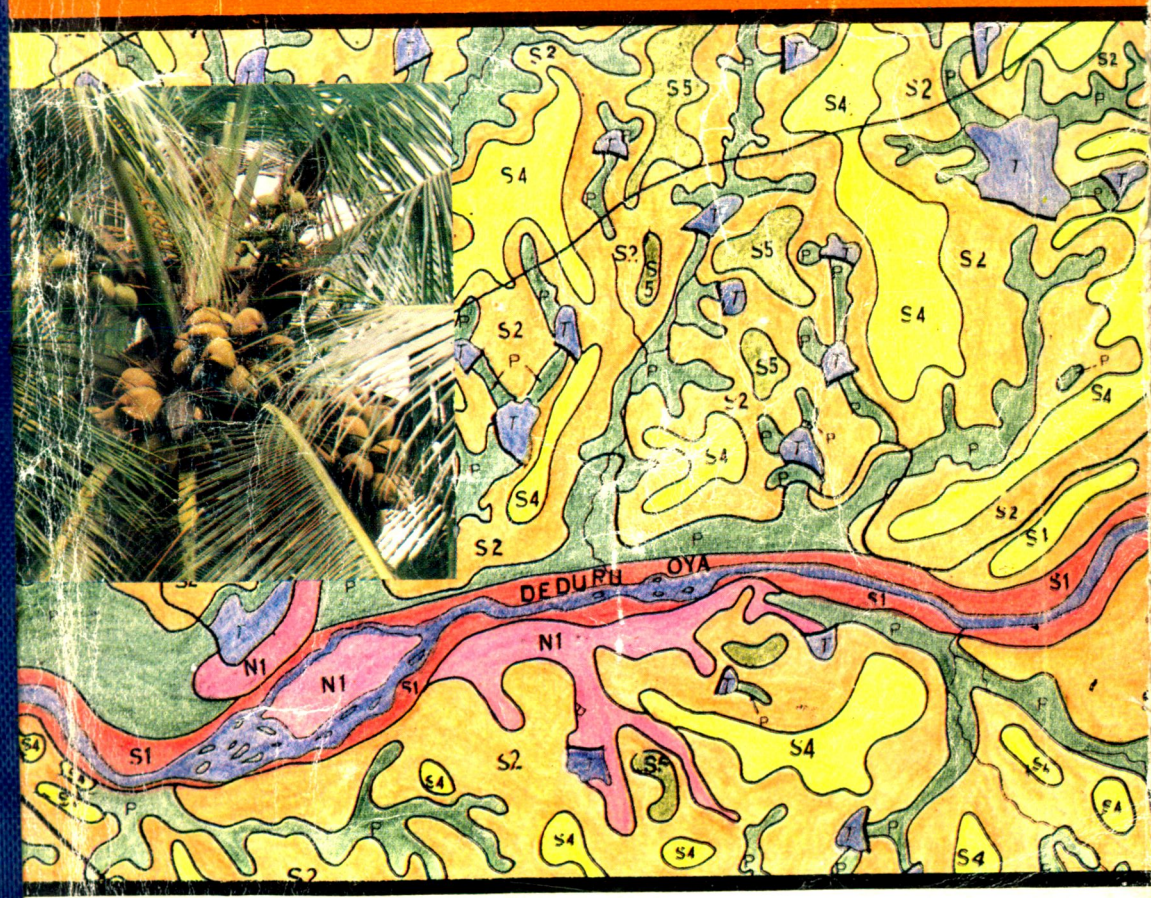
Occasional Publication Series No. 3

LAND SUITABILITY ASSESSMENT OF COCONUT GROWING AREAS IN THE COCONUT TRIANGLE

L. W. Somasiri, N. Nadarajah, L. Amarasinghe and H. A. J. Gunathilake



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Land Suitability Assessment of Coconut Growing Areas in the Coconut Triangle

by

L. L. W. Somasiri
(Soil Scientist, Coconut Research Institute of Sri Lanka)

N. Nadarajah
(Soil Survey Consultant to the Coconut Research Institute of Sri Lanka)

L. Amarasinghe
(Soil Survey Consultant to the Coconut Research Institute of Sri Lanka)

H. A. J. Gunathilake
(Agronomist, Coconut Research Institute of Sri Lanka)

Editors: **R. Mahindapala** Ph D.
and
C. R. Panabokke Ph D

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FOREWORD

Coconut is ubiquitous in Sri Lanka with a large area in the North Western Province. There is a general belief that coconut can be grown in any part of the low and mid-country. Many grow it as a homestead crop, irrespective of whether or not soil and climatic conditions are quite appropriate, and without any consideration to its productivity.

This work to characterize and classify the diverse kinds of coconut-growing areas of the 'coconut triangle' can be considered a landmark study by the Coconut Research Institute of Sri Lanka. For the first time, an assessment of the potential of the area covered by the 'coconut triangle' has been attempted, based on the soil and climatic data. This land suitability study offers for the first time, an assessment of the potential of the land, and it is now possible for the policy maker to selectively concentrate the development assistance in those areas likely to give maximum returns. This would indeed be a handy reference work for the extension personnel, who would be able to guide and advise the growers about the level of production that is possible - which in turn would help them a great deal on deciding on investment not only for coconut but also for intercropping.

This study will also benefit the growers and managers of existing plantations. They will perhaps be surprised to know the diversity of suitability conditions within relatively small areas and that only a very limited area falls within the category of 'high' potential or S_1 lands. They would now be able to have a realistic assessment of the yields that are possible. More importantly, it is hoped that plantation managers will use this information to rationalize inputs by concentrating on areas that require costly agronomic practices. By that, he could reduce the all-important Cost of Production.

As the study progressed, it became abundantly clear that the soil and climatic factors could be meaningfully related to the yield. Also, it was obvious that a standard package of agronomic practices cannot be applied across all coconut-growing lands. Perhaps only a few adaptive research trials are all that is required now to prove that some of the costly agronomic practices are superfluous in the better soils.

This study is a good example of productive research-results of very practical use have been obtained with minimal funding, and it provides the basic information for a proper exploitation of the different types of coconut-growing lands.

The team of scientists led by Dr L L W Somasiri and ably assisted and

professionally advised by Vidya Jyothi Dr C R Panabokke, who devoted much of his valuable time on this project, should be congratulated for this pioneering work. It is hoped that the other main coconut growing areas in the country will also be similarly covered.

It is my fervent hope that the information generated from this study will be used to the maximum extent possible, particularly by the policy makers, extensionists and the professional planters and that a re-orientation of the development policies will follow.

Ranjith Mahindapala
Director

Coconut Research Institute
Lunuwila
Sri Lanka

28 February, 1994

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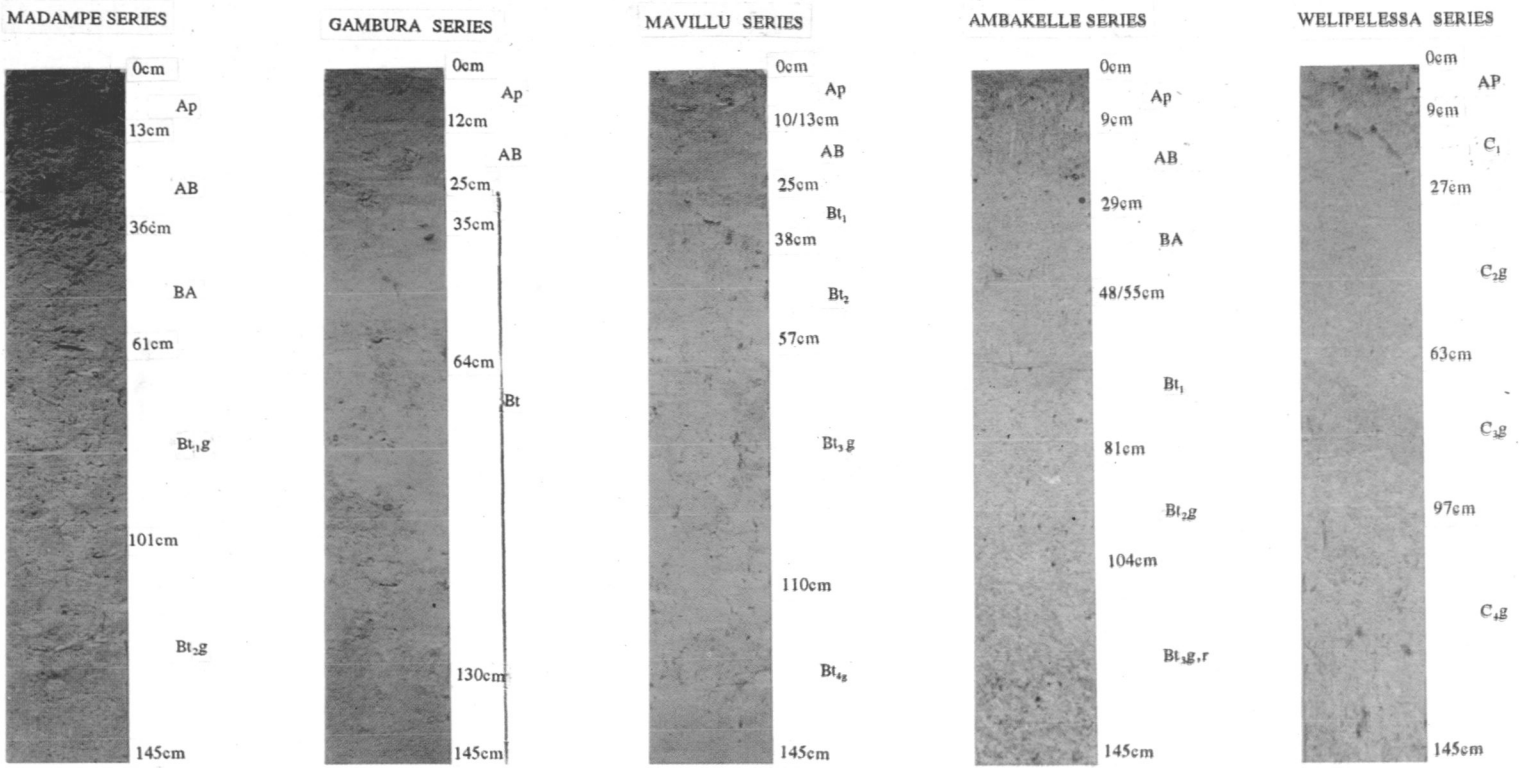

PLATE 1 : PROFILES OF SOME WIDESPREAD COCONUT SOILS

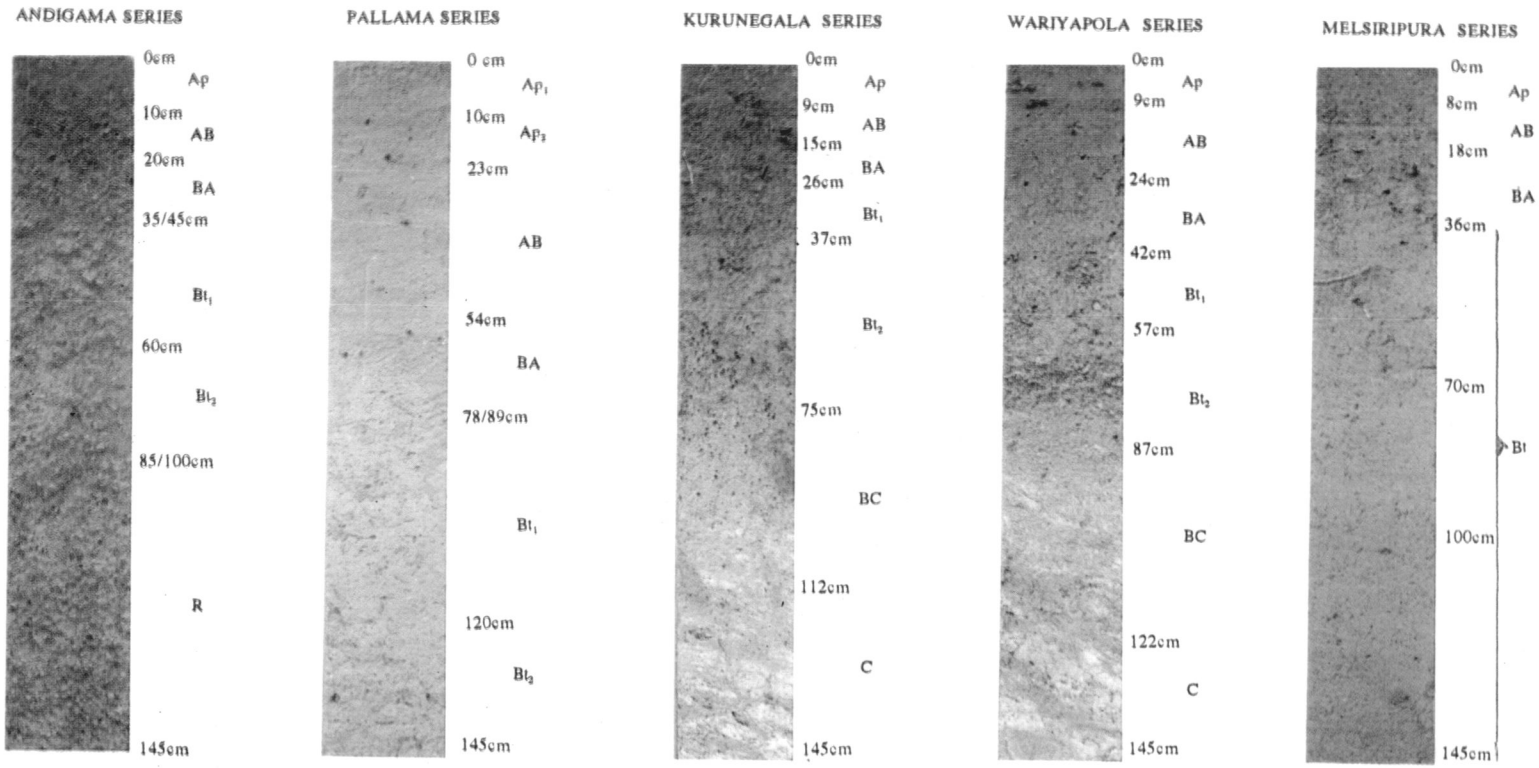

PLATE 2 : PROFILES OF SOME WIDESPREAD COCONUT SOILS

The related soils and land suitability maps

Soil maps (one inch to one mile)

1. Kalpitiya
2. Puttalam
3. Battulu Oya
4. Chilaw
5. Wariyapola
6. Dandagamuwa
7. Gampaha
8. Avissawella
9. Nalanda

Land Suitability Maps (one inch to one mile)

1. Kalpitiya
2. Puttalam
3. Battulu Oya
4. Chilaw
5. Negombo
6. Wariyapola
7. Dandagamuwa
8. Gampaha
9. Avissawella
10. Nalanda

The above maps are available at the Coconut Research Institute of Sri Lanka. For furthur information, please contact the Director, Coconut Research Institute, Lunuwila.

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CHAPTER 1
INTRODUCTION AND OVERVIEW

The total extent under coconut in the country is 416,253 ha.(CDA, 1991). Yet the total extent of **pure coconut stand** is estimated at approximately 323,887 ha. (Dimantha 1988). The "**coconut triangle**" refers to the main coconut growing areas in the **North Western province** and a part of the **Western province** (north of the Kelani river). The coconut triangle has 248,405 ha. or around 75 percent of the country's coconut growing lands (excluding coconut in the mixed stands and home gardens), and this is situated almost entirely within the Kurunegala, Puttalam and Gampaha districts. A small area is situated in the Kegalle district. According to the 'Present Land Use' maps, based on air photo interpretation, prepared by the Survey Department in 1984, the respective extents of pure coconut stand in these districts are given in Table 1.

Table 1 Estimated extent of pure coconut stands in different Districts*

District	Extent (ha.)	Percentage
Kurunegala	165,250	67
Puttalam	47,376	19
Gampaha	25,000	10
Kegalle	10,779	4
Total	248,405	100

* Figures given in the Present Land Use maps of the Survey Department 1984.

Within this triangle, coconut is grown across three main agro-climatic zones, viz. the Dry zone, the Intermediate zone and the Wet zone. An agro-ecological **region** (AER) is a sub division of an agro-climatic **zone**. The AERs falling within the three agro-climatic zones in the coconut triangle are shown in Figure 1 and Table 2 (Agro-ecological Regions in Sri Lanka, 1979). The average monthly rainfall distribution for the period of 1907- 1956 in the respective agro-ecological regions is shown in Figure 2. (Report on a Survey of the Kelani-Aruvi Area, Ceylon, 1963; Annual Report of the Department of Meteorology, 1970).

Table 2 Agro-climatic Zones and Agro-ecological Regions (AERs) of the Coconut Triangle.

Agro-Climatic Zone	Agro-Ecological Region (AER)	Descriptive Terms Commonly Used
Dry	DL3	Latosol region (RYL) and Regosol region (REG) of the Dry Low country region.
	DL1	Dry Low country region.
Intermediate	IL3	Semi-dry Intermediate Low country region.
	IL1	Semi-wet Intermediate Low country region.
	IM3	Semi-dry Intermediate Mid country region.
Wet	WM3	Moderately Wet Mid country region.
	WL3&4	Moderately Wet Low country region.
	WL2	Wet Low country region.
	WL1	Very Wet Low country region.

The mean annual rainfall in the northern areas (Dry zone) of the coconut triangle is between 1000 mm to 1250 mm which can be regarded as the lower limit for coconut. However, solar radiation (or number of sunshine hours per day) in this area promotes high productivity when soil moisture is not limiting.

It should be noted that in the Dry zone coconut is confined mainly to the deep sandy soils (sandy Regosols) in the Kalpitiya peninsula; and also to the very

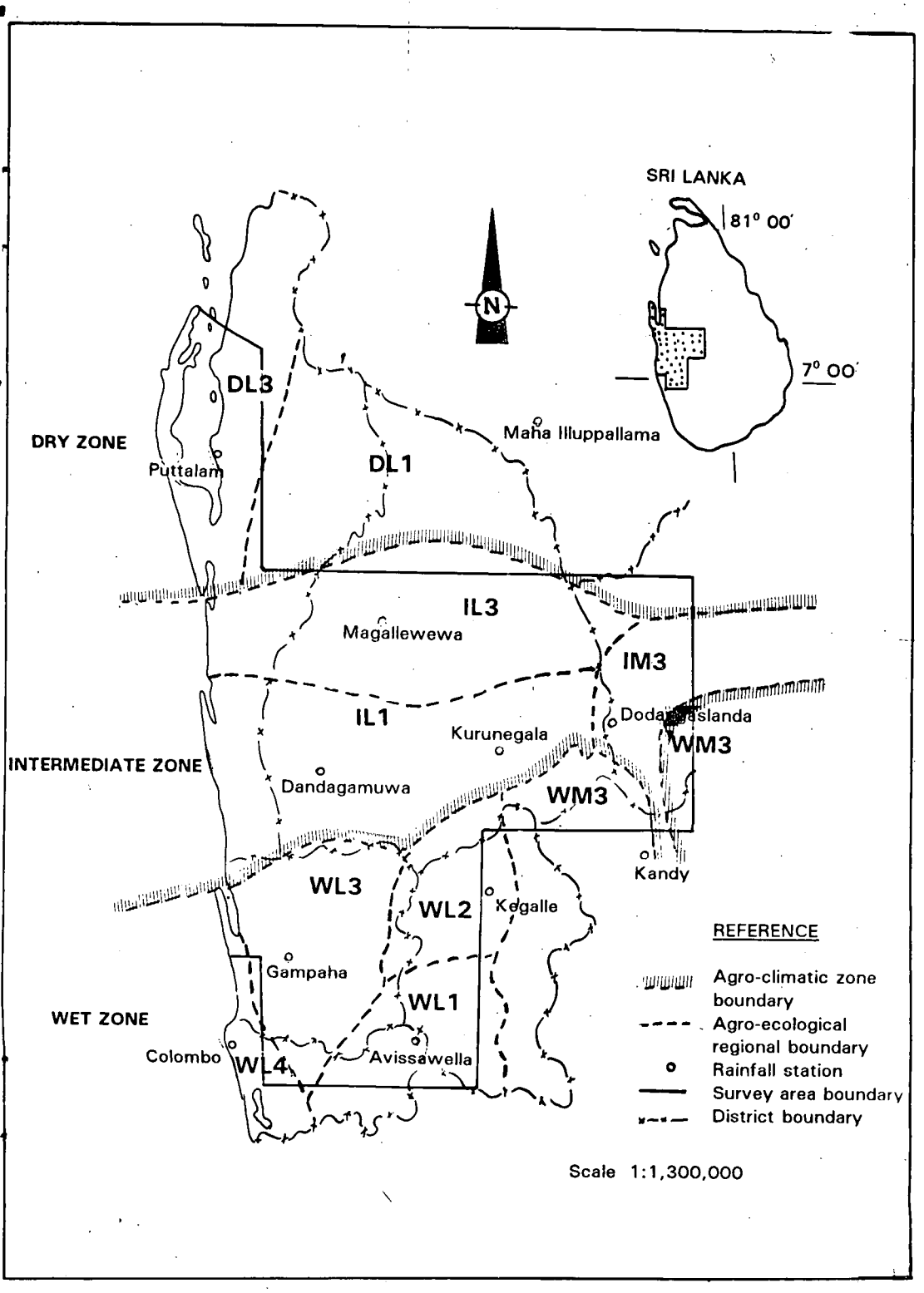

Figure 1. Map showing agro-ecological regions (AER) of the survey area

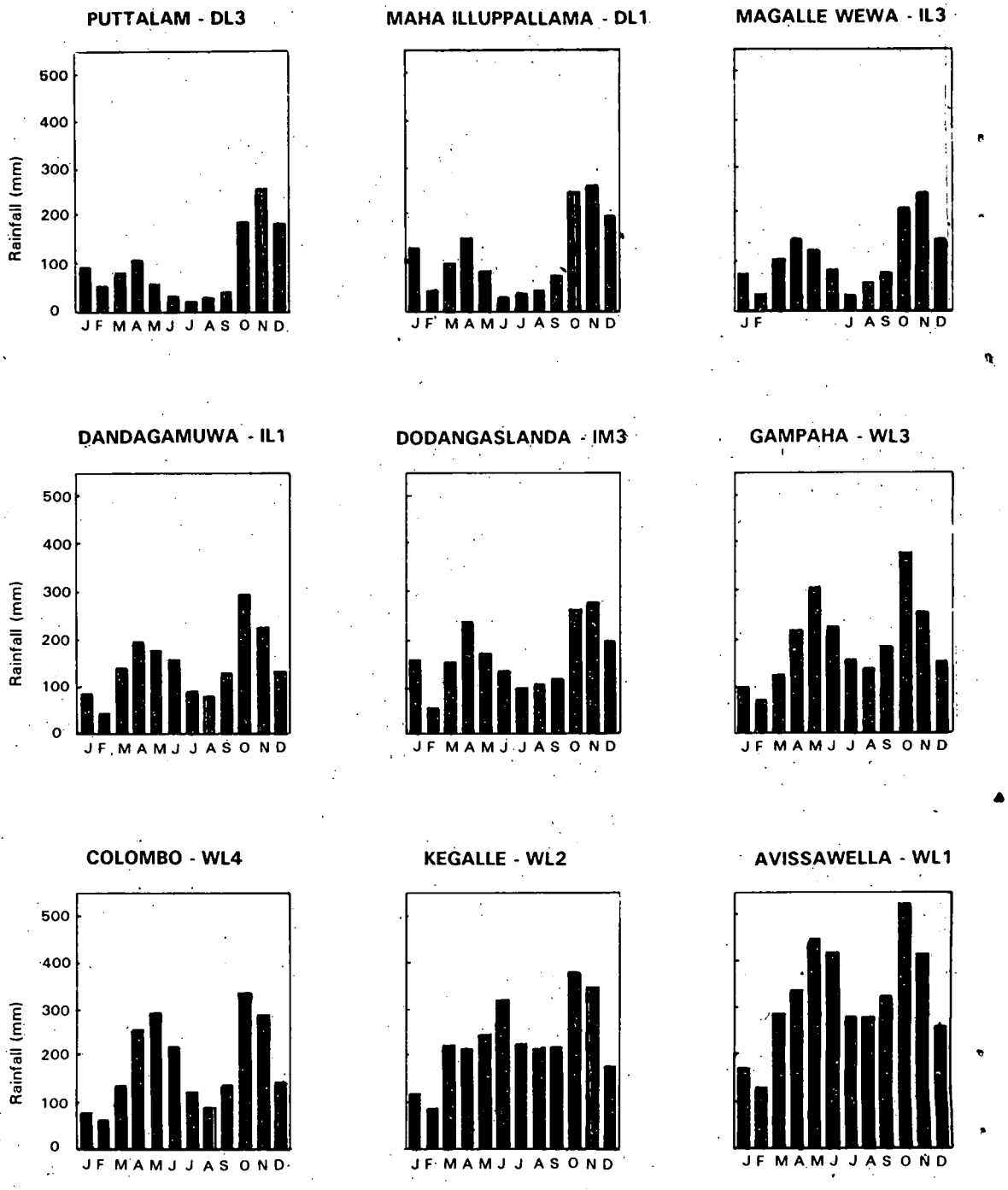

Figure 2. The monthly average rainfall distribution of different agro-ecological regions.

deep, coarse loamy textured soils (Red and Yellow Latosols) of the old coastal plain. Because the sandy Regosols have an underlying lens of fresh water, moisture is readily available to the coconut palm throughout the dry season. The Latosols on the other hand, are very deep and friable and have less run-off of rain water because of the high infiltration rate. As a result, sufficient quantity of moisture moves down and gets stored in the soil profile of Latosols; and the coconut roots can easily penetrate the friable soil and make use of this stored moisture during the dry season. Coconut performs poorly on other non-friable soils in the Dry zone such as the Reddish Brown Earths unless there is seepage from irrigation channels and tanks.

In the southern part (Wet zone) of the coconut triangle, the mean annual rainfall is between 2250 mm to 2500 mm which is quite adequate for coconut. But the solar radiation in these southern areas is lower than that in the northern areas. The central parts (Intermediate zone) of the coconut triangle have the best combination of rainfall and solar radiation for the performance of coconut.

Although coconut is presently grown across all these different agro-ecological regions (AERs), some of these AERs are ideally suitable for coconut while others are less ideally suitable. Furthermore, within an AER there could be different kinds of soils; some deep and coarse-textured, some shallow and gravelly, and others moderately deep and fine-textured. Obviously the productivity of the coconut palm will be different on these different kinds of soils or coconut growing lands even within each AER. The main task of this study therefore, was to identify, characterize and demarcate these different kinds of coconut growing lands according to their potential, and then to rank them according to their suitability into different classes.

The modern methods of land suitability assessment that have evolved in a systematic and scientific manner over the last 100 years, today constitute a powerful tool that could be used for several different requirements. Chief amongst these is that of assessing the suitability of the different kinds of lands with a view to ranking them according to their production potential.

In the chapters 2 and 3, the methodology that has been adopted in the assessment and demarcation of the different suitability categories of coconut lands, as well as their ranking from highly suitable through moderately suitable to unsuitable will be briefly outlined and explained.

CHAPTER 2.
THE SOILS, THEIR GENERAL PROPERTIES AND SCOPE OF THE SOIL SURVEY

2.1 Introduction

The first step in a land suitability assessment is to identify, characterize and map the different kinds of soils that occur throughout the coconut triangle. The soil survey was done according to the standard soil survey procedures established for Sri Lanka over the last 30 years.

The survey area consists of the entire area of Gampaha District, a major part of Kurunegala District and nearly one half of Puttalam District. It also includes portions of Matale, Kegalle and Colombo Districts as well. The survey area is covered by the following 1 inch to a mile topographic sheets published by the Survey Department (Figure 3).

(1) Kalpitiya(6) Wariyapola(11) Kurunegala
(2) Puttalam(7) Dandagamuwa
(3) Battulu-Oya (8) Gampaha
(4) Chilaw (9) Avissawella
(5) Negombo (10) Nalanda

The main purpose of the soil survey was to gather the basic information on soils for the purpose of land suitability evaluation for coconut. The soil can be considered one of the best indicators of the quality of the land because the soil profile integrates most of the components of the land namely climate, vegetation, geology, landscape, hydrology, topography and biological activity. Hence the rationale of using the soil profile information as the main basis for land suitability evaluation.

2.2 Previous work

The coconut triangle had been previously covered under the Kelani-Aruvi area survey (1963) by the Hunting Survey Corporation, Canada in collaboration with the Land Use Division formerly of the Department of Agriculture. The results of this work were published in two volumes under the title "A Report on a Survey of the Resources of Kelani-Aruvi area, Ceylon, Volumes I and II". A consolidated soil map on a scale of 1:250,000 titled "Soils of the Kelani-Aruvi Area" which shows the location and distribution of 'soil catenas' or 'associations

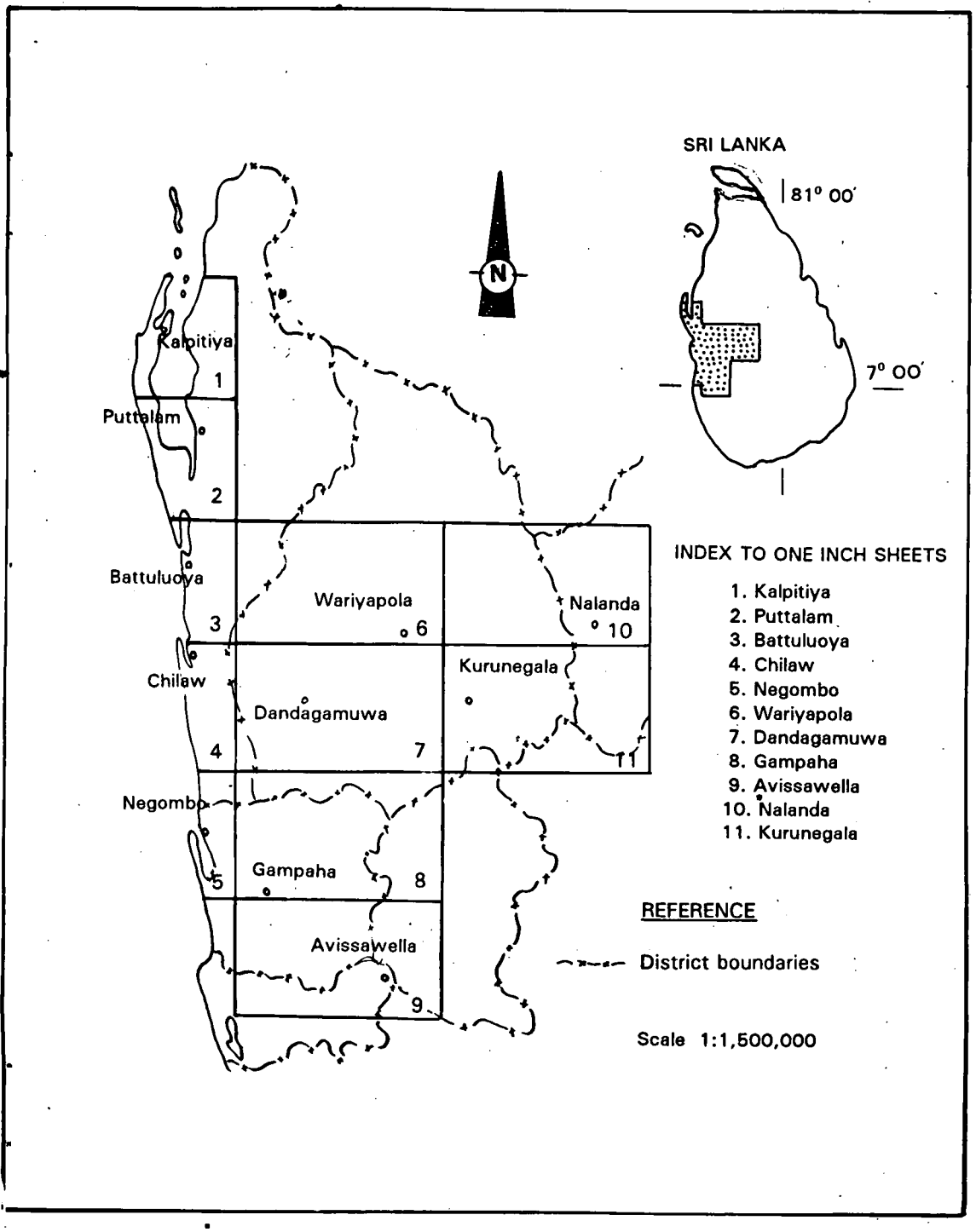

Figure 3. Location map for one inch sheets

of soil series' was also published along with these two volumes.

The soils of the Kelani-Aruvi area were grouped within the newly identified categories of the **Great Soil Group and Subgroup** according to the classification of Moormann and Panabokke (1961). All soils which belong to a particular **Great Soil Group** will have a similar sequence and arrangement of the **master horizons** and the **sub-horizons** within the soil profile. Considerable variation in the thickness of the individual master horizons and sub-horizons which make up the profile of a particular soil is permitted. However, the main soil characteristics such as colour, structure, consistence and soil reaction (soil pH) of the master horizons should be nearly similar in all profiles which belong to a specific Great Soil Group, while a certain degree of variation in soil texture is permitted within a Great Soil Group. The **Great Soil Subgroup** has been adopted in order to classify soils which differ from the typical Great Soil Group in **one important feature**; for example existence of soft laterite in typical Red Yellow Podzolic soils (Panabokke, 1967).

It should also be noted that the soils of the whole country were surveyed and mapped at the Great Soil Group level from 1963 to 1971 under the National Soil Survey programme of Sri Lanka.

The General Soil Map of Ceylon (later Sri Lanka) published in 1971 was based on these studies and it shows the distribution of the Great Soil Groups and sub-groups as well as associations of Great Soil Groups. The Great Soil Groups that make up of the coconut triangle area and the respective AERs in which they are located or distributed are shown in Table 3.

The past soil survey studies conducted under the National Soil Survey were adequate for the purpose of providing an inventory of the soil resources of the country and they also provided useful information on soils at a general level. **Such a broad level of survey was however considered inadequate for the purpose of the present study, and a more detailed level of soil survey had therefore to be undertaken.**

It should also be borne in mind that there is a wide variation in the soil profile characteristics within a single Great Soil Group and this correspondingly results in a variation in the performance of coconut within a Great Soil Group. **As such, the previous studies carried out in this area were not adequate to provide the necessary information on soils for the purpose of the land suitability assessment and mapping for coconut. The present studies had therefore to**

be carried out at a more detailed or 'series' level.

Each **Great Soil Group** can be sub divided into the component **soil series.** A soil series is defined as soils which are developed from the **same parent material** under similar conditions and having soil horizons **similar in differentiating characteristics and arrangement** within the soil profile except for the texture of the surface soil. An example of the subdivision of a Great Soil Group into soil series is given in Table 4.

Table 3. The Great Soil Groups in each Agro-ecological Region (AER) of the Survey Area.

Agro-Ecological Region (AER)	Great Soil Group
DL3	Sandy Regosols. Red and Yellow Latosols.
DL1	Reddish Brown Earths. Low Humic Gley soils.
IL3	Sandy Regosols. Reddish Brown Earths. Non Calcic Brown soils. Alluvial soils of variable texture and drainage.
IL1	Latosols and Regosols on old red and yellow sands. Red Yellow Podzolic soils with strongly mottled sub soils. Red Yellow Podzolic soils with soft or hard laterite. Alluvial soils of variable texture.
IM3	Reddish Brown Latosolic soils.
WM3	Immature Brown Loams. Red Yellow Podzolic soils.
WL3&4	Latosols and Regosols on old red and yellow sands. Red Yellow Podzolic soils with soft or hard laterite.
WL1&2	Red Yellow Podzolic soils.

The variation in soil characteristics and qualities within a soil series is minimal, and correspondingly the variation in the performance of coconut is also minimal within a soil series. The **soil series** is therefore considered as the appropriate mapping unit that could provide the necessary information on soils for the purpose of land suitability mapping for coconut.

Table 4. Soil Series within some Great Soil Groups

Great Soil Group	Soil Series
Sandy Regosols	Kalpitiya series Negombo series Weliketiya series
Red Yellow Latosols	Gambura series Wilpattu series Borupan series Mavillu series
Red Yellow Podzolic soils	Kurunegala series Kuliyapitiya series Boralu series
Alluvial soils	Aruvi series Ambakelle series Bangadeniya series

2.3 Present soil survey

In the present soil survey, the **soil series** was the basic mapping unit. Accordingly, the respective soil series were identified and mapped in the field with the aid of air photographs of scale 1:50,000 taken in 1981 as base maps. Initially, air photo interpretation was carried out to identify the **land form units**. Land form refers to a unit of land which is homogeneous pertaining to its morphology and genesis. Some examples of land forms are coastal plain, mantled plain and alluvial flood plain. The term 'mantled plain' is used to designate plains having a mantle of residual materials derived in situ by weathering from

underlying rock. These land form units could in turn be subdivided into terrain classes or topography of the surrounding areas such as level, gently undulating, Oundulating, rolling and hilly terrains. These terrain classes can be categorized as follows.

Categories of Terrain Classes		Slope Range
Flat or nearly level terrain	-	0 - 2%
Gently undulating terrain	-	2 - 4%
Undulating terrain	-	4 - 8%
Rolling terrain	-	8 - 16%
Hilly terrain	-	16 - 30%
Steep hilly terrain	-	over 30%

Soils within each land form unit were identified in the field. The relationship between the different kinds of soils and different major and sub-land form units were subsequently established. Using these relationships, mapping of the soil series was then carried out. The soil boundaries were then checked in the field making use of soil bore observations, burrow pits etc. The distribution of each soil series across the coconut triangle is shown in soil maps prepared at one inch to one mile scale.

Representative soil profile monoliths of the more important and widespread soil series (Plates 1 and 2) have been made and displayed at the museum of the Coconut Research Institute (CRI). It would be very useful for the reader of this text to visit the CRI and view these soil monoliths because this would enable him/her to get a first hand impression of the real nature and characteristics of the main soil series that occur within the coconut triangle.

2.4 Interpretation of the soil properties

The performance of coconut chiefly depends on :

1. Moisture availability
2. Rooting depth of the soil
3. Aeration and drainage status of the soil
4. Fertility status of the soil.

(1) Moisture availability in the soil is mainly determined by (a) climate, (b) hydrology and (c) drainage.

In some soils, no significant moisture stress is experienced by coconut palm

because of the ideal rainfall distribution or else the hydrological conditions of the landscape. In other soils, moisture stress is experienced by coconut palm in varying degree depending on the duration of dry periods and the hydrological conditions of the landscape. Coconut performs better where there is no moisture stress, and it performs moderately well where there is a minimum period of moisture stress. It performs poorly on soils where moisture stress is experienced for a considerable period.

(2) Rooting depth in the soils

Occurrence of a thick quartz or gravel layer (thickness more than 15 cm), or else the occurrence of decomposing bed rock or a clayey hard pan within a depth of 120 cm from the surface may inhibit the root penetration of coconut resulting in limited availability of moisture and nutrients. Thus, in **deep soils** which are free of gravel or rock up to a depth of 120 cm, coconut performs very well. In **moderately deep** soils where a thick quartz or gravel layer occurs at a depth of 30 - 60 cm, or else the bed rock or a hard pan occurs at a depth of 60 - 90 cm coconut performs moderately well. In **shallow to very shallow** soils where a thick gravel layer occurs at a depth of less than 30 cm, or else where the bed rock or a hard pan occurs at a depth of less than 60 cm coconut performs poorly.

(3) Aeration and soil drainage

Aeration or oxygen availability is very important for the performance of coconut. In some soils the aeration is good but in other soils it is insufficient or poor. The aeration of the soil depends on the **soil texture** and the **soil drainage**.

(a) *Soil Texture*

There are three main groups of soil particle size; viz., sand, silt and clay. The particle size of those three groups is as follows;

Category	Diameter of the Particles
Sand	2 - 0.02 mm
Silt	0.02 - 0.002 mm
Clay	less than 0.002 mm

The feel of the soil or texture depends on the proportion in which the sand, silt and clay are present in a particular soil. Soil texture is broadly classified into three broad categories, viz., (i) sandy soils, (ii) loamy soils and (iii) clayey soils, according to the proportion of sand, silt and clay fraction present in soil as indicated below.

Sandy soils: More than 70% sand, and less than 30% silt or clay or both in variable proportions.

Loamy soils: Between 15 - 40% clay, and the balance in different proportions of silt and sand.

Clayey soils: More than 40% clay, and less than 60% in different proportions of silt and sand (Soil Survey Manual, 1951).

In sandy textured soils, the particle size is larger, less cohesive, and less compact compared to the loamy textured or clayey soils and therefore more space is available among particles which is generally filled with air. In such soils, aeration or oxygen availability is high. Similarly, in loamy textured soils, the aeration is moderate because the space between the particles is less; while in clayey soils because of the smaller pore sizes, the aeration is poor.

(b) *Soil drainage status*

The soil drainage refers to the removal of water from the soil generally by the surface run off *(external drainage)* and by flow through the soil (*internal drainage*). There are three main soil drainage classes; viz., (i) *well drained, (ii) imperfectly drained* and (iii) *poorly drained.*

Well drained soils

These soils are usually reddish or brownish in colour and occur in the upper part of the landscape. In well drained soils, the water flows through the profile readily and as a result, saturated conditions do not occur for a significant period. In these soils, both aeration and oxygen availability is high.

Imperfectly drained soils

These soils are usually yellowish, brownish or greyish in colour and commonly have dark brown and reddish mottling in the profile of the subsoil. Water flows through the profile of these soils slowly and the subsoil remains wet and almost saturated with water for significant period of the year. In these soils, both aeration and oxygen availability are moderate. These soils occur in the lower to mid-aspects of the landscape.

Poorly drained soils

These soils are grey (gley) in colour. They usually occur in the lowest part of the landscape. Water flow through the profile of poorly drained soils is very slow, and the soil therefore remains in a saturated condition with water for a greater

part of the year. Both aeration and oxygen availability in these soil are very poor.

(4) Fertility status of soils

In some soils the nutrient availability for the coconut palm is good and in other soils the nutrient availability is moderately good or poor. The nutrient availability in soils and the ability of soils to retain the applied fertilizer nutrients in an available form to plants mainly depends on the nature of the clay mineralogy which in turn may depend on the soil parent materials and the degree of pedogenic weathering. The proportion and nature of clay particles present in a soil is also an important factor influencing the soil fertility status. The soil fertility is greater when a greater proportion of clay particles is present in the soil. Generally sandy soils are poor in soil fertility while loamy soils have a better fertility. Within a soil series, the soil fertility is fairly uniform within acceptable limits.

From the foregoing paragraphs 1-4, the criteria for **good, moderately good, or poor soils for coconut** could be expressed as follows;

Good soils for coconut are those soils which are deep, well to imperfectly drained and sandy to loamy in texture. Soils where depth, drainage, and texture impose no limitations to root distribution of coconut are regarded as good soils for coconut. Some examples of good coconut soils are (1) *Rathupasa* series, (2) *Madampe* series and (3) *Pallama* series.

Moderately good soils are those soils which are moderately deep to shallow, well to imperfectly drained and loamy in texture. In some of these soils the root penetration is moderately inhibited and this affects the performance of coconut. In some soils where there is moisture stress during a dry spell it could affect the yield. Some examples of moderately good coconut soils are (1) *Boralu* series, (2) *Andigama* series, (3) *Maho* series and (4) *Kuliyapitiya* series.

Poor soils for coconut are those soils which are either very shallow or clayey, or are very poorly drained. In such soils either the rooting depth is very much limited, or the aeration of the soil is very poor. Some example of poor coconut soils are (1) *Puttalam* series, (2) *Norachcholai* series and (3) *Toppuwa* series.

A separate publication titled " Soils of the Coconut Triangle" is under preparation and will describe the soils in a more detailed manner. Supporting soil maps will also be included in this proposed publication. For the purpose of

this publication, however, a brief statement of the soil series that were identified and mapped, as well as the AERs in which these soil series occur together with their relationships to the land forms are outlined in Table 5.

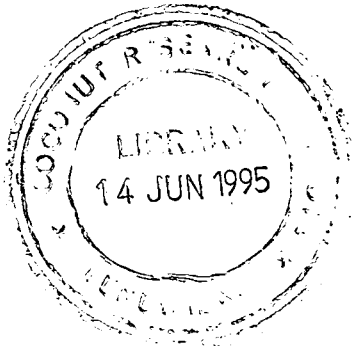

Table 5. Soils of the coconut triangle and their occurrence in different agro-ecological regions.

(i) Agro-ecological region: DL3

Great Soil Group	Soil Series	Land form and Occurrence	Brief Description of Soils
Red Yellow Latosols	Gambura Wilpattu	Older deposits of the coastal plain; upper slopes, occur in the off-shore area	Somewhat excessively drained, very deep, sandy to loamy soils
	Mavillu Borupan	Older deposits of the coastal plain; lower slopes, occur in the off-shore area	Imperfectly drained, very deep, sandy to loamy soils
	Eluvankulama	Older deposits of the coastal plain; occur at depressions or valleys in the off-shore area	Imperfectly drained, shallow to moderately deep, gravelly loamy soils
Sandy Regosols	Madurankuli Mampuri	Sand dunes in the coastal plain	Excessively drained, deep, coarse sandy soils
	Negombo	Recent sand drifts along the coastal line (upper slope)	Excessively drained, deep, sandy soils
	Kalpitiya Weliketiya	Recent sand drifts along the coastal line (lower slope)	Imperfectly drained, deep, sandy soils

Sandy Regosols	Tetku Udappu	Recent sand drifts along the coastal line (lower slope)	Imperfectly drained, moderately deep, sandy soils overlying clayey soils with some sea-shells
	Norachcholai	Recent deposits of coastal plain; depressions or valleys occur along the coastal line	Poor to very poorly drained, deep ,loamy to clayey soils
Alluvial soils	Aruvi-Kutupotha-Labugama-Siyambalan-kotuwewa complex	Alluvial-colluvial valleys	Poor to very poorly drained, deep, loamy to clayey soils.
	Marichchikatti	Alluvial terraces	Imperfectly drained, deep, sandy to loamy soils
	Navandankulam		Imperfectly to poorly drained, deep, sandy to loamy soils
Solodized Solonetz and Solanchacks	Puttalam Kadolkelle	Lagoon deposits occur adjacent to the lagoons	Poor to very poorly drained, deep, loamy to clayey soils.

(ii) Agro-ecological Region: DL1

Reddish Brown Earths	Aluthwewa Kelegama Ranorewa Tonigala	Undulating mantled plain occur away from the sea-shore (Interior part of the country)	Well drained, moderately deep to deep, loamy soils with gravel
	Hambegamuwa Anamaduwa Elayapattuwa Tabbowa	Gently undulating mantled plain (interior part of the country)	Imperfectly drained, moderately deep to deep, loamy soils with gravel
Low Humic Gley Soils	Adipola Gampaha	Nearly level mantled plain (interior part of the country)	Poorly drained, deep, loamy to clayey soils

(iii) Agro-ecological Region: IL3

Non Calcic Brown Soils	Maho	Undulating mantled plain (interior part of the country)	Well drained, moderately deep to deep, gravelly loamy soils
	Wariyapola Tambarawa	Gently undulating mantled plain (interior part of the country)	Imperfectly drained, moderately deep to deep, gravelly loamy soils
Red Yellow Podzolic soils with soft or hard laterite	'Andigama	Undulating mantled plain (interior part of the country)	Well to moderately well drained, moderately deep, loamy to clayey soils with considerable Fe stone gravel
Alluvial Soils	Ambakelle-Welipelessa association Rajakadaluwa-Palugaswewa association Kakkapalliya-Kumbukgahawela association Dummalasuriya	Alluvial upper and mid terraces	Moderately well to imperfectly drained, deep, sandy to loamy soils

Alluvial Soils	Bangadeniya	Alluvial lower terrace	Poorly drained, deep loamy to clayey soils
	Elvitiya Rambepitiya	Alluvial flood plain (levee soils)	Well to imperfectly drained, deep sandy to loamy soils
	Bombiwila	Alluvial flood plain (basin)	Poor to very poorly drained
	Aruvi-Katupotha-Labugama-Siyambalan--kotuwewa complex	Alluvial-colluvial valleys	Poor to very poorly drained, deep loamy to clayey soils
Colluvial members of Red Yellow Podzolics with soft or hard laterites.	Wilattawa-Tuntota association	Gently undulating mantled plain (interior part of the country)	Imperfectly drained, deep, coarse loamy soils
Red Yellow Latosols	Wilpattu Borupan	As described in DL_3	As described in DL_3
Sandy Regosols	Negombo Weliketiya	As described in DL_3	As described in DL_3

Solodized Solonetz	Puttalam	As described in DL_3	As described in DL_3

(iv) Agro-ecological Region: IL1

Red Yellow Podzolic Soils	Kurunegala Weligamuwa	Gently undulating mantled plain (interior part of the country)	Moderately well drained to Imperfectly drained, moderately deep to deep, loamy soils
	Kuliyapitiya	Undulating mantled plain (interior part of the country)	Well drained, moderately deep to deep, loamy soils
	Andigama	Undulating mantled plain (interior part of the country)	Well to moderately well drained, moderately deep to deep, loamy soils
	Kiriwana	Undulating mantled plain (interior part of the country)	Well drained, moderately deep to deep, loamy soils
Alluvial Soils	Rajakadaluwa-Palugaswewa association	Alluvial upper and mid terraces	Moderately well to imperfectly drained, deep, sandy to loamy soils
	Kakkapalliya-Kumbukgahawela association		

Alluvial Soils	Dummalasuriya	Alluvial upper and mid terraces	moderately well to imperfectly drained, deep, sandy to loamy soils
	Dampitiya		
	Bangadeniya	Alluvial lower terrace	Poorly drained, deep, loamy to clayey soils
	Halpe	Alluvial flood plain (levee)	Well to moderately well drained, deep, sandy to loamy soils
	Metikotuwa	Alluvial flood plain (back slope)	Imperfectly drained, deep, loamy soils
	Toppuwa	Alluvial flood plain (basin)	Poor to very poorly drained, deep, loamy to clayey soils
	Aruvi-Katupotha-Labugama-Siyambalankotu-wewa complex	As described in DL3	As described in DL3
	Bakmigolla	Alluvial-colluvial valleys	Moderately well to imperfectly drained, deep, sandy to loamy soils
Latosols and Regosols on old red and yellow sands	Rathupasa	Older deposits occur in off-shore area (upper slope)	Well drained, very deep, sandy to coarse loamy soils
	Katunayake Madampe	Older deposits occur in off-shore area (lower slope)	Imperfectly drained, very deep, sandy to coarse loamy soils

Latosols and Regosols on old red and yellow sands	Medagama Sudu	Older deposits occur in off-shore area (depressions)	Poorly drained, deep, sandy soils
Sandy Regosols	Negombo	As described in DL3	As described in DL3
	Weliketiya	As described in DL3	As described in DL3
	Halawatha	Recent sand deposits	Imperfectly to poorly drained, deep, sandy to loamy soils
Colluvial members of Red Yellow Podzolics with soft or hard laterites	Wilattawa-Tuntota association	As described in IL3	As described in IL3

(v) Agro-ecological Region: IM3

Reddish Brown Latosolic Soils	Melsiripura Nalanda	Undulating to rolling terrain (mantled plain; occurs in the interior part of the country)	Well drained, very deep, loamy soils

(vi) Agro-ecological Region: WL4

Sandy Regosols	Negombo	As described in DL3	As described in DL3
	Weliketiya	As described in DL3	As described in DL3
Latosols and Regosols on old red and yellow sands	Rathupasa	Older deposits occur in off-shore area (upper slope)	Well drained, very deep, sandy to coarse loamy soils
Latosols and Regosols on old red and yellow sands	Katunayake	Older deposits occur in off-shore area (lower slope)	Imperfectly drained, very deep, sandy to coarse loamy soils

(vii) Agro-ecological Region: WL3

Red Yellow Podzolic with soft or hard laterite	Boralu	Undulating terrain (mantled plain; occurs in the interior part of the country)	Well drained to moderately well drained, moderately deep, loamy to clayey soils with considerable Fe stone gravel
Colluvial members of Red Yellow Podzolics with soft or hard laterites	Pallama	Gently undulating terrain (mantled plain; occurs in the interior part of the country)	Moderately well drained to imperfectly drained, deep, coarse loamy and loamy soils
Alluvial Soils	Halpe	Alluvial flood plain (levee)	Well to moderately well drained, deep, sandy to loamy soils
	Metikotuwa	Alluvial flood plain (back slope)	Imperfectly drained, deep, loamy soils
	Toppuwa	Alluvial flood plain (basin)	Poor to very poorly drained, deep, loamy to very clayey soils

(viii) Agro-ecological Region: WL2

Red Yellow Podzolic Soils	Warakapola Nelundeniya	Rolling to hilly terrain (steep hills and rolling plain; occur in the interior part of the country)	Well drained, deep loamy to clayey soils
Colluvial members of Red Yellow Podzolics	Mirigama	Gently undulating terrain (foot slopes of hills; occur in the interior part of the country).	Moderately well drained to imperfectly drained, coarse loamy soils.

(ix) Agro-ecological Region: WM3

Immature Brown Loams	Akurana Kundasale	Rolling to hilly terrain (rolling mantled plain and steep hills; occur in the interior part of the country)	Well drained, moderately deep,loamy soils with weatherable minerals
Red Yellow Podzolic soils	Rattota Wattegama		Well to moderately well drained, deep, loamy to clayey soils

CHAPTER 3
LAND SUITABILITY ASSESSMENT FOR COCONUT

3.1 Introduction

The concept of **land** in land suitability assessment and classification is wider than that of either soil or terrain. Land comprises the physical environment including climate, relief, soils, hydrology and vegetation to the extent that these influence potential for land use. The variation of each of the above factors influence the coconut productivity in varying degrees. However, within a region of fairly uniform climate, relief and hydrology, soil is the main cause of differences in the productivity of a particular crop. This is the principle employed for the present land suitability classification for coconut.

Land suitability maps for coconut have been prepared in a simple form for practical purposes of the users like administrators, planners and extension staff etc. These maps will provide the basis for the following:

1. Assessing the suitability of different coconut growing lands with a view to ranking them according to their yield potential.
2. As an extension tool for making environment-specific and location-specific recommendations for management of coconut.
3. Exploiting the optimum potential from coconut lands by adopting a balanced package of management practices.
4. Formulating appropriate strategies for both coconut research and development.

3.2 Diagnostic criteria

Coconut growing lands can be categorized into two broad categories as **suitable lands (S)** and **unsuitable lands (N)**. This categorization is done on the following basis.

Suitable lands (S) are those on which sustained cultivation of coconut will give benefits which justify the inputs without unacceptable risk or damage to land resources. Suitable lands (S) can be further subdivided into **five land suitability classes.** The land suitability class reflects the degree of suitability of each land unit for coconut cultivation. The classes are numbered consecutively, in sequence of decreasing order of suitability from S1 to S5.

Unsuitable lands (N) are those which have qualities that would preclude sustained cultivation of coconut with economic benefits. A land can be classified as unsuitable for coconut for the following reasons:

1. Cultivation is technically impractical due to poor physical properties (e.g., clayey texture, presence of rocks or hard pan at a depth less than 30 cm) and/or chemical properties (e.g., high saline and/or alkaline conditions) of the soils.
2. Such cultivation could cause severe environmental degradation (e.g., erosion by cultivation in steep slopes).
3. Cultivation is technically impractical due to inadequate soil depth, poor drainage or lack of moisture within the soil profile. Very shallow rooting depth due to the presence of gravelly compact soils, rock, hard pan or clay pan. The supply of moisture and nutrient is inhibited as a result of the shallow rooting depth.

   Poor moisture availability in the soil profile occurs in very deep sands (unstable sand dunes) and in moderately deep, well drained Reddish Brown Earths in the AER of DL1 during the dry period of the year.

   Very poor internal drainage or permanent water logging condition that inhibit oxygen availability to the roots may occur in the basin or valley in the river flood plains in all AERs and near lagoons in the coastal area.

Unsuitable lands can be further classified as **currently unsuitable lands (N1)** and **permanently unsuitable lands (N2).**

Both land characteristics and land qualities have been used in the classification of coconut lands into suitability classes. The soil characteristics, land form, and external together with internal drainage were employed as **land characteristics.** Land units having different combinations of these characteristics were identified. The average yield of coconut palms in each of the land units under variable management practices was assessed, and was employed as an index for the **land quality** (F.A.O. 1976).

In the present assessment, the input to the coconut lands and the output were not evaluated in detail but they were considered in general terms. Therefore, the present assessment should be considered a semi-quantitative one as indicated in the subsequent paragraph.

The yield of coconut plantations falling into each of different soil mapping units (soil series) was estimated by the number of nuts in the last two bunches per palm averaged over about 40 palms per ha. that were to be plucked at the next immediate pick. The number of nuts per ha. per year was estimated giving due consideration to seasonal yield variation pattern of the coconut (Pethiyagoda, 1980). Such yield assessments were made in as many holdings as possible falling into each of the soil mapping units maintained under different management practices such as fertilizer application, mixed cropping, cover cropping, mulching etc. The **potential yield of each soil mapping unit** was thus established from these data.

On the completion of soil mapping at the series level, the soil maps were carefully interpreted with respect to their potentiality for sustained coconut cultivation based on their physical and chemical properties as explained in section 2.4, together with the other relevant factors such as the topography of the terrain, the agro-ecological region in which the soil occurs and the yield. For example, coconut cultivation in the hilly terrain results in land degradation due to severe soil erosion; and preventive measures for which are very expensive and less effective. Therefore such lands are rated very low in the suitability assessment.

Mapping units or the soil series falling into identical ranking were grouped together based on (i) **land characteristic** which include soil properties and (ii) **land quality** for which yield data was used as an index (Table 6). The appropriate land suitability class was assigned to each group and mapped to obtain land suitability maps for coconut. In this land suitability classification there are five suitability classes and two unsuitable classes for coconut. The diagnostic features for each suitability class based on the yield potential and soil/land characteristics are shown in Table 6 (see page 38).

3.3 Suitability class S1 (highly suitable)

Definition: Lands that have no significant physical limitations to sustained coconut cultivation and will also not require inputs above an acceptable level.

Land form and location:

(a) Nearly level or gently undulating coastal plain in the AERs of IL1 and WL3 (refer Figure 1 and land suitability maps of Chilaw and Negombo).

Soils: General characteristics of different soil series in S1 lands are as follows:

(a) Agro-ecological regions: IL1 and WL3

Rathupasa series:

Well drained, very deep, sandy to coarse loamy soils.

Madampe series, *Katunayake* series:

Moderately well drained to imperfectly drained, very deep sandy to coarse loamy soils.

Halpe series:

Imperfectly drained, very deep sandy to coarse loamy soils.

Production potential: Coconut palms on these lands will have the potential of yielding more than 15,000 nuts/ha/year (over 6000 nuts/ac/year) up to a maximum of 25,000 nuts/ha/year (approximately 10,000 nuts/ac/year).

Inputs: There is no significant moisture stress for coconut in these lands throughout the year. Therefore under normal circumstances, strict moisture conservation practices may not be essential. High nut production results in the removal of large quantity of soil nutrients and therefore fertilizer application should be adjusted to compensate for the loss. Mulching and occasional weeding are the cultural practices that can be adopted.

3.4 Suitability class S2 (suitable to highly suitable)

Definition: Lands that have minor limitations to sustained coconut cultivation that will slightly reduce productivity, and will also not require inputs above an acceptable level.

Land form and location:

(a) Nearly level or gently undulating coastal plain (recent and old deposits) covering the AERs of DL3, IL3, IL1, WL4 and WL3 (refer Figure 1 and land suitability maps of Kalpitiya, Puttalam, Battulu Oya, Chilaw and Negombo).

(b) Alluvial levees located along rivers and streams covering the AERs of DL3, IL3, IL1 and WL3 (refer land suitability maps of Battulu Oya, Wariyapola, Chilaw, Negombo and Gampaha).

(c) Undulating to rolling terrain covering mainly the AER of IM3 (refer land suitability maps of Kurunegala and Nalanda).

(d) Gently undulating terrain covering the AERs of IL1 and WL3 (refer land suitability maps of Dandagamuwa, Kurunegala, Gampaha, Chilaw and Negombo).

Soils: General characteristics of different soil series in S2 lands are as follows:

(a) **Agro-ecological region: DL3**

Weliketiya series and *Kalpitiya* series:

Imperfectly drained, deep, sandy soils.

Borupan series, *Mavillu* series and *Nawandankulam* series:

Imperfectly drained, very deep, sandy loam to sandy clay loam soils.

(b) **Agro-ecological region: IL3**

Weliketiya series:

Imperfectly drained, deep, sandy soils.

Borupan series:

Imperfectly drained, very deep, sandy loam soils.

Elvitiya series, *Ambakelle-Welipelessa* association, *Palugaswewa-Rajakadaluwa* association, *Rambepitiya* series and *Bakmigolla* series:

Imperfectly drained, deep, sandy to sandy loam soils.

(c) **Agro-ecological region: IL1**

Weliketiya series and *Halawatha* series:

Imperfectly drained, deep, sandy soils.

Rambepitiya series, *Elvitiya* series, *Rajakadaluwa-Palugaswewa* association and *Metikotuwa* series:

Moderately well drained to imperfectly drained, deep, sandy to sandy loam soils.

Kurunegala series:

Moderately well drained to imperfectly drained, deep sandy loam to sandy clay loam soils.

(d) **Agro-ecological region: IM3**

Melsiripura series:

Well drained, deep, sandy clay loam to clay loam soils.

(e) **Agro-ecological region: WL4**

Weliketiya series:

Imperfectly drained, deep, sandy soils.

(f) **Agro-ecological region: WL_3**

Pallama series:

Moderately well to imperfectly drained, deep, sandy to sandy loam soils.

Production potential: Coconut palms on these lands will have the potential of yielding 12,500 to 15,000 nuts/ha/year (5000-6000 nuts/ac/year).

Inputs: Generally, there is no significant moisture stress for coconut throughout the year in the S2 lands located in the AERs of IL1 and WL3. Therefore, moisture conservation practices may have limited benefits. However, S2 lands located in the AERs of IL3 and DL3 would experience moisture stress for brief periods of the year. In these areas some moisture conservation measures may therefore be required. In sandy soils, split application of fertilizer is a better practice to avoid nutrient loss and waste due to leaching. Application of organic matter helps improve both moisture and nutrient retention in sandy soils. Fertilizer dose will have to be determined according to the soil nutrient loss due to both removal by nuts and leaching.

3.5 Suitability class S3 (suitable)

Definition: Lands that have some limitations to sustained coconut cultivation that will reduce productivity, and also requiring increased inputs to the extent that the overall profit is attractive but will be inferior to that from S2 lands.

Land form and location:

(a) Nearly level or gently undulating coastal plain covering the AERs of DL3, IL3, IL1 and WL3 (refer Figure 1 and land suitability maps of Kalpitiya, Puttalam, Battulu Oya, Chilaw, Negombo and Gampaha).

(b) Gently undulating alluvial plains in the AER of IL1 (refer land suitability map of Chilaw).

(c) Gently undulating mantled plain in the AER of IL3 (refer land suitability maps of Wariyapola, Dandagamuwa and Nalanda).

Soils: General characteristics of different soil series in S3 lands are as follows:

(a) **Agro-ecological region: DL3**

Negombo series:

Well drained, deep, sandy soils.

Wilpattu series and *Gambura* series:

Well drained, deep, sandy loam to sandy clay loam soils.

(b) **Agro-ecological region: IL3**

Negombo series:

Well drained, deep, sandy soils.

Wilpattu series and *Gambura* series:

Well drained, very deep, sandy loam to sandy clay loam soils.

Wariyapola series:

Moderately well to imperfectly drained, moderately deep to deep, sandy loam to sandy clay loam soils.

Tambarawa series and *Wilattawa-Tuntota* association:

Imperfectly drained, moderately deep to deep, sandy to loamy soils underlain by gravelly loam soils.

(c) **Agro-ecological region: IL1**

Negombo series:

Well drained, deep, sandy soils.

Kakkapalliya - Kumbukgahawela association and *Dummalasuriya* series:

Well drained, deep, sandy to sandy loam soils.

(d) **Agro-ecological region: WL3**

Negombo series:

Well drained, deep, sandy soils.

Production potential: Coconut palms on these lands will have the potential of yielding 10,000 to 12,500 nuts/ha/year (4000-5000 nuts/ac/year approximately).

Inputs: In these lands, moisture availability for coconut would be limiting during the dry periods of the year. Therefore appropriate moisture conservation practices such as establishment of cover crops and husk pits and maintenance of a mulch around palms will be required. The fertilizer dose should be adjusted according to the nutrient removal along with nuts.

3.6 Suitability class S4 (moderately suitable)

Definition: Lands that have limitations which in aggregate are moderately severe for sustained coconut production. The limitations will reduce coconut productivity, and it will also require increased input to the extent that the overall profit will be moderately attractive, but appreciably less than that expected from class S3.

Land form and location:

(a) Nearly level coastal plain (beach) in the AERs of DL3, IL3 and IL1

(refer Figure 1 and land suitability maps of Kalpitiya, Puttalam, Battulu Oya and Chilaw).

(b) Gently undulating to undulating and rolling mantled plain in the AERs of IL3, IL1 and WL3 (refer Figure 1 and land suitability maps of Battulu Oya, Nalanda, Chilaw, Dandagamuwa, Kurunegala, Negombo and Gampaha).

(c) Gently undulating mantled plain in the AERs of DL3 and DL1 (refer Figure 1 and land suitability maps of Kalpitiya and Puttalam).

Soils: General characteristics of different soil series in S4 lands are as follows:

(a) **Agro-ecological region: DL3**

Mampuri series:

Deep, excessively drained, coarse sand in slightly stabilized dunes.

Tetku series and *Udappu* series:

Imperfectly to poorly drained, moderately deep, sand underlain by sandy clay.

(b) **Agro-ecological region: IL3**

Maho series:

Well drained, moderately deep to deep, sandy loam to gravelly sandy clay loams.

(c) **Agro-ecological region: IL1**

Andigama series, *Kiriwana* series, *Kuliyapitiya* series and *Dambakanda* series:

Well drained, moderately deep, sandy clay loam to gravelly sandy clay loams.

Medagama series:

Poorly drained, deep, coarse sandy soils.

(d) **Agro-ecological region: WL3**

Boralu series:

Well drained, moderately deep, sandy clay loam to gravelly sandy clay loams.

Production potential: Coconut palms on these lands will have the potential of yielding 5000 to 10,000 nuts/ha/year (2000 - 4000 nuts/ac/year approximately).

Inputs: Well drained soils located mostly on the mid slopes of rolling terrains in AERs of IL1 and WL3 are subjected to erosion and therefore establishment of contour drains or terracing is required as a preventive measure. Intensive moisture conservation practices such as establishment of husk pits and cover crops and also maintenance of a mulch around the palm will be required in AERs of IL3 and IL1. Fertilizer application is also important.

3.7 Suitability class S5 (marginally suitable)

Definition: Lands that have limitations which in aggregate are severe for sustained coconut cultivation and reduce productivity. It will also require a higher input to the extent that the expenditure will be only marginally justified.

Land form and location:

(a) Nearly level coastal plain in the AER of DL3, gently undulating mantled plain of DL1 and low lying terrain of the gently undulating plain of the coastal area in the AERs of IL1 and WL3. (refer Figure 1 and land suitability maps of Kalpitiya, Puttalam, Chilaw and Negombo).

(b) Undulating to rolling terrain of the mantled plain in the AERs of IL3, IL1 and WL3 (refer Figure 1 and land suitability maps of Dandagamuwa, Kurunegala, Chilaw, Negombo and Gampaha).

Soils: General characteristics of different soil series in S5 lands are as follows:

(a) **Agro-ecological region: DL3**

Norachcholai series:

Poorly drained, deep, clayey soils overlain by a thin sand layer.

(b) **Agro-ecological region: IL3**

Andigama series (*shallow phase*):

Well drained to moderately well drained, very shallow, sandy clay loam to gravelly sandy clay loams.

(c) **Agro-ecological region: IL1**

Sudu series:

Poorly drained, deep, sands.

Andigama series (*shallow phase*):

Well drained to moderately well drained, very shallow, sandy clay loam to gravelly sandy clay loams.

(d) **Agro-ecological region: WL3**

Boralu series (*shallow phase*):

Well drained, very shallow, gravelly sandy clay loams.

Sudu series:

Poorly drained, deep, sands.

(e) **Agro-ecological regions: WL1 and WL2**

Warakapola - Nelundeniya association :

Well drained, moderately deep to deep, sandy clay loam to clay loam on steep hilly terrain.

Production potential: Coconut palms on these lands will have the potential of yielding 2500 to 5000 nuts/ha/year (1000 - 2000 nuts/ac/year approximately).

Inputs: Most S5 lands except those in WL1, WL2 and WL3 need intensive moisture conservation measures including establishment of cover crops, husk pits, mulching and contour drains to protect coconut palms against moisture stress that may likely to occur during the dry periods of the year. Fertilizer application is essential to supply nutrients as the root zone of palms in S5 lands is generally limited due to the shallow depth.

3.8 Currently unsuitable lands N1

Definition: Lands that have limitations which cannot be corrected with the present knowledge at currently acceptable costs. The limitations are so severe as to preclude successful sustained cultivation of coconut.

Land form and location:

(a) Adjacent to lagoons and unstable sand dunes in the nearly level coastal plain in the AERs of DL3 , IL3 and IL1 (refer land suitability maps of Kalpitiya, Puttalam, Battulu Oya, and Chilaw),

(b) Valley of the alluvial flood plains in the AERs of DL1, IL3, IL1 and WL3 (refer land suitability maps of Puttalam, Battulu Oya, Wariyapola, Chilaw, Gampaha and Negombo) and

(c) Upper slope of the undulating mantled plain in the AER of DL1 (refer land suitability maps of Puttalam and Kalpitiya).

Soils: General soil characteristics of different soil series in N1 lands are as follows:

(a) **Agro-ecological region: DL3**

Madurankuliya series:

Excessively well drained, deep, sands (unstable sand dunes).

Puttalam series and *Kadolkelle* series:

Poorly to very poorly drained, deep, loamy to clayey soils.

Aruvi-Katupotha-Siyambalankotuwewa complex:

Poorly drained, deep, clayey soils.

Eluvankulama series:

Imperfectly drained, shallow to moderately deep, gravelly sandy clay loam.

(b) **Agro-ecological region: DL1**

Kalegama series, *Ranorewa* series, *Tonigala* series and *Aluthwewa* series:

Well drained, shallow to moderately deep, gravelly sandy clay loam.

(c) **Agro-ecological region: IL3**

Bombiwila series, *Bangadeniya* series and *Aruvi-Katupotha-Siyambalankotuwewa* complex:

Poorly drained, deep, clayey soils.

(d) **Agro-ecological regions: IL1 and WL3**

Toppuwa series:

Poorly drained, deep, clayey soils.

3.9 Permanently unsuitable lands (N2)

Definition: Lands that have limitations which appear so severe as to preclude any possibility of successful sustained cultivation of coconut.

Land form and location:

(a) Rock knob plains on the undulating mantled plain in the AERs of IL3, IL1, and WL3 (refer land suitability maps of Dandagamuwa, Wariyapola, Nalanda, Kurunegala and Gampaha).

(b) Erosional remnants and very steep lands in the AERs of IM3, WL2 and WL1 (refer land suitability maps of Kurunegala and Gampaha).

Table 6. Diagnostic Features for Land Suitability Classification for Coconut

Suitability Class	Agro-Ecological Region	Terrain Class and Physiographic Position	Soil/Land Characteristics	Potential Yield (Nuts/ha/yr)
S1: highly suitable	IL1 & WL3	Nearly level or gently undulating coastal plain.	Very deep, loamy sand to sandy loam, well drained to imperfectly drained soils.	More than 15,000.
S2: suitable to highly suitable	DL3, IL3, IL1, WL3 & WL4	Nearly level or gently undulating coastal plain.	Deep to very deep, sandy, imperfectly drained soils.	12,500 -15,000
	DL3, IL3, IL1 & WL3	Gently undulating alluvial plain levees.	Deep to very deep, sandy to loamy, moderately well drained to imperfectly drained soils.	
	IL1, IM3, WL3 & WL4	Undulating to rolling terrain in the mantled plain.	Deep to very deep sandy to loamy, well drained to imperfectly drained soils.	
S3: suitable	DL3, DL1 & IL3	Nearly level or gently undulating coastal plain.	Very deep, sandy or sandy to loamy, well drained soils.	10,000 - 12,500
	IL3	Gently undulating mantled plain.	Moderately deep to deep, sandy loam to sandy clay loam soils.	

S4: moderately suitable	DL3, IL3 & IL1	Nearly level coastal plain.	Deep to moderately deep, coarse sandy, imperfect to poorly drained soils.	5,000 - 10,000
	IL3, IL1 & WL3	Gently undulating to undulating or undulating to rolling mantled plain.	Moderately deep, sandy clay loam with gravels, well drained to moderately well drained soils.	
S5: marginally suitable	DL3, IL3 & IL1	Nearly level coastal plain	Deep, clay overlain by sand or sand, poorly drained soils.	2,500 - 5,000
	IL3, IL1, WL3,	Gently undulating to undulating mantled plain.	Shallow, sandy clay loam to gravelly sandy clay loam, well drained soils.	
	WL2 & WL1	Rolling to hilly terrain in the mantled plain.	Moderately deep, sandy clay loam to clay loam, well drained soils.	
N1: unsuitable without major improvements	DL3, IL3 & IL1	Nearly level coastal plain or valley of alluvial flood plains	Deep, sandy, well drained or deep, clayey, poorly drained soils.	-
	DL1	Undulating mantled plain.	Moderately deep, gravelly loam, well drained soils.	
N2: permanently unsuitable	All	Very steep hilly and rocky lands.	Very shallow, gravelly or loamy, well drained soils.	-

CHAPTER 4
THE EXTENT AND THE POTENTIAL PRODUCTIVITY OF THE DIFFERENT LAND CLASSES IN RESPECTIVE DISTRICTS

4.1. The extent of the total surveyed area

The extent of the land falling within each suitability class (S1 - S5), unsuitability class (N1 and N2), paddy lands and water bodies was computed by the Dotted Grid method from each of the one inch to a mile land suitability maps that were compiled. These were then totalled on a district basis and expressed both in extent and percentage of the total area.

The total surveyed area includes pure coconut stands as well as mixed coconut stands (homesteads), paddy and water bodies etc. which amount to 833,750 ha. As could be seen in Table 7, suitable lands for coconut cultivation occur in an extent of 567,864 ha and unsuitable lands occur in an extent of 80,706 ha which altogether amount to 78% of the total survey area. The rest of the area includes paddy lands and water bodies which amount to 185,180 ha and cover 22% of the total surveyed area.

Table 7. The extent of the total surveyed area.

Description	Extent(ha)	Percentage
Suitable lands for coconut (S1 - S5)	576864	68
Unsuitable lands for coconut (N1 and N2)	80706	10
Paddy lands	132774	16
Water bodies	52406	6
Total	833750	100

4.2 The extent of each land class

Table 8 shows the extent of lands falling within each suitability class (S1 - S5) and unsuitability class (N1 and N2) across each district. The total extent of S1 lands is very much small compared to that of S2, S3 and S4 lands. The largest extent of S1 lands occurs in the Puttalam district followed by the Gampaha and

Table 8. The extent of each land class in the total survey area in ha.

Classification	District					Total
	Puttalam	Kurunegala	Gampaha	Matale	Kegalle	
S1	6962	1068	3918	0	0	11948
S2	48036	101366	19525	28171	4776	201874
S3	17129	57895	21662	0	13033	109719
S4	30437	74684	46789	11042	3125	166077
S5	2024	17987	15478	21079	21678	78246
N1	42450	4776	2590	6330	0	56146
N2	194	16109	777	6994	486	24560
Others	50626	86940	34695	11559	1360	185180
Total	197858	360825	145434	85175	44458	833750

Table 9. Percentage of extent in each land class of the total surveyed area

Classification	District					Total
	Puttalam	Kurunegala	Gampaha	Matale	Kegalle	
S1	0.8	0.1	0.5	0.0	0.0	1.4
S2	5.8	12.1	2.3	3.4	0.6	24.2
S3	2.0	6.9	2.6	0.0	1.5	13.0
S4	3.7	9.0	5.6	1.3	0.4	20.0
S5	0.2	2.2	1.9	2.5	2.6	9.4
N1	5.1	0.6	0.3	0.8	0.0	6.8
N2	0.0	2.0	0.1	0.8	0.0	2.9
Others	6.1	10.4	4.2	1.4	0.2	22.3
Total	23.7	43.3	17.5	10.2	5.3	100.0

Table 10. The estimated annual potential coconut yield of each district falling within the coconut triangle in million nuts.

Classification	District					Total
	Puttalam	Kurunegala	Gampaha	Matale	Kegalle	
S1	67.9	10.4	38.2	0.0	0.0	116.5
S2	429.3	905.9	174.5	251.8	42.7	1804.2
S3	125.2	423.3	158.4	0.0	95.3	802.2
S4	148.4	364.1	228.1	53.8	15.2	809.6
S5	4.9	43.8	37.7	51.4	52.8	190.6
Total	775.7	1747.5	636.9	357.0	206.0	3723.1

Kurunegala districts respectively. Lands falling within the suitability class S1 arenot found in the Matale and Kegalle districts. But the largest extent of S2 lands occur in the Kurunegala district followed by the Puttalam, Matale, Gampaha and Kegalle districts respectively. Further, the largest extent of S3 and S4 lands also occur in the Kurunegala district. Lands falling within the suitability class S3 are not found in the Matale district. The lands falling within the unsuitability class N1 are mostly found in the Puttalam district.

Table 9 shows the percentage of each land class in the respective districts. In the surveyed area, only 1.4% is S1 lands of which more than half (0.8%) occur in the Puttalam district. The total extent of S2 and S3 lands is 37.2% of the surveyed area which is considerably greater than the total extent of S4 and S5 lands. It follows that a major portion of the coconut growing areas ~~in the coconut growing areas~~ in the coconut triangle is highly productive. About half of the total extent of S2 and S3 lands (19.0% of the surveyed area) and a large portion of S4 and S5 lands (11.2% of the surveyed area) occur in the Kurunegala District.

The annual potential coconut yield of the total surveyed area was estimated assuming that only 65% of the extent of lands falling within each suitability class could be effectively used for coconut cultivation. The annual potential coconut yield correspond to each suitability class was estimated by multiplying the median of the potential yield range of each suitability class (Table 6) by the extent (65% of the actual extent) of the respective class (Table 8). As could be seen from Table 10, the potential coconut yield of the Kurunegala district is the highest among other districts. The potential yield of the Puttalam district is less than half that of the Kurunegala district. The annual potential yield of the coconut triangle is approximately 3700 million nuts per year. Nearly a half of that potential yield could be obtainable from S2 lands alone. The potential yield of 190.6 million nuts of S5 lands is the smallest contribution to the total potential yield of the coconut triangle.

4.3 The potential productivity of each district

The potential coconut productivity of each district was calculated by dividing the potential yield of each district by 65% of the extent of total suitable lands (S1 - S5) falling within the respective district. As could be seen in Table 11, the potential productivity (potential yield per unit area) is the highest in the Puttalam district although the aggregate potential yield is the highest in the Kurunegala district (Table 8). The potential productivity of the other districts in descending

order is Kurunegala, Gampaha, Matale and Kegalle respectively. The estimated average potential productivity of the coconut triangle is approximately 10,000 nuts/ha/year which is equivalent to 4048 nuts/ac/year.

Table 11. Potential productivity of coconut in each district falling within the coconut triangle

District	65% of the extent of total suitable lands (ha)	Potential yield (million nuts/year)	Potential productivity (nuts/ha/year)
Puttalam	69782	775.7	11410
Kurunegala	164450	1747.5	10626
Gampaha	69792	636.9	9126
Matale	39190	357.0	9109
Kegalle	27698	206.0	7437
Total	369112	3723.1	10087

CHAPTER 5
USE AND LIMITATIONS OF LAND SUITABILITY MAPS

5.1 How to use the land suitability maps

The land suitability maps have been prepared on the scale of one inch to one mile. In order to reduce complexity and for easy identification of boundaries of land suitability classes, only a limited amount of topographic details such as the main roads, streams, water sources, major towns and major villages have been included. The user may therefore not find it easy to locate a position exactly by using the suitability maps alone. In such circumstances, these maps should be used along with the corresponding topographic sheets of one inch to a mile produced by the Survey Department in order to identify the location and transfer the location to the suitability map. This can be achieved in two ways.

1. rectangular coordinates at the location can be measured by means of a scale (foot ruler) on the topographic sheet. The same distance could be measured on the land suitability map in the same way to obtain the location on it, or
2. the topographic sheet can be superimposed on the suitability map and the located point on the topographic sheet could be marked by a pin so that the point is transferred to the suitability map.

The whole of the coconut triangle has been covered by ten land suitability maps on the scale of 1 inch to a mile as shown in Figure 3. Since the user of this information would not require all the ten land suitability maps, he should obtain only those maps corresponding to his particular area of interest. Because of the high cost of printing of land suitability maps in colour, the number of prints has been restricted to 500 copies of each sheet and each sheet will be sold at the cost price.

The soil maps have also been prepared on the scale of one inch to one mile and printed in black and white. Each soil series is indicated in the map by a code which is described in the legend given in the map itself. Since the demand for black and white soil maps would be less than that for the coloured land suitability maps, the number of prints has been restricted to 250 copies of each sheet; and each sheet will be sold at the cost price. The above maps are available for sale at the Information Services Division of the Coconut Research Institute.

The suitability classes are shown on the land suitability map in different colours, and this is self explanatory. However details of soil types in each of the suitability class are not indicated in the map. A general outline on the soil types

that may occurs in each suitability class is given in Chapters 2 and 3 of this publication. Those who require more details should refer to the soil maps and the relevant text which is to be published separately.

5.2 Limitations of the maps

The survey was of medium intensity which involved initial air photo interpretation followed by field checking. The air photos used were of 1:50,000 scale. Small pockets of different soil series extending up to about 0.8 ha (1.9 ac) on the ground are difficult to identify on the photographs. Therefore such small pockets have been omitted. Furthermore a circle of radius 1 mm on the map is equivalent to 1.3 ha on the ground. Therefore, the suitability map has limitations in that small pockets of 1.3 ha or less are not mappable at the scale of the map and therefore suitability of such small areas are not represented.

In small areas, it is possible that there can be more than one suitability class. In such circumstances, it may not be possible to use the map to differentiate boundaries from which those small land areas are divided into different suitability classes. It should also be noted that all the individual lands are not indicated in the map. Therefore the map has the limitations in that the exact boundary cannot be located from the map itself. For the assessment on suitability of individual lands, one should be conversant with suitability criteria that have been described earlier.

Although the land suitability maps shows suitability class boundaries, it should be noted that they do not in fact change abruptly. They gradually merge from one type to another and there will be a certain amount of gap or an overlap which cannot be indicated accurately in maps of this scale.

CHAPTER 6.
USE OF LAND SUITABILITY MAPS FOR INTERCROPPING IN COCONUT LANDS

Intercropping and animal husbandry are the strategies that can be employed for maximum use of coconut lands. General guidelines for growing other crops under coconut and raising of livestock have been outlined and discussed by Mahindapala and Pinto (1991). Various kinds of intercropping however are associated with a complex set of interacting and inter-dependent determinants such as crop type, soil characteristics, moisture availability, climate, condition of coconut (eg. age, yield etc.), slope of the land, management, labour availability and environmental and social influences. A combination of all these factors will ultimately determine the feasibility of intercropping. The more common intercrops grown in coconut lands are as follows :

1. *Perennials*:
   cocoa, coffee, pepper, clove, cinnamon, rambutan, avocado, lime, lemonime, cashew, mango, arecanut, pasture and fodder for livestock.
2. *Semi-perennials:*
   banana, pineapple, passion fruit, papaya and betel.
3. *Annuals:*
   pulses and cereals, tubers and yams, ginger, turmeric, chilies and vegetables.

Generally, intercrops in contrast to coconut, do not display the same wide adaptability to a diversity of soil conditions. In most cases, intercrops require specific soil conditions for their optimum performance. Coconut performs well in both well drained and imperfectly drained, moderately deep soils. However, a majority of intercrops are more adapted to well drained soils than imperfectly drained soils, and selection of intercrops for different coconut lands is based on this consideration. It is therefore necessary that in coconut-based farming systems, due consideration should be given to the soil type when intercrops are selected for coconut lands. Also, intercrops should not compete with coconut for nutrients and moisture. The other considerations are the combined performance of coconut and intercrops in different soil types, agro ecological region, physical properties of the soil (e.g., texture, depth, drainage) and the effect of intercrops on coconut by their growth and management on soil conditions (e.g., soil erosion). Some of the broad considerations in selection of crops for coconut intercropping for the different AERs and soil conditions have been outlined and discussed by Mahindapala and Pinto (1991).

Where coconut performs well in **S1, S2 and S3 lands**, the dominant limiting factor for growth of intercrops is the shade. Therefore, either shade-tolerant (e.g., banana) or shade-loving (e.g., legumes, coffee, ginger) should be the major crop character for intercrops in S1 and S2 coconut lands and to some extent for S3 coconut lands. A majority of semi-perennials (e.g., pineapple) and annual crops (e.g., pulses and cereals, cassava) are adversely affected by the shade, and are therefore suitable only during the immature phase of coconut (0-5 yrs.) in S1, S2 and S3 lands planted to square and triangular planting systems where there is adequate light. Such crops however, would not be possible in mature coconut lands (25-50 years of age) of S1 - S3 due to shade. The scenario would be different with the avenue planting system of coconut where there is wide spacing in the avenue of coconut in East-West direction (e.g., 10 m x 5 m) which permits light. However, avenue planting was not considered here because of its limited occurrence in adult coconut plantations.

There are better possibilities for intercropping in **S4 lands** not only due to the moderate performance of coconut (e.g., small crown) resulting in increased light infiltration to the ground, but also because of the favourable physical properties of the soils for intercrops (e.g., well drained, sandy clay loam soils such as in moderately deep *Boralu* series and *Andigama* series). Therefore, a wider range of light-loving crops as well as shade-tolerant crops are suitable for such lands. Although light availability on the ground level is satisfactory in **S5 lands**, soil properties that limit the performance of coconut in such lands would **also** affect the performance of intercrops (e.g., shallow depth, poor drainage). Therefore, the scope for intercropping in S5 lands is limited compared to S4 coconut lands. The intercrops suitable for S5 lands should display crop characters such as shallow rooting depth and demanding less moisture and wide adaptability for marginal soils (e.g., cashew).

Considering the above, a wide range of intercrops can be identified for coconut lands in the Wet Zone (WZ) compared to the Dry and Intermediate zones (DZ and IZ). According to the order of suitability for intercropping the agro-ecological regions can be ranked as WL2 > WL3 >IM3 > IL1 > IL3 > DL1 > DL3. For the Dry zone, the range of suitable intercrops are limited only to cashew, lime, orange, mango and some seasonal crops.

Generally, cultivation of annual crops is not encouraged in coconut lands where the slope exceeds 15 percent. This is because of the requirement of land preparation which may result in soil erosion. Thus adequate soil conservation measures should be adopted with intercropping particularly in the high rainfall

areas (e.g., AERs of WL1 and WL3) and also in sloping lands of the AER of IM3. Perennial crops would prove to be the most suitable for sloping lands because they provide a permanent canopy cover which result in soil conservation and provide organic matter from leaf fall, thereby improving the soil structure, which is mutually beneficial for both coconut and intercrops.

The intercrops suitable for different coconut land suitability classes in each agro-ecological region are listed in Table 12 according to soil series. It would be more convenient to use the soil maps as a guide for making choices for intercropping according to the recommendations made in Table 12.

Table 12. Suitable intercrops for different agro ecological regions in each district of the coconut traingle.
District: Puttalam Agro-ecological region: DL3

Suitability class for coconut	Soil series	Intercrops	
		Young coconut plantations (0 - 5yrs.)	Mature coconut plantations (25 - 60yrs)
S_2	Borupan	banana[1], chillies[2], cassava[2], vegetables[2]	none
	Kalpitiya	banana[2], chillies[2], onion[2], tobacco[2], vegetables[2]	lime[2], banana[2]
	Mavillu	banana[1], greengram[2], chillies[2], cassava[2], vegetables[2]	lime[2], banana[2]
	Weliketiya	banana[1], greengram[2], chillies[2], cassava[2], vegetables[2]	lime[2], banana[2]
S_3	Negombo	tobacco[2&3], chillies[2&3], onion[2&3], vegetables[2&3]	chillies[3], vegetables[3]
	Gambura	banana[1], cassava[3], chillies[3], vegetables[3]	chillies[3], vegetables[3]
	Wilpattu	banana[1], greengram[2], chillies[2], vegetables[2]	lime[1], orange[1], banana[1], vegetables[2]

S4	Mampuri	banana[1&2], chillies[2], vegetables[2]	banana[1&2], chillies[2], vegetables[2]

District: Puttalam **Agro-ecological region: IL3**

S_2	Ambakelle-Welipelessa association	banana[1], pulses[3], cassava[3], chillies[2&3], vegetables[2&3]	banana[1]
	Elvitiya	banana[1], pulses[3], cassava[3], chillies[2&3], vegetables[2&3]	banana[1]
	Borupan	banana[1], pulses[3], cassava[3], chillies[2&3], vegetables[2&3]	none
	Palugaswewa-Rajakadaluwa association	banana[1], pulses[3], cassava[3], chillies[2&3], vegetables[2&3]	$banana_1$
	Rambepitiya	banana[1], pulses[3], cassava[3], chillies[2&3], vegetables[2&3]	$banana_1$
	Weliketiya	banana[1], pulses[3], cassava[3], chillies[2&3], vegetables[2&3]	$banana_1$

S_3	Negombo	chillies[2&3], onion[2&3],ground nut[2&3], vegetables[2&3]	chillies[2&3], vegetables[2&3]
	Tambarawa	chillies[2&3], onion[2&3],ground nut[2&3], vegetables[2&3]	lime, orange, pasture, banana[1]
	Wariyapola	chillies[2&3], green gram[2&3], ground nut[2&3], cowpea[2&3], cassava[2&3], vegetables[2&3]	lime, pasture, banana[1], cassava[2], green gram and cowpea[2], vegetables[2&3]
	Wilattawa- Tuntota association	chillies[2&3], onion[2&3], vegetables[2&3]	pasture, banana[1]
	Wilpattu	chillies[2&3], onion[2&3], vegetables[2&3]	lime, orange, pasture, banana.
S_4	Andigama (moderately deep)	chillies$_{2\&3}$, green gram and ground nuts[2&3], cassava[3], vegetables[2&3]	cashew, mango, pasture, banana[1], greengram[2&3], cassava[2&3], vegetables[2&3]
	Maho	chillies$_{2\&3}$, green gram and ground nuts[2&3], cassava[3], vegetables[2&3]	cashew, mango, lime, orange, greengram and cowpea[2&3], cassava[3], vegetables[2&3]

S_5	Andigama (very shallow)	chillies[2&3], green gram and ground nuts[2&3], cassava[3], vegetables[2&3]	cashew, mango, pasture, green gram and cowpea[3], cassava[3], vegetables[3]

District: Puttalam **Agro-ecological region: IL1**

S_1	Halpe	pineapple, banana[1], passionfruit, papaya, betel yams & tubers[5], vegetables[5]	cacao, coffee, pepper, pasture, banana[1], ginger[4], turmeric[4], yams5
	Madampe	pineapple, banana, papaya, cassava[5], yams & tubers[5], vegetables[5]	coffee, pasture, banana
	Rathupasa	pineapple, banana, passionfruit, papaya, cassava[5], yams & tubers[5], vegetables[5]	pepper, coffee, pasture, banana, ginger[4], turmeric[4], yams[5]

S_2	Dampitiya	banana, papaya, betel, yams & tubers[5], vegetables[5]	cacao, coffee, pepper, clove, cinnamon, rambutan, arecanut, avocado, lemonime, pasture,
	Halawatha	banana, yams & tubers[5], vegetables[5]	banana, papaya, betel [2] cinnamon, pasture banana, vegetables[5]
S_2	Metikotuwa	banana, papaya, betel, yams & tubers[5], vegetables[5]	cacao, coffee, pepper, clove, cinnamon, rambutan, arecanut, avocado, lemonime, pasture, banana, papaya, betel[2], yams[5], vegetables[5]

S_2	Palugaswewa-Rajakadaluwa association	banana, vegetables[5]	cinnamon, pasture, banana, yams & tubers[5], vegetables[5]
	Weliketiya	onion[4], vegetables[4]	none
S_3	Dummalasuriya	banana, yams[5], vegetables[5]	pasture, banana
	Kakkapalliya-Kumbukgahawela association	banana, chillies[5], yams & tubers[5], vegetables[5]	cinnamon, pasture, banana, yams & tubers[5], vegetables[5]
	Negombo	banana, chillies[5], yams & tubers[5], vegetables[5]	cinnamon, pasture, banana, yams & tubers[5], vegetables[5]
	Tambarawa	banana, yams & tubers[5], vegetables[5]	cinnamon, arecanut, pasture, vegetables[5]
S_4	Andigama (moderately deep)	pineapple, passionfruit, papaya, betel, banana cassava[5], vegetables[5]	coffee, pepper, cashew, mango, lime, lemonime, pasture, pineapple, banana, passionfruit, papaya, betel[2], yams & tubers[5], ginger[4], turmeric[4], vegetables[5]

S_4	Medagama	banana, groundnut[5], vegetables[5]	cashew, mango, pasture banana, yams & tubers[5], vegetables[5]
S_5	Andigama (Shallow)	pineapple, passionfruit, cassava[5], green gram and cowpea[5], vegetables[5]	cashew, mango, pasture, pineapple, passionfriut, papaya, cassava[5], green gram and cowpea[5], vegetables[5]
	Sudu	vegetables[5]	cashew, vegetables[5]

District: Kurunegala Agro-ecological region: IL3

S_2	Ambakelle-Welipellessa association	banana[1], chillies[3], green gram and cowpea[3], onion[3], vegetables[3]	pasture, banana[1], vegetables[3]
	Bakmigolla	banana[1], chillies[3], green gram and cowpea[3], onion[3], vegetables[3]	pasture, banana[1], vegetables[3]
	Rajakadaluwa-Palugaswewa association	banana[1], chillies[3], green gram and cowpea[3], onion[3], vegetables[3]	pasture, banana[1], vegetables[3]

S_2	Rambepitiya	banana[1], chillies[3], cassava[3], pulses & cereals[3], vegetables[3]	pasture, banana[1], vegetables[3]
S_3	Wariyapola	banana, cassava[3], pulses & cereals[3], vegetables[3]	banana[1], vegetables[3]
	Wilaththawa-Tuntota association	banana, cassava[3], pulses & cereals[3], vegetables[3]	banana[1], vegetables[3]
S_4	Andigama (moderately deep)	banana[1], papaya, chillies[3], pulses & cereals[3], cassava[3], vegetables[3]	cashew, mango, lime[1], orange, pasture, banana[1], cassava[3], pulses & cereals[3], vegetables[3]
	Maho	banana[1], papaya, chillies[3], pulses & cereals[3], cassava[3], vegetables[3]	cashew, mango, lime[1], orange, pasture, banana[1], cassava[3], pulses & cereals[3], vegetables[3]
S_5	Andigama (shallow)	pulses & cereals[3], chillies[3], cassava[3], vegetables[3]	cashew, mango, pulses & cereals[3], cassava[3], vegetables[3]
N_1	Bombiwila	vegetables[3]	vegetables[3]

District: Kurunegala **Agro-ecological region: IL1**

S_2	Kurunegala	banana, betel[2], yams[5], vegetables[5]	cacao, arecanut, rambutan, pasture, fodder, banana, betel[2] yams[5], vegetables[5]
S_3	Tambarawa	banana, yams[5], vegetables[5]	banana, betel[2], yams & tubers[5], vegetables[5]
	Wilattawa-Tuntota	banana, yams[5], vegetables[5]	banana, betel[2], yams & tubers[5], vegetables[5]
S_4	Andigama (moderately deep)	pineapple, banana, passionfruit, papaya, betel[2], greengram and cowpea[5], yams & tubers[5], vegetables[5]	coffee, pepper, cashew, lime, mango, lemonime, pasture, pineapple, passionfriut, banana, papaya, betel[2], ginger[4], turmeric[4], yams & tubers[5], greengram and cowpea[5], vegetables[5]
	Dambakanda	pineapple, banana, passionfruit, papaya, betel[2], cassava[5], sweet potato[5], greengram and cowpea[5], vegetables[5]	coffee, pepper, cashew, lime, mango, lemonime, pasture, pineapple, passionfriut, banana, papaya, betel[2], ginger[4], turmeric[4], yams & tubers[5], greengram and cowpea[5], vegetables[5]

S_4	Kiriwana	pineapple, banana, passionfruit, papaya, betel[2], cassava[5], sweet potato[5], greengram and cowpea[5], vegetables[5]	cacao, coffee, pepper, cashew, mango, lime, lemonime, pasture, pineapple, banana, passionfruit, papaya, betel[2], ginger[4], turmeric[4], yams & tubers[5], vegetables[5]
	Kuliyapitiya	pineapple, banana, passionfruit, papaya, betel[2], cassava[5], sweet potato[5], greengram and cowpea[5], vegetables[5]	Coffee, pepper, cashew, mango, lime, lemonime,pasture, pineapple, banana, passionfruit, papaya, betel[2], ginger[4], turmeric[4], yams & tubers[5], vegetables[5]
S_5	Andigama (shallow)	pineapple, passionfruit, papaya, cassava[5], greengram and pulses[5], vegetables[5]	cashew, mango, pasture, pineapple, passionfruit, papaya, cassava[5], vegetables[5]

District: Matale **Agro-eclogical region: IM3**

S_2	Melsiripura (undulating terrain)	banana, passionfriut, papaya, betel[1] yams & tubers[5], vegetables[5]	cacao, coffee, pepper, clove, nutmeg, cinnamon, avacado, arecanut, lemonime, pasture, fodder, banana, papaya, ginger[4], turmeric[4], yams & tubers[5], vegetables[5]
S_4	Melsiripura (Rolling terrain)	banana, passionfruit, papaya	cacao, coffee, pepper, clove, nutmeg, cinnamon, avacado, lemonime, lime, mango, pasture, banana, papaya, passionfruit

District: Gampaha **Agro-ecological region: WL3**

S_1	Halpe	pineapple, banana, passionfruit, papaya, betel[1], yams & tubers[5], vegetables[5]	cacao, coffee, pepper, clove, cinnamon, rambutan, avocado, arecanut, lemonime, pasture, fodder, banana, betel[1], ginger[4], turmeric[4], yams[5], vegetables[5]

S_1	Katunayake	banana, papaya, yams & tubers[5], vegetables[5]	pepper, cinnamon, arecanut, pasture, fodder, banana, ginger[4], turmeric[4], yams & tubers[5], vegetables[5]
	Ratupasa	banana, papaya, yams & tubers[5], vegetables[5]	cacao, coffee, pepper, cinnamon, arecanut, pasture, fodder, banana, betel[1], ginger[4], turmeric[4], yams[5], vegetables[5]
S_2	Metikotuwa	banana, papaya, betel[1], yams[4], sweet potato[4], vegetables[4]	cacao, coffee, cinnamon, rambutan, avocado, arecanut, pasture, fodder, banana, papaya, betel[1], yams[5], sweet potato[5], vegetables[5]
	Pallama	banana, papaya, betel[1], yams[4], sweet potato[4], vegetables[4]	cinnamon, rambutan, avocado, arecanut, pasture, fodder, banana, betel[1], yams[5], sweet potato[5], vegetables[5]
	Weliketiya	banana, yams[5], sweet potato[5], vegetables[5]	cinnamon, pasture, fodder, banana, yams[5], sweet potato[5], vegetables[5]

S_3	Negombo	banana, papaya, yams[5], sweet potato[5], vegetables[5]	cinnamon, pasture, fodder, banana, papaya, yams[5], sweet potato[5], vegetables[5]
S_4	Boralu (moderately deep)	pineapple, banana, passionfruit, papaya, betel[1], ginger[4], turmeric[4], yams & tubers[5], vegetables[4]	cacao, coffee, pepper, cinnamon, rambutan, avocado, arecanut, pasture, pineapple, banana, passionfruit, papaya, betel[1], ginger[4], turmeric[4], yams & tubers[5], vegetables[5]
	Medagama	banana, betel[1], yams & tubers[5], vegetables[5]	cinnamon, arecanut, cashew, mango, pasture, fodder, banana, betel[1], yams[5], sweet potato[5], vegetables[5]
S_5	Boralu (shallow)	pineapple, passionfruit, banana, papaya, cassava[5], vegetables[5]	cinnamon, cashew, mango, pasture, pineapple, passionfruit, papaya, cassava[5], vegetables[5]
	Sudu	sweet potato[5], vegetables[5]	cinnamon, cashew, mango, vegetables[5]

District: Gampaha **Agro-ecological region:** WL2

S_3	Warakapola-Nelundeniya (undulating to rolling)	banana, passionfruit, betel[1], yams & tubers[5], vegetables[5]	cacao, coffee, pepper, clove, nutmeg, cinnamon, rambutan, avocado, arecanut, lomonime, pasture, fodder banana, betel[1], passionfruit, ginger[4], turmeric[4], vegetables[5]

1. With supplimentary irrigation.
2. With lift irrigation.
3. Under rainfed (only in October/November).
4. Under rainfed (only in May/June).
5. Under rainfed (both May/June and October/November).

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