIANTS:	Unnamed variant: has redder hues throughout due to the red colour of the scoria rather than due to more advanced weathering.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be moderately acid in the topsoil (0-30 cm) and slightly acid in the other horizons; organic carbon is low in the topsoil and very low below it; very high phosphorus retention; % base saturation medium in the topsoil and low in the other horizons; CEC high throughout; TEB high 0-30 cm and medium in the subsoils; calcium medium; magnesium very high in the topsoil and high in the other horizons; and potassium very high in the topsoil dropping to very low below it.
LABORATORY Nos:	USP TAV101A-C
SOIL LIMITATIONS:	Slope; susceptibility to erosion; moderately rapid permeability; surface boulders; profile stones (and commonly boulders); soil acidity; very high phosphorus retention properties; nutrient deficiencies of potassium, nitrogen and probably phosphorus.

## Typifying Profile

SOIL NAME: Nacaugai soils, steep phase.  
PROFILE No.: TAV101  
SITE LOCATION: Nagasau Estate. East flank of scoria cone 1400 m from the coastal road, North Taveuni Island.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar midslope of scoria cone.  
PARENT MATERIAL: Weakly weathered *in situ* basaltic scoria and ash.  
SLOPE: 29°  
ASPECT: East  
ELEVATION: 150 m  
MICRORELIEF: Uneven. Area has series of narrow (<3 m) steps.  
SITE VEGETATION: Coconuts, ferns, shrub species, and grasses.  
LAND USE: Coconut (copra) production.  
DRAINAGE: Well drained  
EROSION: Some evidence of slumping in near vicinity to the site.  
DISTURBANCE: None  
LABORATORY Nos: USP TAV101A-C  
COMMENTS: NaF reaction: strong positive for all horizons.

### PROFILE DESCRIPTION

Ah	0-30 cm (30 cm)	Moist; dark brown (10YR 3/3) gritty and stony silty clay loam; weakly developed coarse blocky structure breaking to moderate fine granular; very friable, slightly sticky; non plastic; many fine fibrous and fine woody roots; few earthworms; many ants; very diffuse smooth boundary,
Bw1	30-130 cm (100 cm)	Moist; dark brown (10YR 3/3) very stony and bouldery (rounded to sub-rounded) silty clay; weakly developed very coarse blocky structure breaking to moderate very fine granular; very friable; slightly sticky; fine earth material very light; stones and boulders vesicular; few roots; distinct smooth boundary,
Bw2	130-160+ cm (30+ cm)	Moist; dark brown (7.5YR 3/4) gritty silty clay loam; moderately developed coarse blocky structure breaking to moderate medium nut structure; very friable; slightly sticky and smeary; few unweathered stones; very light material; no trace of unweathered ash.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nacokula series**

REFERENCE: Nacokula sandy clay (52a) defined by Twyford & Wright (1965) as a strongly mottled and gleyed alluvial soil derived from acidic rocks and formed under a climate with no dry season.

Forms the Nacokula set.

The central concept for Nacokula soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Trophaquept, fine, mixed, isohyperthermic
- (b) FAO: Dystric Gleysol
- (c) Twyford and Wright: Gley soil related to red yellow podzolic soils with no dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Nacokula soils (64)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Limited to very few small areas in the upper Sigatoka Valley.

PARENT ROCK: Silicified marls and basalts.

PARENT MATERIAL: Moderately weathered alluvial outwash.

PHYSIOGRAPHIC POSITION/LANDFORM: Small floodplains

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-2°).

VEGETATION AND LAND USE: Used for dalo and rice.

RANGE OF ELEVATION: 30-120 m

RAINFALL: Annual average range: 2,800-4,000 mm;  
dry season range: 800-1,400 mm;  
wet season range: 1,700-2,500 mm.

TEMPERATURE: Mean annual: 23.5°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Moderately slow

FLOODING: Floods depositing alluvium have a return period of one in 25 years. Other floods have a return period of 2 in one year. The high water table is high in the profile during the wet season.

EROSION: No erosion hazard.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 12 cm of dark greyish brown slightly mottled reddish brown gritty clay of moderate medium blocky structure, and sticky and plastic moist, overlying olive grey gritty clay mottled yellow brown, reddish brown and dark grey, very plastic and very sticky, and of massive structure breaking to weak coarse blocky structure.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only one profile description available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Not analysed but considered to be strongly acid, of low base status with low values for phosphorus and potassium.
LABORATORY Nos:	Not sampled for analysis.
SOIL LIMITATIONS:	Frequency of flooding; high seasonal (wet season) water table; strong soil acidity; and nutrient deficiencies of phosphorus and potassium

## Typifying Profile

SOIL NAME: Nacokula soil  
PROFILE No: TW 26  
SITE LOCATION: West bank of Sigatoka River 1 km south of Keiyasi village.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Low angle fan.  
PARENT MATERIAL: Outwash colluvium from silicified marls and basalts.  
SLOPE: Level  
ASPECT: Not applicable  
ELEVATION: 80 m  
MICRORELIEF: Uneven as a result of cultivation.  
SITE VEGETATION: Dalo garden with miscellaneous weeds.  
LAND USE: Food garden  
DRAINAGE: Poorly drained  
EROSION: None observed  
DISTURBANCE: Cultivated  
LABORATORY Nos: Not sampled for analysis.

### PROFILE DESCRIPTION

Apg	0-12 cm (12 cm)	Moist; dark greyish brown (10YR 4/2) gritty clay; common faint reddish brown (5YR 5/4) mottles; moderately developed medium blocky structure; friable to firm; sticky; plastic; few fibrous roots; distinct smooth boundary,
Bwr	12-80 cm+ (62 cm+)	Wet; olive grey (5Y 5/2) gritty clay; strongly mottled yellow (10YR 7/6), dark grey (10YR 4/1) and reddish brown (5YR 5/4); massive breaking to weakly developed coarse blocky structure; firm; very sticky; very plastic.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nacula series**

REFERENCE: Nacula steepland clay (84c) and Nacula steepland boundary clay (84d) defined by Twyford and Wright (1965) as formed from basic tufts and andesite agglomerate under a climate with a weak dry season.

Forms part of the Visa set. The central concept for Nacula soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Orthoxic Palehumult, clayey, kaolinitic, isohyperthermic
- (b) FAO: Humic Acrisol
- (c) Twyford and Wright: Steepland soil related to or associated with humic latosols with a weak dry season.

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nacula soils, easy rolling phase (130C)	Nacula soils, moderately steep phase (130F)
Nacula soils, rolling phase (130D)	Nacula soils, steep phase (130G)
Nacula soils, strongly rolling phase (130E)	Nacula soils, very steep phase (130H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Widespread in areas in north-east of Vanua Levu and parts of north-eastern of Viti Levu around Tailevu point.

PARENT ROCK: Basic tuft and andesite agglomerate.

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Planar and convex surfaces in all slope positions in strongly dissected hilly land.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-27°), steep (28-35°), and very steep (36-40°).

VEGETATION AND LAND USE: Mostly under tall forest (*vesi*, *cibicibi*, *yasi yasi*, *balabala*) or regenerating forest. Commonly used for subsistence agriculture but gardens cannot be used for more than three to four years before allowed to fallow.

RANGE OF ELEVATION: 20-600 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-2,000 mm;  
wet season range: 1,800-3,000 mm.

TEMPERATURE: Mean annual: 24.5°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY: Moderate

FLOODING: Never floods

EROSION: Severe sheet and rill erosion potential when permanently cleared of forest or scrub.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 30 cm of dark brown very friable clay loam, of moderate fine and very fine nut structure, and slightly sticky and slightly plastic when moist, overlying 40 cm of dark and yellowish friable clay loam, of weak fine and medium blocky structure with some crumb, and slightly sticky and plastic when moist, over 50 cm or more of yellowish red firm clay with common reddish yellow parent material mottles, of massive structure.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows a strong acid reaction with a moderate to low base status and moderate-to-low contents of calcium and magnesium but quite a high content of potassium. Available phosphorous levels are very low.
LABORATORY NOS:	FACL: 9211120 - 22
SOIL LIMITATIONS:	Slope, soil acidity, low fertility and susceptibility to erosion.

## Typifying Profile

NAME: Nacula soils, steep phase.  
PROFILE NO: VS 37  
LABORATORY NO: LAB 6  
SITE LOCATION: Lodonu, Tailevu Province.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex shoulder in weakly dissected hill country.  
PARENT MATERIAL: Strongly weathered *in situ* rock of intermediate composition.  
SLOPE: 30°  
ASPECT: North-east  
ELEVATION: 120 m  
MICRORELIEF: Hummocky  
SITE VEGETATION: Tall forest in which vesi, cibicibi, yasi yasi and bala bala trees are predominant.  
LAND USE: Mostly cassava, dalo, yaqona and banana.  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: Previously cultivated (shifting cultivation).  
LABORATORY Nos.: FAC: 9211120 - 22

### PROFILE DESCRIPTION

Nacula soils

Ap	0-30 cm (30 cm)	Moist; dark brown (10YR 3/3) clay loam; moderately developed fine and very fine nut structure; very friable; slightly sticky; slightly plastic; abundant very fine and fine fibrous roots; distinct smooth boundary,
Bt1	30-70 cm (40 cm)	Moist; dark yellowish brown (10YR 4/4) clay loam; weakly developed fine and medium blocky with crumb; friable; slightly sticky; plastic; many clay cutans; many fine and medium roots; diffuse wavy boundary,
Bt2	70-120 cm (50 cm)	Moist; yellowish red (5YR 4/8) clay; common medium distinct reddish yellow (5YR 6/6) parent material mottles; massive; firm; sticky; plastic; common clay cutans; few medium roots.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nadala series**

REFERENCE: Nadala clay loam (59c) defined by Twyford & Wright (1965) as an upland soil from basic outwash on old terraces formed under a climate with no dry season.

Forms part of the Waibici set.

The central concept for Nadala soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Fluventic Eutropept, fine-loamy, mixed, isothermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Upland humic latosol with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nadala soils (211)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs along the Nadala and Navai rivers near Nadarivatu.

PARENT ROCK: Basic rocks

PARENT MATERIAL: Strongly weathered outwash alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Small terraces with very gently undulating surfaces.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: In natural state supports mixed dakua (*Agathis vitiensis*) broadleaf forest. Many areas have been cleared for subsistence root crops (particularly yams) and commercial temperate vegetable crops.

RANGE OF ELEVATION: 750-850 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 600-800 mm;  
wet season range: 2,000-2,800 mm.

TEMPERATURE: Mean annual: 18°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 45 cm of dark yellowish brown friable clay loam of moderate medium granular structure and commonly with a few basalt boulders overlying 60 cm or more dark brown firm clay of strong coarse blocky structure and again with a few basalt boulders.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be moderately acid; organic carbon and nitrogen values are very low throughout; very low available phosphorus; CEC is medium throughout; % base saturation is medium 0-45 cm and of high value below 45 cm; exchangeable calcium is low 0-45 cm and medium below; magnesium is of high value 0-45 cm and very high below; and potassium is low 0-45 cm and very low below 45 cm.
LABORATORY Nos:	KRS V685-686 (inclusive)
SOIL LIMITATIONS:	Soil acidity; and nutrient deficiencies of nitrogen, potassium and phosphorus.

## Typifying Profile

SOIL NAME: Nadala soils  
PROFILE No.: VS110  
SITE LOCATION: Terrace surface Nukunuku Creek (draining the Lewa Valley) 5.6 km from function at Nadarivatu Forestry Station. Site on same bank as the road.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Old terrace surface.  
PARENT MATERIAL: Strongly weathered outwash alluvium from rocks of basic composition.  
SLOPE: 3°  
ASPECT: West  
ELEVATION: 800 m  
MICRORELIEF: Smooth  
SITE VEGETATION: *Pinus caribaea* with understorey of reeds, guava and prickly solanum.  
LAND USE: Exotic forestry  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: KRS V685-686 (inclusive)

### PROFILE DESCRIPTION

Nadala soils

Ah	0-45 cm (45 cm)	Dark yellowish brown (10YR 3/4) clay loam; moderately developed medium granular structure; friable; non-sticky; few rounded medium boulders; common large pores; many woody roots; diffuse smooth boundary,
Bw	45-100 cm (55 cm)	Dark brown to very dark brown (7.5YR 3/4) clay; strongly developed coarse blocky structure; firm; non-sticky; few medium to large boulders; few fine pores; few woody and fibrous roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nadarivatu series**

REFERENCE: The Nadarivatu set defined by Twyford & Wright (1965) includes Nadarivatu steepland clay (96a) from olivine basalt; Nadarivatu steepland red brown clay (96b) from andesite; and Nadarivatu steepland brown clay loam (96c) from basic tuffs, and all developed under a climate with a weak to moderate dry season.

The central concept for Nadarivatu soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Dystrypept, fine-silty, kaolinitic, isothermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Upland steepland soil related to or associated with humic latosols with a weak to moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nadarivatu soils, easy rolling phase (224C)	Nadarivatu soils, moderately steep phase (224F)
Nadarivatu soils, rolling phase (224D)	Nadarivatu soils, steep phase (224G)
Nadarivatu soils, strongly rolling phase (224E)	Nadarivatu soils, very steep phase (224H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nadarivatu soils occur mainly on steep slopes in central Viti Levu uplands.

PARENT ROCK: Olivine basalt

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Mainly planar and convex surfaces occupying most slope positions in steep country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°), and very steep (>35°).

VEGETATION AND LAND USE: In natural state supports mainly dakua forest. Where cleared have reverted to stunted scrub and fern i.e. typical talasiga vegetation.

RANGE OF ELEVATION: 600-1200 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 600-800 mm;  
wet season range: 2,000-2,800 mm.

TEMPERATURE: Mean annual: 18°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Severe sheet, rill and mass movement erosion potential when cleared of forest.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 25 cm of dark brown very friable clay loam of strong fine granular structure commonly with yellow weathered stones, overlying 50 cm of yellowish red firm silty clay loam, of fine nutty structure with common varicoloured weathered boulders, overlying 25 cm of reddish brown firm silty clay of massive structure with common weathered boulders on weathered <i>in situ</i> massive basalt.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Nadarivatu series have an Ah, Bw, BC, C1 horizon sequence.  The Ah horizon ranges in thickness from 18 to 25 cm; its colours include dark brown (7.5YR 3/4), dark reddish brown (5YR 3/3, 3/4) and reddish brown (5YR 4/3, 4/4); textures are clay loam or clay; structures strong fine nut and/or fine or very fine granular; and with or without weathered stones.  The Bw horizon ranges in thickness from 25 to 60 cm; its colours include yellowish red (5YR 4/6, 5/6) and red (2.5YR 4/6, 5/6, 5/3, 4/8); textures may be clay or silty clay; structures may be massive or massive breaking to fine blocky; few or common (often alumina coated) boulders; <u>on</u> varicoloured weathered <i>in situ</i> basalt or weathered basalt boulders.
VARIANTS:	Unnamed variant that occurs on small flattish surfaces within the steepland complex of Nadarivatu soils (VS106) KRS V675-677 (inclusive).
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be strongly acid throughout; organic carbon and nitrogen have medium values in the topsoil (0-25 cm) and very low values below it; very low available phosphorus; CEC values are medium throughout; % base saturation is low; exchangeable calcium is low in the topsoil and very low below it; magnesium values are medium throughout; and potassium is low in the topsoil and of very low values in the other horizons.
LABORATORY Nos:	KRS V664-667 (Inclusive)
SOIL LIMITATIONS:	Slope; severe erosion potential; surface bounders and rock outcrops; soil acidity; and nutrient deficiencies of nitrogen, phosphorus and potassium.

## Typifying Profile

SOIL NAME: Nadarivatu soils, very steep phase.  
PROFILE No.: VS103  
SITE LOCATION: 1.5 km WNW of Koro-o transmitting site.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar midslope in strongly dissected hill country.  
PARENT MATERIAL: Strongly weathered *in situ* olivine basalt.  
SLOPE: 40°  
ASPECT: South-east  
ELEVATION: 1000 m  
MICRORELIEF: Uneven - common surface rock outcrops.  
SITE VEGETATION: Mission grass and reeds.  
LAND USE: Unused. Frequently burnt in the past.  
DRAINAGE: Well drained  
EROSION: Past sheet erosion.  
DISTURBANCE: Fires in the past.  
LABORATORY Nos: KRS V664-667 (inclusive)

### PROFILE DESCRIPTION

Nadarivatu soils, very steep phase

Ah	0-25 cm (25 cm)	Moist; dark brown (7.5YR 3/4) clay loam; very strongly developed fine granular structure; very friable; non-sticky; common large stones weathering to yellow; common large pores; common fine fibrous roots; distinct wavy boundary (sometimes broken by surface rocks),
Bw	25-75 cm (50 cm)	Moist; yellowish red (5YR 4/6) silty clay; massive breaking to fine nut structure; firm; slightly sticky; common large weathered boulders of varied colours ranging from black, yellow and grey; many fine tubular pores; few fine fibrous roots; broken wavy boundary,
BC	75-100 cm (25 cm)	Moist; reddish brown (5YR 4/4) silty clay; massive; firm; somewhat smeary; common large weathered boulders of variable colours; common large tubular pores; few fine fibrous roots; distinct wavy boundary,
C1	100-140cm (40 cm)	Moist; varicoloured reddish brown (2.5YR 5/4) red (2.5YR 4/6, 5/8) dark yellowish brown (10YR 4/4) and white (10YR 8/1) silty clay loam; massive; firm; somewhat smeary; more boulders as in above C1) horizon, but reddish with more grey specks; few fine pores; few fine fibrous roots.



## PROFILE DESCRIPTION

Unnamed variant of Nadarivatu soils

A	0-50 cm (50 cm)	Moist; dark red (2.5YR 3/6) clay loam; moderately developed medium granular structure; firm; smeary; common large pores; common fine fibrous roots; few medium subrounded boulders; diffuse wavy boundary,
Bw	50-100 cm (50 cm)	Moist; dark reddish brown (2.5YR 3/4) clay; massive breaking to weakly developed coarse blocky structure; firm; slightly sticky; few fine pores; common fine fibrous roots; diffuse wavy boundary,
BC	100-120+cm (20 cm+)	Moist; dark yellowish brown (10YR 3/4) clay; massive structure; firm; slightly sticky; few fine pores; very few fine roots.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nadawa series**

REFERENCE: Nadawa sandy clay (12) and Nadawa hill soils (12H) defined by Twyford & Wright (1965) as sandy heavy clays from siliceous marls formed under a climate with no or weak dry season. Forms the Nadawa set.

The central concept for Nadawa soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Eutropept, fine, kaolinitic, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Nigrescent soil with no or a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Nadawa soils, undulating phase (151B)
- Nadawa soils, easy rolling phase (151C)
- Nadawa soils, rolling phase (151D)
- Nadawa soils, strongly rolling phase (151E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nadawa soils are found mainly in south-eastern Vanua Levu (Uda peninsula and Natewa Bay lowlands) on land of rolling or strongly rolling relief.

PARENT ROCK: Siliceous marls

PARENT MATERIAL: Moderately weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Convex backslopes and midslopes in rolling country.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°); easy rolling (8-11°), rolling (12-15°), and strongly rolling (16-20°).

VEGETATION AND LAND USE: Mostly under coconuts and used intermittently for food gardens.

RANGE OF ELEVATION: 20-200 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: In part severely eroded due to repeated burning. Have very severe sheet and rill erosion potential on slopes > 7°.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of very dark grey, firm to friable sandy clay overlying 15 cm of brown or brownish yellow firm to very firm sticky and plastic sandy clay on weathering pumiceous marl.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	This soil is likely to be slightly acid and fairly well supplied with calcium and magnesium. Potassium probably high but acid soluble phosphate moderate to low.
LABORATORY Nos:	Not sampled for analysis.
SOIL LIMITATIONS:	Profile shallowness; experiences some periods of soil moisture deficit during the dry season; severe past soil erosion and very severe sheet and rill erosion hazard on slopes $>7^\circ$ ; nutrient deficiencies of phosphorus and nitrogen.

## Typifying Profile

SOIL NAME: Nadawa soils, easy rolling phase.  
PROFILE No.: TW 39  
SITE LOCATION: East facing slopes above Nalagi river 1 km west of Nadogo village, south-east Vanua Levu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar upper midslope.  
PARENT MATERIAL: Weathered *in situ* siliceous marls.  
SLOPE: 10°  
ASPECT: East  
ELEVATION: 50 m  
MICRORELIEF: Smooth even surface  
SITE VEGETATION: Dalo and yagona under coconuts.  
LAND USE: Food garden  
DRAINAGE: Well drained  
EROSION: Past sheet erosion of having been cropped and burned for many years.  
DISTURBANCE: Cultivation  
LABORATORY Nos: Not sampled for analysis.

### PROFILE DESCRIPTION

Nadawa soils, easy rolling phase

Ap	0-10 cm (10 cm)	Moist; very dark grey (10YR 3/1) sandy clay; moderately developed fine and medium nut structure; firm to friable; sticky; plastic; many fine and medium fibrous roots; distinct smooth boundary,
Bw	10-25 cm (15 cm)	Moist; brown (10YR 5/3) and brownish yellow (10YR 6/6) sandy clay; moderately developed medium blocky structure; firm to very firm; sticky; plastic; few fine fibrous roots; distinct smooth boundary,
C	on	Weathering pumiceous marl.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nadi series**

REFERENCE: The Nadi clay (31d) defined by Twyford & Wright (1965) as a soil developed on the old terraces (i.e. colluvial outwash soils) from basic materials and formed under a climate with a strong dry season. Formed part of the Drasa set. Nadi series are defined as well drained soils formed from basic and andesitic alluvium on flat to undulating terraces. Profiles are characterised by loamy textures with friable or very friable consistence.

The central concept for Nadi soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Eustrustox, clayey, mixed, isohyperthermic
- (b) FAO: Orthic Ferralsol
- (c) Twyford and Wright: Humic latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nadi soils, flat to gently undulating phase (36A)	Nadi soils, easy rolling phase (36C)
Nadi soils, undulating phase (36B)	Nadi soils, rolling phase (36D)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Of limited area extent and are mapped in the Namaka, Nadi Airport/Legalega areas.

PARENT ROCK: Andesites and other basic rocks and probably some acidic rocks.

PARENT MATERIAL: Strongly weathered outwash colluvia..

#### PHYSIOGRAPHIC

POSITION/LANDFORM: Terrace systems - mainly crests and backslopes of dissected terraces.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), easy rolling (8-11°), and rolling (12-15°).

VEGETATION AND LAND USE: Intensively used for sugar cane, pineapples (more so in the past) and pulses. Used for wide range of experimental crops (e.g. peanuts) on Legalega Agricultural Research Station.

RANGE OF ELEVATION: 6-24 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Sheet erosion under cultivation on sloping land.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Deep, permeable soils with uniform sandy clay loam to sandy loam texture profiles. A horizons are thick and dark reddish brown, and B horizons are either reddish brown to yellowish red, or brown. Subsoils satisfy oxic horizon criteria.
DIAGNOSTIC HORIZONS:	Mollic epipedon, oxic horizon.
RANGE OF PROFILE FEATURES:	<p>Nadi series have an Ap, Bw1, Bw2 horizon sequence.</p> <p>The Ap horizon ranges in thickness from 15 to 54 cm (most &gt;25 cm); colours range from dark reddish brown (5YR 3/2) to very dark brown (10YR 2/2); and textures either sandy clay loam, silt loam or silty clay loam.</p> <p>The Bw horizons exceed 100 cm in thickness; they range in colour from dark reddish brown (5YR 3/3) to yellowish brown (10YR 5/8) with the mean colour reddish brown (5YR 4/4) and have a textural range from sandy clay loam through silt loam to sandy loam.</p> <p>Soil structures are weakly developed blocky or crumb with friable consistence throughout profile.</p>
VARIANTS:	<p>A brown subsoil variant occurs but it has not been differentiated from the more common reddish Bw horizon soil.</p> <p>Nadi sandy variant: Profiles have coarser textures in control section (sands or loamy sand) and particle size class is sandy. Not mapped separately, included with Nadi soils.</p> <p>Nadi coarse loamy variant: Profiles have sandy loams in control section, and particle size class is coarse loamy. Not mapped separately, included with Nadi soils.</p>
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Namaka series: Well drained soils formed from strongly weathered siliceous alluvium with argillic horizons and massive or weakly developed subsoil structures.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Moderately acid in A horizon; near neutral to slightly alkaline in B horizons; organic C % very low throughout profile. %BS medium in A horizon and very high in B horizons. Exchangeable Ca low throughout profile, Mg very low and K very low throughout profile. CEC very low throughout profile. Satisfies oxic criteria on basis of ammonium chloride at pH 8.2, cation retention capacity (Soil Survey Staff 1975) &lt; 10 me.%. </p> <p>Particle size family class is clayey.</p> <p>Mineralogy class is mixed.</p>
LABORATORY Nos:	KRS R2710-13 (inclusive) KRS R2727-30 (inclusive) (L33) SB9653 A-D (L1)
SOIL LIMITATIONS:	Seasonal soil moisture deficit; nutrient deficiencies (nitrogen, phosphorus and potassium); very low cation retention capacity; and severe sheet erosion potential on slopes > 2° under cultivation.

## Typifying Profile

SOIL NAME: Nadi soils, flat to gently undulating phase.  
PROFILE No.: L1  
SITE LOCATION: Refer soil map of Legalega Agricultural Research Station (Laffan, 1988).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Crestal surface of dissected terrace.  
PARENT MATERIAL: Strongly weathered mixed siliceous and basic outwash colluvia.  
SLOPE: 0°  
ASPECT: Not applicable  
ELEVATION: 13 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Fallow, previously cropped for pulses.  
LAND USE: Experimental crop research.  
DRAINAGE: Well drained  
EROSION: Negligible at site.  
DISTURBANCE: Cultivated  
LABORATORY Nos: KRS R2710-13 (inclusive)  
KRS R2727-30 (inclusive)  
SB9653 A-FD

### PROFILE DESCRIPTION

Ap1	0-28 cm (28 cm)	Dry; dark reddish brown (5YR 3/3) (moist, ped face and rubbed colours) sandy clay loam; very friable; non-sticky; non-plastic; weakly developed very fine blocky structure breaking to moderately developed very fine crumb structure; few fine roots; diffuse smooth boundary,
Ap2	28-54 cm (26 cm)	Dry; dark reddish brown (5YR 3/4) (moist, ped face and rubbed colours) sandy clay loam; very friable; slightly sticky; non-plastic; weakly developed medium blocky structure breaking to weakly developed very fine crumb structure; few fine roots; diffuse smooth boundary,
Bw1	54-109 cm (55 cm)	Slightly moist; reddish brown (5YR 4/4) (moist and ped face colours), dark reddish brown (5YR 3/4) (rubbed colour) sandy loam; very friable; slightly sticky; non-plastic; massive breaking to single grain and fine crumb structure; distinct wavy boundary,
Bw2	109-141+ cm (32 cm+)	Slightly moist; strong brown (7.5YR 5/8) (moist and ped face colours), strong brown (7.5YR 5/6) (rubbed colours) sandy clay loam; friable; non-sticky; non-plastic; massive breaking to single grain and weakly developed fine blocky structures.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nadranu series**

REFERENCE: Nadranu peat (63b) described by Twyford and Wright as an upland organic soil formed from rushes and ferns.

The central concept for Nadranu soil is retained in this survey.

The Nadranu soil mapping unit includes a small area of fringing gleyed mineral soils previously included with Nadrau soils (62) as defined by Twyford and Wright (1965).

#### CLASSIFICATION:

- (a) Soil Taxonomy: Hemic Tropofibrist, dysic, isothermic
- (b) FAO: Dystric Histosol
- © Twyford and Wright: Upland organic soil

#### INCLUDING MAPPING UNITS AND PHASES:

Nadranu soils (210)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs in the Nadrau bog and the Nanuku catchment where stream flow is sluggish. Always in association with Nadrau soils.

PARENT ROCK: Not applicable

PARENT MATERIAL: Rushes and sedges.

PHYSIOGRAPHIC POSITION/LANDFORM: Upland swamp and peat bog.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-2°).

VEGETATION AND LAND USE: Swamp vegetation of rushes (*Rhynchospora*, *Jussiaea*) and ferns.

RANGE OF ELEVATION: 800-900 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-3,000 mm;  
wet season range: 2,000-3,200 mm.

TEMPERATURE: Mean annual: 18°C

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Very poorly drained.

PERMEABILITY CLASS: Moderately slow.

FLOODING: Almost continuously flooded with the water table at or near the ground surface for most of the year.

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 25 cm of olive grey soft mucky peat, overlying 50 cm of very dark grey soft peaty much with both these horizons having profuse dead and living sedge fibres and roots, overlying 200 cm or more of dark olive grey soft and moderately decomposed peat.
DIAGNOSTIC HORIZONS:	Histic epipedon
RANGE OF PROFILE FEATURES:	Profiles show little variation in their properties to that described
VARIANTS:	Unnamed variant that occurs on the fringe of the peat bog proper. It typically shows 15 cm of peaty black clay containing much partly decomposed organic matter and plant debris smelling strongly of hydrogen sulphide, with no obvious structure, on 15 cm of black clay. The profile is under standing water.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows this soil to be extremely acid, of very low base status and containing moderate to low quantities of exchangeable calcium, magnesium and potash. Available phosphorus levels are high.
LABORATORY Nos:	V720-722
SOIL LIMITATIONS:	Organic soils, permanent high water table and inability to drain, soil acidity, and very low base status.

## Typifying Profile

SOIL NAME: Nadranu soils  
PROFILE No.: VS 128  
SITE LOCATION: A bog 600 m south-east of Nadrau School in the uppermost reach of the Nanuku river basin.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Upland swamp  
PARENT MATERIAL: Weakly decomposed peat from rushes, sedges and ferns over moderately decomposed peat.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 800 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Rushes (*Rhynchospora*, *Jussiaea*)  
LAND USE: Rough grazing  
DRAINAGE: Very poorly drained. Water table at 1 m but rose quickly in the pit to 50 cm from the surface.  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: V720-722

### PROFILE DESCRIPTION

Of1	0-25 cm (25 cm)	Moist; olive grey (5Y 4/2) mucky peat; massive; soft; slightly sticky; profuse sedge fibres and roots; diffuse smooth boundary,
Of2	25-75 cm (50 cm)	Moist; very dark grey (5Y 3/1) peaty muck; structureless; very soft; slightly sticky; abundant sedge fibres and roots; diffuse smooth boundary,
Of3	75-300 cm+ (325 cm+)	Wet; dark olive grey (5Y 3/2) moderately decomposed peat; soft.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nadrau series**

REFERENCE: Nadrau clay loam (62) defined by Twyford and Wright (1965) as an upland gley soil from basic and intermediate materials of low quartz content and formed under a climate with a weak or no dry season.

The central concept the Nadrau soils is changed in this survey to include imperfectly drained soils which experience a high seasonal water table but do not have an aquic moisture regime, i.e. less gleyed than defined by Twyford and Wright. Associated gleyed soils with an aquic soil moisture regime are now included with Nadrau soils.

CLASSIFICATION:

- (a) Soil Taxonomy: Oxyaquic Humitropept, fine, mixed, isothermic
- (b) FAO: Gleyic Cambisol
- (c) Twyford and Wright: Upland gley soil related to humic latosols with no dry season

INCLUDING MAPPING UNITS AND PHASES:

Nadrau soils (213)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Confined to the Nanuku floodplain catchment on the Nadrau plateau.

PARENT ROCK: Rocks of basic and intermediate composition.

PARENT MATERIAL: Deep alluvium and colluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Alluvial fringes to the large Nadrau swamp and alluvial pockets along Nanuku creek.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: Food gardens; some grazing and attempts at potato production. Wild vegetation of guava, yaqona, reeds, cevuga, vula and sedges.

RANGE OF ELEVATION: 800-1100 m

RAINFALL: Annual average range: 3,200-4,800mm;  
dry season range: 600-800 mm;  
wet season range: 2,000-2,800 mm.

TEMPERATURE: Mean annual: 18°C

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Imperfectly drained

PERMEABILITY CLASS: Moderately slow

FLOODING: One in 20 year return period for floods depositing alluvium or colluvium. For other flood events 2 in 1 year return period.

EROSION: Some stream bank erosion only.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of very dark greyish brown firm clay loam of moderate medium nut structure, overlying 25 cm of very dark brown and dark yellowish brown firm clay of strong coarse blocky structure and slightly sticky and plastic when moist, overlying 30 cm of dark yellowish brown very firm clay of weak coarse prismatic structure, slightly sticky and plastic when moist and with distinct organic and iron/manganese cutans on 55 cm or more of dark yellowish brown and dark brown very firm silty clay of massive structure breaking to weak coarse prismatic and again with cutans.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Likely to have good base status, slightly acid, high organic matter and high levels of available phosphorous.
LABORATORY Nos:	V717-719
SOIL LIMITATIONS:	Soil itself is good but the poor internal drainage and the frequency of flooding limits its potential. Deep draining and use of fertilizer will increase its value for temperate type vegetables.

## Typifying Profile

SOIL NAME: Nadrau soils  
PROFILE No.: VS 123  
SITE LOCATION: Nanuku floodplain 1500 m south-east of Nadrau School, Navosa.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Alluvial floodplain levee.  
PARENT MATERIAL: Alluvium  
SLOPE: 3°  
ASPECT: North-west  
ELEVATION: 800 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Guava, yaqona, reeds, cevuga vula and sedges.  
LAND USE: Rough grazing, dalo, bananas and potatoes.  
DRAINAGE: Imperfectly drained  
EROSION: None observed  
DISTURBANCE: Pouched by hoof marks. Also ruts made by logs.  
LABORATORY Nos: V717-719

### PROFILE DESCRIPTION

Ah	0-10 cm (10 cm)	Moist; very dark greyish brown (10YR 3/2) clay loam; moderately developed medium nut structure; firm; slightly sticky; slightly plastic; abundant very fine roots; sharp smooth boundary,
Bw1	10-35 cm (25 cm)	Moist, very dark brown (10YR 2/2) and dark yellowish brown (10YR 4/4) clay; strongly developed coarse blocky structure; firm; slightly sticky; plastic; common fine live roots; diffuse and irregular boundary,
Bw2	35-65 cm (30 cm)	Moist; dark yellowish brown (10YR 4/4) clay; weakly developed coarse prismatic structure; very firm; slightly sticky; plastic; common distinct organic and Fe/Mn cutans; many medium fibrous roots; indistinct smooth boundary,
BC	65-120 cm (55 cm+)	Moist; dark yellowish brown (10YR 4/4) and dark brown (10YR 3/3) silty clay; massive breaking to weakly developed very coarse prismatic structure; very firm; sticky; slightly plastic; many prominent organic and Fe/Mn cutans; few medium live roots.





# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Nadroga series**

REFERENCE: Nadroga steepland stony clay loam and clay (72) defined by Twyford & Wright (1965) as developed from marls and calcareous tuffs under a climate with a strong dry season.

Forms part of the Vanuavou set.

The central concept for Nadroga soils is retained in this survey.

### CLASSIFICATION:

- (a) Soil Taxonomy: Udertic Haplustoll, fine, mixed, isohyperthermic
- (b) FAO: Haplic Kastanozem
- (c) Twyford and Wright: Nigrescent soil with a strong dry season

### INCLUDED MAPPING UNITS AND SYMBOLS:

Nadroga soils, easy rolling phase (114C)	Nadroga soils, moderately steep phase (114F)
Nadroga soils, rolling phase (114D)	Nadroga soils, steep phase (114G)
Nadroga soils, strongly rolling phase (114E)	Nadroga soils, very steep phase (114H)

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nadroga soils develop in Sigatoka and Suva marls in Nadroga province of Viti Levu. They are uncommon in Vanua Levu mapped only in the Lekutu - Upper Dreketi region.

PARENT ROCK: Calcareous tuffs and marls.

PARENT MATERIAL: Shallow weakly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Convex and planar hill slopes in moderate and strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°) through all slope classes to very steep (>35°).

VEGETATION AND LAND USE: Mainly under reeds and grasses and used for rough grazing, some subsistence root cropping (followed by 5 years of fallow) and elsewhere planted out in *Pinus caribaea*.

RANGE OF ELEVATION: 30-450 m

RAINFALL: Mean annual range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Moderate and severe sheet and rill erosion potential. Also risk of debris slides and soil creep, particularly on slopes >15°. Have experienced significant topsoil losses in the past.

**Nadroga**

## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

Typically shows 12 cm of black very friable gritty clay loam, of strongly developed fine and medium nut structure, overlying 15 cm of dark reddish brown very friable stony clay loam of strongly developed very fine nut structure, that overlies 15 cm of dark brown firm stony silt loam on massive *in situ* weathering rock of yellowish brown colour and extremely firm and with iron/manganese cutans to rock fissures.

The paralithic contact is normally encountered by 35 cm depth.

Black coated weathered stones occur throughout the profile.

### DIAGNOSTIC HORIZONS:

Mollic epipedon, cambic horizon and paralithic contact.

### RANGE OF PROFILE FEATURES:

Nadroga series have an A1, A2, BC(Bw), R horizon sequence.

The A1 horizon thickness ranges from 11 to 20 cm; its colours include very dark grey (10YR 3/1) and black (10YR 2/1); textures are clay loam and silty clay loam (rarely clay); and light yellowish brown and brownish yellow parent materials fragment are present in varying amounts.

The A2 horizon thickness ranges from 8 to 15 cm; its colours include dark reddish brown (5YR 3/2) and dark brown (7.5YR 3/2 and 10YR 3/3); textures and p.m. fragments as for the A1 horizon; and structures may be moderate or strong, fine or medium nut or blocky.

The BC(Bw) horizon thickness ranges from 8 to 35 cm; its colours include brown (10YR 4/3, 5/3) and yellowish brown (10YR 5/4, 5/6); textures may be clay loam, silt loam, silty clay, fine sandy clay or sandy clay loam; sand structures are either massive breaking to single grain or weak fine or medium, blocky or nut with single grain.

The R horizon is varicoloured (10YR 5/4, 4/4, 2.5Y 6/4, 6/6) and with or without cutans to rock fissures.

### VARIANTS:

Unnamed. Lithic Haplustolls occur within the mapping unit.

A 0-19 cm

Very dark grey (10YR 3/1) clay loam to sandy clay; friable; sticky; non-plastic; strongly developed medium and fine nut structure; many fine roots; few medium sandstone fragments; distinct irregular boundary (lithic contact),

R 19-53 cm

Light yellowish brown (2.5Y 6/4) weathered sandstone; hard; massive; distinct dark grey (10YR 3/1) humus cutans to fissures; few distinct yellowish red (5YR 4/6) iron mottles and cutans to fissures in the rock; indistinct irregular boundary.

### SIMILAR SOILS AND

#### DISTINGUISHING FEATURES:

None recognised

### GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:

Analysis shows the soil to be strongly acid in the topsoil (0-11), moderately acid 11-35 cm, and the R horizon is slightly acid; organic carbon is very low and nitrogen is low; available phosphorus is very low with medium phosphorus retention; % blue saturation is very high throughout; CEC is medium; exchangeable magnesium is very high; calcium is medium; and potassium is very high in the topsoil, medium 11-25 cm and low and very low below this.

The particle size family class is fine.

The mineralogical class is mixed.

LABORATORY Nos: USP NB10A-D

SOIL LIMITATIONS: Profile shallowness; slope; severe soil moisture deficits experienced during the dry season; moderate to severe erosion potential; nutrient deficiencies of phosphorus, and nitrogen.

### Typifying Profile

SOIL NAME: Nadroga soils, rolling phase.

PROFILE No.: NB10

SITE LOCATION: Permanent sample plot P75/1/8 Nabou Forest, Nadroga Province.

#### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Flat, planar to convex shoulder ridge in strongly dissected hill country.

PARENT MATERIAL: Very shallow colluvium over *in situ* sandstone of intermediate composition.

SLOPE: 13° (slope length 150 m)

ASPECT: North-west

ELEVATION: 100 m

MICRORELIEF: Smooth

SITE VEGETATION: Fern (50 cm), mission grass (2 m) and scattered guava (3 m) under 7 year old *Pinus caribaea*.

LAND USE: Exotic forestry

DRAINAGE: Well drained

EROSION: None

DISTURBANCE: None

LABORATORY Nos: USP NB10A-D

#### PROFILE DESCRIPTION

A1	0-11 cm (11 cm)	Slightly moist; moist and rubbed black (5YR 2/1) gritty clay loam; strongly developed fine and medium nut structure; very friable; non-sticky; non-plastic; many fine and medium roots; few moderately weathered angular stones (coated 2.5YR N2/0); indistinct smooth boundary,
A2	11-25 cm (14 cm)	Slightly moist; moist dark reddish brown (5YR 2/2) and rubbed dark reddish brown (5YR 3/2) stony clay loam; strongly developed very fine nut structure; very friable; non-sticky; non-plastic; few fine and medium roots; common moderately weathered angular stones (coated 2.5YR N2/0); distinct wavy boundary (paralithic contact),
BC	25-35 cm (10 cm)	Slightly moist; moist and rubbed dark brown (10YR 4/3) stony silt loam; massive breaking to single grain (between the stones); firm; non-sticky; non plastic; few fine roots; profuse weakly weathered angular stones (coated black, 2.5YR N2/0); distinct wavy boundary (paralithic contact),

R

35-55 cm  
(20cm+)

Dry; yellowish brown (10YR 5/4) massive fractured *in situ* rock; extremely firm; black (2.5YR N2/0) Fe/Mn coatings to fissures with some red (2.5YR 4/6) iron coatings; few fine roots following fissures in rock.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nadruka series**

REFERENCE: New soil series introduced in the detailed soil survey of Legalega Agricultural Research Station (Laffan, 1988) to include poorly drained, clayey textured soils occurring on floodplains, with very dark grey colours and generally strongly developed blocky structures throughout the profile.

Nadruka series is most closely correlated with Matavelo clay (50a) as defined by Twyford & Wright (1965) and appears to be very similar to the Matavelo 'variant' derived from basic alluvium (p.308, Twyford & Wright 1965). This soil is described as having profiles with uniformly dark grey clay with a strongly developed coarse blocky structure, whose aggregate surfaces are often mottled reddish brown.

Previously included with Nadi clay (31d) and Matavelo clay (50a) (Twyford & Wright 1965) and mapped as Matavelo clay by Chandra (1972).

Named after Nadruka Creek, a small tributary of Nadi river, some 2 km south-east of Legalega Station.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Cumulic Haplaquoll, very-fine, kaolinitic, isohyperthermic
- (b) FAO: Mollic Gleysol
- (c) Twyford and Wright: Gley soil related to latosols with a moderate to strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nadruka soils (56)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nadruka soils occur in association with Matavelo soils on narrow margins of creeks in the dry zone of Viti Levu.

PARENT ROCK: Mixed rocks of acidic and basic composition.

PARENT MATERIAL: Recent deep alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Floodplains of small creeks.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: Sugar cane, and some fallow. Also, used for pulses, rainfed rice cropping.

RANGE OF ELEVATION: 3-8 m

RAINFALL: Mean annual range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual 25°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Slow

FLOODING: Periodically from adjacent creek during wet season.

EROSION: Deposition of fine textured sediments during larger floods.

### **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES: Deep, heavy textured (clayey) soils with very dark grey colours throughout the profile. Reddish mottles commonly occur throughout. Soil structures are strongly or moderately developed blocky throughout the profile. Water tables are characteristically high (<1 m below surface during dry season).

DIAGNOSTIC HORIZONS: Mollic epipedon, cambic horizon.

RANGE OF PROFILE FEATURES: Nadruka series have an Ag1, Ag2, or Ap, Ag horizon sequence. Horizons range from black to dark greyish brown humic clays. Common or many yellowish red mottles occur throughout the profile, and soil structures range from moderately developed to strongly developed blocky throughout. Soil consistence is generally firm although some horizons may be friable or very firm.

VARIANTS: Nadruka disturbed variant: differentiated on map in southern part of property where upper 50 cm of profile have been removed or disturbed by earthworks.

Nadruka sandy subsoil variant: Profiles with coarse loamy particle size class. Not mapped separately but included with Nadruka humic clay.

SIMILAR SOILS AND DISTINGUISHING FEATURES: Malika series: Moderately well drained to imperfectly drained soils with an argillic horizon and reddish or yellowish mottles, occur on low terraces of streams.

GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES: Organic C % is low in topsoils and upper subsoils, and very low in lower subsoils. %BS is high in topsoil and medium to high in subsoils. Exchangeable Ca and Mg are very high in topsoils and high to very high in subsoils. K is low in topsoils and very low in subsoils. CEC is very high throughout profile. The particle size family class is very fine clayey. The mineralogical class is kaolinitic.

LABORATORY Nos: KRS R2704-2706 (L80)

SOIL LIMITATIONS: Poor drainage with high water tables, heavy textures and nutrient deficiencies potassium, phosphorus and nitrogen.

## Typifying Profile

SOIL NAME: Nadruka soils  
PROFILE No.: L80  
SITE LOCATION: Refer soil map of Legalega Agricultural Research Station (Laffan, 1988)

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Flood plain of creek.  
PARENT MATERIAL: Recent mixed siliceous and basic alluvium.  
SLOPE: 0°  
ASPECT: Not applicable  
ELEVATION: 4 m  
MICRORELIEF: Smooth, apart from shrinkage cracks.  
SITE VEGETATION: Bare ground  
LAND USE: Experimental crop research programme.  
DRAINAGE: Poorly drained  
EROSION: Negligible, but subject to deposition during large floods.  
DISTURBANCE: Cultivated  
LABORATORY Nos: KRS R2704-2706 (inclusive)  
COMMENTS: Water table at 70 cm below the surface.

### PROFILE DESCRIPTION

Nadruka soils

Ap	0-18 cm (18 cm)	Moist; very dark grey (10YR 3/1) moist ped face and rubbed colour clay; common fine distinct yellowish red (5YR 5/8) mottles*; firm; sticky; plastic; moderately developed fine blocky structure breaking to strongly developed fine nut structure; few fine roots; indistinct smooth boundary,
Ag	18-98+ cm (80+ cm)	Very moist; black (7.5Yr 2/0) moist ped face and rubbed colour clay; many fine prominent yellowish red (5YR 5/8) mottles; firm; very sticky; plastic; strongly developed coarse prismatic structure breaking to strongly developed fine blocky structure; few fine roots.

\* mottles occur mainly down root channels and on ped faces





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Naduru series**

REFERENCE: New soil series introduced in this survey to include brown coloured lower base status and less fertile soils, previously recognised by Twyford & Wright (1965) as Rewa brown clay (4c) and Rewa brown clay mottled phase (4f). Purnell (1972) also recognised Rewa brown clay loam, Rewa brown mottled clay loam, Rewa brown loam, and Rewa brown mottled clay loam over sand. The mottled phases have been included with the Tamanua series the remainder with the Naduru series.

Naduru series are formed on alluvium deposited by the Rewa and Navua rivers when they formerly flowed over different courses from their present ones.

Series name derived from Naduru Road near Kuku Village on the Rewa floodplain. Naduru Road follows the former course of the Rewa River.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Eutropept, fine, kaolinitic, isohyperthermic
- (b) FAO: Eutric Fluvisol
- (c) Twyford and Wright: Recent soil from alluvium with a very weak to no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Naduru soils (25)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs on old channels and water courses of the Rewa River in ESE Viti Levu.

PARENT ROCK: Predominantly rocks of intermediate and basic composition.

PARENT MATERIAL: Riverine alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Old levees of former water courses of the Rewa River or its tributaries.

SLOPE CLASS AND RANGE OF SLOPES: Near level or very gently sloping. 0-3°.

VEGETATION AND LAND USE: Irrigated and rainfed rice. Pasture (predominantly Para grass) for dairying. In some areas market gardening is practised.

RANGE OF ELEVATION: 3-8 m

RAINFALL: Mean annual range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained.

PERMEABILITY CLASS: Moderate

FLOODING: One in 50 year return period for floods depositing alluvium. One in 2 year return period for smaller (water only) flood events.

EROSION: No erosion risk.

*Naduru*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically show deep firm moderately well drained profiles with predominantly silty clay loam textures. Soil colour is very dark greyish brown to 50-60 cm becoming dark greyish brown below this. If present, mottling is weakly expressed. Most horizons are slightly sticky and plastic. Manganese stains are common in the deeper subsoil.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	Naduru loam and Naduru loam over sand.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	<p>Rewa series: Friable clayey soils with yellowish brown subsoils and commonly with well expressed paleosols.</p> <p>Tamanua series: Imperfectly drained with fluctuating water table within 1 m of soil surface. Manganese nodules and coatings are a feature of subsoils. Also coarse grey mottling below 35 cm.</p>
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Naduru series are generally moderately acid, with medium base status. Organic carbon values are very low and constant for all horizons showing only a small decrease. CEC and calcium are medium; magnesium very high; sodium low and potassium extremely low; and available phosphorus is very low.</p> <p>The particle size family class is fine.</p> <p>The mineralogy is kaolinitic.</p>
LABORATORY Nos:	KRS P18A-D
SOIL LIMITATIONS:	Susceptibility to flooding; moderate soil acidity; and nutrient deficiencies of potassium, phosphorus and nitrogen.

## Typifying Profile

SOIL NAME: Naduru soils  
PROFILE No.: P18  
SITE LOCATION: Junction of Kuku Road, north of Nausori Airport.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Summit of levee of ancient course of the Rewa River.  
PARENT MATERIAL: Riverine alluvium derived from basic and intermediate rocks.  
SLOPE: Level  
ASPECT: Not applicable  
ELEVATION: 4 m  
MICRORELIEF: Cloddy soil surface.  
SITE VEGETATION: Rainfed rice fallow, scattered weeds of *Mimosa pudica*, *Ageratum* and *Cuphea*.  
LAND USE: Rainfed rice  
DRAINAGE: Moderately well drained.  
EROSION: None observed  
DISTURBANCE: Ploughed  
LABORATORY Nos: KRS P18A-D

### PROFILE DESCRIPTION

Ap1	0-15 cm (15 cm)	Moist; very dark greyish brown (10YR 3/2) silty clay loam; moderately developed fine to medium nut structure; firm; slightly sticky; plastic abundant fine and medium pores; common, fine roots; distinct smooth boundary,
Ap2	15-30 cm (15 cm)	Moist; very dark greyish brown (10YR 3/2) silty clay loam; moderately developed fine nut to blocky structure; firm; slightly sticky; plastic; common fine and medium pores; few fine roots; distinct smooth boundary,
Bw1	30-52 cm (22 cm)	Moist; very dark greyish brown (10YR 3/2) with few, fine faint yellowish brown (10YR 5/6) mottles clay loam; moderately developed fine and very fine nut structure; firm; slightly sticky; plastic; common coarse and medium pores,
Bw2	52-125 cm (73 cm)	Moist; dark yellowish brown (10YR 3/4) with few, fine faint yellowish brown (10YR 5/6) mottles silty clay loam; moderately developed fine nut structure; firm; slightly sticky; plastic; some mica flecks; few manganese stains.



# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Naevuevu series**

REFERENCE: Naevuevu clay (26) and Naevuevu hill soils (26H) defined by Twyford and Wright (1965) as red, friable and clayey latosolic soils from limestone materials formed under a climate with a strong dry season.

Forms the Naevuevu set.

The central concept for Naevuevu soils is retained in this survey.

### CLASSIFICATION:

- (a) Soil Taxonomy: Ochreptic Haplustalf, clayey-skeletal, smectitic, isohyperthermic
- (b) FAO: Eutric Nitosol
- (c) Twyford and Wright: Latosolic soil with a strong dry season

### INCLUDED MAPPING UNITS AND PHASES:

- Naevuevu soils, flat to gently undulating phase (82A)
- Naevuevu soils, undulating phase (82B)
- Naevuevu soils, easy rolling phase (82C)
- Naevuevu soils, rolling phase (82D)
- Naevuevu soils, strongly rolling phase (82G)

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occur on raised limestone terraces on the coast west of the Sigatoka River mouth at three locations - Nodaulau, Yadua and Yugama.

PARENT ROCK: Coralline limestone and residuum of andesitic origin.

PARENT MATERIAL: Strongly red weathered residuum over weakly weathered limestone.

PHYSIOGRAPHIC POSITION/LANDFORM: Karst landscape on uplifted coral reef.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3 °), undulating (4-7°), easy rolling (8-11 °), rolling (12- 15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Formerly carried reeds and light forest. Now cleared for sugar cane and food gardens. Reverted areas support vaivai (*leucaena glauca*).

RANGE OF ELEVATION: 4m - 20m

RAINFALL: Annual average range: 1,800 - 2,400 mm;  
dry season range: 400 - 500 mm;  
wet season range: 1,800 - 2,800 mm.

TEMPERATURE: Mean annual: 25 - 5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Very good

PERMEABILITY: Moderately rapid

FLOODING: Never floods

EROSION: Moderate sheet and rill erosion potential on slopes.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 35cm moist dark yellowish brown friable clay of strongly developed coarse nut structure overlying 30cm Bt horizon of yellowish red firm clay of moderately developed medium blocky structure on hard limestone.
DIAGNOSTIC HORIZONS:	Ochric epipedon; argillic horizon, lithic contact.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	Unnamed variant (Pedon VS23). Profile description attached. Whereas Naevuevu series occur in areas of limestoned pinnacles, the variant occurs on the same raised reef limestone in closed drainage depressions and where there are no limestone outcrops.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Near neutral pH with very high levels of CEC, total bases, Ca and Mg.
LABORATORY Nos:	FACL 9410871-9410872
SOIL LIMITATIONS:	Broken uneven land surface, rock outcrops, surface boulders, shallow soil profile over hard limestone, and soil moisture deficits particularly in the dry season.

## Typifying Profile

NAME: Naevuevu soils  
PROFILE NO: FSC 4  
SITE LOCATION: Queens Highway opposite Malaqereqere Indian School near Yadua, Nasigatoka.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Undulating to strongly rolling kaast landscape.  
PARENT MATERIAL: Strongly indurated *in-situ* limestone rock.  
SLOPE: 5°  
ASPECT: East  
ELEVATION: 7m  
MICRORELIEF: Broken by rock outcrops.  
SITE VEGETATION: Leucaena and guinea grass.  
LAND USE: Sugarcane, grazing and housing in vicinity.  
DRAINAGE: Well drained.  
EROSION: Some sheet erosion.  
DISTURBANCE: None  
LABORATORY Nos: FACL 9410871 - 9410872

### PROFILE DESCRIPTION

Naevuevu soils

Ap	0 - 35cm (35 cm)	Moist; dark yellowish brown (10 YR 4/4) clay; strongly developed coarse angular nut structure; friable; hard; many fibrous roots; diffuse smooth boundary.
Bt	35 50cm (15 cm)	Moist; yellowish red (5YR 4/8) clay; moderately developed medium blocky structure; firm; common distinct dark reddish brown (5 YR 3/3); many fine roots; sharp undulating (lithic contact) boundary),
R	on	hard coralline limestone.

### PROFILE DESCRIPTION

Variant of Naevuevu series (VB 23)

Ap	0 - 30 cm (30 cm)	Moist; very dark greyish brown (10 YR 3/2) silty clay; strongly developed medium nut structure breaking into strong very fine granular; very firm; sticky; slightly plastic; abundant fine and medium roots; diffuse wavy boundary,
Bw	30 - 60 cm (30 cm)	Moist; brownish yellow (10 YR 6/6) sandy clay; massive; breaking to weak coarse blocky and medium nut structure; friable; slightly sticky; slightly plastic; no roots (lithic contact),
	on	hard coralline limestone.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Naicola series**

REFERENCE: Naicola steepland bouldery clay (83e) defined by Twyford & Wright (1965) as steepland soils from andesitic rocks (also andesitic tuffs and marls) formed under a climate with no dry season.

They form part of the Visa set. The central concept for Naicola soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Humitropept, fine, ferruginous, isohyperthermic
- (b) FAO: Humic Cambisol
- (c) Twyford and Wright: Steepland soil related to or associated with humic latosols with no dry season.

INCLUDED MAPPING UNITS AND SYMBOLS:

Naicola soils, rolling phase (166D)

Naicola soils, steep phase (166G)

Naicola soils, strongly rolling phase (166E)

Naicola soils, very steep phase (166H)

Naicola soils, moderately steep phase (166F)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Naicola soil is widespread in Vanua Levu where they derive from the andesites of the axial mountain range; they are probably the soil of greatest area. On Viti Levu they are extensive in Naitasiri and cover the mountains which are drained by the Waidina river.

PARENT ROCK: Andesites and sedimentary rocks of intermediate composition.

PARENT MATERIAL: Deep moderate and strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Convex and planar midslopes and backslopes in strongly weathered hill country.

SLOPE CLASS AND RANGE OF SLOPES: Rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (27-35°), and very steep (>35°).

VEGETATION AND LAND USE: Predominantly under indigenous forest. Elsewhere in subsistence gardens, for yams, bananas, dalo, kumala and cassava. Cropping period 2-3 years followed by bush fallow.

RANGE OF ELEVATION: 30-600 m

RAINFALL: Mean annual range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate to severe sheet and rill erosion potential when forest cleared and cultivated. Debris potential on the steeper slopes.

*Naicola*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 25 cm of yellowish red firm silty clay loam, of moderately developed fine granular structure, overlying 30 cm of red friable clay, of weakly developed fine and medium blocky structure on more than 50 cm of red firm clay, of weakly developed medium blocky structure with common weakly weathered boulders.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Naicola series have an Ap(Ah), Bw1, Bw2 horizon sequence.</p> <p>The Ap(Ah) horizon thickness ranges from 15 to 30 cm; its colours include reddish brown (5YR 4/3, 4/4) and yellowish red (5YR 4/6, 4/8); textures are clay, clay loam or silty clay loam; structures include weak or moderate, fine or medium, not or granular; weakly weathered stones may be absent or few, common or many.</p> <p>The Bw1 horizon thickness ranges from 20-40 cm; its colours include reddish brown (2.5YR 4/4, 5/4) and red (2.5YR 4/6, 5/6, 5/8); textures are clay or clay loam; and structures vary weak, fine or medium blocky.</p> <p>The Bw2 horizon thickness ranges from 10-90 cm; varicoloured but predominantly red (2.5YR hue); textures are clay, clay loam, or silty clay loam; consistence friable or firm; structures massive or weak, fine or medium blocky; boulders (weathered) may be common to profuse in abundance.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be extremely acid; organic carbon and nitrogen have medium values in the topsoil (0-30 cm), very low below this and the C/N ratios are medium; very low available phosphorus; % base saturation very low; CEC values medium throughout the profile; exchangeable calcium low in the topsoil and very low below it; magnesium medium in the topsoil and low below it; potassium very low throughout; and aluminium significant in the exchange complex.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is ferruginous.</p>
LABORATORY Nos:	KRS U1718-1720 (inclusive)
SOIL LIMITATIONS:	Slope; moderate to severe soil erosion potential when the forest is cleared; surface boulders; extremely acid pH; nutrient deficiencies of phosphorus, potassium, and nitrogen; and likely aluminium toxicity.

## Typifying Profile

SOIL NAME: Naicola soils, steep phase.  
PROFILE No.: M3  
SITE LOCATION: Waitolu- Waibau area, Naitasiri.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Linear midslope  
PARENT MATERIAL: Strongly weathered *in situ* andesite agglomerate.  
SLOPE: 28°  
ASPECT: South  
ELEVATION: 180 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Cassava and bananas under breadfruit and coconut.  
LAND USE: Subsistence cropping  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: Cultivated (by hand) in vicinity but not at pit site.  
LABORATORY Nos: KRS U1718-1720 (inclusive)

### PROFILE DESCRIPTION

Ap	0-30 cm (30 cm)	Moist; yellowish red (5YR 4/6) silty clay loam; weakly developed fine granular structure; firm; slightly sticky; few, weakly weathered angular stones; abundant fine and medium fibrous roots; diffuse smooth boundary,
Bw1	30-60 cm (30 cm)	Moist red (2.5YR 5/6) clay; weakly developed fine and medium blocky structure; friable; slightly sticky; common fine fibrous roots; diffuse smooth boundary,
Bw2	60-140cm (80 cm)	Moist; red (2.5YR 4/6) clay; weakly developed fine and medium blocky structure; friable to firm; slightly sticky; few fine fibrous roots; few (10 cm diameter) weakly weathered boulders.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nairai series**

REFERENCE: The Nairai steepland stony and gritty clay (87b) defined by Twyford & Wright (1965) as a severely degraded soil from basic parent materials under talasiga and thought to have developed as a result of continual firing from Vuya soils (85). Also defined as forming under a climate with a moderate dry season. In this survey the climatic definition has been extended to include a strong dry season.

Forms part of the Lakeba set. This central concept for Nairai soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Kandiuustult, clayey, kaolinitic, isohyperthermic
- (b) FAO: Orthic Acrisol
- (c) Twyford and Wright: Steepland soil related to or associated with ferruginous latosols with a moderate and strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nairai soils, easy rolling phase (179C)	Nairai soils, moderate steep phase (179F)
Nairai soils, rolling phase (179D)	Nairai soils, steep phase (179G)
Nairai soils, strongly rolling phase (179E)	Nairai soils, very steep phase (179H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nairai soils are important talasiga soils in Nairai Island, Lomaiviti Group. They also occur in small patches in Vanua Levu and Lakeba Island, Lau Group.

PARENT ROCK: Andesites (some basalts).

PARENT MATERIAL: Deep strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Long linear slopes, and convex backslopes and concavo-linear midslopes in very strong rolling and moderately dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°), and very steep (>35°).

VEGETATION AND LAND USE: The main vegetation is fern (*D. linearis*), nokonoko, vasa, molau etc. Generally unused but in some areas grazed or in forest (*P. caribaea*).

RANGE OF ELEVATION: 7-250 m

RAINFALL: Annual average range: 2,200-3,000 mm;  
dry season range: 400-600 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Often severely eroded - sheet erosion primarily, but serious rilling in many areas.

*Nairai*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of dark reddish brown friable, gritty clay loam, sticky and plastic, moist and of strongly developed fine nut structure, overlying 60 cm of firm red clayey argillic horizon(s), sticky and plastic moist, of blocky structure and with well expressed clay cutans to peds. This underlying BC horizon(s) are clayey and massive showing rock structures and of variable colour - commonly grey veined of red and yellowish hues.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	<p>Nairai series have a Ah, Bt1, Bt2, BC horizon sequence.</p> <p>The Ah horizon thickness ranges from 5-15 cm; it includes dark reddish brown (2.5YR 3/4; 5YR 3/3, 3/4); textures are normally gritty and clays or clay loam; structures may be moderate or strong fine nut or granular; and weathered stones may be few, common or many in abundance.</p> <p>The Bt horizons combined thickness ranges from 20-100 cm; their colours include red (2.5YR 4/6, 4/8, 5/8) reddish brown (5YR 4/4, 5/4) and yellowish red (5YR 5/6, 5/8); textures may be clay or clay loam; consistence may be friable, firm or very firm; structures are commonly massive breaking to weak, moderate or strong coarse or very coarse blocky; clay cutans may be few, many or common.</p> <p>The BC horizons colours are dark reddish brown, red or yellowish red; and consistence may be friable or firm.</p>
VARIANTS:	<p>Eroded shallow variant.</p> <p>Typically shows 7 cm of varicoloured dark reddish brown, grey, yellowish brown friable gravelly clay of strongly developed fine blocky structure overlying 13 cm of red firm clay of moderately developed medium blocky structure with clay cutans to peds, over vari-coloured very strongly weathered <i>in situ</i> rock.</p>
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Topsoils are moderately acid with underlying horizons strongly acid. Organic carbon values are low in topsoils and very low below with phosphorus status very low throughout the profile. Topsoils have a medium % base saturation with very low values for all other horizons (&gt;20%). The CEC is medium in the topsoil and very low below with calcium and magnesium values showing similar trends. Potassium is very low.</p> <p>The fine earth fraction is dominated by clay (&gt;75%) with sand less than 5% in all horizons and the particle size family class is clayey.</p> <p>The mineralogical class is kaolinitic.</p>
LABORATORY Nos:	SB9361A-F
SOIL LIMITATIONS:	Slope; clayey textures; severe soil moisture deficits during the dry season; severe sheet and rill erosion potential; strong soil acidity; and nutrient deficiencies of nitrogen, phosphorus and potassium.

## Typifying Profile

SOIL NAME: Nairai soils, moderately steep phase.  
PROFILE No.: LK5  
SITE LOCATION: Map I III (Lakeba) 450930 E 115750 N. Lakeba, Lau Group.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Concavo-linear segment in backslope position.  
PARENT MATERIAL: Colluvium derived from andesitic rocks over *in situ* andesite.  
SLOPE: 24°  
ASPECT: South  
ELEVATION: 180 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Reed dominated cover with some short forest species and fern (*D. linearis*).  
LAND USE: Unused  
DRAINAGE: Moderately well-drained, moderate permeability, medium runoff.  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: SB9361A-F

### PROFILE DESCRIPTION

Ah	0-13 cm (13 cm)	Dry; dark reddish brown (5YR 3/3) moist dark reddish brown (5YR 3/4) rubbed dark reddish grey (5YR 4/2) gritty clay; firm <i>in situ</i> friable; sticky; slightly plastic; strongly developed fine nut structure; abundant fine and medium roots; few to many casts; rare weathered stones (less than 2 mm); distinct regular boundary,
Bt1	13-52 cm (39 cm)	Dry; reddish brown (5YR 4/4) and red (2.5YR 4/8) moist reddish brown (5YR 4/4) and red (2.5YR 4/6) rubbed yellowish red (5YR 4/6) clay; firm; plastic; sticky; primary structure of moderately developed coarse blocky with secondary structure of weakly developed fine blocky; abundant fine thin continuous mottles (2.5YR 4/8) along root channels; many fine roots; indistinct regular boundary,
Bt2	52-80 cm (28 cm)	Dry; red (2.5YR 4/6) moist red (2.5YR 4/7) rubbed reddish brown (2.5YR 4/4) clay; friable; firm <i>in situ</i> ; sticky; plastic; primary structure massive tending weakly developed very coarse blocky with a secondary structure of weakly developed fine and coarse blocky; many thin indistinct cutans along channels; few roots; indistinct regular boundary,
Bt3	80-120 cm (40 cm)	Dry; red (2.5YR 4/7), moist red (2.5YR 4/6), rubbed red (2.5YR 4/6) clay; friable to firm; firm <i>in situ</i> ; sticky; plastic; massive tending weakly developed blocky structure; few faint thin cutans; few roots; distinct regular boundary,
BC1	120-129 cm (9 cm)	Dry; yellowish red (5YR 4/8) moist yellowish red (5YR 4/7) rubbed yellowish red (5YR 4/8) clay; friable; sticky; plastic; massive breaking to single grain; distinct regular boundary,



BC2

129-140 cm+  
(11 cm)

Dry; dark red (2.5YR 3/6) moist dark reddish brown to dark red (2.5YR 3/5) rubbed reddish brown (2.5YR 4/4) clay; friable; firm *in situ*; sticky; plastic; massive primary structure breaking to secondary structure of weakly developed fine blocky.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Naitata series**

REFERENCE: Naitata bouldery silty clay loam (58a) defined by Twyford & Wright (1965) as an upland latosolic soil from subrecent olivine basalt flows, on rolling and hilly land and formed under a climate with no dry season. Forms part of the Naitata set.

The central concept for Naitata soils is retained in this survey.

#### CLASSIFICATION:

- (B) Soil Taxonomy: Acrudoxic Hapludand, medial over medial-skeletal, isothermic
- (b) FAO: Vitric Andosol
- (c) Twyford and Wright: Upland latosolic soil with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Naitata soils, strongly rolling phase (214E)
- Naitata soils, moderately steep phase (214F)
- Naitata soils, steep phase (214G)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs above 600 m altitude at the southern end of island axial range of Taveuni and in one small area high above Somosomo Village.

PARENT ROCK: Basalt

PARENT MATERIAL: Weakly weathered *in situ* 'aa' lava.

PHYSIOGRAPHIC POSITION/LANDFORM: Broken and uneven rolling terrain.

SLOPE CLASS AND RANGE OF SLOPES: Strongly rolling (16-20°), moderately steep (21-25°) and steep (26-35°).

VEGETATION AND LAND USE: Mostly under forest. Are used in some areas for subsistence crops.

RANGE OF ELEVATION: 600-1000 m

RAINFALL: Annual average range: 3,000-6,400 mm;  
dry season range: 800-3,000 mm;  
wet season range: 2,000-2,800 mm.

TEMPERATURE: Mean annual: 18°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Moderate sheet erosion potential where forest cleared and soil bared.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows under forest 2 cm of leaf litter overlying 10 cm of dark yellowish brown firm slightly peaty silt loam, of moderate nut structure with a few stones and gravels, overlying 35 cm of reddish brown and yellowish red very firm stony silty clay loam, of weak blocky structure and with many vesicular basalt stones and boulders, overlying 20 cm of olive yellow and dark brown friable stony, gravelly and gritty loam with many basalt stones and boulders, on varicoloured angular and subangular basalt boulders.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Naitata series have an Ah, Bw, BC, C horizon sequence.  The Ah horizon thickness ranges from 5 to 12 cm; its colours include dark reddish brown (5YR 3/3, 3/4), dark brown (7.5YR 4/4) and dark yellowish brown (10YR 3/4, 4/4); textures are silt loam and silty clay loam and usually slightly peaty; and structures are moderate or strong fine nut and/or granular; with or without boulders.  The Bw horizon thickness ranges from 30-55 cm; its colours include dark brown (7.5YR 3/2, 4/2, 4/4), reddish brown (5YR 4/4, 5/4) and yellowish red (5YR 4/6, 4/8, 5/8); textures are silt loam or silty clay loam and commonly bouldery or stony; and structures may be firm massive or friable weak blocky.  The BC horizon (if present) is as for the Bw but more bouldery and of massive structure.  The C horizon is always bouldery with some fine soil material in the interstices.
VARIANTS:	None
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analysis shows the soil to be slightly acid 0-45 cm and moderately acid below 45 cm; organic carbon is high in the topsoil (0-10 cm) and very low in the other horizons; phosphorus retention is very high throughout; % base saturation is low; CEC is very high in the topsoil and high in the other horizons; TEB values are low in the topsoil and very low below it; calcium and magnesium are low in the topsoil and of very low values in the other horizons; potassium values are low throughout; and Tamms aluminium extract is very high.
LABORATORY Nos:	USP TAV108A-C
SOIL LIMITATIONS:	Slope; rock outcrops; surface and profile boulders; moderately rapid permeability; nutrient deficiencies of nitrogen and potassium; and very high phosphate retention properties.

## Typifying Profile

SOIL NAME: Naitata soils, strongly rolling phase.  
PROFILE No.: TAV108  
SITE LOCATION: Western Taveuni Island; on Des Veoux Peak Road 10 m below the 2000 ft marker post, on south side of the road.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Gently rolling toeslope in volcanic terrain.  
PARENT MATERIAL: Weakly weathered *in situ* 'aa' lava with minor amounts of ash and scoria.  
SLOPE: 16°  
ASPECT: North-west  
ELEVATION: 650 m  
MICRORELIEF: Uneven. Boulders on the surface.  
SITE VEGETATION: Indigenous rainforest, with low canopy of tree ferns, low ferns, shrubs etc.  
LAND USE: Unused (in natural state).  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: USP TAV108A-C  
COMMENTS: NaF reaction. Medium positive for all horizons.

### PROFILE DESCRIPTION

L	2-0 cm (2 cm)	Partly decomposed leaf litter.
Ah	0-10 cm (10 cm)	Moist; dark yellowish brown (10YR 3/4) slightly peaty silt loam; massive breaking to moderately developed nut structure; firm; slightly sticky; plastic; few weakly weathered stones and gravels; abundant fine fibrous roots; sharp wavy boundary,
Bw	10-45 cm (35 cm)	Moist; reddish brown (5YR 4/4) and yellowish red (5YR 4/6) silty clay loam; massive breaking to weakly developed medium blocky structure; very firm; non sticky; plastic; many weathered olive yellow (2.5Y 6/6) vesicular basalt stones; few fine and medium fibrous roots; diffuse wavy boundary,
BC	45-65 cm (20 cm)	Moist; olive yellow (2.5Y 6/6) and dark brown (7.5YR 4/2) gravelly and gritty loam; single grain; friable; many weathering basalt stones; diffuse wavy boundary,
C	65 cm+	Moist; varicoloured (red, yellow and black) weakly weathered large angular and subangular boulders with some olive yellow (2.5Y 6/6) soil in the interstices.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nakavika series**

REFERENCE: Nakavika clay and gravelly clay (28b) and Nakavika hill soils (28bH) defined by Twyford & Wright (1965) as soils developed on undulating country from basalts and basic tuffs under a climate with no dry season. Forms part of the Wainunu set.

The central concept for Nakavika soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Kanhaplohumult, clayey, gibbsitic, isohyperthermic
- (b) FAO: Humic Acrisol
- (c) Twyford and Wright: Humic latosol with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nakavika soils, flat to gently undulating phase (174A)	Nakavika soils, rolling phase (174D)
Nakavika soils, undulating phase (174B)	Nakavika soils, strongly rolling phase (174E)
Nakavika soils, easy rolling phase (174C)	Nakavika soils, moderately steep phase (174F)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nakavika soils are developed in flattish or undulating land on plateau surfaces, mainly in the Wainunu district of Vanua Levu.

PARENT ROCK: Basalts and tuffaceous rocks of basic composition.

PARENT MATERIAL: Deep strongly weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Most slope positions on flattish or undulating land on plateau surfaces.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), and moderately steep (21-25°).

VEGETATION AND LAND USE: Mainly in indigenous forest (dakua, dakua salusalu, and yaka)

RANGE OF ELEVATION: 75-450 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Slow

FLOODING: Never floods

EROSION: Slight and moderate sheet and rill erosion potential on slopes >3° when forest removed and cultivated.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of yellowish red very friable clay loam, of strong very fine and fine nut structure, overlying 30 cm of yellowish red firm gravelly clay loam, of moderate fine and medium blocky, with fine gravelly iron concretions, overlying more than 80 cm red very firm stony clay, of massive structure breaking to weak fine and medium blocky, very sticky and plastic moist, with abundant rounded stones.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	<p>Nakavika series have an Ah, Bt1, Bt2 horizon sequence.</p> <p>The Ah horizon thickness ranges from 5 to 12 cm; its colours include reddish brown (5YR 4/3, 4/4) and yellowish red (5YR 4/6, 4/8); consistence is friable or very friable; textures are clays or clay loams and commonly gravelly (non concretions); and structures are moderate or strong very fine, fine or medium nut.</p> <p>The Bt1 horizon thickness ranges from 25 to 35 cm; its colours include yellowish red (5YR 5/6, 5/8), red (2.5YR 4/6, 4/8), and dark red (2.5YR 3/6); textures are clays or clay loams; consistence is firm or friable; structures are moderate medium nut or blocky, and with or without gravelly iron concretions.</p> <p>The Bt2 horizon thickness ranges from 60 to 100 cm; colours include yellowish red (5YR 5/6, 5/8) and red (2.5YR 5/6, 6/8); textures are clays or clay loams and with or without stones or gravels; consistence may be firm or very firm; and structures are massive breaking to weak or moderate fine or medium, nut or blocky.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be strongly acid 0-40 cm and extremely acid below this; organic carbon and nitrogen have medium values in the topsoil (0-10 cm) and are low below it, and the C/N ratio is high; very low available phosphorus and phosphorus retention is high; % base saturation is very high in the topsoil and of low values in the other horizons; CEC and TEB values are low in the topsoil and very low below it; for topsoils exchangeable calcium and potassium have low values, magnesium medium and all give very low values in the other horizons; and aluminium is significant in the exchange complex for the 10-40 cm horizon.</p> <p>The particle size family class is clayey.</p> <p>The mineralogical class is gibbsitic.</p>
LABORATORY Nos:	KRS U491-493 (inclusive)
SOIL LIMITATIONS:	Clayey textures; moderate soil erosion potential on slopes > 11° if forest cleared and cultivated; slow soil permeability that results in surface ponding for many hours following high intensity storm events; strong soil acidity; nutrient deficiencies of phosphorus and potassium; high phosphorus fixation; and possible aluminium toxicity in the upper subsoil.

## Typifying Profile

SOIL NAME: Nakavika soils, undulating phase.  
PROFILE No.: TEA015  
SITE LOCATION: Wainunu District, Western Vanua Levu.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar toeslope of 'fan-like' surface in rolling country.  
PARENT MATERIAL: Strongly weathered *in situ* rock.  
SLOPE: 4° (length 200 m)  
ASPECT: South-east  
ELEVATION: 200 m  
MICRORELIEF: Terracettes  
SITE VEGETATION: Indigenous forest  
LAND USE: Unused  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: KRS U491-493 (inclusive)

### PROFILE DESCRIPTION

Ah	0-10 cm (10 cm)	Moist; yellowish red (5YR 4/8) clay loam; very friable; strongly developed fine nut structure breaking to strong very fine nut structure; abundant fine roots; diffuse wavy boundary,
Bt1	10-40 cm (30 cm)	Moist; yellowish red (5YR 5/8) gravelly clay loam; firm; slightly sticky; slightly plastic; moderately developed medium blocky structure breaking to weak fine blocky; many clay coatings to peds; common medium roots; common fine gravelly iron concretions; diffuse wavy boundary,
Bt2	40-120cm (80 cm+)	Moist; red (2.5YR 5/8) stony clay; very firm; very sticky; plastic; massive breaking to weakly developed fine and medium blocky structure; many clay coatings to peds; few medium roots; profuse unweathered rounded stones.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nakelo series**

REFERENCE: Nakelo sandy clay loam (46b) and Nakelo clay (46a) defined by Twyford & Wright (1965) as slightly better drained soils (compared to Toguru series) that develop on estuarine alluvium. Further described and characterised by Purnell (1972) for the soil survey of the Rewa delta.

Forms part of the Nakelo set.

The more extensive Nakelo sandy clay loam (46b) described by Twyford & Wright (1965) and Purnell (1972) is taken as the central concept for the series and is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Fluvaquentic Eutropept, fine-loamy, kaolinitic, isohyperthermic
- (b) FAO: Eutric Gleysol
- (c) Twyford and Wright: Gley soil related to latosols with a weak or no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nakelo soils (18)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nakelo series comprises a significant area amongst estuarine soils on the Rewa delta in ESE Viti Levu.

PARENT ROCK: Rocks of mixed mineralogies.

PARENT MATERIAL: Deep estuarine alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Low lying land on the inland margins of the present saline areas.

SLOPE CLASS AND RANGE OF SLOPES: Level

VEGETATION AND LAND USE: Used for dairy pastures and rice.

RANGE OF ELEVATION: 0.5-2 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Moderate permeability (due to vertical tubular pores and old root channels) and 1.2 cm/hr average infiltration rate.

FLOODING: Frequently flooded. The water table is at the surface after heavy rain but falls to 1 m depth in dry periods. It fluctuates rather rapidly.

EROSION: None, other than surface disturbance by crabs and rodents.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 12-15 cm of dark brown sandy clay loam with slight root channel mottling, with well developed nut structures. There is a clear boundary to yellowish-brown sandy clay loam with common grey mottles, with medium to fine blocky structure, tubular pores, sticky and plastic. Below 50-75 cm this merges into olive-grey with many strong brown mottles, sandy clay loam. This merges into greenish-grey sandy loam with strong brown mottling (root channels) and a little undecomposed plant remains, and finally into dark greenish-grey sand.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Nakelo series have an A(Ap), Bg1, Bg2, Cr1, Cr2 etc. horizon sequence.</p> <p>The Ap horizon thickness ranges from 12-30 cm; its colours include dark brown (10YR 3/3, 4/3, 7.5YR 4/2,4/4) and brown (10YR 5/3, 7.5YR 5/2, 5/4); textures are either sandy clay or sandy clay loam (both sometimes tending peaty); structures are either weak or moderate fine nut or fine blocky; and consistence may be friable or firm.</p> <p>The B horizons in combination range from 40-70 cm in thickness; colours include yellowish-brown (10YR 5/4, 5/6, 5/8) dark yellowish-brown (10YR 4/4) and strong brown (7.5YR 5/6,5/8); textures are sandy clay or sandy clay loam; structures are weak or moderate fine or medium blocky; and mottles are light grey (10YR 6/1, 7/1, 7/2) or light brownish-grey (10YR 6/2).</p> <p>The Cr horizons in combination exceed 75 cm in thickness; colours include greenish grey, dark greenish-grey or very dark greenish grey; textures are medium or fine sands, sandy loams, and fine sandy loams; structures are massive or very weak blocky, both breaking to single grain.</p>
VARIANTS:	Nakelo clay loam and Nakelo loam
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Toguru series: Poorer natural drainage. Mangrove woody remnants in subsoils. Uniform dark grey soil colour with heavy sandy loam textures. Weaker subsoil structures and overall higher organic matter content for the whole profile.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Compared with Toguru series, better drainage for Nakelo series has permitted oxidation and leaching to remove the sulphides from the surface so that the high sulphide contents are found only below 75 cm, and recognised by the greenish-grey colours, and the presence of organic matter and plant remains (loss on ignition &lt;10%). pH values remain above 5 to 100-125 cm below which they drop to &lt;3. Base status is high to 70 cm but still medium below. Potassium and sodium values are very low; calcium low; and magnesium very high. Organic carbon values are very low in the upper 70 cm and increase below this.</p> <p>The particle size family class is fine-loamy.</p> <p>The mineralogy class is kaolinitic. Sand dominates (50-65%) the fine earth fraction.</p>
LABORATORY Nos:	KRS C2357-2362 (inclusive)
SOIL LIMITATIONS:	Susceptibility to flooding; high water tables; strong soil acidity; and nutrient deficiencies of available phosphorus, potassium and nitrogen.

## Typifying Profile

SOIL NAME: Nakelo soils  
PROFILE No.: P173  
SITE LOCATION: Adjacent Nakelo village.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Floodplains. Flat land with very slight slope to Qaranike mangroves.  
PARENT MATERIAL: Riverine alluvium over estuarine alluvium.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 3.5 m  
MICRORELIEF: Large dry clods on soil surface.  
SITE VEGETATION: Ploughed. Remnants of Para grass, willow, primrose and other weeds.  
LAND USE: Ploughed for rice  
DRAINAGE: Poorly drained  
EROSION: None observed  
DISTURBANCE: Ploughed  
LABORATORY Nos: KRS C2357-2362 (inclusive)  
COMMENTS: Water table at 114 cm.

### PROFILE DESCRIPTION

Ap	0-13 cm (13cm)	Dry; dry, brown (10YR 5/3) and moist, dark brown (10YR 4/3) sandy clay loam; weakly developed, medium prismatic structure, breaking to moderately developed, fine nut structure; firm; sticky; plastic; few, fine root pores; common fine roots; distinct smooth boundary,
Bg1	13-25 cm (12 cm)	Slightly moist; yellowish brown (10YR 5/6) sandy clay loam; common, medium, light brownish-grey (10YR 6/2) mottles; weakly developed, fine, blocky structure; firm; sticky; plastic; few pores; few fine roots; indistinct smooth boundary,
Bg2	25-46 cm (21 cm)	Moist, yellowish-brown (10YR 5/6) sandy clay loam; abundant medium, distinct, light brownish-grey mottles; weakly developed, fine blocky structure; firm; sticky; plastic; few medium pores; no live roots; indistinct smooth boundary
Bg3	46-76 cm (30 cm)	Moist; strong brown (7.5YR 5/8) sandy clay; abundant, coarse, permanent light grey (10YR 6/1) mottles; weakly developed, fine blocky structure; firm; sticky; plastic; indistinct smooth boundary,
Cr1	76-112 cm (36 cm)	Moist; greenish-grey (5G 5/1) medium sandy loam, common, fine, distinct dark brown (7.5YR 4/4) and strong brown (7.5YR 5/7) mottles along root channels and a few, medium, faint olive brown (2.5Y 4/4) mottles; single grain; firm; slightly sticky; plastic; rare, small non-calcareous stones; few fine root channels; no roots; distinct smooth boundary,

2Cr2	112-152cm (40 cm)	Wet; dark greenish-grey (5Y 4/1) medium sandy loam; single grain; slightly sticky; slightly plastic; porous; few large decayed roots,
2Cr3	152-203cm (51 cm)	Wet; very dark greenish-grey (5GY 3/1) sand; single grain, non sticky; non plastic; some mica flakes; porous; very permeable.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nalotu series**

REFERENCE: Nalotu clay and sandy clay (15a) and Nalotu hill soils (15aH) and Nalotu hill soils (15aH) defined by Twyford & Wright (1965) as sandy heavy clays from siliceous marl formed under a climate with moderate dry season.

Forms part of the Nalotu set.

The central concept for Nalotu soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Eutropept, fine, smectitic, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Nigrescent soil, with a moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nalotu soils, easy rolling phase (111C)  
Nalotu soils, rolling phase (111D)  
Nalotu soils, strongly rolling phase (111E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occur in small patches in north-eastern Vanua Levu and between Nununuku and Yakita Villages on Kadavu.

PARENT ROCK: Calcareous quartz-rich andesitic tuff.

PARENT MATERIAL: Strongly weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Convex backslopes and midslopes in strongly rolling land.

#### SLOPE CLASS

AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Used extensively for dalo gardens where water is available to flood the dalo beds. Elsewhere, yams, cassava and kumala are grown but crops are only fair and long intervals (five to seven years) of fallow under gasau are customary. Where the gasau has been frequently burnt talasiga vegetation has developed.

RANGE OF ELEVATION: 10-300 m

RAINFALL: Annual average range: 2,000-4,000 mm;  
dry season range: 600-1,000 mm;  
wet season range: 1,400-2,800 mm.

TEMPERATURE: Mean annual: 24.5°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate to severe sheet and rill erosion potential.

## **Morphological and Chemical Properties**

<b>CHARACTERISTIC PROFILE FEATURES:</b>	Typically shows 15 cm of reddish black firm to friable sandy heavy clay of strong medium blocky structure breaking to granules, and slightly sticky and plastic when moist, overlying 25 cm of very pale brown firm sandy heavy clay of very strong coarse blocky structure breaking to fine granules with difficulty and sticky and very plastic when moist, on weathering sandy tuff.
<b>DIAGNOSTIC HORIZONS:</b>	Ochric epipedon, cambic horizon.
<b>RANGE OF PROFILE FEATURES:</b>	Not applicable. Only two profile descriptions available.
<b>VARIANTS:</b>	Unnamed variant under talasiga vegetation typically shows 25 cm of dark reddish grey firm to friable sandy clay, of weak coarse blocky structure breaking to strong fine blocky and granular and moderately plastic and slightly sticky when moist, overlying 25 cm of red very compact heavy clay, of massive structure breaking to strong fine blocky and coarse granular, and very plastic and sticky when moist, on strongly mottled varicoloured (weak red, pale grey and dark red) heavy clay with fragments of weathering tuff.
<b>SIMILAR SOILS AND DISTINGUISHING FEATURES:</b>	None recognised
<b>GENERAL CHEMICAL, PHYSICAL &amp; MINERALOGICAL PROPERTIES:</b>	Though not analysed these soils are expected to be strongly acid, of moderate base status, and low in phosphorus, nitrogen and potassium .
<b>LABORATORY Nos:</b>	Not sampled for analysis.
<b>SOIL LIMITATIONS:</b>	Clayey textures, profile shallowness; erosion hazard; strong acidity; nutrient deficiencies of nitrogen, phosphorus and potassium; and soil moisture deficits experienced during the dry season.

## Typifying Profile

SOIL NAME: Nalotu soils, rolling phase.  
PROFILE No.: TW 22  
SITE LOCATION: 200 m north-west of Nuku village, Kadavu Island.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Convex backslope in hilly land.  
PARENT MATERIAL: Weathered *in situ* acidic andesitic tuff.  
SLOPE: 13°  
ASPECT: West  
ELEVATION: 180 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Food garden (dalo, tavioka, kumala).  
LAND USE: Subsistence cropping  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: Natural site  
LABORATORY Nos: Not sampled for analysis.

### PROFILE DESCRIPTION

Ah	0-15 cm (15 cm)	Moist; reddish black (10R 2/1) sandy heavy clay; very strongly developed medium blocky structure breaking to granular; firm to friable; slightly sticky; plastic; common fine and medium fibrous roots; distinct smooth boundary,
Bw	15-40 cm (25 cm)	Moist; very pale brown (10YR 7/3) sandy heavy clay; very strongly developed coarse blocky structure breaking to fine granules under considerable pressure; firm; sticky; very plastic; few fine fibrous roots; distinct smooth boundary,
C	on	Weathering sandy tuff.





# SOIL TAXONOMIC UNIT DESCRIPTION

## Reference/classification

SOIL NAME: **Namaka series**

REFERENCE: Namaka gritty clay (41d) defined by Twyford & Wright (1965) as strongly weathered colluvial soils from quartz-rich sediments developed on flattish land under a climate with a strong dry season.

Forms part of the Kelikoso set.

The central concept for Namaka soils is retained in this survey.

### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Paleustult, clayey, kaolinitic, isohyperthermic
- (b) FAO: Ferric Acrisol
- (c) Twyford and Wright: Red-yellow podzolic soil with a strong dry season

### INCLUDED MAPPING UNITS AND SYMBOLS:

Namaka soils (35)

## Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Of limited areal extent in the environs of the Nadi Airport/Namaka/Legalega areas.

PARENT ROCK: Quartz-rich rocks.

PARENT MATERIAL: Deep strongly weathered colluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Planar and slightly convex surfaces on relict weakly dissected terrace surfaces.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: Almost entirely under sugar cane and to a lesser extent pulse crops and rainfed rice.

RANGE OF ELEVATION: 6-20 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Sheet erosion under cultivation.

## Morphological And Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 18 cm of dark reddish brown loamy fine sand, of moderately developed fine blocky structure, and friable, overlying 20 cm of reddish brown fine sandy clay loam of massive structure breaking to weakly developed coarse blocky structure; very firm, with a few unweathered rounded quartz gravels, overlying 20 cm of yellowish red clay, of weakly developed fine blocky structure, friable with faint yellowish red clay coatings to peds, over more than 70 cm of yellowish red clay, of weakly developed fine blocky structure, very friable, and with yellowish red clay cutans to peds.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Namaka series have an Ap, Bt horizon sequence.  Ap horizons range in thickness from 30-38 cm; colours include dark reddish brown (5YR 3/3, 3/4); textures are either sandy clay loam or clay loam; structures vary either moderate or weakly developed blocky; and consistence is either friable or firm.  Bt horizons exceed 90 cm in thickness; colours include yellowish red (5YR 4/6, 4/8); textures range clay to sandy clay; structures are either massive breaking to weak fine blocky or coarse blocky breaking to fine blocky; and consistence is either firm or friable.
VARIANTS:	Unnamed variants: Well drained yellowish red soils without argillic horizon (Typic Dystropept, fine loamy, kaolinitic)
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Nadi series: Well drained reddish or yellowish brown soils formed from strongly weathered mixed siliceous and basic alluvium but do not have an argillic horizon.  Legalega series: Imperfectly drained soils formed from strongly weathered siliceous alluvium with grey-mottled argillic horizons (Laffan, 1988).  Mocambo series: Moderately well drained to imperfectly drained soils formed from strongly weathered mixed alluvium over siliceous alluvium with argillic horizons and oxic-like horizons (Laffan, 1988).
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	% base saturation medium to high in A horizons and upper B horizons, low in lower B horizons. Exchangeable calcium low to medium in A horizons, low to very low in B horizons, magnesium medium throughout profile, potassium low in Ap1 horizon and very low elsewhere. Cation exchange capacity low throughout. % base saturation < 35 at depths 1.25 m below top of argillic horizon.  The particle size family class is clayey.  Mineralogical class kaolinitic.
LABORATORY Nos:	KRS R2742-46 (inclusive) SB9665A-E
SOIL LIMITATIONS:	Severe seasonal soil moisture deficits, erosion risk under cultivation on sloping land, and nutrient deficiencies of potassium, phosphorus and nitrogen.

## Typifying Profile

SOIL NAME: Namaka soils  
PROFILE No.: L77  
SITE LOCATION: Refer soil map of Legalega Agricultural Research Station (Laffan, 1988).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Backslope of low relief dissected terrace.  
PARENT MATERIAL: Strongly weathered siliceous alluvium.  
SLOPE: 3°  
ASPECT: North  
ELEVATION: 9 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Sorghum  
LAND USE: Cropping for experimental purposes.  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: Cultivated  
LABORATORY Nos: KRS 2742-46 (inclusive)  
SB9665A-E

### PROFILE DESCRIPTION.

Namaka soils

Ap1	0-18 cm (18 cm)	Dry; dark reddish brown (5YR 3/4) (moist, ped face and rubbed colours) loamy fine sand; friable; non-sticky; non-plastic; moderately developed fine blocky structure; distinct smooth boundary,
Ap2	18-38 cm (20 cm)	Dry; dark reddish brown (5YR 3/3) (moist, ped face and rubbed colours) fine sandy clay loam; very firm; non-sticky; non-plastic; massive breaking to weakly developed coarse blocky structure; few unweathered rounded quartz gravels; distinct smooth boundary,
Bt1	38-58 cm (20 cm)	Slightly moist; yellowish red (5YR 4/6) (moist, ped face and rubbed colours) clay; friable; non-sticky; non-plastic; weakly developed fine blocky structure breaking to weakly developed fine crumb structure; few faint yellowish red (5YR 4/6) clay cutans; diffuse smooth boundary,
Bt2	58-128+ cm (70 cm+)	Slightly moist; yellowish red (5YR 4/8) (moist, open face and rubbed colours) clay; very friable; non-sticky; non-plastic; massive breaking to weakly developed fine blocky structure; few faint yellowish red (5YR 4/6) clay cutans.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Namalata series**

REFERENCE: New soil series introduced to include deep, red clayey soils that develop mainly on rolling hill country under forest. They have thick dark topsoils and would previously have been included with Delaimatai clay and silty clay (30b) as described by Twyford & Wright (1965).

The name is derived from Namalata Island part of the Southern Vanua Balavu Group.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Udic Haplustoll, fine, mixed, isohyperthermic
- (b) FAO: Hyplic Kastanozem
- (c) Twyford and Wright: Humic latosol with a moderate to strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Namalata soils, undulating phase (184B)
- Namalata soils, easy rolling phase (184C)
- Namalata soils, rolling phase (184D)
- Namalata soils, strongly rolling phase (184E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Namalata soils occur in association with Delaimatai soils in Vanua Levu but are of limited extent. Elsewhere they are mapped in small patches in Lau Group.

PARENT ROCK: Andesites and basalts.

PARENT MATERIAL: Deep strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Concave and convex midslope and toeslope positions in moderately rolling hill country.

SLOPE CLASS AND RANGE OF SLOPES: Undulating 4-7°; easy rolling, 8-11°; rolling, 12-15°; and strongly rolling, 16-20°.

VEGETATION AND LAND USE: Still part forest-covered. Elsewhere after forest removal, scrubby vegetation and where further burned, under bracken fern and reed grass.

RANGE OF ELEVATION: 20-30 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained to moderately well drained.

PERMEABILITY CLASS: Moderate permeability

FLOODING: None

EROSION: Minor sheet erosion under green forest. High potential erosion when forest cleared and shifting cultivation practised.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Thick (20-30 cm) friable, dark reddish brown clayey topsoil with sticky and slightly plastic consistence and strongly developed nut structures overlie thick (>75 cm) friable dusky red Bw horizons with <i>in situ</i> weathered rock normally encountered below 1 m of the soil surface. The upper Bw horizon is a slightly gritty plastic and sticky clay with weak coarse blocky structure. The lower Bw horizon tends to massive, slightly sticky and slightly plastic with clay loam textures.
DIAGNOSTIC HORIZONS:	Mollic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Delaimatai series: Ochric epipedon, dark red in B horizons, more clay and generally shallower. Occur more on steeper slopes.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Profiles are moderately acid with very low organic carbon values except for the topsoil where values are low. % base saturation is very high and the CEC values are high. Exchangeable calcium values are medium; magnesium, very high; and potassium high. Tamms oxalate extractable aluminium, iron and silica values are very low.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is mixed.</p>
LABORATORY Nos:	SB9410A-C
SOIL LIMITATIONS:	Susceptibility to erosion when forest cleared, seasonal soil moisture deficits, soil acidity, and low organic matter status.

## Typifying Profile

SOIL NAME: Namalata series  
PROFILE No.: VB10  
SITE LOCATION: Map I43 (Vanua Balavu) 178° 58' 90" E, 17° 17' 25" N.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex midslope in moderately dissected hill country.  
PARENT MATERIAL: Colluvium derived from andesitic rock overlying *in situ* andesite.  
SLOPE: 8°  
ASPECT: North  
ELEVATION: 20 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Yams under scattered forest trees.  
LAND USE: Food garden  
DRAINAGE: Moderately well drained; moderate permeability; medium runoff.  
EROSION: None recognised  
DISTURBANCE: Cultivated  
LABORATORY Nos: VB10 SB9410A-C  
COMMENTS: None

### PROFILE DESCRIPTION

Ap	0-23 cm	Dry, dark reddish brown (5YR 3/2), moist dark reddish brown (5YR 3/2.5) clay; friable, firm <i>in situ</i> ; sticky, slightly plastic; strongly developed medium and coarse nut with cast granular structure; abundant fine medium and coarse nuts; many casts and worm channels; indistinct regular boundary,
Bw1	23-50 cm	Dry, dusky red (2.5YR 3/2), moist very dusky red to dusky red (2.5YR 2.5/2), slightly gritty clay; friable; sticky; plastic; primary structure of weakly developed coarse blocky and secondary structure of moderate to weakly developed nut with crumb; many fine and medium roots; few to many casts; indistinct regular boundary,
Bw2	50-110 cm	Moist, dusky red (2.5YR 3/2), rubbed dusky red to weak red (2.5YR 3.5/2) clay loam; friable; slightly sticky; slightly plastic; massive breaking to weakly developed blocky structure with crumb; few coarse dead roots; few casts, indistinct regular boundary,
BC	on	<i>in situ</i> weathered andesite rock.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Namara series**

REFERENCE: Namara sandy clay and sandy clay loam (39c) and Namara hill soils (39cH) defined by Twyford & Wright (1965) as degraded Qaliira soils under forest, reed and talasiga vegetation on rolling and hilly land and formed from acid andesite and quartz-rich tuff under a climate with a weak dry season.

Forms part of the Namatiu set. The central concept for Namatiu soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Palendult, clayey, kaolinitic, isohyperthermic
- (b) FAO: Dystric Nitosol
- (c) Twyford and Wright: Red yellow podzolic soil, with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Namara soils, undulating phase (139B)
- Namara soils, easy rolling phase (139C)
- Namara soils, rolling phase (139D)
- Namara soils, strongly rolling phase (139E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Of limited distribution on the windward side of Kadavu Island, particularly in the vicinity of Soso Bay.

PARENT ROCK: Acid andesite and quartz-rich tuffs.

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM:

Convex backslopes and midslopes on gentle ridges and undulating plateaux.

SLOPE CLASS AND RANGE OF SLOPES:

Undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE:

Formerly reputed to have supported tall forest, now supports low open forest with much caukoro and patches of reed grass and talasiga vegetation.

RANGE OF ELEVATION:

20-400 m

RAINFALL:

Annual average range: 1,600-2,800 mm;  
dry season range: 600-1,500 mm;  
wet season range: 1,400-2,600 mm.

TEMPERATURE:

Mean annual: 24°C.

SOIL MOISTURE REGIME:

Udic

SOIL TEMPERATURE REGIME:

Isohyperthermic

SOIL DRAINAGE CLASS:

Well drained

PERMEABILITY CLASS:

Moderately slow

FLOODING:

Never floods

EROSION:

Moderate to severe sheet and rill erosion potential if cultivated without implementation of soil conservation measures.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 12 cm of dark brown to reddish grey, firm to friable sandy clay loam; of weak coarse blocky structure breaking to medium blocky and slightly sticky and plastic when moist, overlying 33 cm of brown grading to strong brown very firm sandy clay, of massive structure with weak columnar fracturing, and sticky and very plastic on strong brown slightly mottled weak red, very compact plastic clay with a few iron-coated fragments of weathered sandy tuff.
DIAGNOSTIC HORIZONS:	Ochric epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Namara soils are expected to be strongly acid, of very low base status and low levels of phosphorus
LABORATORY Nos:	Not sampled for analysis.
SOIL LIMITATIONS:	Clayey textures; profile shallowness; erosion hazard; low base status; nutrient deficiencies of nitrogen, phosphorus and potassium, strong soil acidity; and probable aluminium toxicity (note forest trees are shallow rooting).

## Typifying Profile

SOIL NAME: Namara soils, easy rolling phase

PROFILE No.: TW 19

SITE LOCATION: Soso Bay, Kadavu Island.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar midslope

PARENT MATERIAL: Weathered sandy tuff.

SLOPE: 10°

ASPECT: South-west

ELEVATION: 45 m

MICRORELIEF: Uneven

SITE VEGETATION: Open forest with much caukoro and patches of reed grass and talasiga vegetation.

LAND USE: Unused

DRAINAGE: Well drained

EROSION: None observed

DISTURBANCE: None

LABORATORY Nos: Not sampled for analysis.

### PROFILE DESCRIPTION

Ah	0-12 cm (12 cm)	Moist; dark brown (7.5YR 4/2) to reddish grey (5YR 5/2) sandy clay loam; weakly developed coarse blocky structure, breaking to medium blocky; firm to friable; slightly sticky; plastic; many fine and medium fibrous roots; distinct smooth boundary,
Bw	12-45 cm (33 cm)	Moist; brown (7.5YR 5/4) to strong brown (7.5YR 5/6) sandy clay; massive structure with weakly developed coarse columnar fracturing; very firm; sticky; very plastic; hard to dig; few very fine fibrous roots; few fine fragments of weathered tuff; distinct smooth boundary,
Bt	45-70 cm (25 cm)	Moist; strong brown (7.5YR 5/6) clay; few faint weak red (2.5YR 5/2) mottles; massive structure with weak coarse columnar fracturing when dry; firm; sticky; very plastic; very compact; few iron-coated fragments of weathered sandy tuff,
BC	on	Weathered <i>in situ</i> quartz-rich tuff.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Namatiu series**

REFERENCE: Namatiu sandy clay (39a) and Namatiu hill soils (39aH) defined by Twyford & Wright (1965) as strong yellow soils from quartz-rich tuffs and acid andesite on rolling and hill land and formed under a climate with a weak dry season.

Forms part of the Namatiu set.

The central concept for Namatiu soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Dystrypept, fine-loamy, kaolinitic, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Red yellow podzolic soil with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Namatiu soils, undulating phase (138B)
- Namatiu soils, easy rolling phase (138C)
- Namatiu soils, rolling phase (138D)
- Namatiu soils, strongly rolling phase (138E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occur only on southwest Kadavu Island and are of limited extent.

PARENT ROCK: Quartz-rich tuffs and acid andesite.

PARENT MATERIAL: Moderate to strongly weathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION/LANDFORM: Convex backslopes and midslopes in rolling and hilly country.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°) and strongly rolling (16-20°).

VEGETATION AND LAND USE: Due to their low fertility are little used other than odd cassava crop.

RANGE OF ELEVATION: 20-300 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate sheet and rill erosion potential on slopes >7° if cultivated in the absence of soil conservation measures.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 17 cm of brown to dark grey brown friable to firm sandy clay (locally stony), of weak coarse blocky structure breaking to moderate fine and medium blocky, and sticky and plastic when moist, overlying 25 cm of reddish brown to reddish yellow firm sandy clay (locally stony flints), and sticky and plastic when moist on 50 cm or more of reddish yellow to strong brown very firm heavy stony lay, very hard to dig, of massive structure, very sticky and plastic when moist and flints becoming abundant below 60 cm depth.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available. Profiles on steep slopes (>12°) tend to be shallower and more stony.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be strongly acid; organic carbon values are medium in the topsoil (0-17 cm) and very low below it; nitrogen is low; low available phosphorus; % base saturation is low; CEC is medium; TEB values are low; exchangeable calcium is low; magnesium is high for the topsoil and medium below; and potassium is low in the topsoil and very low below it.</p> <p>The particle size family class is fine-loamy.</p> <p>The mineralogical class is kaolinitic.</p>
LABORATORY Nos:	KRS 663-664
SOIL LIMITATIONS:	Profile shallowness; erosion hazard on slopes >7°; low base status; nutrient deficiencies of nitrogen, phosphorus and potassium; and strong soil acidity.

## Typifying Profile

SOIL NAME: Namatiu soils, rolling phase.  
PROFILE No.: TW 32  
SITE LOCATION: Namatiu village at the head of Korolevu Bay, Kadavu Island.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Planar upper backslope.  
PARENT MATERIAL: Weathered *in situ* quartz-rich rock.  
SLOPE: 13°  
ASPECT: South-west  
ELEVATION: 145 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Open scrub and fern land.  
LAND USE: Unused  
DRAINAGE: Well drained  
EROSION: Evidence of serious past sheet erosion relating to burning.  
DISTURBANCE: No recent evidence.  
LABORATORY Nos: KRS 663-664

### PROFILE DESCRIPTION

Ah	0-17 cm (17 cm)	Moist; brown (7.5YR 4/2) to dark greyish brown (10YR 4/2) sandy clay; weakly developed coarse blocky structure breaking to moderate medium and fine blocky; friable to firm; sticky; plastic; common fine weakly weathered angular stones; many fine and medium fibrous roots; distinct smooth boundary,
Bw	17-42 cm (25 cm)	Moist; reddish brown (5YR 5/4) to reddish yellow (5YR 6/6) sandy clay; weakly developed medium blocky structure; firm; sticky; very plastic; many fine unweathered angular stones (flint); common fine and very fine fibrous roots; indistinct smooth boundary,
BC	42-82 cm (40+ cm)	Moist; reddish yellow (5YR 6/6) to strong brown (7.5YR 5/6) heavy stony clay; massive structure; very firm; very hard to dig; very sticky; plastic; profuse unweathered angular stones (flint) particularly below 60 cm,
	on	Hard white flinty rock.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Namosau series**

REFERENCE: The Namosau sandy and gravelly loam (36) defined by Twyford & Wright (1965) as a very old soil on old flattish to undulating penepplain surfaces and developed from highly weathered basic rocks under a climate with a strong dry season.

This concept for Namosau series is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Acrustox, clayey, gibbsitic, isohyperthermic
- (b) FAO: Acric Ferralsol
- (c) Twyford and Wright: Ferruginous latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Namosau soils, flat to gently undulating phase (39A)
- Namosau soils, gently undulating phase (39B)
- Namosau soils, easy rolling phase (39C)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Namosau soils occur on high terrace remnants behind Nadi, Lautoka and Ba in Viti Levu and on similar landscapes at Bua province in Vanua Levu.

PARENT ROCK: Rocks of basic and intermediate rocks.

PARENT MATERIAL: Deep strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Old relict high terraces and plateau surfaces.

SLOPE CLASS AND RANGE OF SLOPES: Flat, gently undulating (10-30°), gently undulating (4-70°) and easy rolling (8-11°).

VEGETATION AND LAND USE: Very depleted 'talasiga' vegetation comprising Nokonoko and *Dicranopteris* fern with significant areas of gravelly erosion pavement.

RANGE OF ELEVATION: 60-200 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Evidence (erosion pavements) of very severe past erosion related to regular burning over several centuries.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of reddish brown silty clay loam, of moderate to strongly developed fine nut with crumb structure, very friable, and sticky when moist, overlying 50 cm of red clay loam, of weakly developed blocky structure breaking easily to fine nut and crumb, friable, and sticky moist, overlying 3 cm of hard discontinuous iron pan, overlying 20 cm of red weakly mottled olive yellow clay loam, of weakly developed blocky structure breaking easily to fine nut and crumb structure; overlying 3 cm of hard discontinuous iron pan and overlying more than 25 cm of red mottled olive yellow silty clay loam, of weakly developed coarse blocky structure breaking to fine crumb and single grain, and friable.
DIAGNOSTIC HORIZONS:	Ochric epipedon, oxic horizon.
RANGE OF PROFILE FEATURES:	<p>Namosau series have an Ap(Ah), Bw1, Bfm1, Bw2, Bfm2, BC horizon sequence. The A horizon thickness ranges 5-20 cm; colours include reddish brown (5YR 4/3, 4/4, 2.5YR 4/4) and dark reddish brown (5YR 3/3, 3/4, 2.5YR 3/4); textures are either silty clay, clay loam or gravelly loam; few to abundant ironstone nodules may or may not be present.</p> <p>The Bw1 horizon thickness ranges 30-60 cm; colours include red (2.5YR 4/6, 4/8, 5/6) or yellowish red (5YR 4/6, 4/8); textures are clay, clay loam or loam; and few or none ironstone nodules.</p> <p>The Bfm1 and Bfm2 horizons are 1-4 cm in thickness; hard, discontinuous and black with light olive brown.</p> <p>The Bw2 horizon thickness ranges 30-60 cm; and as for Bw1, and few to many olive yellow mottles.</p> <p>The BC horizons exceed 30 cm (dependent on presence of further iron pans); colours include red (2.5YR 4/6, 4/8, 5/6); textures are silty clay, silty clay loam, clay or clay loam; and olive yellow mottles may be few or many.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be very strongly acid in the topsoil, strongly acid in the other horizons and of variable change; organic carbon is high in the topsoil and low below it; nitrogen is medium in the topsoil, of low values 16-64 cm and very low below 64 cm; total phosphorus high in the topsoil and medium in the other horizons; Both TEB and CEC are extremely low; % base saturation values are medium in the topsoil and very high in the other horizons but meaningless in view of the extremely low CEC values exchangeable calcium, potassium and sodium values are very low and magnesium low throughout the profile; and % aluminium is dominant in the exchange complex.</p> <p>The particle size family class is clayey.</p> <p>The mineralogy class is gibbsitic.</p>
LABORATORY Nos:	Q DPI 11718-11722
SOIL LIMITATIONS:	Severe erosion potential on slopes $> 3^\circ$ ; severe seasonal soil moisture deficits; limited rooting volume and moisture storage potential due to iron pan at about 60 cm; variable charge; strong soil acidity; aluminium toxicity; and limited nutrient reserves that would be depleted rapidly under a cropping regime.

## Typifying Profile

SOIL NAME: Namosau series  
PROFILE No.: NLDC08  
SITE LOCATION: Plateau margin adjacent to NLDC quarters for Nasarowaqa pigeon pea project 1 km west of Naibulu creek (the boundary separating Bua and Macuata provinces).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar crest on 100 m slope on weakly dissected plateau surface in flat to gently rolling country.  
PARENT MATERIAL: Strongly weathered *in situ* rock of basic composition.  
SLOPE: 1°  
ASPECT: North  
ELEVATION: 80 m  
MICRORELIEF: Flat  
SITE VEGETATION: Mission grass with scattered nokonoko trees.  
LAND USE: Unused (previously planted in pineapples).  
DRAINAGE: Well drained  
EROSION: Past sheet and rill erosion.  
DISTURBANCE: Previously mechanically cultivated.  
LABORATORY Nos: Q DPI 11718-11722

### PROFILE DESCRIPTION

Namosau series

Ap	0-16 cm (16 cm)	Dry; reddish brown (5YR 4/4) silty clay loam; moderate to strongly developed fine nut structure with moderate fine crumb structure; very friable; sticky; non-plastic; many fine and medium roots; distinct smooth boundary,
Bw1	16-64 cm (48 cm)	Slight moist; red (2.5YR 4/6) clay loam; weakly developed medium blocky structure breaking to moderate fine nut and crumb structure; friable; sticky; non-plastic; common fine roots; sharp smooth boundary,
Bfm1	64-67 cm (3 cm)	Dry; metallic black with light olive brown (2.5Y 5/6) discontinuous iron pan; massive; extremely firm; non-sticky; non-plastic; no roots; sharp smooth boundary,
Bw2	67-89 cm (22 cm)	Slightly moist; red (2.5YR 4/8) clay loam; few fine distinct olive yellow (2.5Y 6/6) mottles; weakly developed medium blocky structure; breaking to moderate fine nut and crumb structure; friable; slightly sticky; non-plastic; no roots; sharp smooth boundary,
Bfm2	89-92 cm (3 cm)	Dry; metallic black with light olive brown (2.5Y 5/6) discontinuous iron pan; massive; extremely firm; non-sticky; non-plastic; no roots; sharp smooth boundary,

BC

92-117+ cm  
(25 cm+)

Moist; red (2.5YR 4/6) silty clay loam; many medium distinct olive yellow (2.5Y 6/6) mottles; weakly developed coarse blocky structure breaking to weak fine crumb structure and single grain; friable; non-sticky; non-plastic; no roots.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Namosi series**

REFERENCE: Namosi stony soil loam (27d) and Namosi hill soils (27dH) as described by Twyford & Wright (1965) as from acid andesite, commonly forest covered and formed under a climate with little or no dry season.

They form part of the Sote set.

The central concept for Namosi soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Humitropept, fine, kaolinitic, isohyperthermic
- (b) FAO: Humic Cambisol
- (c) Twyford and Wright: Humiclatosol with a weak or no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Namosi soils, easy rolling phase (158C)	Namosi soils, moderately steep phase (158F)
Namosi soils, rolling phase (158D)	Namosi soils, steep phase (158G)
Namosi soils, strongly rolling phase (158E)	Namosi soils, very steep phase (158H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Namosi soils are widespread but in small patches in east central Viti Levu.

PARENT ROCK: Acid andesite agglomerate.

PARENT MATERIAL: Weathering colluvium over unweathered *in situ* rock.

#### PHYSIOGRAPHIC

POSITION/LANDFORM: Convex strongly rolling hill country fringing 'mesa-like' relief.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°), and very steep (>35°).

VEGETATION AND LAND USE: Secondary forest and plantation crops. Mainly in subsistence crops.

RANGE OF ELEVATION: 50-500 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Slight to moderate sheet and rill erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of very dark grey friable clay loam, of strongly developed medium nut structure, with common rounded boulders, overlying 15 cm of dark brown friable clay, of moderately developed medium nut structure, with angular stones overlying 40 cm of dark yellowish brown friable silty clay, of weak coarse blocky structure and with boulders and stones, overlying 20 cm of dark yellowish brown firm fine sandy clay of massive structure breaking to fine blocky, with boulders on (lithic contact) massive unweathered rock.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be moderately acid, though the AB horizon (21-40 cm) is strongly acid; organic carbon and nitrogen have medium values in the topsoil, low values 21-40 cm, and very low values below these depths; available phosphorus is very low; CEC is medium; % base saturation is low 0-40 cm and medium below 40 cm depth; exchangeable calcium is low in all horizons except 21-40 cm where it is of very low value; potassium is medium in the topsoil and very low below this; and magnesium is high in the topsoil, medium 21-88 cm, rising to high again below 88 cm.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is kaolinitic.</p>
LABORATORY Nos:	KRS V140-143 (inclusive)
SOIL LIMITATIONS:	Moderately rapid permeability; surface and profile boulders; abundant surface rock outcrops; moderate soil erosion risk on slopes > 11°; soil acidity; and nutrient deficiencies of phosphorus and potassium.

## Typifying Profile

SOIL NAME: Namosi soils, strongly rolling phase.  
PROFILE No.: VS09  
SITE LOCATION: Above Saliadrau Village, Namosi District.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Concave midslope in landscape comprising volcanic plugs and mesa-like intrusions and strongly rolling fringing hill country .  
PARENT MATERIAL: Shallow colluvium over unweathered acid andesite agglomerate.  
SLOPE: 18°  
ASPECT: South south-west  
ELEVATION: 200 m  
MICRORELIEF: Smooth. Exposed hard rock in vicinity.  
SITE VEGETATION: Miscellaneous grasses and fern.  
LAND USE: Grazing  
DRAINAGE: Well drained  
EROSION: No erosion observed.  
DISTURBANCE: None  
LABORATORY Nos: KRS V140-143  
COMMENTS: Lithic contact at 110 cm.

### PROFILE DESCRIPTION

Ap	0-21 cm (21 cm)	Moist; very dark grey (10YR 3/1) clay loam; strongly developed medium nut structure plus moderate fine granular structure; friable; slightly sticky; slightly plastic; abundant fine and very fine roots; few unweathered subangular boulders (mainly on surface); indistinct smooth boundary,
AB	21-40 cm (19 cm)	Moist; dark brown (10YR 3/3) clay; moderately developed medium nut structure plus moderate fine granular structure; friable; many fine and very fine roots; few weakly weathered subangular stones; distinct wavy boundary,
Bw1	40-88 cm (48 cm)	Moist; dark yellowish brown (10YR 4/4) silty clay; weakly developed coarse blocky structure breaking to weak fine nut structure; friable to firm; slightly sticky; slightly plastic; few very fine roots; common weak to moderately weathered stones plus a few boulders; distinct smooth boundary,
Bw2	88-110cm (22 cm)	Moist; dark yellowish brown (10YR 4/4) fine sandy clay; massive breaking to weakly developed fine blocky structure; firm; slightly sticky; slightly plastic; few very fine roots; few unweathered subrounded boulders; sharp wavy boundary (lithic contact).
	on	hard unweathered rock.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Namuana series**

REFERENCE: Namuana steepland stony sandy clay (92d) defined by Twyford and Wright (1965) as formed from silicified tuffs under a climate with a moderate dry season.

Form part of the Sarowaqa set.

The central concept for Namuana soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Dystrypept, fine, kaolinitic, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Steepland soil related to or associated with red yellow podzolic soils with a moderate dry season.

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Namuana soils, easy rolling phase (134C)	Namuana soils, moderately steep phase (134F)
Namuana soils, rolling phase (134D)	Namuana soils, steep phase (134G)
Namuana soils, strongly rolling phase (134E)	Namuana soils, very steep phase (134H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Confined largely to the Kadavu Group but of restricted extent in Viti Levu in the basins of the Waisei, Qalinabulu, Nadrau and Sabeto.

PARENT ROCK: Silicified quartz rich and acidic tuffs.

PARENT MATERIAL: Strongly weathered *in-situ* rock.

#### PHYSIOGRAPHIC

POSITION/LANDFORM: Mainly planar slopes in strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-35°), steep (26-35°), and very steep (35-40°).

VEGETATION AND LAND USE: Still partly clothed in forest although with time an increasing area becomes invaded by reed grass. Used for subsistence crops for 3 to 5 years then allowed to revert to forest for a similar (or longer) period. After successive cycles the reversion is to reeds rather than forest.

RANGE OF ELEVATION: 400-600 m

RAINFALL: Annual average range: 3,200 - 4,800 mm;  
dry season range: 800 - 1,600 mm;  
wet season range: 1,800 - 2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY: Moderate

FLOODING: Never floods

EROSION: Severe sheet and rill erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of dusky red friable to firm fine sandy clay, of weak nut and blocky structure, and slightly sticky and plastic when moist, overlying 18 cm of weak red firm to friable clay, of massive structure, and sticky and strongly plastic when moist.  Profiles may be with or without stones.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable, only two profile descriptions available.
VARIANTS:	Unnamed shallow variant. Typically shows 7 cm of dark reddish grey stony sandy clay, on 10 cm of pale reddish grey sandy clay, on 10 cm of very pale reddish grey to pinkish brown coarse sandy clay loam, on weathering rock.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analyses show the soils to be moderately acid; organic carbon is medium in the topsoil (0-10 cm) and very low below 10 cm; nitrogen is low in the topsoil and very low below it; very low available phosphorous; % base saturation is very high; CEC is medium throughout; exchangeable calcium is high 0-10 cm and medium below 10 cm; magnesium is high throughout; and potassium is medium in the topsoil and low below it.  The particle size family class is fine.  The mineralogical class is kaolinitic.
LABORATORY NOS:	KRS 675-676
SOIL LIMITATIONS:	Slope; erosion potential; dry season soil moisture deficits; and nutrient deficiencies of nitrogen and phosphorus.

## Typifying Profile

SOIL NAME: Namuana soils  
PROFILE NO: TW 400  
SITE LOCATION: Above Nalotawa village, 0.5 km NE.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Very steep slopes, 36°  
PARENT MATERIAL: Strongly weathered *in-situ* rock.  
SLOPE: Long 100m slopes, concave, convex.  
ASPECT: South  
ELEVATION: 450-580 m  
MICRORELIEF: Disturbed, logging marks.  
SITE VEGETATION: Pine trees.  
LAND USE: Pine forest estate.  
DRAINAGE: Well drained  
EROSION: Severe sheet and some gully erosion.  
DISTURBANCE: Roding  
LABORATORY Nos.: KRS 675 - 676

### PROFILE DESCRIPTION

Ah	0-0cm (10 cm)	Moist; dusky red (10R 3/3) fine sandy clay; weakly developed fine and medium nut and blocky structure; friable to firm; slightly sticky; plastic; many fine and medium fibrous roots; distinct smooth boundary,
Bw	10-28cm (20 cm)	Moist; weak red (10R 4/4) clay; massive structure breaking to fine granules; firm to friable; moderately compact; sticky; very plastic; common fine and very fine fibrous roots; distinct smooth boundary.
BC	28-118 cm (90 cm)	Moist; light reddish brown (2.5YR 6/4) slightly sandy clay; massive structure; friable; sticky; very plastic.

Author: V. Seru & V. Masibalavu



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference Classification

SOIL NAME: **Nanukuloa series**

REFERENCE: The Nanukuloa bouldery clay (19a) defined by Twyford & Wright (1965) as friable clays from basic flows and agglomerates formed under a climate with a moderate dry season.  
Forms part of Nanukuloa set.  
The climate definition is restricted in this survey to the ustic moisture regime, but in all other respects the central concept for Nanukuloa soils is retained.

CLASSIFICATION:

- (a) Soil Taxonomy: Typic Ustropept, fine, mixed, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Nigrescent soil with a moderate to dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Nanukuloa soils, undulating phase (192B)	Nanukuloa soils, moderately steep phase (192F)
Nanukuloa soils, easy rolling phase (192C)	Nanukuloa soils, steep phase (192G)
Nanukuloa soils, rolling phase (192D)	Nanukuloa soils, very steep phase (192H)
Nanukuloa soils, strongly rolling phase (192E)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nanukuloa soils occur as small areas on gentle spurs above Vaidoki soils and are confined to the east coast of Viti Levu from Dawasamu to the Penang valley. They also occur in Lomaiviti and Lau Groups.

PARENT ROCK: Basic flow rocks and agglomerates.

PARENT MATERIAL: Moderately weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Convex backslopes and concave toeslopes in moderately rolling hill country. Rock outcrops are common.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°) and very steep (>35°).

VEGETATION AND LAND USE: Sugar cane, subsistence root crops, grazing and other cropping, e.g. maize.

RANGE OF ELEVATION: 15-300 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Past sheet erosion. Having shallow profiles, limited water holding capacity and friable consistence these soils have a severe sheet and rill erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	<p>Typically shows 15 cm of dark brown friable clay, sticky and slightly plastic consistence moist, and of moderately developed fine and medium nut structure, overlying 15 cm of strong brown friable clay, sticky and plastic moist, and of weakly developed coarse blocky structure that breaks easily to stronger fine nut.</p> <p>Normally at about 30 to 40 cm depth the friable and massive reddish yellow BC horizon is encountered.</p> <p>Grits and very fine stones are common in most horizons.</p>
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable, only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Moderately acid soils with very high % base saturation. Organic carbon values are low. Values for the CEC and exchangeable calcium are medium; magnesium, very high; potassium and sodium values are low.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is mixed.</p>
LABORATORY Nos:	SB9408A-C
SOIL LIMITATIONS:	Profile shallowness; surface rock outcrops and boulders; severe soil moisture deficits experienced during the dry season; moderate soil acidity; and nutrient deficiencies of nitrogen and potassium.

## Typifying Profile

SOIL NAME: Nanukuloa soils, easy rolling phase.  
PROFILE No.: VB8  
SITE LOCATION: Map I43 (Vanua Balavu) 178° 59' 05" E, 17° 17' 05" N  
Vanua Balavu Island, Lau Group.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Convex toeslope  
PARENT MATERIAL: *In situ* basic andesite.  
SLOPE: 10°  
ASPECT: East  
ELEVATION: 10 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Cassava mounds 1 m from site.  
LAND USE: Subsistence root cropping.  
DRAINAGE: Well drained; moderate permeability; moderately rapid runoff.  
EROSION: None observed  
DISTURBANCE: Cultivation  
LABORATORY Nos: SB9408A-C

### PROFILE DESCRIPTION

Ap	0-14 cm (14 cm)	Dry; dark brown to brown (10YR 4/3) moist dark yellowish brown (10YR 4/4) rubbed brown to dark yellowish brown (10YR 4/3.5) gritty clay; friable; sticky; slightly plastic; moderate to strongly developed medium and fine nut with some crumb and cast granular structure; small orange rock fragments throughout the horizon; abundant fine and medium roots; many casts; few strongly weathered very fine stones; indistinct regular boundary,
Bw	14-28 cm (14 cm)	Dry; strong brown (7.5YR 5/8) and dark yellowish brown (10YR 4/4) gritty clay; friable; sticky; plastic; primary structure of weakly developed coarse blocky and secondary structure of moderate to strongly developed medium nut; many fine and medium roots, few to many casts; many very fine angular stones, strongly weathered; many very fine orange concretions; distinct irregular boundary,
BC	28-40 cm (12 cm+)	Moist; reddish yellow (7.5YR 6/8) gritty clay; firm <i>in situ</i> , friable; sticky; plastic; massive breaking to single grain; strongly weathered <i>in situ</i> rock.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Naqalotu series**

REFERENCE: Naqalotu steepland sandy clay (71) defined by Twyford & Wright (1965) as formed from sandy marls under a climate with a moderate dry season.

The central concept for Naqalotu is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Ustropept, fine-loamy, kaolinitic, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Steepland soil related to and associated with Nigrescent soils with a moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Naqalotu soils, moderately steep phase (117F)
- Naqalotu soils, steep phase (117G)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Naqalotu soils develop in association with Nalotu and Yakita soils on the leeward side of Kadavu Island between Dagai and Natokalau villages.

PARENT ROCK: Sandy marl

PARENT MATERIAL: Moderately weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Planar and convex backslopes and midslopes in moderately dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Moderately steep (21-25°) and steep (26-35°).

VEGETATION AND LAND USE: Extensively used for subsistence food crops and in some areas of Kadavu Island is terraced and irrigated for dalo cultivation.

RANGE OF ELEVATION: 50-250 m

RAINFALL: Annual average range: 2,000-2,800 mm;  
dry season range: 500-800 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Moderate to severe sheet and rill erosion potential.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 8 cm of very dusky red friable stony sandy clay, of weak coarse blocky structure breaking to moderate fine and medium blocky, overlying 8 cm of greyish brown grading light yellowish brown slightly mottled light brownish grey firm stony sandy clay of massive structure breaking to weak fine blocky, sticky and very plastic moist, on pinkish grey firm to friable very stony sandy clay with a high proportion of weathering sandy marl and very plastic.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profiles available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Near neutral soil with high base status.
LABORATORY Nos:	Not sampled for analysis.
SOIL LIMITATIONS:	Profile shallowness; stoniness; erosion hazard; seasonal soil moisture deficits; and deficiencies of potassium and phosphorus.

## Typifying Profile

SOIL NAME: Naqalotu soils, moderately steep phase.  
PROFILE No.: TW 96  
SITE LOCATION: 1 km due south of Korovou village on the north coast of Kadavu Island.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex backslope  
PARENT MATERIAL: Weathering sandy marl.  
SLOPE: 22°  
ASPECT: North-east  
ELEVATION: 160 m  
MICRORELIEF: Uneven  
SITE VEGETATION: Secondary forest cover.  
LAND USE: Subsistence cropping following fallow periods.  
DRAINAGE: Well drained  
EROSION: Past soil depletion.  
DISTURBANCE: Past cultivation  
LABORATORY Nos: Not sampled for analysis.

### PROFILE DESCRIPTION

Naqalotu soils, steep phase

Ap	0-8 cm (8 cm)	Moist; very dusky red (2.5YR 2/2) stony sandy clay; weakly developed coarse blocky structure breaking to moderate medium and fine blocky; friable; slightly sticky; moderately plastic; many fine fibrous roots; distinct smooth boundary,
Bw	8-16 cm (8 cm)	Moist; greyish brown (10YR 5/2) grading to light yellowish brown (10YR 6/4) stony sandy clay; few faint light brownish grey (10YR 6/2) mottles; firm; moderately sticky; very plastic; massive structure breaking to weak fine blocky structure; distinct smooth boundary,
BC	16-46cm+ (30 cm+)	Moist; pinkish grey (7.5YR 6/2) very stony sandy clay; friable to firm; moderately sticky; very plastic; massive structure; abundant fragments of weathering marl; sharp uneven boundary,
C	on	Weathered sandy marl.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Naqilai series**

REFERENCE: Naqilai clay and sandy clay (53b) defined by Twyford & Wright (1965) as moderate to strongly mottled and strongly gleyed soils related to red yellow podzolic soils and formed under a climate with a strong to dry season.

Forms part of the Kedra set.

The central concept for Naqilai soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Aeric Tropaquept, fine, mixed, isohyperthermic
- (b) FAO: Eutric Gleysol
- (c) Twyford and Wright: Gley soil related to red yellow podzolic soils with a strong to moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Naqilai soils (67)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Naqilai soils occur on the wide floodplains of the larger rivers along the Macuata coast of Vanua Levu.

PARENT ROCK: Rocks of acid composition.

PARENT MATERIAL: Moderately weathered quartzose alluvium.

PHYSIOGRAPHIC POSITION / LANDFORM: Wide floodplains of the larger rivers along the Macuata coast .

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-1°).

VEGETATION AND LAND USE: Used mainly for rice and sugar cane (with drainage).

RANGE OF ELEVATION: 0-10 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Very poorly drained.

PERMEABILITY CLASS: Slow

FLOODING: Water table at 30 to 40 cm for long periods during the wet season.

EROSION: No erosion risk.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 15 cm of very dark grey brown, firm to friable clay, of strong coarse nut and blocky structure, sticky and plastic when moist and faintly mottled, overlying 25 cm of strongly mottled pale brown, dark grey, yellowish red and white clay, very firm and compact in place, very sticky and plastic. This overlies 12 cm of a transitional horizon, then on pale grey plastic clay.
DIAGNOSTIC HORIZONS:	Ochric epipedon
RANGE OF PROFILE FEATURES:	Not applicable. Only one profile description made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Likely to have a slight to moderate acid reaction and to be well supplied with plant nutrients.
LABORATORY Nos:	Not sampled for analysis.
SOIL LIMITATIONS:	High water table; poor internal drainage; slow permeability, clayey textures; strong soil acidity; and nutrient deficiencies of phosphorus and potassium.

## Typifying Profile

SOIL NAME: Naqilai soils  
PROFILE No.: TW 57  
SITE LOCATION: Adjacent Matailabasa village, north east Vanua Levu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Flattish floodplain.  
PARENT MATERIAL: Moderately weathered alluvium of acidic composition.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 5 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Weeds after rice.  
LAND USE: Rice production  
DRAINAGE: Very poorly drained. Water table 48 cm.  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: Not sampled for analysis.

### PROFILE DESCRIPTION

Naqilai soils

Apg	0-15 cm (15 cm)	Moist; very dark grey loam (10YR 3/2) clay; diffuse faint dusky red (2.5YR 3/2) mottling along old root channels; strongly developed coarse nut and blocky structure; firm to friable; moderately sticky; plastic; sharp smooth boundary,
Cr1	15-40 cm (25 cm)	Moist; very strongly mottled pale brown (10YR 6/3), dark grey (10YR 4/1), yellowish red (5YR 5/8) and white (10YR 8/2) clay; massive; very firm; compact in place; sticky; plastic; diffuse smooth boundary,
Cr2	40-52 cm (12 cm)	Moist; transitional horizon of pale brown (10YR 6/3), light grey (10YR 7/1) and white (10YR 8/2) mottled clay; diffuse smooth boundary,
Cr3	on	Wet; light grey (10YR 7/1) clay.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Narayawa series**

REFERENCE: The Narayawa steepland and related soils (90a, 90b) defined by Twyford and Wright (1965) as soils developed from granite on hilly and steep country under a climate with a very weak or no dry season.

Morphological and chemical properties correlate with that described previously. However, in this survey the range of slopes is widened to include all slopes from rolling to very steep i.e. 8 to 40°.

The central concept for Narayawa series has been retained for this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Humitropept, sandy, mixed, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Red-yellow podzolic soil with very weak or no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Narayawa soils, easy rolling phase (160C)	Narayawa soils, moderately steep phase (160F)
Narayawa soils, rolling phase (160D)	Narayawa soils, steep phase (160G)
Narayawa soils, strongly rolling phase (160E)	Narayawa soils, very steep phase (160H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Narayawa soils are very widespread in the upper Wainikoroiluva tikina in Wainimalia and Namosi of Viti Levu.

PARENT ROCK: Acidic rocks (predominantly granites).

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION / LANDFORM: Backslope and upper midslope positions in moderately dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Easy rolling (8-11°), rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°) and very steep (>35°).

VEGETATION AND LAND USE: Under indigenous forest in which the dominant species include: salato, yaro, dibi, ota loa, wavuka, saquiwa and damanu.

RANGE OF ELEVATION: 70-300 m

RAINFALL: Annual average range: 3,000-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid to rapid.

FLOODING: Never floods

EROSION: Some rotational slumping on slopes >25° moderate to severe sheet, rill and mass movement erosion potential if forest cleared.

*Narayawa*

## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

Typically shows a topsoil of very friable dark brown sandy loam to loamy sand, of weakly developed very fine nut structure. Transitional AB horizons may sometimes occur and they are of brown sandy loam with weakly developed fine nut structure.

The weakly developed B horizons are strong brown to yellowish red in colour with sandy loam textures, of weak fine blocky and medium nut structures, with a few granite stones.

C horizons are strong brown to yellowish red sandy loam that are massive and loose breaking easily to single grain. They commonly have a few strongly weathered granite stones.

### DIAGNOSTIC HORIZONS:

Ochric epipedon, cambic horizon.

### RANGE OF PROFILE FEATURES:

Narayawa series have a Ah, AB, Bw, C horizon sequence.

The Ah horizon thickness ranges from 5 to 15 cm; colours are dark brown (7.5YR 4/2, 4/4, 3/4); textures range between sandy loam and loamy sand; and structures may be weak very fine or fine nut.

The AB horizon thickness ranges from 5 to 10 cm, and show no significant variation in other properties.

The Bw horizon thickness ranges from 12 to 60 cm; colours include strong brown (7.5YR 5/6), yellowish red (5YR 4/6, 5/6) and red (2.5YR 4/7); textures vary sandy loam and loamy sand; structures are very weak or weak, fine or medium, blocky or nut; and with or without stones.

### VARIANTS:

None recognised

### SIMILAR SOILS AND DISTINGUISHING FEATURES:

Naqarea series: Form from moderately weathered granite in colluvial footslope and toeslope positions. Have paler topsoil colours (10YR 4/3-3/3) and browner B and C horizons (10YR 5/4-5/5) (Smith, 1992).

### GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:

Moderately to strongly acid soil with medium to low base status. Exchangeable calcium, magnesium and potassium are high in topsoils and low to very low in subsoils, while sodium is medium in topsoils and low in all other horizons.

Organic carbon is medium in topsoils, low in Bw1 horizons and very low in all other horizons.

The particle size family class is sandy.

The clay mineralogical class is mixed.

### LABORATORY Nos:

KRS T1734-1740 (inclusive)

### SOIL LIMITATIONS:

Moderate to severe physical limitations of slope and erosion risk - likely to be accelerated if the forest is removed from slopes  $>12^\circ$ ; rapid soil permeability and low moisture holding capacity; soil acidity; and low reserve phosphorus and potassium.

## Typifying Profile

SOIL NAME: Narayawa soils, steep phase.  
PROFILE No.: W23  
SITE LOCATION: Refer soil map of Waidradra Agricultural Research Station (Smith, 1992).  
Grid reference - sheet Viti Levu 13 (1:50 000) 423E 188N.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Concave upper midslope of hill side in moderately dissected country.  
PARENT MATERIAL: Weathered *in situ* granite.  
SLOPE: 34°  
ASPECT: South west  
ELEVATION: 50 m  
MICRORELIEF: Undulating  
SITE VEGETATION: Main canopy approximately 10 m high with dawa, makita, salato, yawa and dibi. Ground species include sour grass, mile-a-minute and uvi.  
LAND USE: Unused. Forest in near natural condition.  
DRAINAGE: Well drained  
EROSION: Some notational slumping near site (on slopes >25°).  
DISTURBANCE: None observed  
LABORATORY Nos: KRS T1734-1740 (inclusive).  
COMMENTS: None

### PROFILE DESCRIPTION

Ah	0-7 cm (7 cm)	Dark brown (7.5YR 3/4) sandy loam; friable; weakly developed fine nut structure; slightly sticky, slightly plastic; few strongly weathered subangular granite stones; many fine and medium roots; distinct wavy boundary,
AB	7-13 cm (6 cm)	Brown to dark brown (7.5YR 4/4) sandy loam; friable weakly developed fine nut structure, slightly sticky, slightly plastic; few strongly weathered subangular granite stones; many fine and medium roots; distinct wavy boundary,
Bw1	13-25 cm (12 cm)	Yellowish red (5YR 4/6) sandy loam; very friable; weakly developed fine blocky structure; slightly sticky, slightly plastic; few strongly weathered subangular granite stones; many fine and medium roots; sharp wavy boundary,
Bw2	25-37 cm (12 cm)	Yellowish red (5YR 5/6) loamy coarse sand; very friable; weak fine block to single grain structure; non-sticky, non-plastic; few strongly weathered subangular granite stones; few medium roots; sharp wavy boundary,
C1	37-56 cm (19 cm)	Strong brown (7.5YR 4/6) loamy coarse sand; massive to single grain; loose; non-sticky, non-plastic; few strongly weathered subangular granite stones; few medium roots; indistinct wavy boundary,

C2	56-82 cm (26 cm)	Reddish brown to yellowish red (5YR 4/5) coarse sand; single grain; loose; non-sticky, non-plastic few strongly weathered subangular granite stones; few medium roots; indistinct wavy boundary,
C3	82-100 cm (18 cm)	Strong brown (7.5YR 4/6) and very pale brown (10YR 7/3) coarse sand; single grain; loose; non-sticky, non-plastic; many strongly weathered subangular granite stones; few medium roots.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Narewa series**

REFERENCE: Narewa clay (51) as described by Twyford and Wright (1965) as a weakly mottled, strongly gleyed soil associated with latosols and occurring under a climate with a moderate to strong dry season.

This concept for Narewa series has been retained for this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Vertic Haplaquoll, fine, smectitic, isohyperthermic
- (b) FAO: Eutric Gleysol
- (c) Twyford and Wright: Gley soil associated with latosols with a strong dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Narewa soils (50)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Narewa soils develop in the lowest parts of alluvial floodplains between the levees and hills in the dry zones of Viti Levu and Vanua Levu.

PARENT ROCK: Rocks predominantly of basic or intermediate composition.

PARENT MATERIAL: Deep weathered alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Valley floors of smaller creek systems in strongly rolling hill country and in the lowest parts of alluvial floodplains

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-2°).

VEGETATION AND LAND USE: Because of surface cracking and hardening of structures in the surface horizons during dry season months little cropping is undertaken at these times. Used for rainfed rice, dalo and pulses. Where drained grows good crops of sugar cane.

RANGE OF ELEVATION: 2-25 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Slow in summer months, moderately rapid in winter (due to cracking and inter-ped voids) .

FLOODING: In normal years experiences 2-3 short duration floods during the months November to April. Normally waterlogging occurs for up to 90 days below 50 cm depth.

EROSION: Accumulating soil. No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 45 cm of black clay, of strongly developed coarse prismatic or blocky structure, very hard when dry but plastic and sticky when moist, the surface of which cracks widely on drying out, overlying 20 cm of very dark grey mottled reddish yellow or yellowish brown clay, whose aggregates are coated black or dark grey, of moderately developed coarse blocky structure, hard when dry, and plastic and sticky when moist, overlying light yellowish brown mottled yellowish brown massive and soft clay with prominent very dark grey humus coatings to pores and worm channels.
DIAGNOSTIC HORIZONS:	Mollic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Narewa series have an Ap, Ag, Cr horizon sequence.  The Ap horizon ranges in thickness from 40-60 cm; its colour includes black (10YR 2/1) and very dark grey (10YR 3/1, 3/2); structures are either strong very coarse blocky or prismatic and soft grits or fine gravels of parent material may be present.  The Ag horizon ranges in thickness from 15-25 cm; its colour varies between very dark grey (10YR 3/1) and dark brown (10YR 3/3); and structures are either weak or moderately developed coarse blocky, nutty or medium prismatic.  The Cr horizon exceeds 30 cm in thickness; its colour varies between light brownish grey and olive yellow i.e. 2.5Y 6/2, 6/4, 6/6 and 6/8; and mottle colours may be either brown (10YR 5/3), yellowish brown (10YR 5/4, 5/6) or light yellowish brown (10YR 6/4).
VARIANTS:	No variants recognised.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	pH slightly acid. % base saturation very high (> 90%). Exchangeable calcium and magnesium very high, sodium high but exchangeable potassium very low. Cation exchange capacity is very high (>50 me.%). Available phosphorus is very low and nitrogen values are very low below the Ap horizon.  The mineralogy class is smectitic.  The particle size family class is fine.
LABORATORY Nos:	KRS V176-178 (inclusive).
SOIL LIMITATIONS:	Water-logging below 50 cm and short duration flooding during the summer months, accumulated soil moisture deficits of > 100 days during the period May to October, montmorillonitic mineralogy that results in surface cracking, formation of gilgai and severe hardening of structural aggregates when dry, and nutrient deficiencies (phosphorus, potassium).

## Typifying Profile

SOIL NAME: Narewa soils  
PROFILE No.: AP02  
SITE LOCATION: Yalavou cattle station.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Valley floor in rolling hill country.  
PARENT MATERIAL: Alluvium derived from rocks of basic and intermediate composition.  
SLOPE: 1° (down valley).  
ASPECT: Not applicable  
ELEVATION: 25 m  
MICRORELIEF: Gilgai  
SITE VEGETATION: Wire grass ground cover with scattered stunted quara.  
LAND USE: Rough grazing (cattle and goats).  
DRAINAGE: Poorly drained (high permeability when dried out).  
EROSION: None observed  
DISTURBANCE: Has been ploughed.  
LABORATORY Nos: KRS V176-178 (inclusive).  
COMMENTS: Water table at 95 cm (November)

### PROFILE DESCRIPTION

Narewa soils

Ap	0-45 cm (45 cm)	dry; moist black (10YR 2/1) clay; strongly developed coarse prismatic structure breaking to strongly developed medium blocky structure firm; sticky; plastic; common fine and very fine roots; distinct smooth boundary,
Ag	45-63 cm (18 cm)	moist; very dark grey (10YR 3/1) clay; common medium distinct yellowish brown (10YR 5/4) mottles; weak to moderately developed coarse blocky structure; firm; sticky; plastic; common distinct black (10YR 2/1) organic coatings; few very fine roots; distinct smooth boundary,
Cr	63-95 cm (32 cm)	wet; light yellowish brown (2.5Y 6/4) clay; many medium and yellowish-brown (10YR 5/4) coarse mottles; massive; soft; very sticky; plastic; common prominent very dark grey (10YR 3/1) organic coatings to pores and infillings of worm channels.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nasau series**

REFERENCE: Nasau steepland bouldery clay (81) defined by Twyford & Wright (1965) as a steepland latosolic soil from olivine basalt flows of Pleistocene age under a climate with a moderate dry season.

Forms part of the Ravilevu set.

The central concept for Nasau soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Andic Dystropept, fine-silty, halloysitic, isohyperthermic
- (b) FAO: Humic Cambisol
- (c) Twyford and Wright: steepland soil related to or associated with latosols with a moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Nasau soils, moderately steep phase (105F)
- Nasau soils, steep phase (105G)
- Nasau soils, very steep phase (105H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occurs extensively on Cicia Island, Lau Group, in small areas in the dry northwest part of Koro Island, Lomaiviti Group, and in very small patches on Taveuni Island.

PARENT ROCK: Basalt

PARENT MATERIAL: Moderately weathered *in situ* rock

PHYSIOGRAPHIC POSITION / LANDFORM: Planar and convex backslopes and midslopes in strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Moderately steep (21-25°), steep (26-35°) and very steep (35-40°).

VEGETATION AND LAND USE: Mainly under grassland, but some patches of talasiga vegetation particularly on Cicia Island.

RANGE OF ELEVATION: 0-200 m

RAINFALL: Annual average range: 2,000-3,000 mm;  
dry season range: 500-800 mm;  
wet season range: 1,400-2,000 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Ustic (marginal to udic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Have experienced severe erosion in places in the past. Very severe sheet and rill erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of dark brown very friable silty clay loam, of strong fine nut structure, over 5 cm of dark greyish brown transitional AB horizon, that overlies 30 cm of dark yellowish brown friable silty clay, of weak to moderate medium blocky structure, and sticky and plastic moist, on 35 cm or more of dark yellowish brown massive and firm clay loam.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be moderately acid 0-45 cm and slightly acid below 45 cm; organic carbon is medium in the topsoil (0-9 cm) low in the AB and very low below it; nitrogen is high in the topsoil, low in the other horizons and the C/N ratio is low. % base saturation is medium; CEC is high in the topsoil and medium below it; calcium is medium in the topsoil; low in AB and Bw becoming medium again in the BC; magnesium is high in the topsoil and medium below; and potassium is high in topsoil and very low below.</p> <p>The family particle size class is fine - silty.</p> <p>The mineralogical class is halloysitic.</p>
LABORATORY Nos:	ORSTOM TAV191-194
SOIL LIMITATIONS:	Slope; profile shallowness; surface boulders; severe erosion hazard; severe soil moisture deficits in part of the dry season; nutrient deficiencies of phosphorus and potassium; and likely moderate to high phosphate retention properties.

## Typifying Profile

SOIL NAME: Nasau soils, steep phase.  
PROFILE No.: TAV 19  
SITE LOCATION: 0.5 km east of Somosomo Village, Taveuni Island.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar midslope in steep land.  
PARENT MATERIAL: Moderately weathered *in situ* basalt flow rock.  
SLOPE: 28°  
ASPECT: West  
ELEVATION: 150 m  
MICRORELIEF: Uneven. Common basalt boulders on the surface.  
SITE VEGETATION: Dalo crop after forest clearance.  
LAND USE: Shifting cultivation  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: Cultivated  
LABORATORY Nos: ORSTOM TAV191-194

### PROFILE DESCRIPTION

Ap	0-9 cm (9 cm)	moist; dark brown (10YR 3/3) silty clay loam; strongly developed fine nut structure; very friable; slightly sticky; slightly plastic; many fine and medium fibrous roots; distinct smooth boundary,
AB	9-15 cm (6 cm)	moist; dark greyish brown (10YR 4/2) silty clay; moderately developed medium nut structure; very friable; slightly sticky; slightly plastic; many fine and very fine fibrous roots; distinct smooth boundary,
Bw	15-45 cm (30 cm)	moist; dark yellowish brown (10YR 4/4) silty clay; weak to moderately developed medium blocky structure; friable; sticky; plastic; common fine fibrous roots; distinct smooth boundary,
BC	45-70 cm+ (25 cm+)	moist, dark yellowish brown (10YR 4/4) clay loam; massive structure; firm; sticky; plastic; few very fine roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nasegai series**

REFERENCE: Nasegai clay (29e) defined by Twyford & Wright (1965) as a degraded soil under weeds and grasses on undulating dissected plateaux from basalts and formed under a climate with a weak dry season. Forms part of the Lomaiviti set.

The central concept for Nasegai soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Dystropept, fine, kaolinitic, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Humic latosol with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Nasegai soils, flat to gently undulating phase (38A)
- Nasegai soils, undulating phase (38B)
- Nasegai soils, easy rolling phase (38C)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nasegai soils are formed in association with Lodon soils on small plateaux in the upper Ba and upper Sigatoka rivers. They are also developed on comparable landforms in Vanua Levu and Kadavu.

PARENT ROCK: Basalt

PARENT MATERIAL: Deeply weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Convex and planar backslopes and flattish plateau surfaces in weakly dissected hill country .

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating phase (4-7°), and easy rolling phase (8-11°).

VEGETATION AND LAND USE: Some in original forest (yaka, dakua, salusalu etc.), but mostly secondary light forest of young yaka, melastomes and a thick undergrowth of wild pineapples. Gumu, korosiga, wewe, buabua and caukuro are amongst the very common trees.

RANGE OF ELEVATION: 50-400 m

RAINFALL: Annual average range: 2,200-3,800 mm;  
dry season range: 600-1,000 mm;  
wet season range: 1,600-2,600 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Slight sheet and rill erosion potential on slopes > 3° when forest cleared and cultivated.

*Nasegai*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of dark brown firm clay loam, of strongly developed coarse nut structure overlying 15 cm of dark brown firm clay loam of strongly developed coarse blocky structure, with a few fragments of weathered basalt, overlying 30 cm of reddish brown very firm clay, of moderate coarse columnar structure breaking to medium blocky, slightly sticky and plastic moist, with fragments of weathered basalt, overlying 30 cm of strong brown firm clay loam, of moderate columnar structure, sticky and plastic moist on yellowish brown firm and massive in situ weathered basalt.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable, only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be extremely acid; very low available phosphorus; CEC high; % base saturation low in the topsoil (0-10 cm) and very low values below this; calcium medium in the topsoil and very low below; magnesium high in the topsoil and medium below; and potassium very low throughout the profile.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is kaolinitic.</p>
LABORATORY Nos:	KRS N1055-1057 (inclusive)
SOIL LIMITATIONS:	Slight to moderate soil erosion when forest removed and cultivated on slopes > 3°; extremely acid pH; nutrient deficiencies of potassium and phosphorus.

## Typifying Profile

SOIL NAME: Nasegai soils, undulating phase.

PROFILE No.: FFK1-32

SITE LOCATION: Upper Ba river, Viti Levu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex backslope on rolling plateau.

PARENT MATERIAL: Strongly weathered *in situ* basalt.

SLOPE: 5°

ASPECT: North

ELEVATION: 180 m

MICRORELIEF: Uneven

SITE VEGETATION: Yaka forest

LAND USE: Unused

DRAINAGE: Well drained

EROSION: None observed

DISTURBANCE: None observed

LABORATORY Nos: KRS N1055-1057 (inclusive).

### PROFILE DESCRIPTION

Ah	0-10 cm (10 cm)	Moist; dark brown (7.5YR 3/2) clay loam; strongly developed coarse nut structure; firm; slightly sticky; slightly plastic; common fine and medium fibrous roots; smooth wavy boundary,
Bw1	10-25 cm (15 cm)	Moist; dark brown (7.5YR 4/4) clay loam; strongly developed coarse blocky structure; firm; slightly sticky; slightly plastic; few fragments of weathered basalt; common very fine and medium fibrous roots; diffuse irregular boundary,
Bw2	25-53 cm (28 cm)	Moist; reddish brown (5YR 5/4) clay; moderately developed coarse columnar structure breaking to medium blocky structure; very firm; slightly sticky; plastic; few fine and medium weathered basalt fragments; few very fine fibrous roots; diffuse irregular boundary,
Bw3	53-86 cm (33 cm)	Moist; strong brown (7.5YR 5/6) clay loam; moderately developed medium columnar structure; firm; sticky; plastic; many fine fragments of weathered basalt; few fine fibrous roots; diffuse smooth boundary,
	on	Yellowish brown (10YR 5/6) <i>in situ</i> weathered basalt; very firm; massive.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Naselesele series**

REFERENCE: Naselesele sand (2b) defined by Twyford & Wright (1965) as a recent soil from non-calcareous black sands of low quartz content formed under a climate with a weak dry season.

Forms part of the Dawasamu set.

The central concept for Naselesele soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Tropopsamment, carbonatic, isohyperthermic
- (b) FAO: Cambic Arenosol
- (c) Twyford and Wright: Recent soil from coastal sands with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Naselesele soils (20)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Narrow coastal strips around Taveuni Island, particularly the northern half of the eastern coastline.

PARENT ROCK: Basalt and reef coral.

PARENT MATERIAL: Weakly weathered comminated coral sand, basaltic sandy colluvium and minor amounts of pumice (ex-Tongan eruptions).

#### PHYSIOGRAPHIC

POSITION / LANDFORM: Planar, narrow coastal beach strand.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-1°).

VEGETATION AND LAND USE: Mainly under coconut.

RANGE OF ELEVATION: 0-2 m

RAINFALL: Annual average range: 3,000-5,500 mm;  
dry season range: 800-3,000 mm;  
wet season range: 2,000-3,200 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat excessively drained.

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: May experience some surface scouring in places during hurricane storm events.

## Morphological and Chemical Properties

### CHARACTERISTIC PROFILE FEATURES:

Typically shows 25 cm of very dark greyish brown or black loose loamy sand overlying 30 cm of dark brown loose coarse sand on 40 cm of reddish yellow or dark brown loose coarse sand.

Beach rock (or cemented coral sand) is normally encountered by 100 cm depth. In small depressions and where the beach rock is near the surface subsoils are commonly mottled.

Horizon colours vary dependent on the ratio of coral sand to colluvium derived from basalts; structure, if present, is very weakly developed; pumice of varying amounts is present; and textures may be gravelly/stony or not.

### DIAGNOSTIC HORIZONS:

Ochric epipedon

### RANGE OF PROFILE FEATURES:

Not applicable. Only 2 profile descriptions made.

### VARIANTS:

Unnamed variant that occurs in small depressions overlying shallow cemented beach rock and shows mottling in the subsoil due to water perching above the impermeable beach rock.

### SIMILAR SOILS AND

### DISTINGUISHING FEATURES:

None recognised

### GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:

Analysis shows soil to be slightly alkaline; organic carbon has a low value for the topsoil (0-30 cm) and very low values below it; high phosphorus retention throughout; free lime in the cation exchange; CEC is medium in the topsoil, low 30-60 cm and very low 60-90 cm; magnesium is medium throughout; sodium medium in the topsoil and low below it; and potassium is very low in all horizons.

The mineralogical class is carbonatic.

### LABORATORY Nos:

USP TAV107A-C

### SOIL LIMITATIONS:

Coarse textures, low water holding capacity, excessive internal drainage and rapid permeability which in combination can see the soil experiencing soil moisture deficits sometime during the dry season; due to landscape position can experience damage during hurricane event; nutrient deficiencies of nitrogen and potassium; high phosphorus retention; and alkalinity that may induce trace element deficiencies.

## Typifying Profile

SOIL NAME: Naselesele soils  
PROFILE No.: TAV 107  
SITE LOCATION: NW Taveuni Island; coastal strip 2.5 km south of Navakacoa Village, west of the coastal road.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Coastal beach strand.  
PARENT MATERIAL: Comminuted coral sand, basaltic colluvium and pumice.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 2.5 m  
MICRORELIEF: Uneven (crab burrows).  
SITE VEGETATION: Coconut plantation, grasses, *Vitex trifolia*, *Ipomoea reptans*.  
LAND USE: Coconut (copra) production with cattle grazing.  
DRAINAGE: Somewhat excessively drained.  
EROSION: None observed  
DISTURBANCE: Crabs and rodents.  
LABORATORY Nos: USP TAV107A-C  
COMMENTS: Allophane text: medium positive in all horizons.

### PROFILE DESCRIPTION

Ah	0-30 cm (30 cm)	Moist; very dark greyish brown (10YR 3/2) stony and gravelly loamy sand; fairly compact (due to grass root influence); single grain; loose abundant fine roots especially in the top 15 cm; many pieces of pumice; diffuse wavy boundary,
C1	30-60 cm (30 cm)	Moist; dark brown (10YR 3/3) stony and gravelly coarse sand with pumice fragments; single grain; loose; few fine roots; diffuse smooth boundary,
C2	60-100 cm+ (40+ cm)	Moist; reddish yellow (7.5YR 7/8) stony and gravelly coarse sand (gravels up to 2.5 cm diameter) with pumice pieces; single grain; loose; no roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nasou series**

REFERENCE: The Nasou clay (31a) defined by Twyford & Wright (1965) as a red, unmottled and well drained colluvial soil found on flat or gently undulating land in depressions draining Raviravi clay. They are derived from basic materials and occur in the strong dry zone of Viti Levu.

They form part of the Drasa set.

The central concept for Nasou soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Fluventic Dystropept, fine, mixed, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Humic latosol with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Nasou soils, flat to gently undulating phase (70A)
- Nasou series, undulating phase (70B)
- Nasou series, easy rolling phase (70C)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nasou soils are found in association with Raviravi soils on flat or undulating land in the dry zones of Viti Levu and Vanua Levu.

PARENT ROCK: Predominantly basalts but may include andesites.

PARENT MATERIAL: Deep strongly weathered colluvium (some alluvium).

PHYSIOGRAPHIC POSITION/LANDFORM: Gently sloping to easy rolling depressions, valley floors and toeslopes in weakly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), and easy rolling 8-11°.

VEGETATION AND LAND USE: Widely used for sugar cane and also to a limited extent for pastures, rice and other subsistence crops.

RANGE OF ELEVATION: 10-200 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Flooding on slopes <2° occurs 2-3 occasions some time during the wet season. Water ponds for <3 days.

EROSION: Dependent on slope, slight to moderate sheet and rill erosion risk under cultivation on slopes >2°

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 20 cm of dark reddish brown clay loam or gritty clay, of moderate to strongly developed nut structure, friable, and sticky moist, overlying 25 cm of reddish brown gritty silt loam, of weakly developed medium nut structure, very friable, overlying 3 cm of dark reddish brown silt loam buried topsoil, on 32 cm reddish brown gritty silt loam of weakly developed coarse blocky structure, very friable, and with many strongly weathered gravels and stones, commonly overlying another thin buried topsoil that in turn overlies more than 25 cm of reddish brown firm gritty clay loam.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Nasou series have an Ah1, Ah2, BC, bAh, bBC, b2Ah, b2BC horizon sequence.  The A horizons thickness range 15-25 cm; colours are reddish brown (5YR 4/3) dark reddish brown (5YR 3/2, 3/3, 3/4) and dark reddish grey (5YR 4/2, 5/2); textures may be clay, clay loam, gritty clay or gritty clay loam; and structures are either moderate or strongly developed very fine, fine or medium nut or granular.  The BC horizons normally exceed 25 cm thickness; colours are either reddish brown (5YR 4/3, 4/4, 5/4, 2.5YR 4/4, 5/4) or dark reddish brown (5YR 3/4, 2.5YR 3/4); textures may be clay, clay loam, silt loam and commonly gritty; and structures range between moderate and strong, medium or coarse, nutty or blocky. Consistence is friable while the buried BC horizons tend to be firm.  The bA horizons range in thickness from 1-5 cm; colours are dark reddish brown (5YR 2/2, 3/2, 2.5YR 2/4, 3/4); consistence loose or very friable; and structure weak fine nut or granular or single grain.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Analyses show Nasou series to be strongly acid; carbon values are very low and show irregular decrease with depth (due to presence of paleosols) and nitrogen is very low; CEC also shows an irregular pattern and values may be low or medium; % base saturation shows a similar trend and values except for the first paleosol (42-45 cm) which give a very high %BS; exchangeable calcium is low in the topsoil and very low below; exchangeable magnesium gives medium values to 42 cm and is low below; and phosphorus and potassium are very low throughout the profile.  The particle size family class is fine.  The mineralogical class is mixed.
LABORATORY Nos:	USP LOL1 A-F
SOIL LIMITATIONS:	Slight susceptibility to flooding (on slopes <2°) during the wet season; moderate to severe soil moisture deficits are experienced during the dry season in normal years; slight to moderate sheet and rill erosion risk (on slopes >2° under cultivation; nutrient deficiencies of nitrogen, potassium and phosphorus, and strong acidity.
ADDITIONAL COMMENTS:	Most Nasou series show improved chemical properties, compared to that described here (natural site) due to widespread use of coral sand over many years plus application of other fertilizers for sugar cane production.

*Nasou*

## Typifying Profile

SOIL NAME: Nasou soils, undulating phase.

PROFILE No.: LOL1

SITE LOCATION: Lololo Forest PSP 70/II/6

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Underfit gully in-filled with colluvium.

PARENT MATERIAL: Colluvium derived from strongly weathered basic and intermediate rocks.

SLOPE: 4°

ASPECT: South

ELEVATION: 40 m

MICRORELIEF: Planar

SITE VEGETATION: Moderately dense mission grass under planted 13 year old *P. caribaea* with qato, guava and kawaka.

LAND USE: Exotic forestry

DRAINAGE: Well drained

EROSION: Slight sheet erosion.

DISTURBANCE: None observed

LABORATORY Nos: USP LOL1 A-F

### PROFILE DESCRIPTION

Ah1	0-9 cm (9 cm)	Dry; moist, reddish brown (5YR 4/3) and dry, reddish grey (5YR 5/2) clay loam; strongly developed medium nut structure; friable; sticky; slightly plastic; common fine and medium roots; indistinct, smooth boundary,
Ah2	9-19 cm (10 cm)	Dry; moist dark reddish brown (5YR 3/3) and dry dark reddish grey (5YR 4/2) gritty clay; moderately developed fine and medium nut structure; friable; sticky; non-plastic; few, fine and medium roots; few strongly weathered subangular gravels; distinct, smooth boundary,
BC	19-42 cm (23cm)	Dry, moist, reddish brown (5YR 4/4) and dry, reddish brown (5YR 5/4) gritty silt loam; weakly developed medium nut structure, breaking to single grain; very friable; slightly sticky; non-plastic; few fine and medium roots; common strongly weathered subangular gravels and stones; sharp wavy boundary,
bAh	42-45 cm (3 cm)	Dry; moist, dark reddish brown (5YR 2/2) and dry, dark reddish brown (5YR 3/2) silt loam; single grain; loose; non-sticky; non-plastic; common medium roots; sharp wavy boundary,
bBC	45-77 cm (32 cm)	Dry; moist, reddish brown (5YR 4/4) and dry, reddish brown (5YR 5/4) gritty silt loam; weakly developed coarse blocky structure breaking to single grain; very friable; non-sticky; non-plastic; few fine roots; many strongly weathered subrounded gravels with a few subangular stones; sharp wavy boundary,



b2Ah	77-79 cm (2 cm)	Dry; moist, dark reddish brown (5YR 2/2) and dry, dark reddish brown (5YR 3/2) silt loam; single grain; loose; non-sticky; non-plastic; common fine roots; sharp wavy boundary,
b2BC	79-104+cm (25 cm+)	Dry; moist, reddish brown (5YR 4/4) and dry, reddish brown (5YR 5/4) gritty clay loam; moderately developed coarse nut structure breaking to single grain; firm; slightly sticky; slightly plastic; few fine and medium roots; many strongly weathered subangular and subrounded gravels.

Comment: Numerous pores

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nauluvatu series**

REFERENCE: Nauluvatu steepland stony and bouldery clay (83b) defined by Twyford & Wright (1965) as a steepland soil from acid andesite formed under a climate with no dry season.

Forms part of the Visa set.

The central concept for Nauluvatu soils has been retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Eutropept, fine-loamy, mixed, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Steepland soils related to or associated with humic latosols with no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nauluvatu soils, rolling phase (159D)	Nauluvatu soils, steep phase (159G)
Nauluvatu soils, strongly rolling phase (159E)	Nauluvatu soils, very steep phase (159H)
Nauluvatu soils, moderately steep phase (159F)	

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nauluvatu soils develop on steeplands in the upper Waidina - Namosi area in the mountains of the Suva tikina, Viti Levu and only in small areas of central Vanua Levu.

PARENT ROCK: Acid andesite

PARENT MATERIAL: Moderately weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Convex and planar backslopes and midslopes in very strongly dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Rolling (12-15°), strongly rolling (16-20°), moderately steep (21-25°), steep (26-35°), and very steep (36-42°).

VEGETATION AND LAND USE: Much under forest, some developed for pasture, but main use is for subsistence cropping (root crops and yaqona).

RANGE OF ELEVATION: 50-600 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic (perudic)

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Severe sheet and rill erosion potential when forest cleared and cultivated. Slight to moderate potential for debris slides.

*Nauluvatu*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of dark brown friable loam, of moderate to strong nut structure, overlying 50 cm of very dark greyish brown friable clay loam, of moderate to strong medium blocky structure, with many andesite stones, overlying 20 cm of strong brown friable clay loam, of weak to moderate fine blocky structure, with many small and large andesite stones <u>on</u> weakly weathered <i>in situ</i> acid andesite.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only 2 profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the soil to be moderately acid; organic carbon is medium in the topsoil (0-7 cm), low 7-59 cm and very low below these; nitrogen is high in the topsoil and low below; available phosphorus is very low throughout the profile; % base saturation is high; CEC is high in the topsoil and medium below it; exchangeable calcium is high in all horizons, magnesium is very high in the topsoil and high in the other horizons; and potassium is low in the topsoil and very low in the other horizons.</p> <p>The particle size family class is fine-loamy.</p> <p>The mineralogical class is mixed.</p>
LABORATORY Nos:	KRS D1832-1834 (inclusive)
SOIL LIMITATIONS:	Slope; profile shallowness; soil erosion potential when forest cleared and cultivated; moderate soil acidity; and nutrient deficiencies of phosphorus and potassium.

## Typifying Profile

SOIL NAME: Nauluvatu soils, steep phase.  
PROFILE No.: TR3  
SITE LOCATION: Nadakuni area, Naitasiri Province.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Convex backslope in steep hill country.  
PARENT MATERIAL: Weakly weathered *in situ* acid andesite.  
SLOPE: 28°  
ASPECT: South  
ELEVATION: 320 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Yaqona  
LAND USE: Subsistence cropping  
DRAINAGE: Well drained  
EROSION: Some sheet erosion.  
DISTURBANCE: Cultivated  
LABORATORY Nos: KRS D1832-1834 (inclusive)

### PROFILE DESCRIPTION

Ap	0-7 cm (7 cm)	Moist; very dark brown (10YR 2/2) loam; moderate to strongly developed fine nut structure; friable; few weakly weathered andesite stones; few medium woody roots; sharp wavy boundary,
Bw1	7-59 cm (52 cm)	Moist; very dark greyish brown (10YR 3/2) clay loam; moderate to strongly developed medium blocky structure; friable; many small and medium weakly weathered andesite stones; many fine pores; few fine fibrous roots; diffuse irregular boundary,
Bw2	59-79 cm (20 cm)	Moist; strong brown (7.5YR 4/6) clay loam; weak to moderately developed fine blocky structure; friable; many medium and large weakly weathered andesite stones; few very fine fibrous roots,
R	79 cm+	On weakly weathered <i>in situ</i> acid andesite.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nausori series**

REFERENCE: The Nausori soil set as defined by Twyford & Wright (1965) comprises the Nausori clay (45d) and the Nausori drained clay (45e). Nausori clay is more poorly drained than Tokotoko soils and the water table is at the surface during the 'wet' season.

Purnell (1972) recognised a Nausori peaty clay and a Nausori clay with peaty subsoil. These are now included with the Bonatoa series.

The central concept for Nausori series as described by Twyford & Wright (1965) is a weakly mottled, dark grey brown, soft very plastic topsoil of 10 cm that overlies a clayey grey, mottled red subsoil with coarse blocky structure. The water table is at or near the surface in most seasons.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Tropaquept, fine, kaolinitic, isohyperthermic
- (b) FAO: Eutric Gleysol
- (c) Twyford and Wright: Gley soil with a very weak or no dry season.

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nausori soils (31)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nausori soils develop in very poorly drained areas of the larger floodplains of ESE and SSE Viti Levu viz. Rewa and Navua Rivers systems, behind Tokotoko series and grading to the peat bogs where Melimeli series with its inclusions are mapped.

PARENT ROCK: Rocks of basic and intermediate composition.

PARENT MATERIAL: Recent, weakly weathered riverine alluvium derived from basic and intermediate (i.e. quartz-poor) rocks.

PHYSIOGRAPHIC POSITION/LANDFORM: Lowest-lying sites of mineral soils and flood plains. Merges to true peats and commonly fringes the peat bogs. Can show a hummocky surface where overlying peat (>1 m) at depth.

SLOPE CLASS AND RANGE OF SLOPES: Level to near level (0-1°).

VEGETATION AND LAND USE: Supports a cover of para grass, mile-a-minute, yellow primrose, kuta and navua sedge and desmodium. Commonly used as low productivity grazing for dairying, rainfed rice and where drained for some arable crops.

RANGE OF ELEVATION: 2-5 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Very poorly drained. Water table at or near the ground surface throughout most years.

PERMEABILITY CLASS:	Ponded. Low permeability. Very slow infiltration rate.
FLOODING:	Continuous flooding due to extremely slow runoff, a result of very low surface gradients and high water tables.
EROSION:	No erosion observed.

### **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	The main profile features include olive grey hues with yellowish red mottling in all horizons; clay loam textures that become sandy below 90 cm; horizons are compact with firm consistence, massive breaking to well developed coarse blocky structures, though the topsoil appears structureless when saturated showing weak nut structures on drying.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Nausori series have an Apg, ABg, Bg, BCg, Cr horizon sequence.  The Apg horizon thickness ranges 15-25 cm; its colours include dark olive grey (5Y 3/2) and dark greyish brown (2.5Y 4/2); and structures are either weak or moderate, fine or medium nut structure.  The ABg horizon thickness ranges 5-13 cm; its textures are either clay loam, silty clay loam or clay; consistence may be friable or firm; and structure may be fine or medium, blocky or nutty.  The Bg horizon thickness ranges 12-32 cm; textures are either clay or clay loam; consistence firm or friable; and structures weak coarse blocky or prismatic.  The BCg horizon thickness ranges from 45-55 cm; its colours include light olive grey (5Y 6/2) and pale olive (5Y 6/3,6/4); mottles range between common and profuse in abundance.  The Cr horizon exceeds 30 cm in thickness and shows little variation with physical features.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Navua series: Coarser textures and more friable consistence; gley and mottle features are less intensely expressed; structures are finer; and a paleosol(s) is recognised in most profiles.  Tokotoko series: Mottles have brown and/or grey hues and are less intensely expressed. Blocky structures are a feature of all horizons.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Strongly acid topsoils and moderately acid subsoils; base saturation values are medium in surface horizons becoming high with depth; organic carbon decreases from low to very low down the profile; CEC values tend to be at the high end of the medium range with calcium medium, magnesium high, potassium very low and sodium low. Clay (>50%) dominates the fine earth fraction to 50 cm depth and below 80-90 cm sand, silt and clay have equal amounts.  The particle size family class is fine.  The mineralogy class is kaolinitic.
LABORATORY Nos:	SB9594A-E KRS 1359-1363 (inclusive)

*Nausori*

**SOIL LIMITATIONS:**

Permanent high water table; susceptibility to flooding; clayey textures; very poor internal drainage; strong acidity; and nutrient deficiencies of nitrogen, potassium and phosphorus.

### **Typifying Profile**

**SOIL NAME:**

Nausori soils

**PROFILE No.:**

KN11

**SITE LOCATION:**

Refer soil map of Koronivia Agricultural Research Station (Scale 1:3000), Leslie (1984). Middle eastern part of Station 5 m west of principal north/south Station road.

#### **SITE INFORMATION**

**POSITION IN****LANDSCAPE/LANDFORM:**

Fringing floodplain to Rewa peat bog on the Rewa River floodplain.

**PARENT MATERIAL:**

Mixed alluvium derived from quartz-poor rocks.

**SLOPE:**

Flat

**ASPECT:**

Not applicable

**ELEVATION:**

4 m

**MICRORELIEF:**

Uniformly planar and level.

**SITE VEGETATION:**

Setaria grass, para grass and centrosema.

**LAND USE:**

Improved pasture for dairying.

**DRAINAGE:**

Very poorly drained.

**EROSION:**

Subject to period flooding.

**DISTURBANCE:**

Nil. Has been ploughed in the past.

**LABORATORY Nos:**

SB9594A-E  
KRS 1359-1363 (inclusive)

#### **PROFILE DESCRIPTION**

Nausori soils

Apg	0-16 cm (16 cm)	Slight moist; very dark greyish brown (2.5Y 3/2) for both ped face and rubbed; clay loam; few, fine, faint dark brown (7.5YR 4/4) mottles with yellowish red (5YR 4/6) Fe humic staining along root channels; friable to firm; non-sticky; non-plastic; weakly developed, fine, nut structure; with weakly developed medium nut structure; common, fine and medium roots; indistinct smooth boundary,
ABg	16-28 cm (12 cm)	Slightly moist; olive grey (5Y 4/2) ped face, and olive brown (2.5Y 4/4) rubbed, silty clay loam; many, fine, distinct, strong brown (7.5YR 5/6) mottles, with yellowish red (5YR 4/6) mottling along root channels; friable; non-sticky; non-plastic; weakly developed, fine, nut structure; common, fine and medium roots; distinct smooth boundary,
Bg	28-43 cm (15 cm)	Slightly moist; olive grey (5Y 4/2), ped face and olive (5Y 5/4), rubbed, clay loam; profuse, fine, distinct, yellowish red (5YR 5/8) mottling to ped faces; friable; slightly sticky; non-plastic; massive, breaking to weakly developed, coarse, blocky structure; few, medium roots; diffuse smooth boundary,



BCg	43-94 cm (50 cm)	Very moist; light olive grey (5Y 6/2), ped face, and pale olive (5Y 6/4), rubbed, clay loam; profuse, coarse, prominent yellowish red (5YR 5/8) mottling to ped faces; massive, breaking weakly developed, coarse, blocky structure; firm; sticky; plastic; few, very fine roots; indistinct smooth boundary,
Cr	94-118 cm (25 cm)	Wet; greenish grey (5BG 5/1) ped face, greenish grey (5GY 5/1) rubbed, fine sandy clay; common coarse, distinct yellowish red (5YR 5/6) mottles; friable; sticky; slightly plastic; massive, breaking to single grain; no roots.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Navai series**

REFERENCE: Navai clay loam (57) defined by Twyford and Wright (1965) as a recent soil of the warm and wet uplands derived from basic alluvium of low quartz content.

The central concept for Navai soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Fluventic Hapludoll, fine, mixed, isothermic
- (b) FAO: Eutric Fluvisol
- (c) Twyford and Wright: Recent upland soil from alluvium with a very weak or no dry season.

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Navai soils, flat to undulating phase (212A)
- Navai soils, undulating phase (212B)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Restricted to the narrow valleys which form the head waters of the Sigatoka river on the Nadarivatu - Nadrau plateau.

PARENT ROCK: Rocks of basic (mainly basalts) composition.

PARENT MATERIAL: Deep weathered alluvium with some colluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Levee of the narrow river valleys.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°) and undulating (4-7°).

VEGETATION AND LAND USE: Originally in tall rainforest (in which dakua and vuna were predominant) but mostly cleared and used for more temperate vegetable market gardening.

RANGE OF ELEVATION: 700-1000 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 600-800 mm;  
wet season range: 2,000-2800 mm.

TEMPERATURE: Mean annual: 18°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isothermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY: Moderate

FLOODING: One in 20 year return period for floods depositing sediment. For other floods a 1 in 2 year return period.

EROSION: Stream bank only.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 35 cm of dark brown very friable clay loam of strong medium granular structure, overlying 60 cm of very dark greyish brown friable clay loam, of weak coarse nut structure tending to be massive on 25 cm or more of massive yellowish brown firm clay.  Horizons tend to be slightly sticky and non plastic.
DIAGNOSTIC HORIZONS:	Mollic epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions available.
VARIANTS:	Unnamed variant has sandy topsoil textures and gravelly subsoils. Profile description attached (V119, KRS V708-709).
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Chemical analysis shows Navai soils to be slightly acid and of high base status. They have high contents of exchangeable calcium and very high contents of exchangeable potassium and extremely low levels of available phosphorous. Navai soils are highly phosphorous fixing.  The particle size family class is fine.  Mineralogy class is mixed.
LABORATORY NOS:	KRS V698-700
SOIL LIMITATIONS:	Infrequent flooding, phosphorous fixation, soils acidity and commonly subsoil boulders.

## Typifying Profile

SOIL NAME: Navai series  
PROFILE NO: VS 115  
SITE LOCATION: Level valley floor in the upper end of the Nadawa valley about 1500m NE of Nadala School, Nadarivatu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Narrow alluvial low terrace 3 m above sea level.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 700 m  
MICRORELIEF: Some small terracettes created recent flood.  
SITE VEGETATION: Pinus caribaea with lantana and cevuga ground cover.  
LAND USE: Exotic forestry  
DRAINAGE: Well drained  
EROSION: None  
DISTURBANCE: Some traffic marks caused during planting of forest.  
LABORATORY Nos.: KRS V698-700

### PROFILE DESCRIPTION

Navai soils

Ap	0 - 35cm	Moist; dark brown(10 YR 3/3) clay loam; strongly developed medium granular structure: breaking to moderately developed fine crumb structure; very friable, slightly sticky; common large pores; common medium fibrous and woody roots; smooth diffuse boundary,
B	35 - 95cm	Moist; dark grayish brown (5YR 3/2) clay loam; weakly developed coarse nut structure, breaking to moderately developed medium granular and crumb; friable, non sticky, non plastic, common fine tubular pores; common medium woody roots; smooth diffuse boundary,
bAh	95 - 120cm	Moist; dark yellowish brown (10 YR 4/4) clay; weakly developed coarse nut structure, breaking to moderately developed medium nut; firm, slightly plastic, slightly sticky; common large rounded unweathered boulders; few fine pores; few large woody roots.

## PROFILE DESCRIPTION

Unnamed sandy variant of Navai soils (Pedon VS 119)

A	0-16cm (16 cm)	Moist; dark yellowish brown (10YR 4/6) loam and sandy loam; few faint fine brown to dark brown (7.5YR 4/4) mottles in the lower part; weakly developed medium nut structure; friable; slightly sticky; slightly plastic; few fine rounded gravels; common large tubular pores; common fine fibrous roots; sharp smooth boundary,
Bw	16-85 cm (69 cm)	Moist; dark yellowish brown (10YR 3/6) clay; few faint fine brown to dark brown (7.5YR 4/4) mottles; strongly developed coarse blocky structure; very firm; slightly sticky; common medium tubular pores; common fine and medium gravels; few to common fine fibrous roots; diffuse smooth boundary,
C	85-100+ cm (15+ cm)	Moist; dark yellowish brown (10YR 3/6) clay; few faint fine brown to dark brown (7.5YR 4/4) mottles; massive; very firm; slightly sticky; profuse medium to coarse rounded gravels.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Navava series**

REFERENCE: Navava clay (18a) and Navava hill soils (18aH) defined by Twyford & Wright (1965) as soils formed from basalt, basaltic agglomerate cemented by calcareous tuff under a climate with a weak dry season. Forms part of the Navava set.

The central concept for Navava soils is retained in this survey other than that the slope range is extended to include steepland soils.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Mollic Hapludalf, fine, smectitic, isohyperthermic
- (b) FAO: Orthic Luvisol
- (c) Twyford and Wright: Nigrescent soil with a very weak or no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Navava soils flat to gently undulating phase (177A)	Navava soils, strongly rolling phase (177E)
Navava soils, undulating phase (177B)	Navava soils, moderately steep phase (177F)
Navava soils, easy rolling phase (177C)	Navava soils, steep phase (177G)
Navava soils, rolling phase (177D)	Navava soils, very steep phase (177H)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Navava soils are found mainly on the south-eastern part of Vanua Levu extending eastward from Savusavu Bay to the tip of the Natewa peninsula.

PARENT ROCK: Basalt

PARENT MATERIAL: Strongly weathered *in situ* basalt.

PHYSIOGRAPHIC POSITION/LANDFORM: On side slopes, shoulder slopes, ridge crests and gullies in hill country.

SLOPE CLASS AND RANGE OF SLOPES: All slope phases from flat to gently undulating (0-3°) to very steep (> 35°).

VEGETATION AND LAND USE: Coconuts, indigenous forest, taro, cassava, grass, bamboo, yaqona.

RANGE OF ELEVATION: 15-350 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean Annual: 24.5°C.

SOIL MOISTURE REGIME: Perudic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Slight to moderate sheetwash and downslope colluvial movement. A few large scale slips were seen but these were shallow seated. Slight slip. Moderate and severe sheet, rill and soil slip erosion potential on slopes > 11° when forest cleared.

*Navava*

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	The characteristic profile features of this soil are a very dark greyish brown to black A horizon, subsoils with a colour of 10YR 3/4-2/4 with no mottles, and a clay illuvial horizon overlying strongly weathered basalt (saprolite) at a depth of less than 100 cm.
DIAGNOSTIC HORIZONS:	Mollic epipedon, argillic horizon.
RANGE OF PROFILE FEATURES:	The range of features within the taxonomic unit is related to slope with the strongly weathered rock encountered at shallower depths on the steeper slopes. Other properties show very small variation to that described.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>The pH is slightly acid in the topsoil increasing to slightly alkaline with depth; organic C % is medium in the A horizon (but horizon only 7 cm thick), very low in the Ab horizon; %BS is very high throughout profile; exchangeable Ca and Mg are very high (35 me.% and 21 me.% respectively); exchangeable Na is high and exchangeable K is very low.</p> <p>The particle size family class is fine.</p> <p>Mineralogy class is smectitic.</p>
LABORATORY Nos:	KRS S2002-2007 (inclusive)
SOIL LIMITATIONS:	Slope; potential erosion hazards; and nutrient deficiency of potassium.

## Typifying Profile

SOIL NAME: Navava soils, strongly rolling phase.  
PROFILE No.: W23  
SITE LOCATION: Refer soil map of Wainigata Agricultural Research Station (Purdie, 1986).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Concave backslope in moderately dissected hill country.  
PARENT MATERIAL: Strongly weathered *in situ* basic rock plus some colluvium.  
SLOPE: 20°  
ASPECT: North-east  
ELEVATION: 16 m  
MICRORELIEF: Planar  
SITE VEGETATION: Coconuts  
LAND USE: Coconut plantation  
DRAINAGE: Well drained  
EROSION: Downslope colluvial movement.  
DISTURBANCE: None observed  
LABORATORY Nos: KRS S2002-2007 (inclusive)  
COMMENTS: Cracks when dry.

### PROFILE DESCRIPTION

Ah	0-7 cm (7 cm)	Moist; black (10YR 2/1) humic clay; friable to firm; sticky; plastic; moderately developed medium blocky structure breaking to moderately developed very fine and fine crumb; many very fine and fine roots; indistinct wavy boundary,
AB	7-31 cm (24 cm)	Moist; very dark greyish brown (10YR 2/2) heavy clay; firm; sticky; plastic; moderately to strongly developed fine and medium blocky structure breaking to moderately developed very fine and fine nut; fine distinct clay and organic cutans (10YR 3/2); common very fine and fine roots; diffuse boundary,
Bt1	31-60 cm (29 cm)	Moist; dark brown (10YR 3/3) heavy clay; firm; sticky; plastic; moderately to strongly developed fine and medium blocky structure breaking to moderately developed very fine and fine nut; common distinct clay and organic cutans (10YR 3/2); common very fine and fine roots; diffuse boundary,
Bt2	60-91 cm (31 cm)	Moist; dark brown (10YR 3/3) sandy clay; firm; sticky; plastic; moderately to strongly developed fine and medium blocky structure breaking to moderately developed very fine and fine nut; common distinct clay and organic cutans (10YR 3/2); common very fine and fine roots; indistinct wavy boundary,



BC	91-123cm (32 cm)	Moist; brown to dark brown (10YR 4/3) coarse sandy clay loam; firm; slightly sticky; slightly plastic; moderately developed fine and medium blocky structure breaking to single grain; few faint clay cutans (10YR 3/3); few very fine roots; indistinct wavy boundary,
C	on	Weathered <i>in situ</i> rock; olive brown (2.5Y 4/4) coarse sandy loam; firm to very firm; slightly sticky; slightly plastic; massive, breaking to weakly developed medium blocky structure; no cutans; no roots.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Navua series**

REFERENCE: The Navua soil set as defined by Twyford & Wright (1965) comprised Navua clay (44a), a moderately poorly drained soil derived from fairly recent materials and described as having a well drained topsoil, a mottled subsoil and below that a gleyed subsoil; and Navua drained clay (44b) the product of draining 44a, in which the mottling colours have become bright reds and yellows and the gley horizon has become brightly mottled.

Purnell (1972) recognised 2 phases of the Navua clay, the Navua clay loam, and the Navua clay loam over loamy sand. Leslie (1984) recognised a buried topsoil phase.

CLASSIFICATION:

- (a) Soil Taxonomy: Fluvaquentic Eutropept, very-fine, kaolinitic, isohyperthermic
- (b) FAO: Eutric Cambisol
- (c) Twyford and Wright: Gley soil with a very weak or no dry season

INCLUDED MAPPING UNITS AND SYMBOLS:

Navua soils (29)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Navua series develop in poorly drained sites between levees of the Navua and Rewa Rivers in SSE and ESE Viti Levu.

PARENT ROCK: Rocks of basic and intermediate composition.

PARENT MATERIAL: Recent weakly weathered riverine alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Lie behind the levee of the Rewa and Navua Rivers on which Rewa soils develop. Navua series merge into Tokotoko series further from the levee.

SLOPE CLASS AND RANGE OF SLOPES: Near level (more common) to very gently sloping (0-3°).

VEGETATION AND LAND USE: Irrigated or rainfed rice and pasture for dairying dominated by Para grass and often with Navua sedge. Supports good pasture where drained and well managed.

RANGE OF ELEVATION: 2-7 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained. Water table at about 40 cm during the wet season and 1.20 m in dry. season.

PERMEABILITY CLASS: Slow permeability (for soil mass) but high infiltration rate (4-5 cm/hour) due to fissures.

FLOODING: One in 25 year return period for floods that deposit 'fresh' sediment. One in two year return period for small (non-sediment) flood events.

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES: Typically shows 20 cm of olive grey mottled dark reddish brown friable to firm silt loam, of weakly developed coarse blocky structure overlying 15 cm of olive grey mottled dark yellowish brown friable to firm silty clay loam of weakly developed medium nut structure, overlying 15 cm of brown mottled olive grey and dark reddish brown friable silt loam, over weakly developed coarse blocky structure over a buried topsoil of 15 cm of olive brown mottled yellowish red friable silty clay loam of weakly developed fine nut and crumb structure, on 30 cm of yellowish brown mottled olive grey friable clay loam, of massive structure breaking to weak coarse blocky over yellowish brown mottled light olive grey massive friable to firm clay loam.

DIAGNOSTIC HORIZONS: Ochric epipedon, cambic horizon.

RANGE OF PROFILE FEATURES: Navua series have an Ag, Bg, bAg, bBg1, bBg2 horizon sequence.

The A horizon thickness ranges from 25-35 cm; its colours include olive grey (5Y 5/2, 4/2) greyish brown (2.5Y 5/2) and dark greyish brown (2.5Y 4/2); and textures may be silt loam, silty clay loam or clay loam.

The Bg horizon thickness ranges 15-25 cm; its colours include brown (10YR 4/3, 5/3) and yellowish brown (10YR 5/4, 5/6); textures may be silt loam, silty clay loam, clay loam; and consistence is either friable or firm.

The bAg horizon (if present) has thickness range of 5-15 cm; colours are dark brown or olive brown; and textures vary silt loam, clay loam, silty clay loam.

The bBg horizons exceeds 50 cm thickness; its colours are yellowish brown (10YR 5/4, 5/6, 5/8) or light olive brown (2.5Y 5/4, 5/6); structures are massive or weak coarse blocky, and textures are silty clay loam, clay loam or clay.

VARIANTS: A buried topsoil phase.

SIMILAR SOILS AND DISTINGUISHING FEATURES: Tokotoko series: No paleosol. Textures have higher clay fraction throughout. All horizons have strongly expressed gley features.

Nausori series: No paleosol. Finer textures to 90 cm where profiles become sandy. Profiles more strongly gleyed, mottled and compact. Water table higher in the profile. Well expressed blocky structures.

GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES: Moderately acid with high base saturation values and low organic carbon values. CEC values are towards the high end of the medium range. Calcium values are high in topsoils and medium in subsoils; magnesium very high; potassium very low; and sodium values low. The clay fraction is constant at 55-60% throughout the profile while silt decreases from 40 to 30% with depth.

The particle size family class is very-fine.

Mineralogy class is kaolinitic.

LABORATORY Nos: SB9592A-F  
KRS 1349-1354 (inclusive)

SOIL LIMITATIONS: Imperfectly drained; clayey textures; high seasonal water table; small susceptibility to flooding; soil acidity; and nutrient deficiencies of potassium, phosphorus and nitrogen.

*Navua*

## Typifying Profile

SOIL NAME: Navua soils  
PROFILE No.: KN08  
SITE LOCATION: Refer soil map of Koronivia Research Station (Scale 1:3000), Leslie (1983). Eastern part of the Station, 15 m south of Koronivia Road.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Floodplain, adjacent to toe of levee of Rewa River.  
PARENT MATERIAL: Mixed alluvium derived from quartz-poor rocks.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 18 m  
MICRORELIEF: Uniformly planar  
SITE VEGETATION: Para grass and mimosa.  
LAND USE: Cropped in the past. Currently in pasture for dairying.  
DRAINAGE: Imperfectly drained  
EROSION: Subject to flooding and 'fresh' accretion of sediment.  
DISTURBANCE: Has been cultivated.  
LABORATORY Nos: SB9592 A-F  
KRS1349-1354 (inclusive)  
COMMENTS: Water table at 100 cm.

### PROFILE DESCRIPTION

Ag1	0-20 cm (20 cm)	Moist; olive grey (5Y 5/2), ped face, dark greyish brown (10YR 4/2), rubbed, silt loam; profuse, medium, prominent, dark reddish brown (2.5YR 3/4) mottles; weakly developed, coarse, blocky structure breaking to weakly developed nut structure; friable to firm; slightly sticky; non-plastic; abundant fine and medium roots; indistinct smooth boundary,
Ag2	20-33 cm (13 cm)	Moist; olive grey (5Y 5/2), ped face, very dark greyish brown (10YR 3/2) rubbed, silty clay loam; profuse, medium, prominent dark yellowish brown (10YR 5/6) mottles; weakly developed, medium, nut structure breaking to single grain; friable to firm; slightly sticky; non-plastic; abundant fine and medium roots; indistinct wavy boundary,
Bg	33-49 cm (16 cm)	Moist; brown (10YR 4/3) ped face, yellow brown (10YR 5/6), rubbed, silt loam; many, medium, distinct olive grey (5Y 5/2) mottles with common, medium, distinct, dark reddish brown (2.5YR 3/4) mottles; weakly developed, coarse, blocky structure breaking to weak, fine nut structure; friable; slightly sticky; non-plastic; many very fine and fine roots; distinct smooth boundary,
bAg	49-64 cm	Moist; olive brown (2.5Y 4/4) ped face, dark brown (10YR 3/3), rubbed, silty clay loam; many coarse, distinct yellowish red (5YR 4/6) mottles (as coatings to root channels and voids); weakly developed, fine nut structure with weakly developed, medium crumb structure; non-sticky; non-plastic; friable; common, very fine roots; distinct smooth boundary,

bBg1	64-93 cm	Moist; yellowish brown (10YR 5/6) clay loam; many coarse, distinct olive grey (5Y 5/2) mottles (as coatings to root channels); massive; breaking to weakly developed coarse blocky structure; friable; sticky; non-plasticky; non-plastic; diffuse smooth boundary,
bBg2	93-143 cm	wet; yellowish brown (10YR 5/6) clay loam; (50 cm) profuse, coarse, prominent light olive grey (5Y 6/2) mottles; massive; breaking to weakly developed coarse, blocky structure; friable to firm; slightly sticky; non-plastic.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Navunikodi series**

REFERENCE: Navunikodi sandy clay loam (8b) defined by Twyford & Wright (1965) as formed from alluvium of high quartz content (from acidic rocks) under a climate with a weak dry season.

Forms part of the Saliadrau set.

The central concept for Navunikodi soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Fluventic Humitropept, fine, mixed, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Recent soil from alluvium with a weak dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Navunikodi soils (60)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Wainikoroiluva river and upper Waidina river central Viti Levu and confined in small areas in the narrow valleys of interior Vanua Levu that drain the steep dacite mountains.

PARENT ROCK: Acidic rocks

PARENT MATERIAL: Weakly weathered alluvium

PHYSIOGRAPHIC POSITION/LANDFORM: Old and high terraces.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-1°).

VEGETATION AND LAND USE: Mainly used for subsistence root crops.

RANGE OF ELEVATION: 75-200 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Floods depositing sediment have a 1 in 100 year return period. Other floods 1 in 15 years.

EROSION: No erosion hazard.

## **Morphological and Chemical Properties**

CHARACTERISTIC PROFILE FEATURES:	Typically shows 40 cm of brown to very dark grey brown friable sandy clay loam, of weak coarse blocky structure overlying 20 cm of brown friable stony sandy clay loam, of massive structure breaking easily to strong coarse granular, slightly sticky and moderately plastic moist, on strong brown friable to firm and compact in place slightly stony sandy clay, of strong fine blocky structure, and slightly sticky and very plastic when moist.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only one profile description available.
VARIANTS:	Unnamed variant. Poorly drained and moderately to strongly mottled.
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Soils are of moderate to low fertility and strongly acid.
LABORATORY Nos:	FACL 9211104-06
SOIL LIMITATIONS:	Coarse soil textures; strong soil acidity; and nutrient deficiencies of phosphorus, potassum and nitrogen.

## Typifying Profile

SOIL NAME: Navunikodi soils  
PROFILE No.: LAB 2  
SITE LOCATION: Adjacent to bridge by Korotolutolu Indian School, Seaqaqa.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Levee and broad alluvial valley floor.  
PARENT MATERIAL: River alluvium from acidic rocks.  
SLOPE: 3°  
ASPECT: North-west  
ELEVATION: 115 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Velau and doi with guava and miscellaneous weeds (mint weed, blue rats tail).  
LAND USE: Patchwork of food gardens and secondary forest.  
DRAINAGE: Well drained  
EROSION: None observed  
DISTURBANCE: Cultivated  
LABORATORY Nos: FACL 9211104-06

### PROFILE DESCRIPTION

Navunikodi soils

Ap	0-40 cm (40 cm)	Moist; brown (10YR 4/3) to very dark greyish brown (10YR 3/2) sandy clay loam; weakly developed coarse blocky structure; friable; non-sticky; slightly plastic; many fine fibrous roots; distinct smooth boundary,
Bw1	40-60 cm (20 cm)	Moist; brown (10YR 5/3) stony sandy clay loam; massive breaking easily to strongly developed coarse granular structure; friable; slightly sticky; moderately plastic; common fine fibrous roots; distinct smooth boundary,
Bw2	60-100 cm+ (40+ cm)	Moist; strong brown (7.5YR 5/6) slightly stony sandy clay; strongly developed fine blocky structure; compact in place; friable to firm; slightly sticky; very plastic; few fine fibrous roots.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nawai series**

REFERENCE: New soil series introduced in this survey to describe moderately deep, dark coloured soils displaying vertic properties that develop on easy sloping surfaces under a climate with a strong dry season. Nawai series intergrade upslope to Dakadaka soils and downslope to Emuri soils.

Previously included with Emuri clay (17b) as defined by Twyford & Wright (1965), and defined in this survey as a Vertisol.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Vertic Ustropept, very-fine, smectitic, isohyperthermic
- (b) FAO: Vertic Cambisol
- (c) Twyford and Wright: Nigrescent soil with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

- Nawai soils, undulating phase (187B)
- Nawai soils, easy rolling phase (187C)
- Nawai soils, rolling phase (187D)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Restricted to lower slopes in moderately dissected hill country of the 'dry' zone of western Viti Levu.

PARENT ROCK: Andesitic tuffs and marls

PARENT MATERIAL: Strongly weathered colluvium derived from andesitic tuffs and marls.

PHYSIOGRAPHIC POSITION/LANDFORM: Lower midslopes in moderately dissected and commonly easy rolling hill country.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), gently rolling (8-11°) and rolling (12-15°).

VEGETATION AND LAND USE: Where grazed and in improved pasture; Nadi blue grass, wire grass, and desmodium, with scattered guava. Sugar cane.

RANGE OF ELEVATION: 20-300 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 26°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Moderately well drained

PERMEABILITY CLASS: Moderately rapid in dry season; slow in wet season.

FLOODING: Never floods

EROSION: Very slight sheet erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Deep profile with strong coarse structures, shiny (polished) ped faces, and little profile differentiation in upper 60-70 cm. Typically shows 15 cm of black clay loam, sticky and plastic moist, friable to firm, of strongly developed medium blocky structure, with polished surfaces to peds overlying 45 cm of dark brown clay of strongly developed coarse blocky structure, firm, sticky and plastic moist, well developed clay/organic coatings and commonly weakly mottled overlying 50 cm of olive brown, of massive structure with organic coatings to fissures and root channels.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon, vertic properties.
RANGE OF PROFILE FEATURES:	Nawai series have a Ah(Ap), Bw1, Bw2, BC horizon sequence.  The Ah(Ap) horizon thickness ranges from 10-30 cm; colours include black (5YR 2/1, 7.5YR N2/0, 10YR 2/1) and very dark grey (5YR 3/1); textures are clay or clay loam; structures include strong coarse blocky or prismatic that break to strong fine or medium nut structure; consistence may be friable or firm; clay/organic coatings (if present) are black or very dark grey.  The Bw1 horizon thickness ranges from 35-60 cm; its colours include black (5YR 2/1), dark reddish brown (5YR 2/2, 3/1) dusky red (2.5YR 3/2) and very dark greyish brown (10YR 3/2); textures are clay loam or clay; primary coarse blocky or prismatic structures break to strong fine or medium blocky; may be sticky or very sticky; slickensides and organic coatings may be distinct or prominent; and there may be mottles (few strong brown) or not.  The Bw2 thickness ranges from 20-40 cm; colours range as for Bw1; clay/organic coatings (slickensides) may be black (5Y 2/1, 2/2) or dark greenish grey (5GY 4/1) and mottles as for Bw1 horizon.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	New series. Develops in true valley bottom positions; more mottled; more well expressed vertic properties.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	New neutral soil with very high base status; very high values for calcium and magnesium; sodium is high and potassium low in all horizons; organic carbon goes from low in the topsoil to very low in subsoils.  The particle size family class is very-fine.  The mineralogical class is smectitic.
LABORATORY Nos:	KRS R2661-2665 (inclusive) SB9672A-E
SOIL LIMITATIONS:	Clayey textures; montmorillonitic clay with their shrink/swell properties that give rise to the soils vertic features; severe soil moist deficits in the dry season; and nutrient deficiencies of phosphorus, potassium and nitrogen.

## Typifying Profile

SOIL NAME: Nawai soils, easy rolling phase.  
PROFILE No.: N87  
SITE LOCATION: Refer soil map of Nawaicoba Agricultural Research Station (Leslie, 1984).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Concave toeslope to valley floor of moderately dissected hill country.  
PARENT MATERIAL: Colluvium derived from andesitic rocks.  
SLOPE: 8°  
ASPECT: North-west  
ELEVATION: 140 m  
MICRORELIEF: Flat  
SITE VEGETATION: Nadi blue grass, wire grass and desmodium.  
LAND USE: Grazing for beef cattle.  
DRAINAGE: Moderately well drained.  
EROSION: None observed  
DISTURBANCE: None observed  
LABORATORY Nos: KRS R2661-2665 (inclusive)  
SB9672A-E (inclusive)

### PROFILE DESCRIPTION

Ah	0-14 cm (14 cm)	Slightly moist; black to very dark grey (2.5YR 2.5/1) clay loam; strongly developed medium and coarse blocky structure breaking to strong medium nut structure; cracks (>1 cm) between vertical structural faces; sticky; plastic; firm; very firm peds; common fine roots; indistinct smooth boundary,
Bw1	14-39 cm (25 cm)	Slightly moist; dark brown (7.5YR 3/2) clay loam; strongly developed fine and medium prismatic structure breaking to strong medium blocky structure; vertical cracking between primary peds; sticky; plastic; very firm; very firm peds; common distinct very dark grey (5YR 3/1) polished surfaces to ped faces; few fine roots; distinct smooth boundary,
Bw2	39-60 cm (21 cm)	Slightly moist; dark brown (7.5YR 3/2) clay loam; strongly developed medium prismatic structure breaking to strong medium blocky structure; sticky; plastic; very firm; firm peds; common distinct very dark grey (5YR 3/1) polished surfaces to peds; few very fine roots; distinct smooth boundary,
BC	60-120 cm	Slightly moist; light olive brown (2.5Y 5/4) fine sandy clay loam; weakly developed coarse blocky structure to massive breaking to single grain; slightly sticky; firm; few, prominent very dark greyish-brown (10YR 3/2) clay coatings in worm and root channels; no roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Naweni series**

REFERENCE: Naweni clay (18b) defined by Twyford & Wright (1965) as a colluvial soil related to Navava clay (18a) from basalt, basaltic agglomerate cemented by calcareous tuff under a climate with a weak dry season.

Forms part of the Navava set.

In the soil survey of Wainigata Agricultural Research Station (Purdie, 1986) it was further defined as having an aquic moisture regime.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Aerlic Tropaquept, fine, smectitic, isohyperthermic
- (b) FAO: Eutric Gleysol
- (c) Twyford and Wright: Nigrescent soil with a very weak or no dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Naweni soils, flat to gently undulating phase (203A)  
Naweni soils, undulating phase (203B)  
Naweni soils, easy rolling phase (203C)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Naweni soils develop in association with Navava soils on flattish land in the south-eastern part of Vanua Levu eastward from Savusavu Bay to the tip of the Natewa peninsula.

PARENT ROCK: Basalt

PARENT MATERIAL: Fine textured colluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Toeslopes of hills.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), and easy rolling (8-11°).

VEGETATION AND LAND USE: Commonly a patchwork of food gardens (coconuts, cassava, bamboo, cocoa, grass) and secondary growth scrub including wild guava.

RANGE OF ELEVATION: 10-200 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Aquic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Moderately slow

FLOODING: Infrequent and of short duration overflow flooding.

EROSION: Colluvial movement and sheetwash.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of black sandy clay loam of weakly developed blocky structure with crumb, friable, and sticky and plastic moist, overlying 10 cm of very dark greyish brown clay loam of moderately developed blocky structure, friable to firm, and sticky and plastic moist, overlying 35 cm of dark greyish brown clay loam, of well developed medium blocky structure, friable to firm, sticky and plastic moist and with clay cutans to ped faces overlying 30 cm of dark greyish brown mottled strong brown sandy clay 10 cm with clay cutans to ped faces over more than 40 cm of dark greenish grey mottled strong brown clay loam.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Naweni series have an Ah, AB, Btg1, Btg2, Btr horizon sequence. Textures range from clay loams to clay. Gley colours occur immediately below the topsoil, generally hues of 2.5Y, 5Y, 5BG, or 5GY.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Nasinu series: This occurs further downslope, and is formed from alluvium rather than colluvium and is better drained (Purdie, 1986).
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Topsoils are slightly acid to neutral (pH 6.1 to 6.8), subsoils are slightly alkaline (pH 7.2 to 7.6); organic C % is low to medium in A horizons; % BS is very high throughout the profile (81-95%); exchangeable Ca and Mg are very high; exchangeable Na is high; exchangeable K is very low (low in A horizon).</p> <p>The particle size class family is fine.</p> <p>The mineralogical class is smectitic.</p>
LABORATORY Nos:	KRS S1996-2001 (inclusive) KRS S2019-2023 (inclusive)
SOIL LIMITATIONS:	The main limitation to use is poor drainage. Exchangeable potassium is low and trace elements should be checked because of the high pH. Slope may be a limiting factor in some places.

## Typifying Profile

SOIL NAME: Naweni soils, flat to undulating phase.  
PROFILE No.: W22  
SITE LOCATION: Refer soil map of Wainigata Agricultural Research Station (Purdie, 1986).

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Colluvial toeslope in hill country.  
PARENT MATERIAL: Colluvium from strongly weathered basic rocks.  
SLOPE: 2°  
ASPECT: North-east  
ELEVATION: 10 m  
MICRORELIEF: Flat  
SITE VEGETATION: Coconuts  
LAND USE: Coconut plantation  
DRAINAGE: Poorly drained  
EROSION: None observed  
DISTURBANCE: None observed  
LABORATORY Nos: KRS S1996-2001 (inclusive)

### PROFILE DESCRIPTION

Naweni soils, flat to undulating phase

Ah	0-10 cm (10 cm)	Black (10YR 2.1) sandy clay loam; friable; sticky; plastic; weakly developed medium blocky structure breaking to weakly developed fine crumb; many very fine to fine roots.
AB	10-21 cm (11 cm)	Very dark greyish brown (2.5Y 3/2) clay loam; friable to firm; sticky; plastic; moderately developed fine blocky structure breaking to weakly developed very fine and fine nut; few faint clay cutans (2.5Y 3/2); common very fine roots; few strongly weathered subangular gravels (basic rock).
Btg1	21-54 cm (33 cm)	Dark greyish brown (2.5Y 4/2) clay loam; friable to firm; sticky; plastic; moderate to strongly developed fine and medium blocky structure breaking to moderately developed very fine and fine nut; common distinct clay cutans (5Y 3/2); common very fine roots; few strongly weathered subangular gravels (basic rock).
Btg2	54-82 cm (28 cm)	Dark greyish brown (2.5Y 4/2) sandy clay loam; friable to firm; sticky; plastic; moderately to strongly developed fine and medium blocky structure breaking to moderately developed very fine and fine nut; few fine faint mottles (7.5YR 5/6); common distinct clay cutans (5Y 4/2); few very fine roots; few subangular gravels,



Btr

82-120cm  
(38 cm)

Dark greenish grey (5BG 4/1) clay loam; friable to firm; sticky; plastic; moderately to strongly developed fine and medium blocky structure breaking to moderately developed very fine and fine nut; common fine faint mottles (7.5YR 5/6); common distinct clay cutans (5B 4/1); few very fine roots.

## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nayau series**

REFERENCE: Nayau loam (25c) defined by Twyford & Wright (1965) as a red loam latosolic soil from limestone materials developed under a climate with a weak to moderate dry season. Forms part of the Cikobia set.

In this survey the soil moisture regime for Nayau soils is restricted to ustic, otherwise the central concept for these soils as previously defined is retained.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Ustropept, fine, ferruginous, isohyperthermic
- (b) FAO: Ferralic Cambisol
- (c) Twyford and Wright: Latosolic soil with a moderate dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nayau soils (81)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Central part of the central depression of Kabara Island.

PARENT ROCK: Limestone

PARENT MATERIAL: Strongly weathered residuum over hard unweathered rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Limestone plateau, i.e. raised coral reef.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: Mainly agave species with very poor coconut palms scattered through. Have been severely burnt over in the past.

RANGE OF ELEVATION: 55-65 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: No erosion risk.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 1.5 cm of round hardened clay peds of reddish grey colour at the surface overlying 12 cm of reddish brown friable loamy clay of moderate medium granular structure overlying 45 cm of dark red very friable lay of massive structure breaking readily to weak fine blocky and with or without fine gravels of baked clay on hard limestone.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the topsoil (1.5-14 cm) to be neutral and the Bw horizon (14-59 cm) to be slightly alkaline; organic carbon and nitrogen have medium values in the topsoil, and very low values in the Bw horizon and the C/N ratio is low; % base saturation is high in the topsoil and very high below it; CEC is very high in the topsoil and medium below it; exchangeable calcium and magnesium have very high values in the topsoil and high values 14-59 cm; and potassium is low in the topsoil and low below it.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is ferruginous.</p>
LABORATORY Nos:	ORSTOM K11-12
SOIL LIMITATIONS:	Rapid permeability; profile shallowness; soil moisture deficits experienced during the dry season; odd surface boulder and limestone outcrop; nutrient deficiencies of potassium and phosphorus; and high pH that may cause some trace element deficiencies.

## Typifying Profile

SOIL NAME: Nayau soils  
PROFILE No.: K1  
SITE LOCATION: Between Naikeleyaga and Tokalau in the centre of Kabara Island.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Flat surface on uplifted coralline limestone plateau.  
PARENT MATERIAL: Strong weathered residuum over hard limestone.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 60 m  
MICRORELIEF: Smooth. Odd limestone boulder on the surface.  
SITE VEGETATION: Cleared land under coconuts.  
LAND USE: Copra production  
DRAINAGE: Very well drained.  
EROSION: None  
DISTURBANCE: Cultivated  
LABORATORY Nos: ORSTOM K11-12

### PROFILE DESCRIPTION

Ah1c	0-1.5 cm (1.5 cm)	Reddish grey (10R 5/1) round hardened clay concretions; sharp smooth boundary,
Ah2	1.5-14 cm (12.5 cm)	Moist; reddish brown (2.5YR 4/4) loamy clay; moderately developed medium granular structure; friable; abundant medium and fine fibrous roots; many pores; distinct smooth boundary,
Bw	14-59 cm (45 cm)	Moist; dark red (2.5YR 3/6) clay; massive breaking to weak fine blocky structure; very friable; abundant medium and fine fibrous roots; few small iron/manganese gravels; sharp wavy boundary,
R	on	Hard <i>in situ</i> limestone, though somewhat friable in the upper 10 cm.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nika series**

REFERENCE: Nika clay defined by Twyford and Wright (1965) as a gley soil related to nigrescent soil with a strong dry season.

The central concept for Nika soils is retained in this survey.

CLASSIFICATION:

- (a) Soil Taxonomy: Udic Haplustert, fine, smectitic, isohyperthermic
- (b) FAO: Pellic Vertisol
- (c) Twyford and Wright: Gley soil related to nigrescent soils with a strong dry season

INCLUDING MAPPING UNITS AND PHASES:

Nika soils (54)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nika soils occur in widely scattered but small patches throughout the dry zone of Vanua Levu. Mapped in association with Emuri soils on Viti Levu.

PARENT ROCK: Tufts and marls of basic and intermediate composition.

PARENT MATERIAL: Strongly weathered colluvium and alluvium.

PHYSIOGRAPHIC POSITION/LANDFORM: Valley bottoms (underfit) in moderately dissected hill country.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°).

VEGETATION AND LAND USE: Wire grass with rushes and sedges in very wet sites; Guava and scattered tall forest trees. Very rough grazing for cattle. Used for pulse crops and rainfed rice in some areas.

RANGE OF ELEVATION: 10-150 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
wet season range: 400-500 mm;  
dry season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Poorly drained

PERMEABILITY CLASS: Very slow in wet season; rapid in dry season due to cracking (but very slow through peds).

FLOODING: Occasional every 1 in 5 years.

EROSION: Depositional landform. Some soil loss from gilgai microrelief during wet season.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically show 20 cm of black clay loam, of strongly developed medium blocky structure, firm, slightly sticky and non-plastic when moist, and displaying vertical cracking when the soil is dry, overlying 60 cm of dark brown and dark reddish-brown faintly mottled clay loam, firm, with well expressed slickensides, vertical cracking, and of strongly developed prismatic structure, overlying more than 40 cm of grey mottled strong brown clay loam (often sandy), firm, and of massive structure (rarely weak coarse blocky structures). Buried topsoils can occur at depths ranging from 80-120 cm in some profiles.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. All profiles examined show little variation in their profile features to that described.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	Emuri series: Develop in toeslope positions in association with Nika soils; less intensely mottled subhorizons; vertic properties markedly less expressed.
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Moderately acid soil with very high base status; extremely high values in all horizons for calcium and magnesium; low in potassium; high in sodium; organic carbon is medium for topsoils but very low in all other horizons.  The particle size family class is fine.  Mineralogy class is smectitic.
LABORATORY Nos:	KRS R2644-2650, SB 9676 A-D
SOIL LIMITATIONS:	Wet season subsoil waterlogging; extreme soil moisture deficits during the dry season; extreme difficulties of cultivation due to the vertic properties that are expressed when the soil is dry; the shrink-swell (montmorillonite) nature of the clays and the overall high clay content; deficiencies of phosphorus and nitrogen; and the likely trace element imbalances due to slight alkalinity in the subsoils.

## Typifying Profile

SOIL NAME: Nika soils  
PROFILE No.: N 91  
SITE LOCATION: Nawaicoba Agricultural Research Station, Viti Levu.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Planar valley floor (15 m width) in moderately dissected hill country.  
PARENT MATERIAL: Alluvium derived from andesite rock .  
SLOPE: 1°  
ASPECT: Not applicable  
ELEVATION: 130 m  
MICRORELIEF: Gilgai, with 25 cm amplitude to hummocks.  
SITE VEGETATION: Wire grass and guava.  
LAND USE: Rough grazing for beef cattle.  
DRAINAGE: Imperfectly drained.  
EROSION: The vertic and self-munching properties cause the hummocky microrelief that results in exposure of soil on hummock tops that can then be washed away during the wet season.  
DISTURBANCE: None observed  
LABORATORY Nos: KRS R 2644-2650, SB 9676 A-D

### PROFILE DESCRIPTION

Ah	0-20 cm (20 cm)	Slightly moist; black (5YR 2/1) clay loam; strongly developed, coarse blocky structure with strong fine blocky structure in upper 3 cm; firm; slightly sticky; slightly plastic; common faint black (5YR 2/1) slickensides to peds; cracks (> 1 cm) between peds; few medium roots; peds extremely firm; indistinct smooth boundary,
Bw1	20-45 cm (25 cm)	Dry; dark reddish brown (5YR 3/4) clay loam; moderate to strongly developed coarse blocky structure; pronounced vertical cracks between peds giving a pseudo-prismatic appearance; very firm; slightly sticky; slightly plastic; common distinct dark reddish-brown (5YR 2/2) slickensides to ped faces; structural aggregates tilted relative to soil surface; few fine medium roots; indistinct smooth boundary,
Bw2	45-81 cm (36 cm)	Slightly moist; dark brown (7.5YR 4/4) clay loam; few fine faint strong brown (7.5YR 4/6) mottles; moderately developed coarse blocky structure; firm; slightly sticky; slightly plastic; common distinct dark reddish-brown (5YR 2/2) slickensides to ped faces; common very fine roots; distinct smooth boundary,
BC	81-126+ cm (45+ cm)	Moist; grey (5Y 5/1) fine sandy clay loam; many prominent fine strong brown mottles; massive breaking to single grain; firm; non-sticky; non-plastic; no roots.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nuku series**

REFERENCE: The Nuku loamy sand (1c) defined by Twyford & Wright (1965) as a recent soil from coastal sands formed under a climate with a weak dry season.

Forms part of the Yasawa set.

This central concept for Nuku soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Tropopsamment, carbonatic, isohyperthermic
- (b) FAO: Cambic Arenosol
- (c) Twyford and Wright: Recent soil from coastal sands

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nuku soils (6)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nuku soils occur as a narrow discontinuous strip along the windward coastline of Vanua Levu. They are of small area in Viti Levu.

PARENT ROCK: Reef coral

PARENT MATERIAL: Comminuted calcareous sand.

PHYSIOGRAPHIC POSITION/LANDFORM: Occur on coastal sand dune and beach strand.

SLOPE CLASS AND RANGE OF SLOPES: Flat to near level (0-2°).

VEGETATION AND LAND USE: Commonly coconuts with rough under grazing by cattle.

RANGE OF ELEVATION: 2-4 m

RAINFALL: Annual average range: 3,200-4,800 mm;  
dry season range: 800-1,600 mm;  
wet season range: 1,800-2,800 mm.

TEMPERATURE: Mean annual: 24°C.

SOIL MOISTURE REGIME: Udic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Somewhat excessively drained.

PERMEABILITY CLASS: Rapid

FLOODING: Never floods

EROSION: Generally no erosion risk. May experience some surface scouring in places during hurricane events.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of very dark grey loose loamy sand, of weakly developed fine nutty structure with single grain, overlying 40 cm of light yellowish brown loose coarse sand, of single grain, and commonly with faint dark greyish brown organic cutans, overlying more than 60 cm of very pale brown loose coarse sand and of single grain.
DIAGNOSTIC HORIZONS:	Ochric epipedon
RANGE OF PROFILE FEATURES:	Not applicable. Apart from slight differences in the thickness of the Ah horizon (ranges 5-15 cm) profiles show no variation in other profile features to that described above.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Chemical analysis for Nuku soils shows they have moderately alkaline topsoils with strongly alkaline reaction in subsoils; available phosphorus is high in the A horizon, very low in the C1 and low in the C2; carbon and nitrogen are low in the topsoil and very low in the subsoil; exchangeable calcium is very high, potassium is very low, magnesium values high in the topsoil and medium in the subsoil, and sodium is high in the topsoil and medium in the subsoil; TEB and % base saturation are very high; CEC is very high in the topsoil and high in the subsoil; SAR varies from 0.17-0.27 and ESP varies from 1.38-1.70.</p> <p>The mineralogical class is carbonatic.</p>
LABORATORY Nos:	KRS S2080-2082
SOIL LIMITATIONS:	Rapid permeability; dry season soil moisture deficits; high soil alkalinity that may cause trace element deficiencies or imbalances; and nutrient deficiencies of phosphorus, nitrogen or potassium.

## Typifying Profile

SOIL NAME: Nuku soils  
PROFILE No.: V2  
SITE LOCATION: Approximately 80 m from the coast and 110 m east of the main Vunilagi Estate road.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Coastal dune  
PARENT MATERIAL: Comminuted white calcareous sand.  
SLOPE: Flat  
ASPECT: Not applicable  
ELEVATION: 3 m  
MICRORELIEF: Even  
SITE VEGETATION: Grass under coconuts.  
LAND USE: Coconut plantation (copra) and cattle grazing.  
DRAINAGE: Somewhat excessively drained.  
EROSION: None observed  
DISTURBANCE: None  
LABORATORY Nos: KRS S2080-2082

### PROFILE DESCRIPTION

Ah	0-10 cm (10 cm)	Moist; very dark grey (10YR 3/1) loamy sand; loose; firm penetration; single grain with weakly developed fine nutty structure; rapid permeability; many fine roots; distinct wavy boundary,
C1	10-48 cm (38 cm)	Moist; light yellowish brown (10YR 6/4) coarse sand; loose; stiff penetration; single grain; rapid permeability; a few faint dark greyish brown (10YR 4/2) organic cutans; common very fine roots; indistinct boundary,
C2	48-109+ cm (61+ cm)	Moist; very pale brown (10YR 7/4) coarse sand; loose; firm penetration; single grain; rapid permeability; few very fine roots.



## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nukudamu series**

REFERENCE: Nukudamu sandy clay loam (42c) and Nukudamu hill soils (42cH) defined by Twyford & Wright (1965) as soils formed under a climate with a strong dry season from acid and quartz-rich tuffs on rolling and hilly land and normally supporting 'talasiga' vegetation.

Forms part of the Wainikoro set.

This central concept for Nukudamu soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Ustic Dystropept, fine, kaolinitic, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Red yellow podzolic with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nukudamu soils, flat to gently undulating phase (141A)    Nukudamu soils, easy rolling phase (141C)  
Nukudamu soils, undulating phase (141B)                      Nukudamu soils, rolling phase (141D)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Nukudamu soils are developed mainly in north-eastern Vanua Levu, on and in the vicinity of the Udu peninsula.

PARENT ROCK: Acid and quartz-rich tuffs.

PARENT MATERIAL: Deep strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LANDFORM: Convex midslopes and backslopes in rolling and hilly land.

SLOPE CLASS AND RANGE OF SLOPES: Flat to gently undulating (0-3°), undulating (4-7°), easy rolling (8-11°) and rolling (12-15°).

VEGETATION AND LAND USE: Some subsistence root crops but mainly unused supporting 'talasiga' vegetation.

RANGE OF ELEVATION: 20-150 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderately rapid

FLOODING: Never floods

EROSION: Have experienced serious past topsoil losses related to repeated burning. Moderate to severe sheet and rill erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm of red friable clay loam of moderately developed fine nut structure, overlying 60 cm of red friable sandy clay loam of moderately developed medium blocky and granular structure overlying more than 50 cm of yellowish red friable clay loam of moderately developed blocky structure, commonly with clay cutans to ped faces.
DIAGNOSTIC HORIZONS:	Ochric epipedon, cambic horizon.
RANGE OF PROFILE FEATURES:	<p>Nukudamu series have a A, Bt1, Bt2 etc. horizon sequence.</p> <p>The A horizon thickness ranges from 10 to 15 cm; its colours include dusky red (2.5YR 3/2), reddish brown (2.5YR 4/4) and red (2.5YR 4/6, 4/8); textures may be sandy clay loam, silty clay and clay loam; consistence friable or firm; and structures are weak or moderate fine or medium nutty.</p> <p>The Bt horizon in combination range from 40 to 70 cm; their colours include dark red (2.5YR 3/6) red (2.5YR 4/6, 4/8, 5/8 and 10R 4/6, 4/8); textures are sandy clay or sandy clay loam; structures are weak or moderate, fine or medium, blocky, nut or granular; and clay cutans if present are weakly expressed.</p> <p>The Bt3 or 4 horizon thickness ranges from 30 to 60 cm; its colours included yellowish red (5YR 4/6, 4/8, 5/8), red (2.5YR 4/6, 4/8, 5/8) or weak red (10R 4/4, 5/4); textures are clay, clay loam or silty clay; and structures are weak or moderate medium or coarse blocky.</p>
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	<p>Analysis shows the topsoil (0-13 cm) as extremely acid, and strongly acid in the other horizons; organic carbon is very low, and nitrogen is high in the A horizon; available phosphorus is very low; % base saturation is low; CEC medium; exchangeable calcium and potassium are very low; magnesium very high; and aluminium is significant in the exchange complex.</p> <p>The particle size family class is fine.</p> <p>The mineralogical class is kaolinitic.</p>
LABORATORY Nos:	USP SQCTA-E
SOIL LIMITATIONS:	Moderately rapid permeability; severe soil moisture deficits experienced during the dry season; past erosion and severe potential rill and sheet erosion on slopes >3°; strong soil acidity; probable aluminium toxicity; and nutrient deficiencies of phosphorus and potassium.

## Typifying Profile

SOIL NAME: Nukudamu soils, undulating phase.

PROFILE No.: SQCT

SITE LOCATION: Seaqqa Forest, Bua Province.

### SITE INFORMATION

POSITION IN LANDSCAPE/LANDFORM: Convex midslope position in moderately dissected hill country.

PARENT MATERIAL: Strongly weathered *in situ* acid tuff.

SLOPE: 5° (100 m length).

ASPECT: West

ELEVATION: 120 m

MICRORELIEF: Flat

SITE VEGETATION: Talasiga vegetation comprising bracken fern and Nokonoko.

LAND USE: Unused

DRAINAGE: Well drained

EROSION: None observed

DISTURBANCE: None. Dead woody root rotting in the Bt3 horizon (53-79 cm).

LABORATORY Nos: USP SQCTA-E

### PROFILE DESCRIPTION

Ah	0-13 cm (13 cm)	Moist; moist rubbed red (2.5YR 4/8); clay loam; moderately developed fine and medium nut structure; friable to firm; non sticky; non plastic; many fine medium and coarse roots; distinct smooth boundary,
Bt1	13-29 cm (16 cm)	Moist; moist and rubbed red (2.5YR 4/8) sandy clay loam; weak to moderately developed medium blocky structure breaking to weak fine granular; friable; non sticky; non plastic; many fine and medium roots; indistinct smooth boundary,
Bt2	29-53 cm (24 cm)	Moist; moist and rubbed red (2.5YR 4/8) sandy clay loam; weakly developed medium granular structure breaking to weak fine granular; friable; non sticky; non plastic; few fine and coarse roots; indistinct smooth boundary,
Bt3	53-79 cm (26 cm)	Moist; moist rubbed red (10R 4/8) sandy clay loam; moderately developed coarse blocky structure breaking to moderate medium nut; friable; non sticky; non plastic; few roots; distinct smooth boundary,
Bt4	79-110+ cm (31 cm+)	Moist; moist rubbed yellowish red (5YR 5/8) clay loam; moderately developed coarse blocky structure breaking to medium nut structure; friable; non sticky; non plastic; few very fine roots.





## SOIL TAXONOMIC UNIT DESCRIPTION

### Reference/classification

SOIL NAME: **Nukusa series**

REFERENCE: Nukusa sandy clay loam (42a) and Nukusa hill soils (42aH) defined by Twyford and Wright (1965) as formed from quartz rich acid tuffs or tuffaceous sandstone, commonly supporting talasiga vegetation and under a climate with a strong dry season.

Forms part of the Wainikoro set.

The central concept for Nukusa soils is retained in this survey.

#### CLASSIFICATION:

- (a) Soil Taxonomy: Typic Dystropept, fine-loamy, kaolinitic, isohyperthermic
- (b) FAO: Dystric Cambisol
- (c) Twyford and Wright: Red yellow podzolic soil with a strong dry season

#### INCLUDED MAPPING UNITS AND SYMBOLS:

Nukusa soils, undulating phase (142B)	Nukusa soils, rolling phase (142D)
Nukusa soils, easy rolling phase (142C)	Nukusa soils, strongly rolling phase (142E)

### Environmental Factors

GEOGRAPHICAL DISTRIBUTION: Occur mainly on the Dogotuki peninsula and is of limited distribution on Viti Levu.

PARENT ROCK: Quartz rich acidic tuffs or tuffaceous sandstone.

PARENT MATERIAL: Strongly weathered *in situ* rock.

PHYSIOGRAPHIC POSITION/LAND FORM: Convex slopes in rolling and hilly land.

SLOPE CLASS AND RANGE OF SLOPES: Undulating (4-7°), easy rolling (8-11°), rolling (12-15°), and strongly rolling (16-20°).

VEGETATION AND LAND USE: Talasiga vegetation (nokonoko, qiri, doi and usi) or where repeatedly burnt nokonoko and ground fern predominate.

RANGE OF ELEVATION: 20-300 m

RAINFALL: Annual average range: 1,800-2,400 mm;  
dry season range: 400-500 mm;  
wet season range: 1,400-1,800 mm.

TEMPERATURE: Mean annual: 25.5°C.

SOIL MOISTURE REGIME: Ustic

SOIL TEMPERATURE REGIME: Isohyperthermic

SOIL DRAINAGE CLASS: Well drained

PERMEABILITY CLASS: Moderate

FLOODING: Never floods

EROSION: Severe past erosion and repeatedly burnt. Very severe sheet and rill erosion potential.

## Morphological and Chemical Properties

CHARACTERISTIC PROFILE FEATURES:	Typically shows 10 cm very dark grey firm sandy clay loam of moderate medium and crumb structure overlying 20 cm of yellowish red very firm sandy clay of weak coarse prismatic structure breaking to medium blocky and with clay/organic cutans to ped faces, overlying 30 cm yellowish red very friable sandy loam of massive structure breaking to weak nut, on 30 cm or more of yellow and brownish yellow friable loam of massive structure breaking to single grain.
DIAGNOSTIC HORIZONS:	Ochric epipedon cambic horizon.
RANGE OF PROFILE FEATURES:	Not applicable. Only two profile descriptions made.
VARIANTS:	None recognised
SIMILAR SOILS AND DISTINGUISHING FEATURES:	None recognised
GENERAL CHEMICAL, PHYSICAL & MINERALOGICAL PROPERTIES:	Nukusa soils are strongly acid and of very low nutrient content.
LABORATORY Nos:	KRS 9211136-38
SOIL LIMITATIONS:	Seasonal moisture deficits; soil acidity; low fertility; and susceptibility to erosion.

## Typifying Profile

SOIL NAME: Nukusa soils, rolling phase.  
PROFILE No: VS 24  
SITE LOCATION: Togovere district, Nadroga Province.

### SITE INFORMATION

POSITION IN  
LANDSCAPE/LANDFORM: Convex midslope in rolling country.  
PARENTAL MATERIAL: Weathered acidic tuffs.  
SLOPE: 15°  
ASPECT: East  
ELEVATION: 120 m  
MICRORELIEF: Smooth  
SITE VEGETATION: Short grass and stunted shrubs.  
LAND USE: Rough grazing  
DRAINAGE: Well drained  
EROSION: Minor sheet erosion.  
DISTURBANCE: None  
LABORATORY Nos: KRS 9211136-38

### PROFILE DESCRIPTION

Ah	0-10 cm (10 cm)	Moist; very dark grey (10YR 3/1) sandy clay loam; few with fine mottles; moderate medium granular structure breaking to weakly developed fine crumb; firm; slightly sticky; slightly plastic; common fine roots; diffuse irregular boundary,
Bw1	10-30 cm (20 cm)	Moist; yellowish red (5YR 5/6) and (5YR 5/8) sandy clay; weakly developed coarse prismatic structure breaking to medium blocky structure; very firm; sticky; slightly plastic; common fine roots; distinct clay and organic cutans; diffuse irregular boundary,
Bw2	30-60 cm (30 cm)	Moist; yellowish red (5YR 5/6) sandy loam; massive structure breaking to weakly developed medium nut structure; very friable; non sticky; non plastic; common fine roots; diffuse irregular boundary,
Bw3	60-90 cm (30 cm)	Moist; yellow (10YR 7/6) and brownish yellow (10YR 6/6) loam; massive structure breaking to single grain with medium blocky structure; friable; non sticky; non plastic; few very fine roots; diffuse and irregular boundary,
C	90-120 cm (30 cm)	Moist; very pale brown (10YR 8/4) loamy sand; massive structure breaking to singly grain; very friable; non sticky; non plastic.



