Present Status and Future Needs of Soil Database Development

Country Report: Sri Lanka

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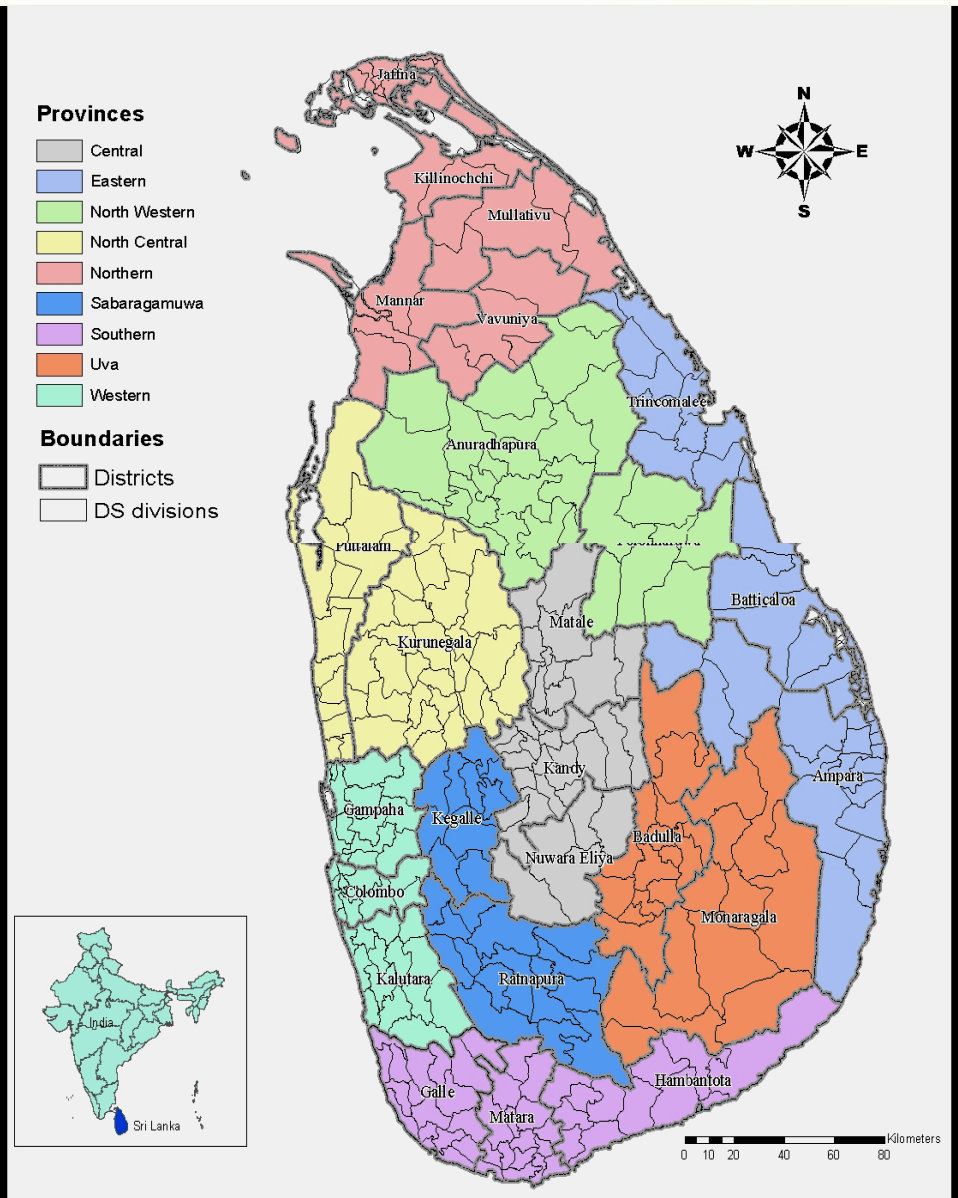
Sri Lanka

A

Presentation Plan

- Problems - Related to Land
- Demand for Soil Resource Information
- Need for a Soil Data Base
- Objectives
- Development of Soil Information to present status
- Outcomes & Applications
- Future Needs
- Conclusions

Background



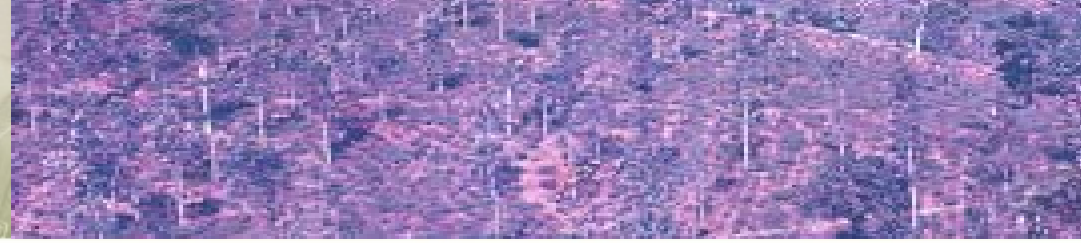
Sri Lanka

- Land area 65, 610 km2
  6.56 million ha
- Population of 20.2 million
- Area wise – 118th
- Population wise 47th
- Population density 19th

- *Showing pressure on land resources*
- *Per capita arable land is 0.15 ha*

Population growth of 1.1%
23 million in 2050

Human Induced Land Degradation



- **Soil Erosion & Sedimentation**

- Soil fertility decline
- Acidification
- Salinity & Alkalinity
- Eutrification
- Leaching of NO_3 and pesticides
- Fe toxicity
- Acid Sulfate conditions

These will further increase pressure on arable land

Growing demand for soil resource information

Need A soil data base - Organized manner

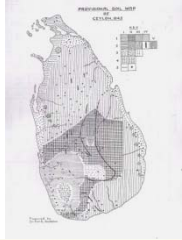
Objectives

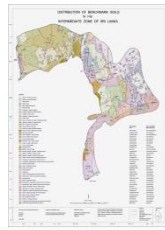
- Discuss the development of soil information to present status

- Highlight the use of the present database for land related applications

- Propose future development needs of a soil database for Sri Lanka

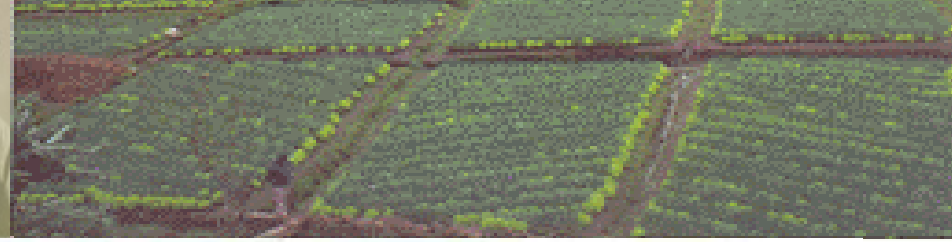
Milestones of Development to present status

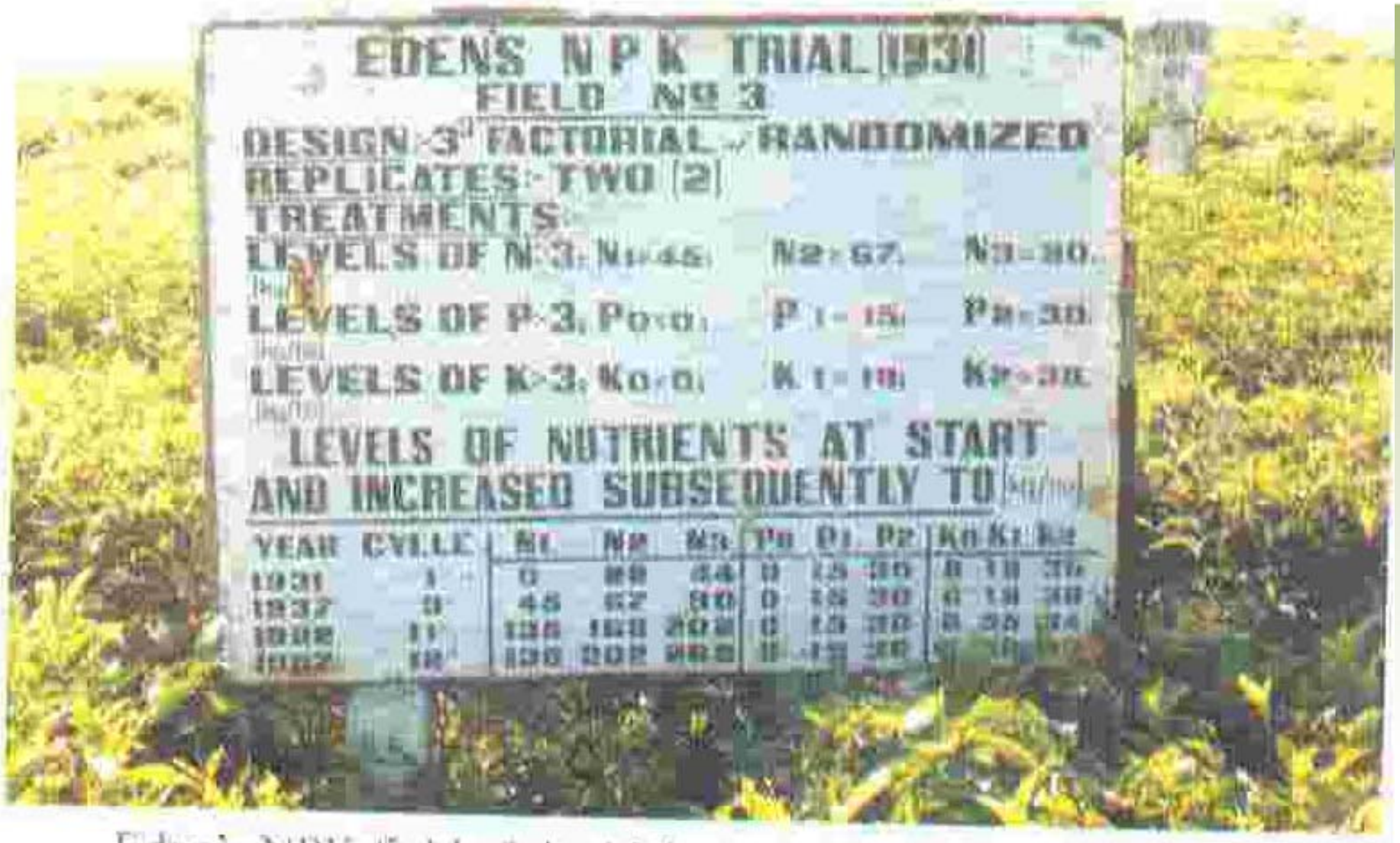


- First documented soil study was by Hughes in 1887 on “Ceylon Coffee Soil and Manures”

- Eden (1929) – Systematic study of Tea Growing soils – Recognized the importance of soil profile
  First Factorial Experiment

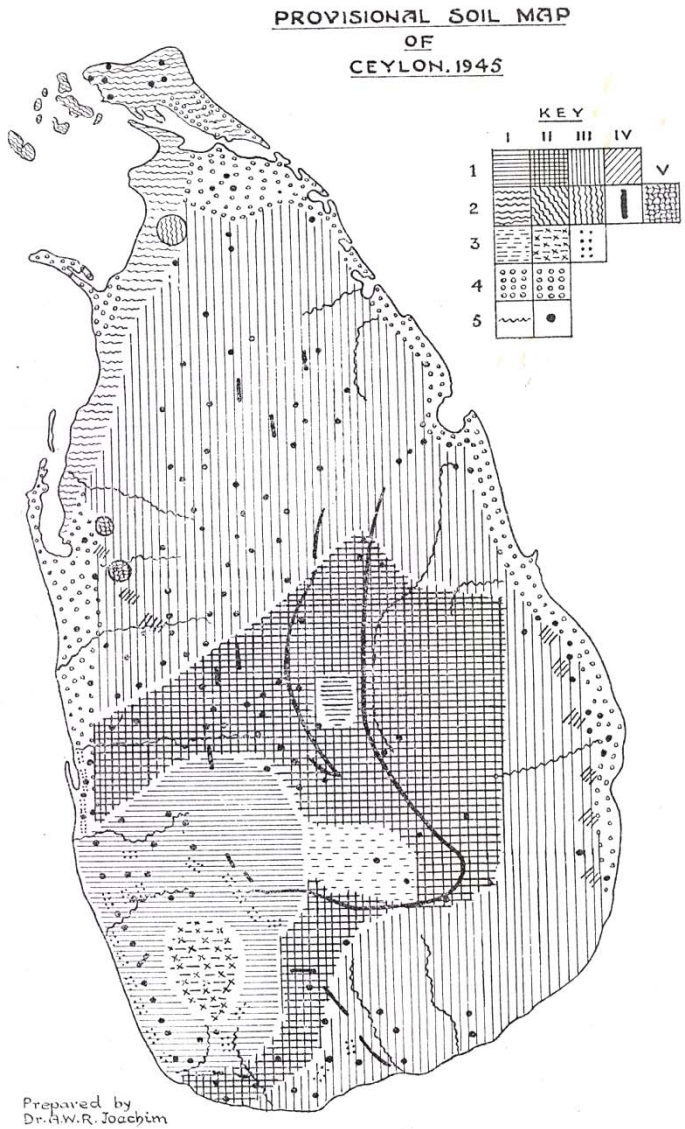




Eden's NPK field trial which started in 1931 at St Coombs

First Provisional Soil Map

In 1955 Joachim & co-workers published the first provisional soil map of Ceylon



Major Features

- Nature of Parent rock
- Climate
- Vegetation
- Topography

- **Ponnamperuma (1959) – Soil classification system for rice growing soils**

Development to Present Status

Mostly used soil map & Report by

De Alwis & Panabokke 1972

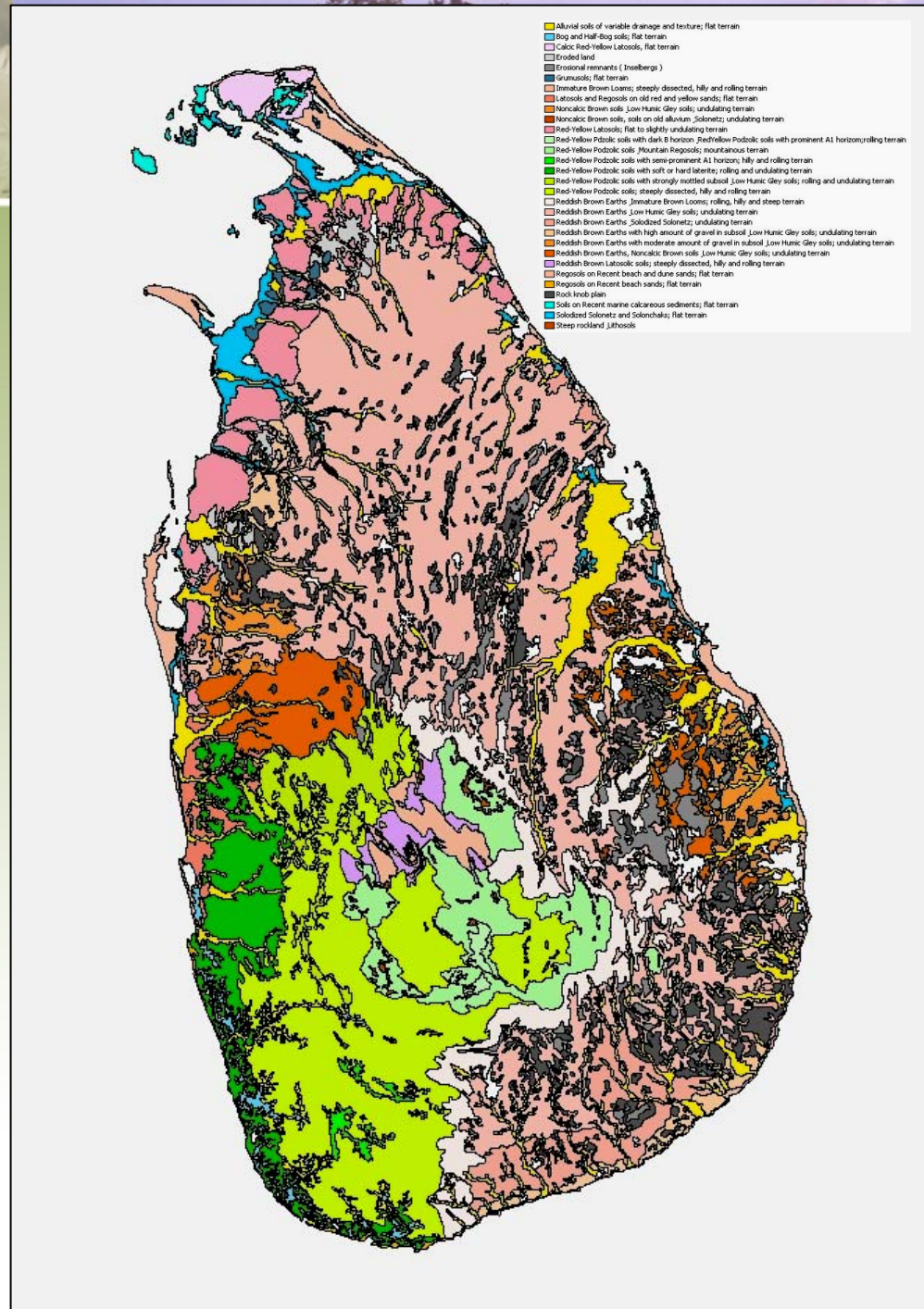
(SSSSL Journal Vol. 2)

Mapping units

- **Soil Associations**
  Consisting of Great Soil Groups

(Same order – Sequence- of genetic horizons)

- **Soil complexes**
- **Miscellaneous land units**



Most Recent

- Soil Science Society of Sri Lanka – Continue
- CIDA Funded SRICANSOL project – Twinning project between SSSSL and CSSS - 1999
- Map the soils in more detail
- Classify according to International methods
- Classify at series level – more applications
- Characterize a Benchmark site – Each soil series

Structure of the Data Base

Developed in 3 stages

Rainfall zones

- **Wet Zone > 2500 mm**
- **Intermediate 1750-2500**
- **Dry Zone < 1750 mm**

Elevation

Low country < 300 m

Dry Zone

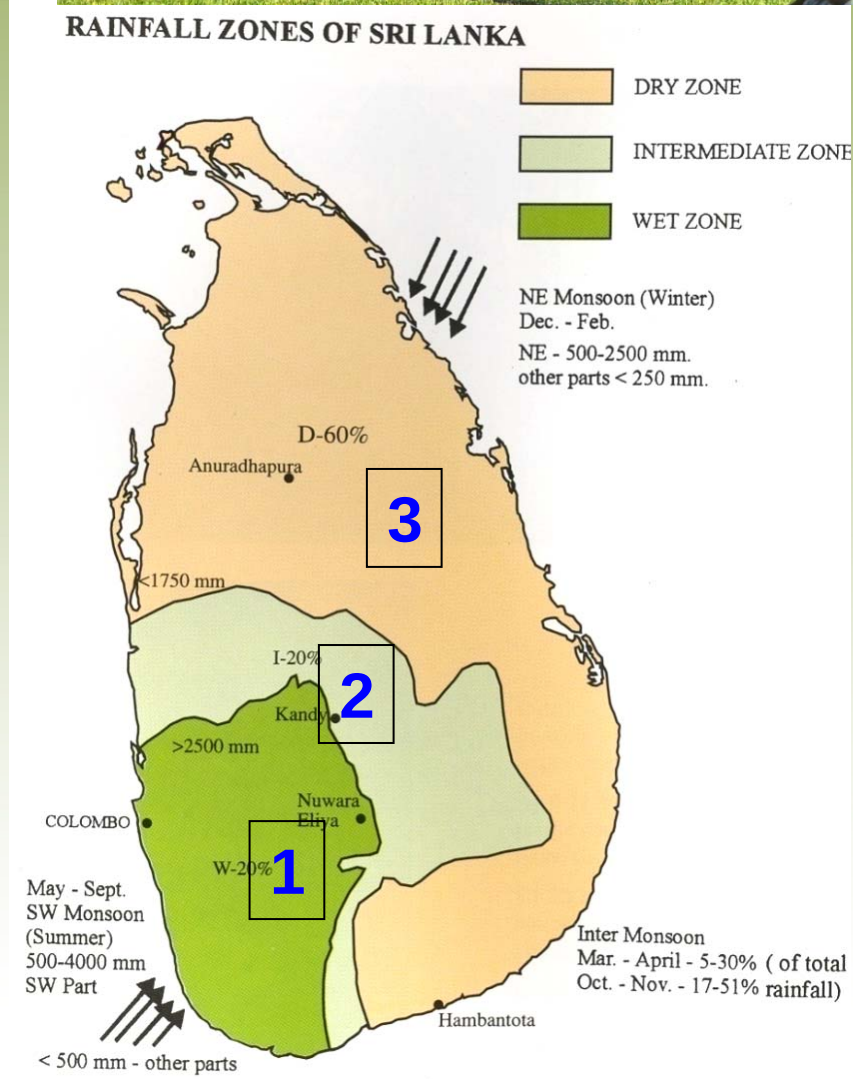
Erosional surfaces

Coastal plains

Flood plains

Mid country 300-900 m

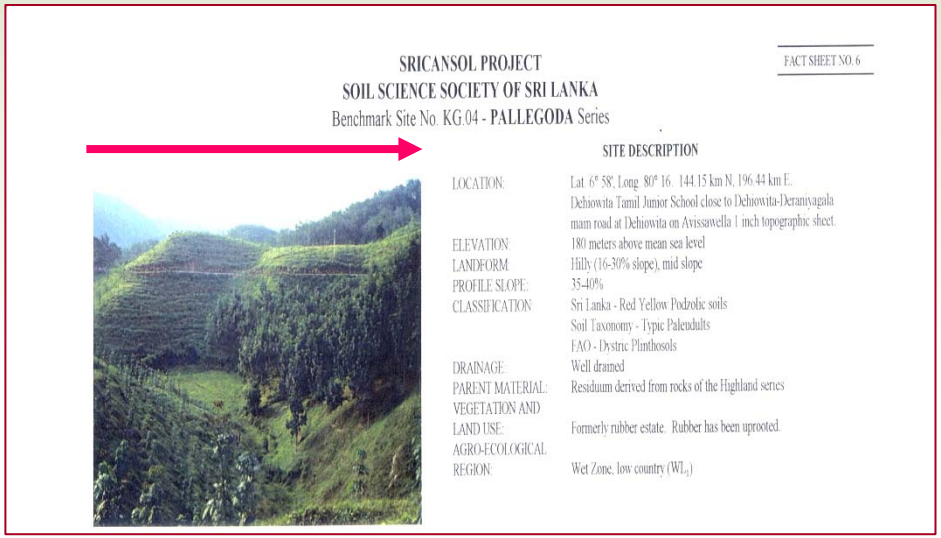
Up country > 900 m



Dev. of Database..

1. **Identification of the major soil series based on soil, topography, parent material, climate, vegetation, previous information**

2. **Selection of bench mark sites**
   - **Exact location - (GPS)**
   - **Description of landscape + Soil Profile**

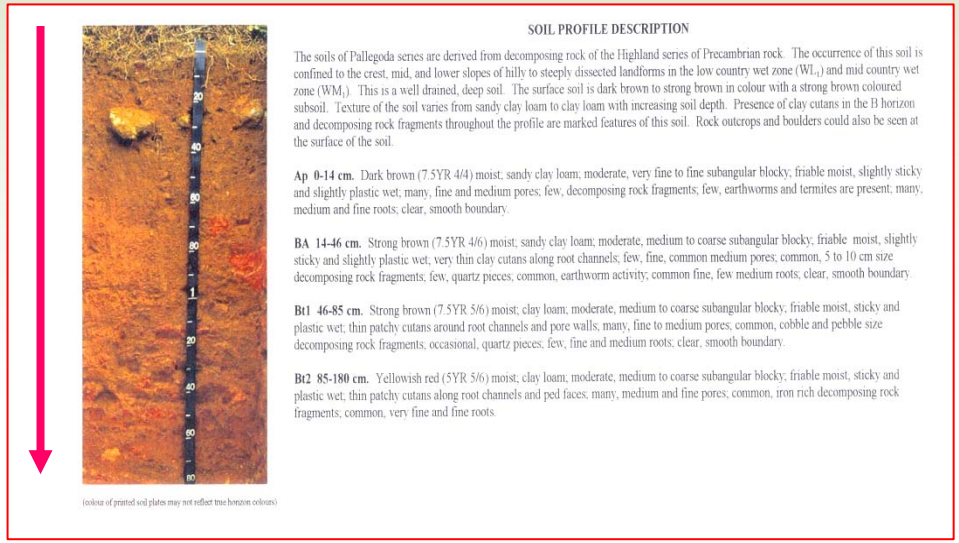


SRICANSOL PROJECT
SOIL SCIENCE SOCIETY OF SRI LANKA
Benchmark Site No. KG.04 - PALLEGODA Series

FACT SHEET NO. 6

SITE DESCRIPTION

LOCATION:	Lat. 6° 58', Long. 80° 16. 144.15 km N, 196.44 km E. Dehiowita Tamil Junior School close to Dehiowita-Deraniyagala main road at Dehiowita on Avissawella 1 inch topographic sheet.
ELEVATION:	180 meters above mean sea level
LANDFORM:	Hilly (16-30% slope), mid slope
PROFILE SLOPE:	35-40%
CLASSIFICATION:	Sri Lanka - Red Yellow Podzolic soils Soil Taxonomy - Typic Paleudults FAO - Dystric Plinthosols
DRAINAGE:	Well drained
PARENT MATERIAL:	Residuum derived from rocks of the Highland series
VEGETATION AND LAND USE:	Formerly rubber estate. Rubber has been uprooted.
AGRO-ECOLOGICAL REGION:	Wet Zone, low country (WL_1)



(colour of printed soil plates may not reflect true horizon colours)

SOIL PROFILE DESCRIPTION

The soils of Pallegoda series are derived from decomposing rock of the Highland series of Precambrian rock. The occurrence of this soil is confined to the crest, mid, and lower slopes of hilly to steeply dissected landforms in the low country wet zone (WL_1) and mid country wet zone (WM_1). This is a well drained, deep soil. The surface soil is dark brown to strong brown in colour with a strong brown coloured subsoil. Texture of the soil varies from sandy clay loam to clay loam with increasing soil depth. Presence of clay cutans in the B horizon and decomposing rock fragments throughout the profile are marked features of this soil. Rock outcrops and boulders could also be seen at the surface of the soil.

Ap 0-14 cm. Dark brown (7.5YR 4/4) moist; sandy clay loam; moderate, very fine to fine subangular blocky; friable moist, slightly sticky and slightly plastic wet; many, fine and medium pores; few, decomposing rock fragments; few, earthworms and termites are present; many, medium and fine roots; clear, smooth boundary.

BA 14-46 cm. Strong brown (7.5YR 4/6) moist; sandy clay loam; moderate, medium to coarse subangular blocky; friable moist, slightly sticky and slightly plastic wet; very thin clay cutans along root channels; few, fine, common medium pores; common, 5 to 10 cm size decomposing rock fragments; few, quartz pieces; common, earthworm activity; common fine, few medium roots; clear, smooth boundary.

Bt1 46-85 cm. Strong brown (7.5YR 5/6) moist; clay loam; moderate, medium to coarse subangular blocky; friable moist, sticky and plastic wet; thin patchy cutans around root channels and pore walls; many, fine to medium pores; common, cobble and pebble size decomposing rock fragments; occasional, quartz pieces; few, fine and medium roots; clear, smooth boundary.

Bt2 85-180 cm. Yellowish red (5YR 5/6) moist; clay loam; moderate, medium to coarse subangular blocky; friable moist, sticky and plastic wet; thin patchy cutans along root channels and ped faces; many, medium and fine pores; common, iron rich decomposing rock fragments; common, very fine and fine roots.

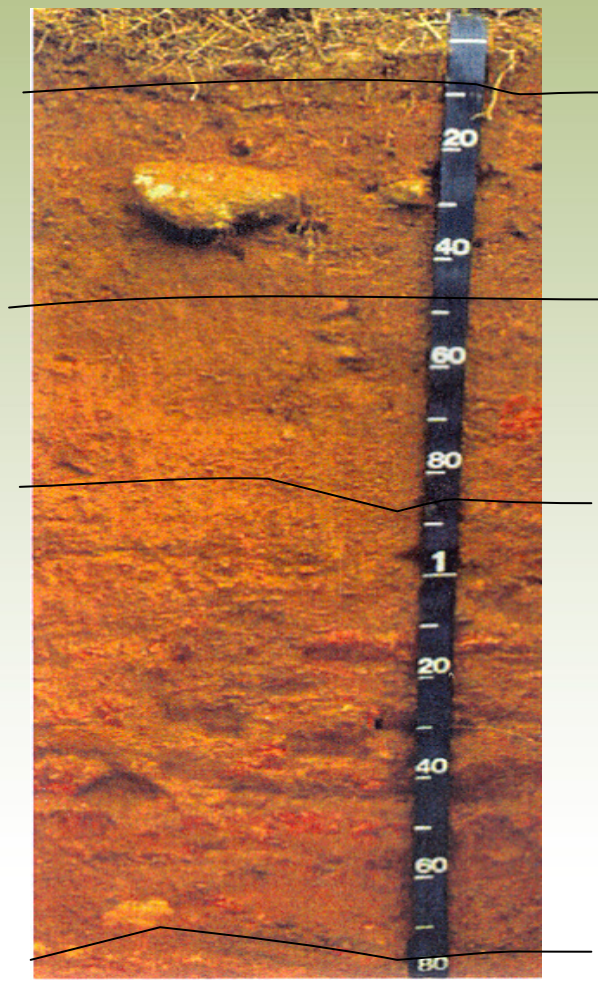
Dev. of Database….

3. Sampling from major soil horizons

4. Analysis for soil physical & chemical parameters

Collection of Data

Soil profile



Methodical Approach

In Wet zone

26 – Soil Series Benchmark Profiles

137 Horizons

17 Properties

Total of 2250

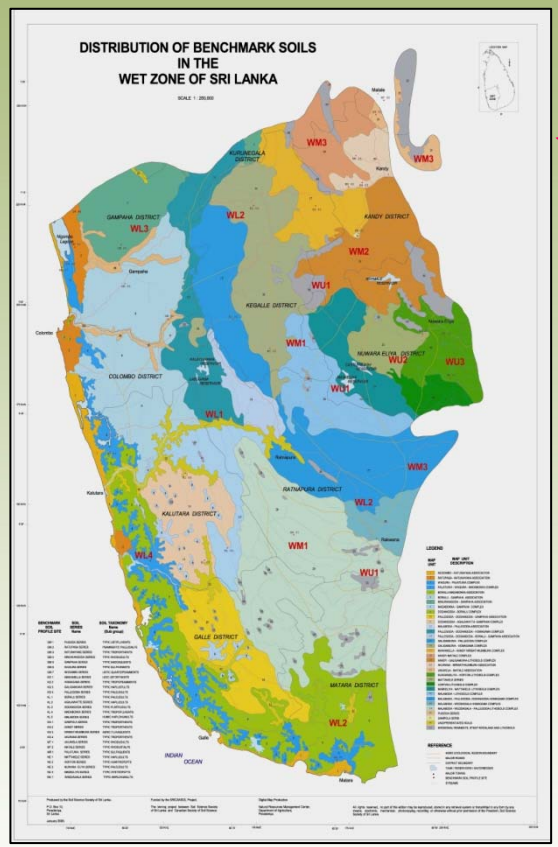
3 Replicates - 6750

In IZ zone – 40 series

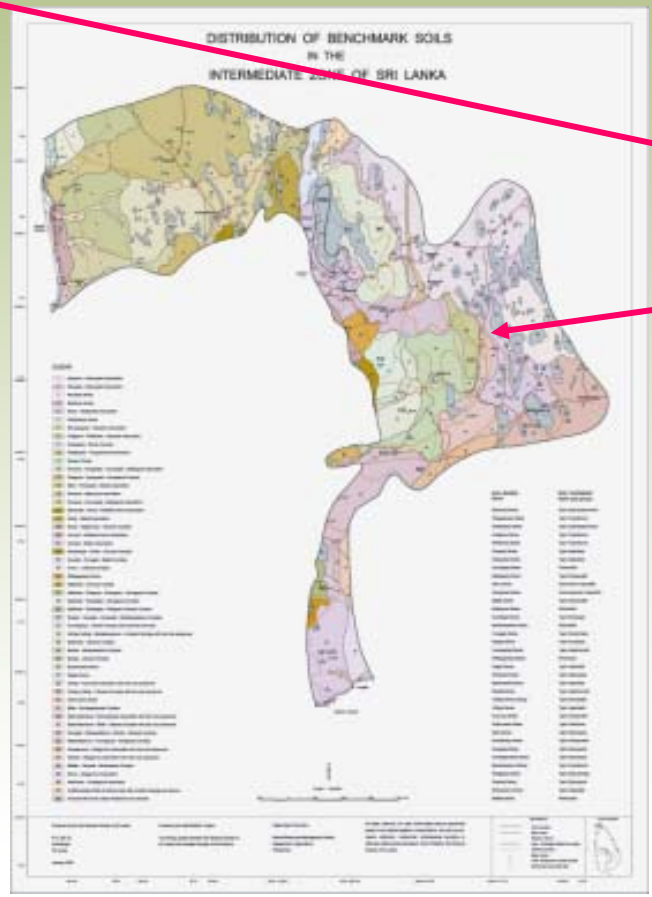
In Dry Zone 51 series

Detailed collection of data

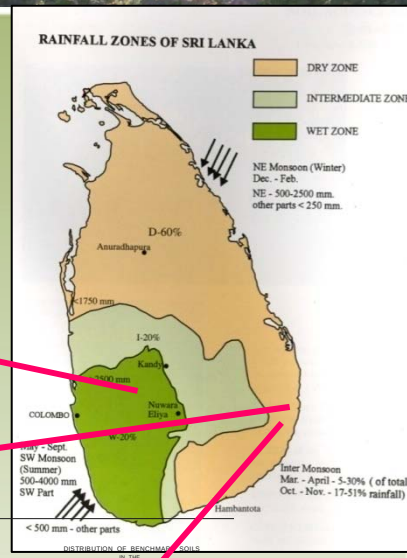
Soil Maps at Series level

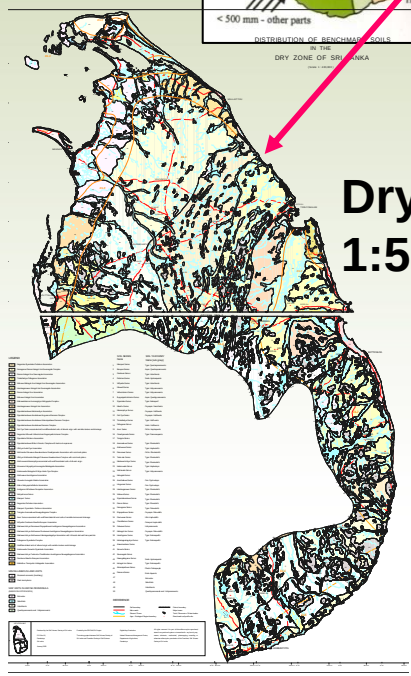


Wet Zone
1;250,000



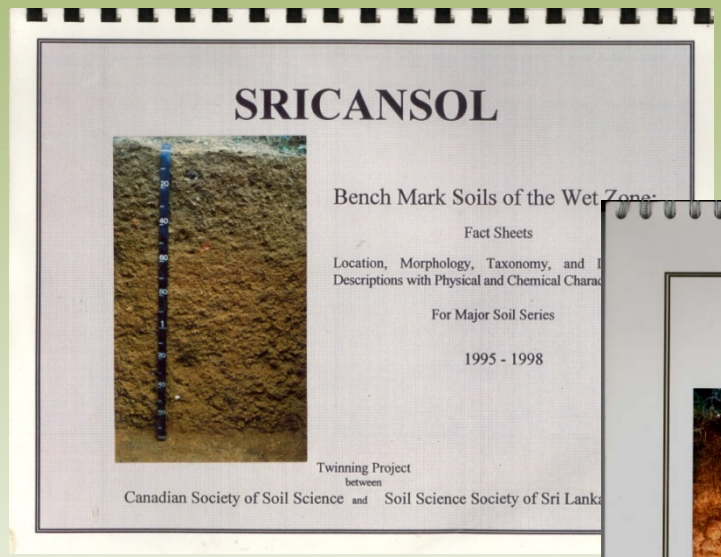
Intermediate Zone
1:400,000

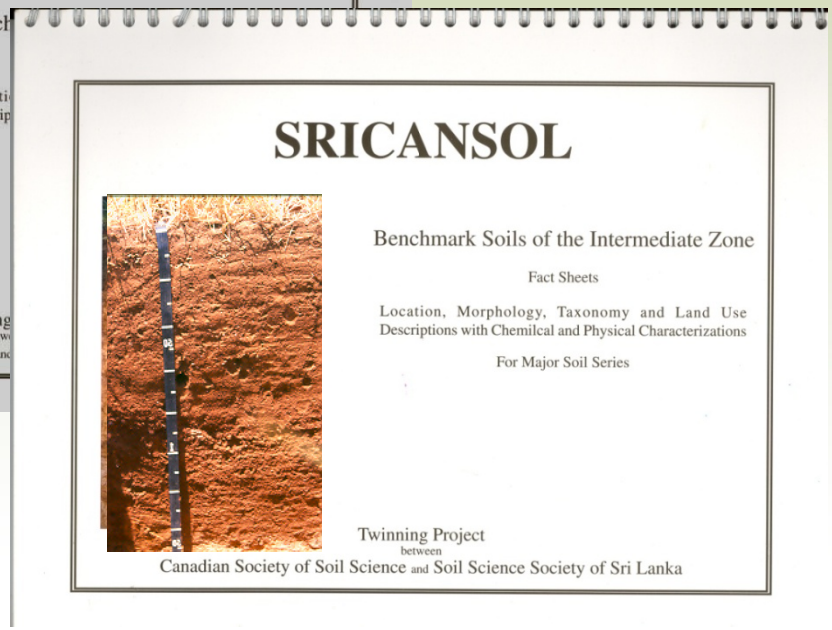




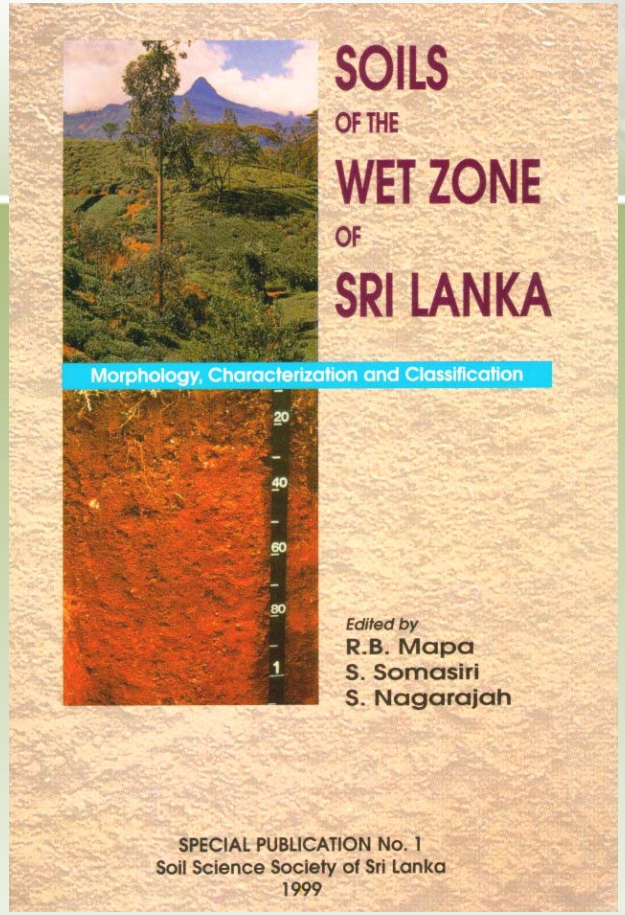
Dry Zone
1:500,000

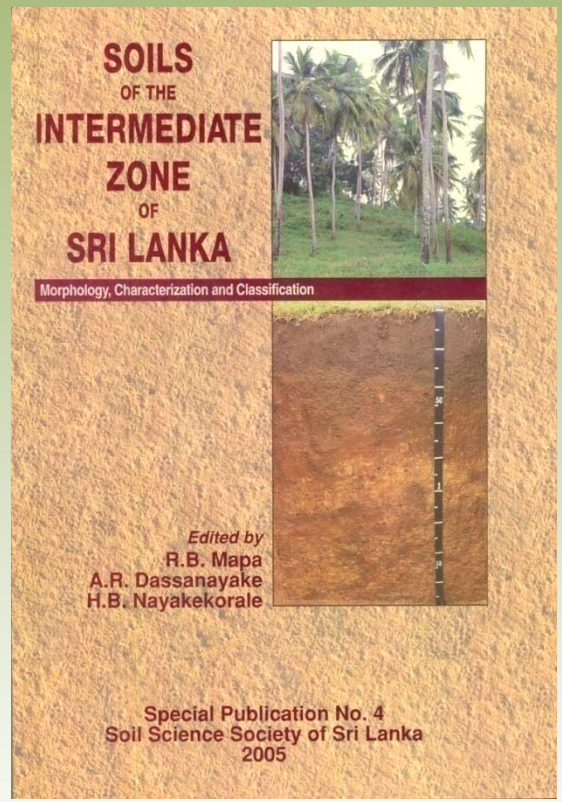
Soil Survey Reports

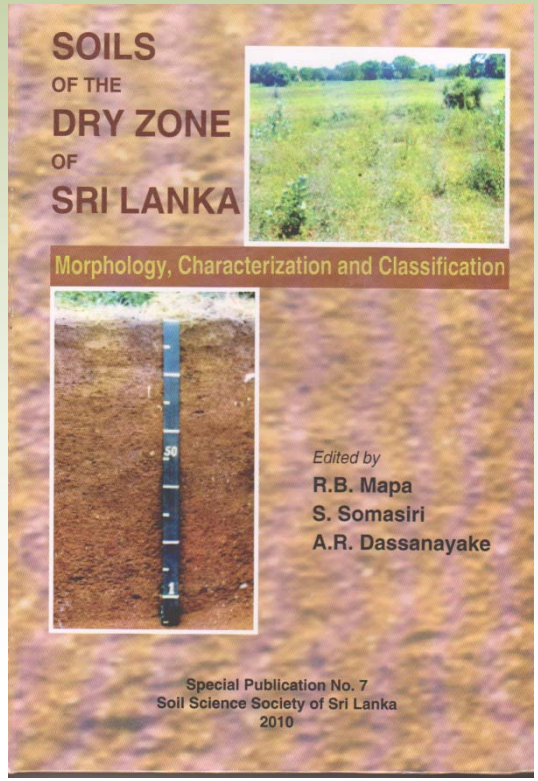




PRODUCTS & OUTPUTS

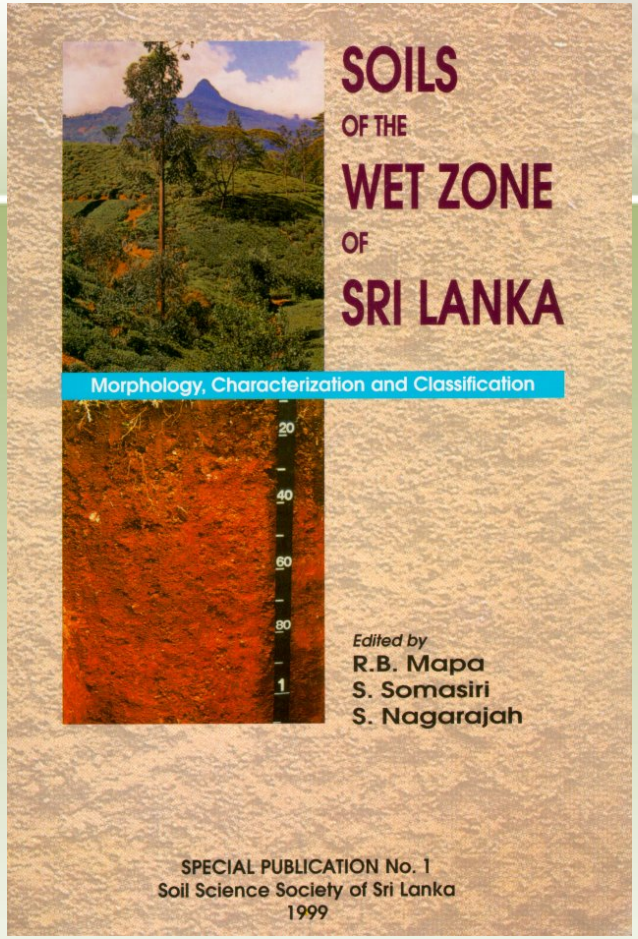


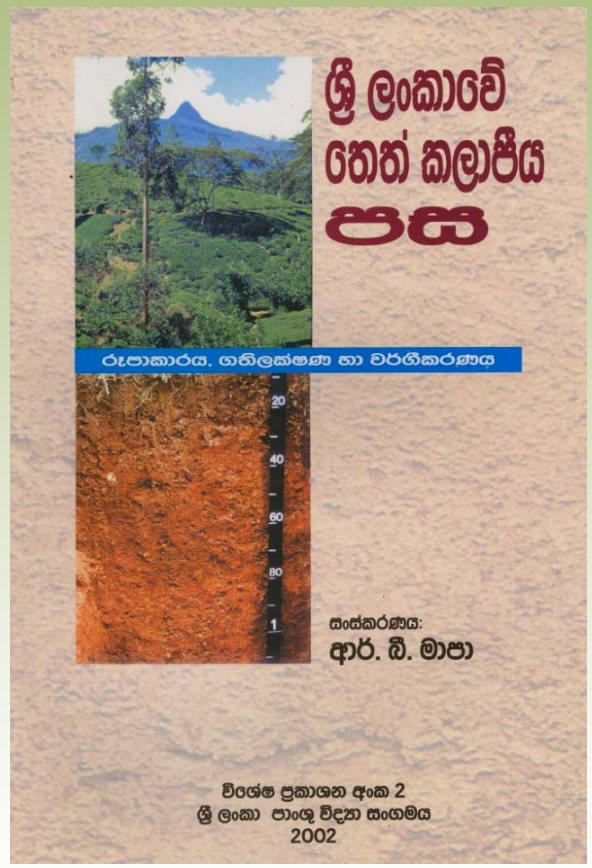


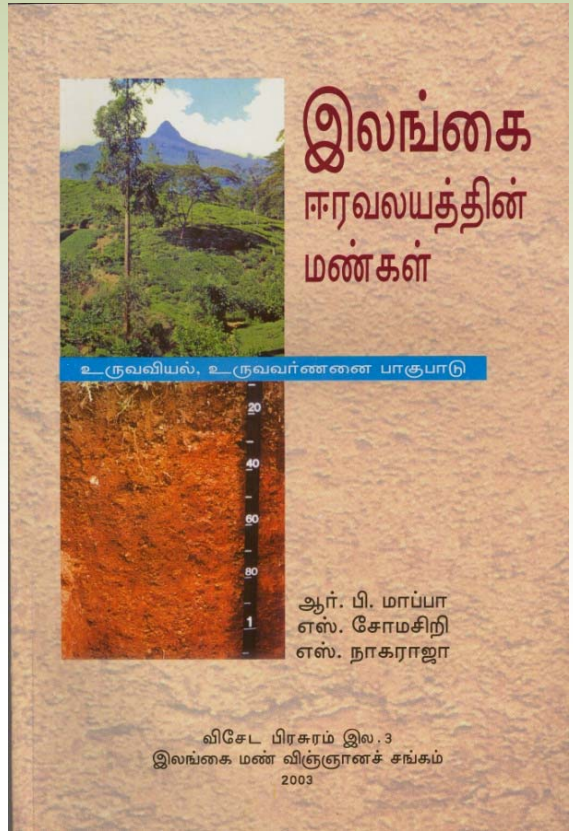


Books – 3 RF Zones

PRODUCTS & OUTPUTS

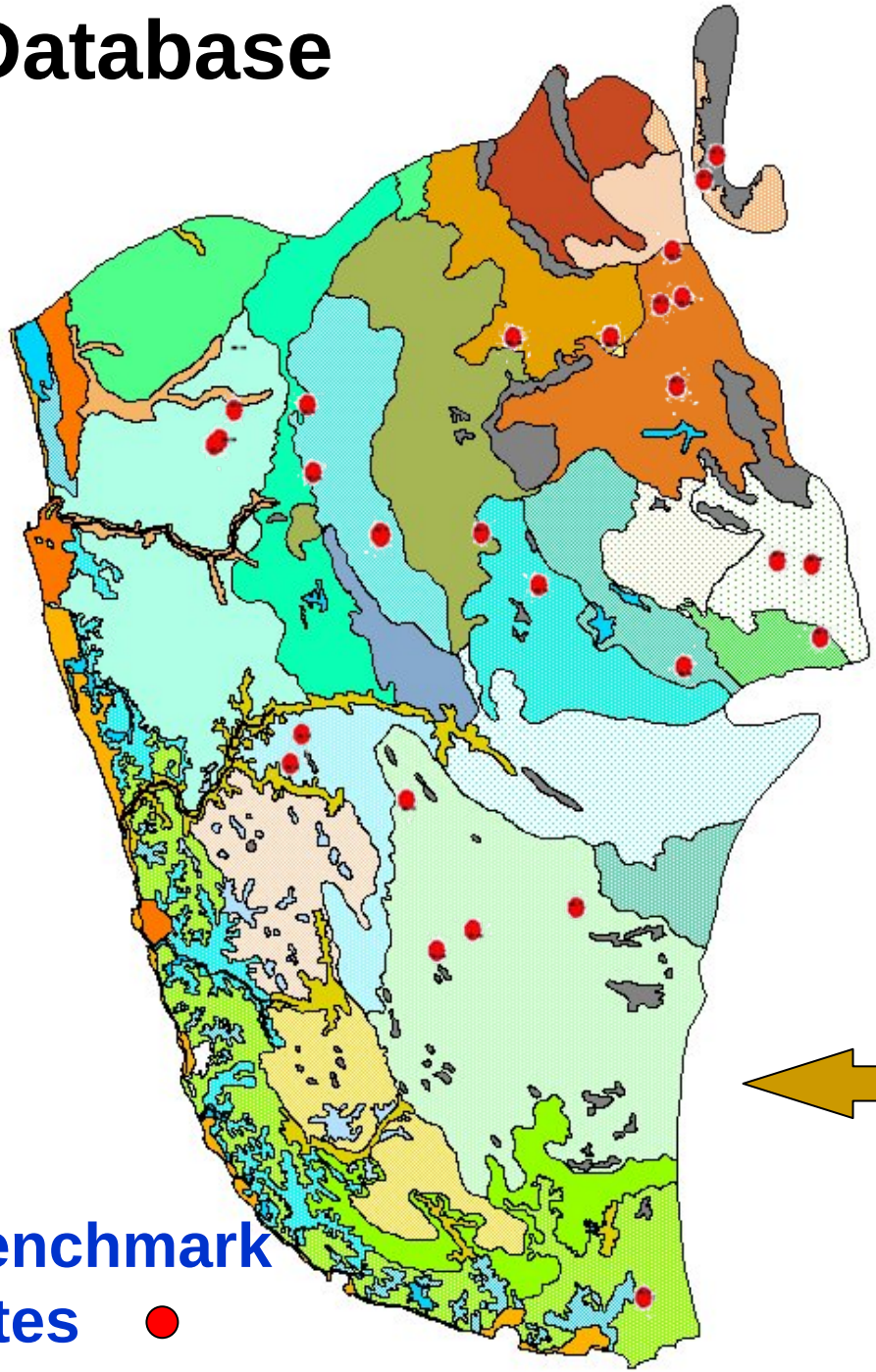




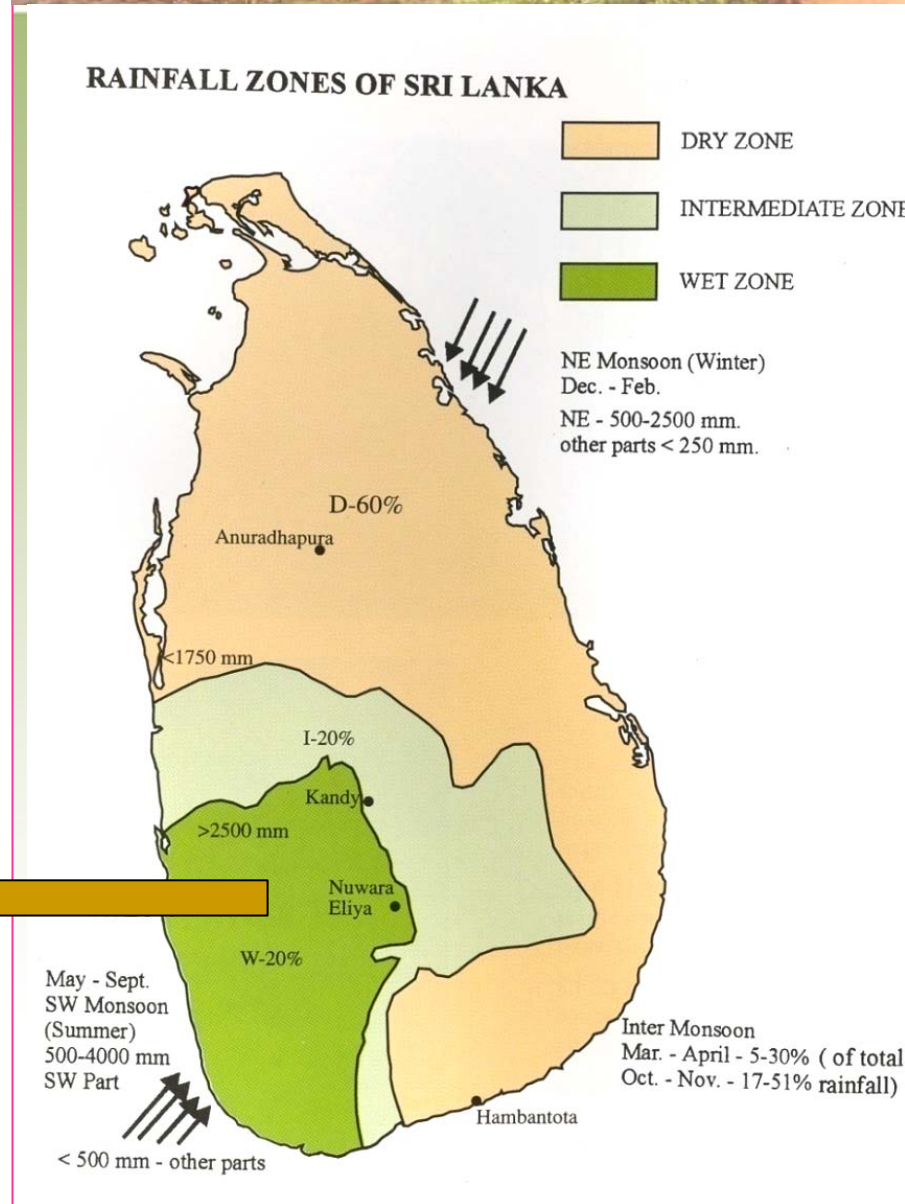


All 3 Languages
English, Sinhala & Tamil

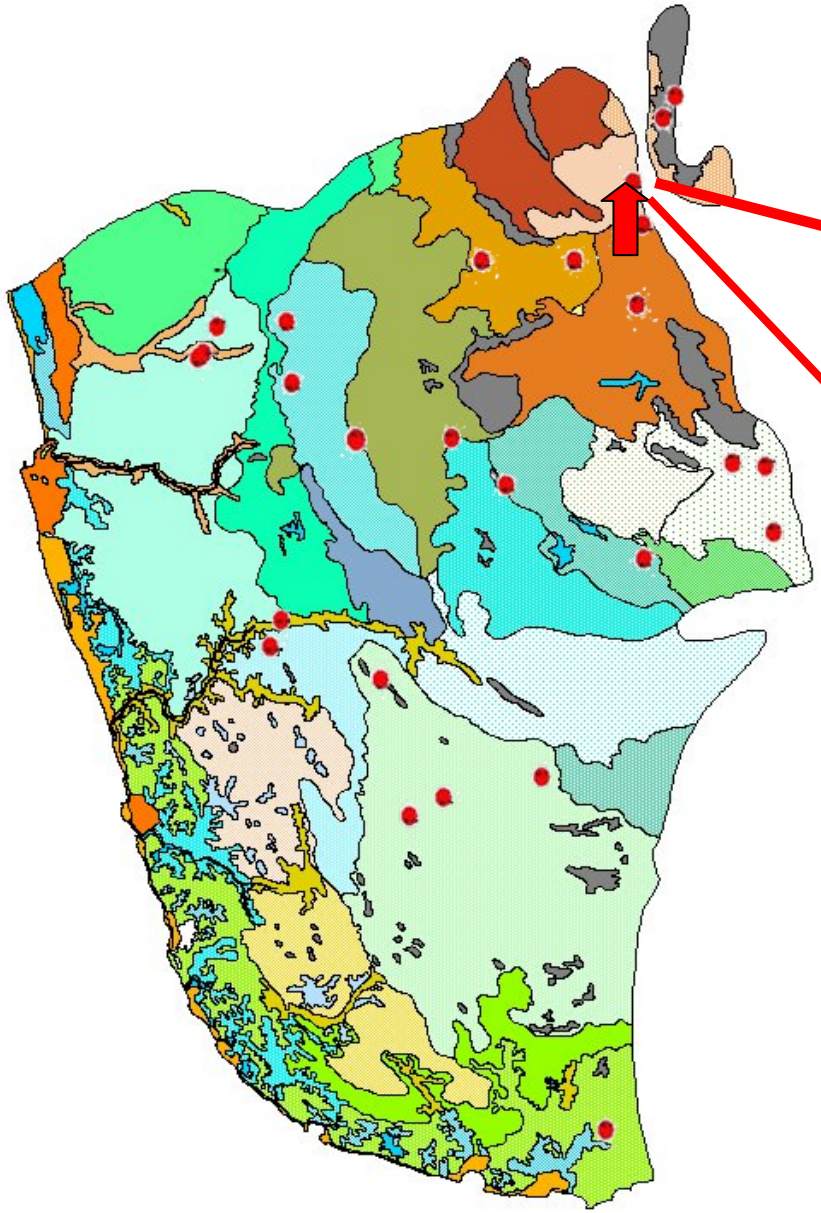
Database



Benchmark Sites

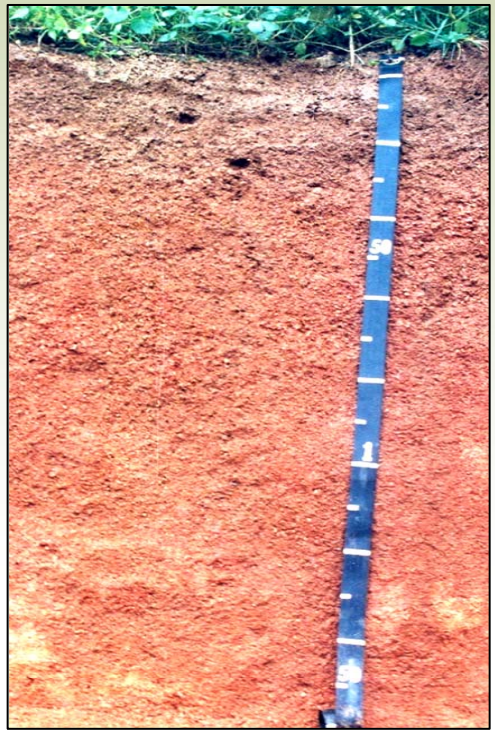


Database



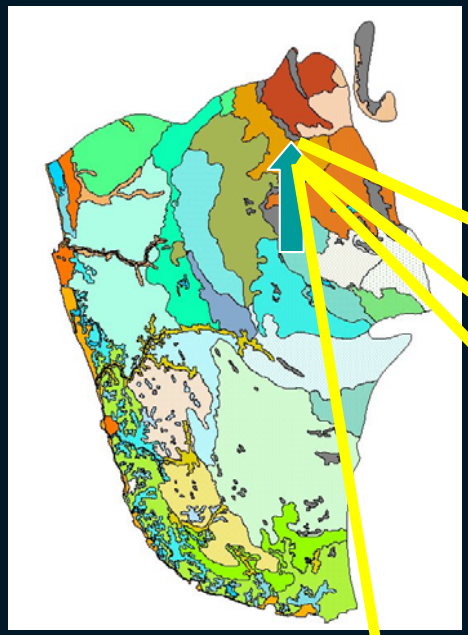
Landscape

Soil profile



Database

Database



FACT SHEET NO. 8

SRICANSOL PROJECT
SOIL SCIENCE SOCIETY OF SRI LANKA
Benchmark Site No. GM.01 - **PUGODA** Series

SITE DESCRIPTION

LOCATION:	Lat. 6° 58', Long. 80° 07. 197.51 km N, 128.58 km E. Senasuntenna, about 200 meters towards Tarala from Pugoda-Kirindiwela main road on Avissawella 1 inch topographic sheet.
ELEVATION:	Approximately 15 m.
LANDFORM:	Plain (0-2%)
PROFILE SLOPE:	Flat (0-1%)
CLASSIFICATION:	Sri Lanka - Alluvial soils Soil Taxonomy - Ustifluents* FAO -
DRAINAGE:	Well to moderately well drained
PARENT MATERIAL:	Alluvium of the Kalani River
VEGETATION AND LAND USE:	Rubber, vegetable cultivation, and brick production
AGRO-ECOLOGICAL REGION:	Wet Zone, low country (WL$_1$)

SOIL PROFILE DESCRIPTION

These soils have been developed from alluvial material transported by the Kalani river. The terrain is flat. Soils are very deep, well drained to moderately well drained. Soil colour is yellowish brown and the soil texture is clay loam. Soil colour and texture are homogeneous throughout the soil profile. Soil structure is well developed and ranges from strong medium subangular blocky to moderate medium to coarse subangular blocky. Consistency is sticky and plastic when wet. Plant roots are distributed throughout the soil profile. Gravel particles are not present in the profile. Black coloured manganese stains appear at a depth of about 40 cm and become hard manganese nodules below a depth of 135 cm.

Ap 0-20 cm. Dark yellowish brown (10YR 4/6) moist; clay loam; strong medium subangular blocky; hard dry, friable moist, sticky and plastic wet; thin patchy cutans; common fine and medium pores; many faint dark coloured stains; few medium, frequent very fine and fine roots; clear smooth boundary.

B1 20-40 cm. Dark yellowish brown (10YR 4/6) moist; many faint mottles; clay loam; strong medium angular blocky; firm moist, sticky and plastic wet; thin patchy cutans along root channels; common fine and medium pores; common fine and very fine roots; occasional dead roots; clear smooth boundary.

B2 40-80 cm. Dark yellowish brown (10YR 4/6) moist; clay loam; moderate medium and coarse subangular blocky; friable moist, sticky and plastic wet; thin patchy cutans along root channels; few fine and medium pores; faint manganese stains; very few medium, few fine and medium roots; clear smooth boundary.

B3 80-135 cm. Dark yellowish brown (10YR 4/6) moist; clay loam; moderate medium to coarse subangular blocky; friable moist, sticky and plastic wet; thin patchy cutans; few fine pores; many, distinct manganese stains; very few very fine roots; clear smooth boundary.

B4 135-180+ cm. Dark yellowish brown (10YR 4/6) moist; clay loam; moderate medium to coarse subangular blocky; friable moist, sticky and plastic wet; few fine pores; many distinct manganese stains and few 1-2 mm size manganese concretions.

*Soil Moisture regime based on New Hall Simulation Model.

FACT SHEET NO. 8

Soil Physical Properties

Horizon Symbol	SAND %					Total Sand %	Silt %	Clay %	Bulk Density (g/cm^3)
	Very Coarse	Coarse	Medium	Fine	Very Fine				
Ap	2.3	2.5	2.7	7.8	10.2	25.5	34	40.5	1.1
B1	1.6	2.1	2.0	9.7	11.4	26.8	28.9	44.3	1.1
B2	1.6	4.0	3.8	8.9	10.8	29.1	26.4	44.5	1.3
B3	1.8	3.0	4.7	7.2	5.2	21.9	31.4	46.7	1.3
B4	1.2	2.1	3.2	8.8	10.4	25.7	27.2	47.1	1.3

Horizon Symbol	Dry Aggregates		Wet Aggregates % remaining >15 min	Soil Moisture Retention %			Sat. Hydraulic Cond. (cm/h)	Steady Infiltration Rate (cm/h)
	Mean Wt. Dia (mm)	Log SD		0.1 bar	0.33 bar	15 bar		
Ap	2.59	0.36	84	44.3	35.3	29.7	ND	ND
B1	2.34	0.92	70	41.8	33.4	28.3		
B2	2.33	0.37	51	35.6	29.4	24.2		
B3	2.27	0.84	40	36.3	31.5	25.2		
B4	ND	ND	ND	37.8	32.5	27.7		

Soil Chemical Properties

Horizon Symbol	pH		CEC* meq/100 g	Exchangeable Bases* (meq/100 g soil)				Base Sat.* %	Organic Carbon %	P_2O_5 ppm
	1:2.5 H_2O	1M KCl		Ca^{+2}	Mg^{+2}	K^+	Na^+			
Ap	4.5	4	19.3	2.1	0.4	0.1	0.2	14	1.3	6
B1	4.8	3.6	17.6	2.3	0.4	0.1	0.1	16	0.9	2.8
B2	5.0	4.0	18.0	3.5	0.5	0.1	0.1	23	0.6	2.6
B3	5.0	4.5	15.6	3.8	0.7	0.3	0.1	31	0.4	3.2
B4	5.2	4.8	16.9	2.9	0.7	0.1	0.1	22	0.3	4.4

Prepared by: A. Senarath, A.R. Dassanayake, R.B. Mapa, Soil Science Society of Sri Lanka. May, 1997.

* In Na OAC pH 7
ND Not Determined
-- Trace

Database Applications

Resource planner → **Query based on his requirements**

Database can display units fulfilling criteria

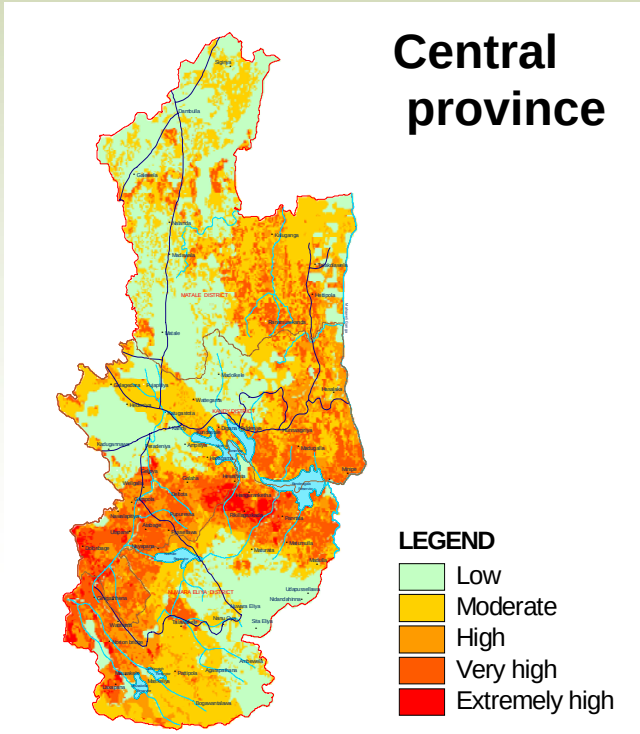
- Erosion hazard assessment
- Suitability mapping
- Management of problem soils
- Agro-ecological zoning
- Land use planning
- Simulation of fertilizer, agro-chemicals movement to ground water

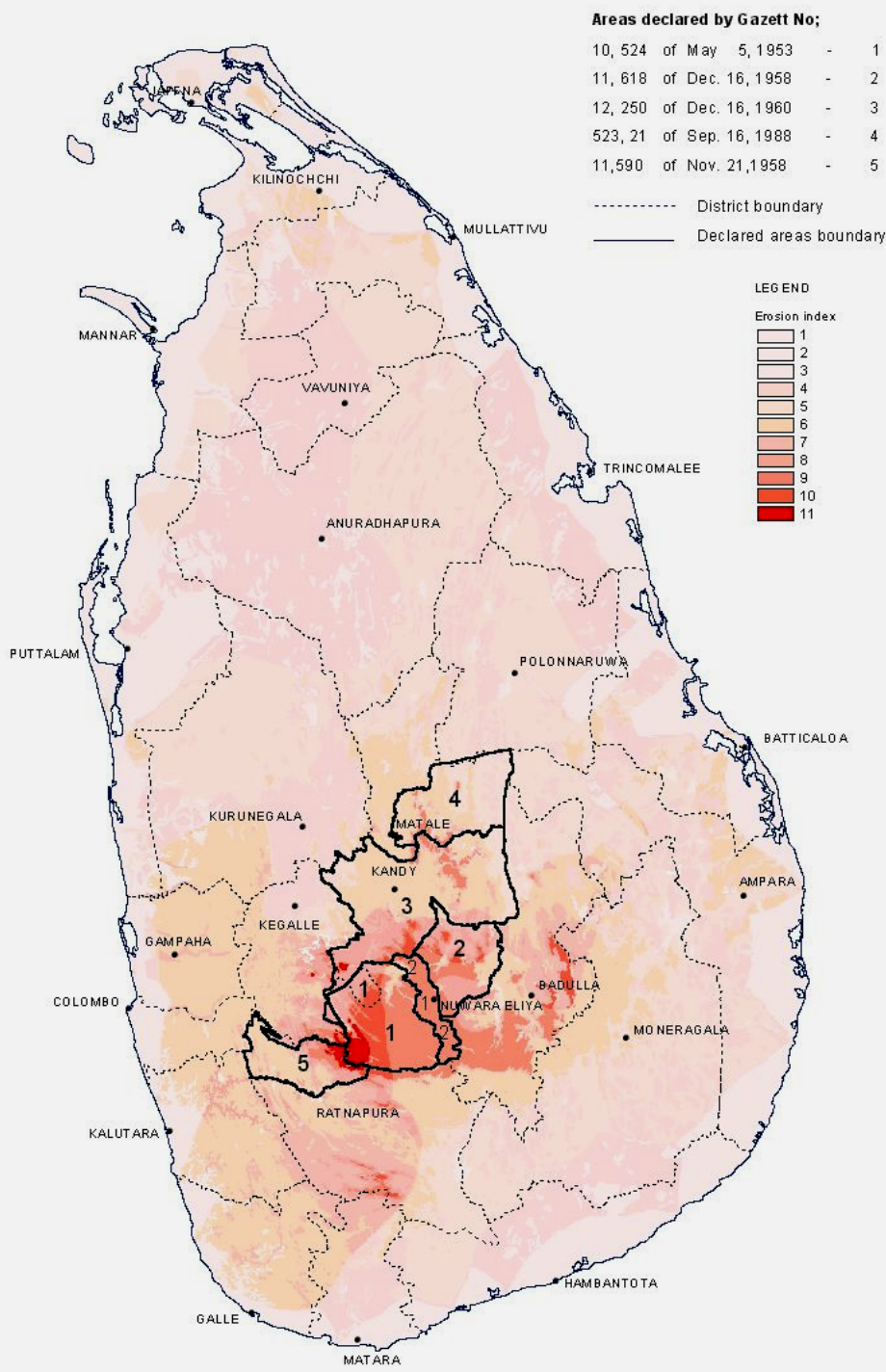
Database Applications

SOIL EROSION HAZARD MAP DEVELOPED

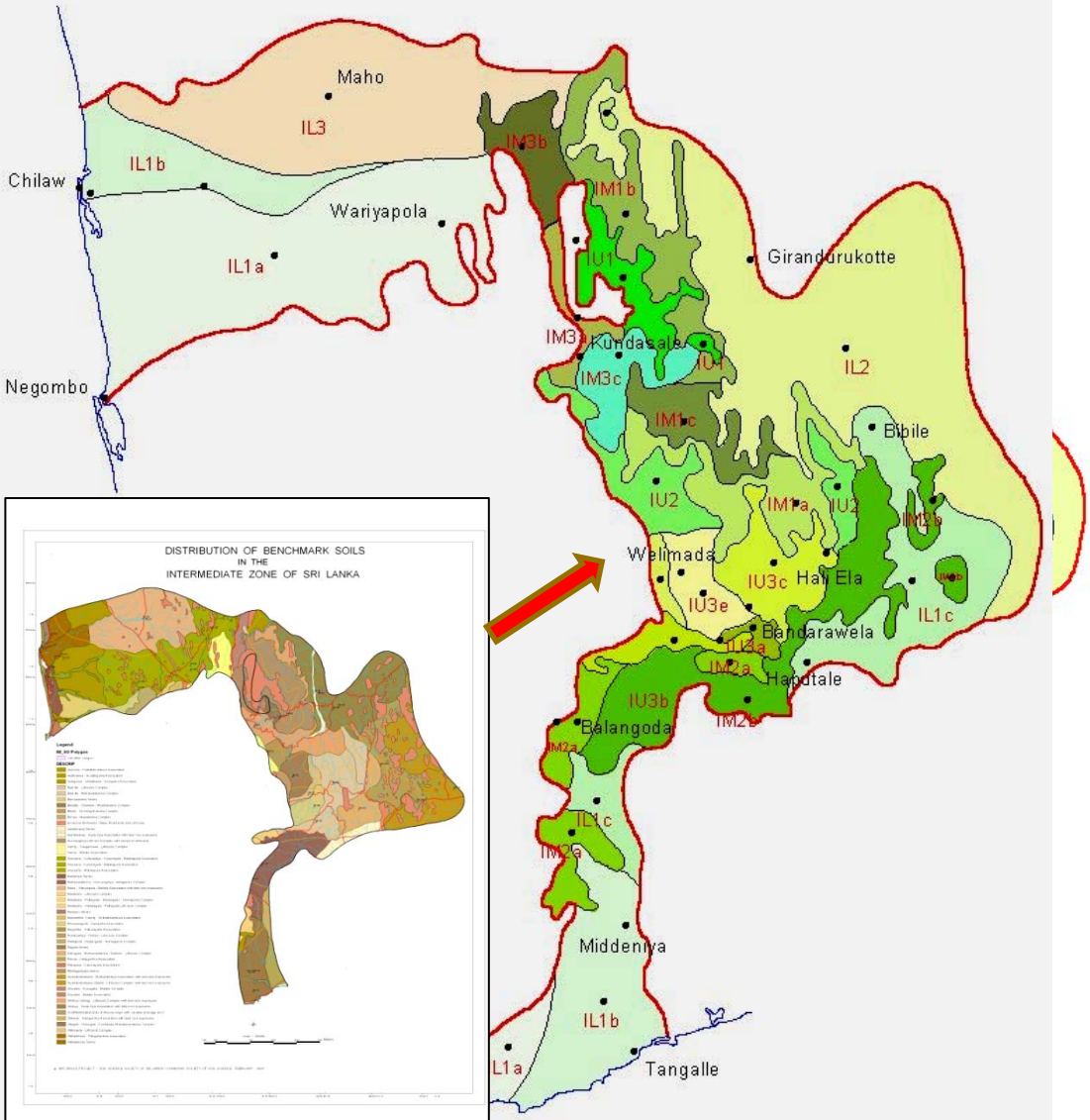
Soil data → Erodibility

Rainfall → Erosivity





Agro-Ecological Regions of the Intermediate Zone

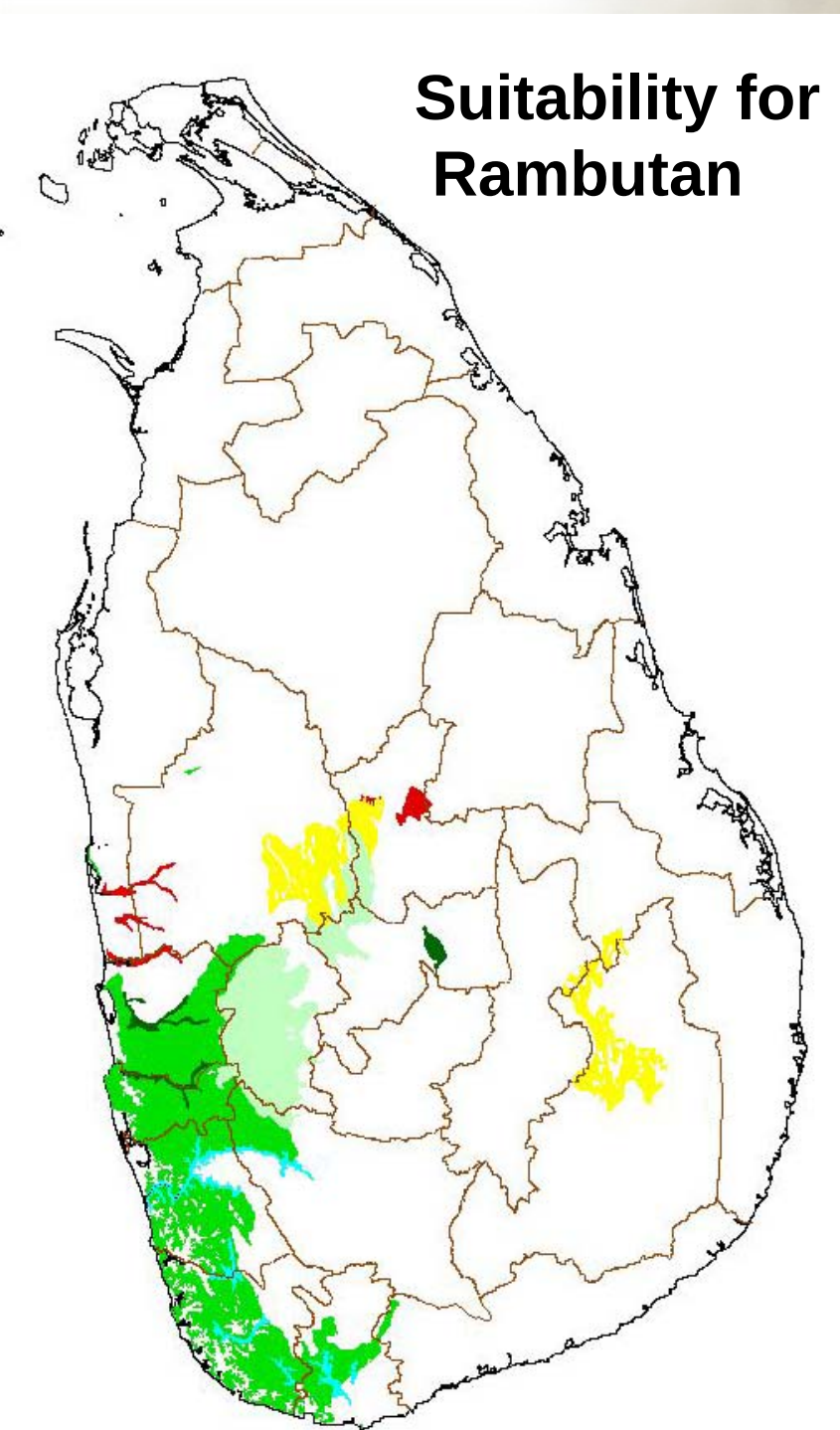


IU1
IU2
IU3a
IU3b
IU3c
IU3d
IU3e

IM1a
IM1b
IM1c
IM2a
IM2b
IM3a
IM3b
IM3c

L1a
IL1b
IL1c
IL2
IL3

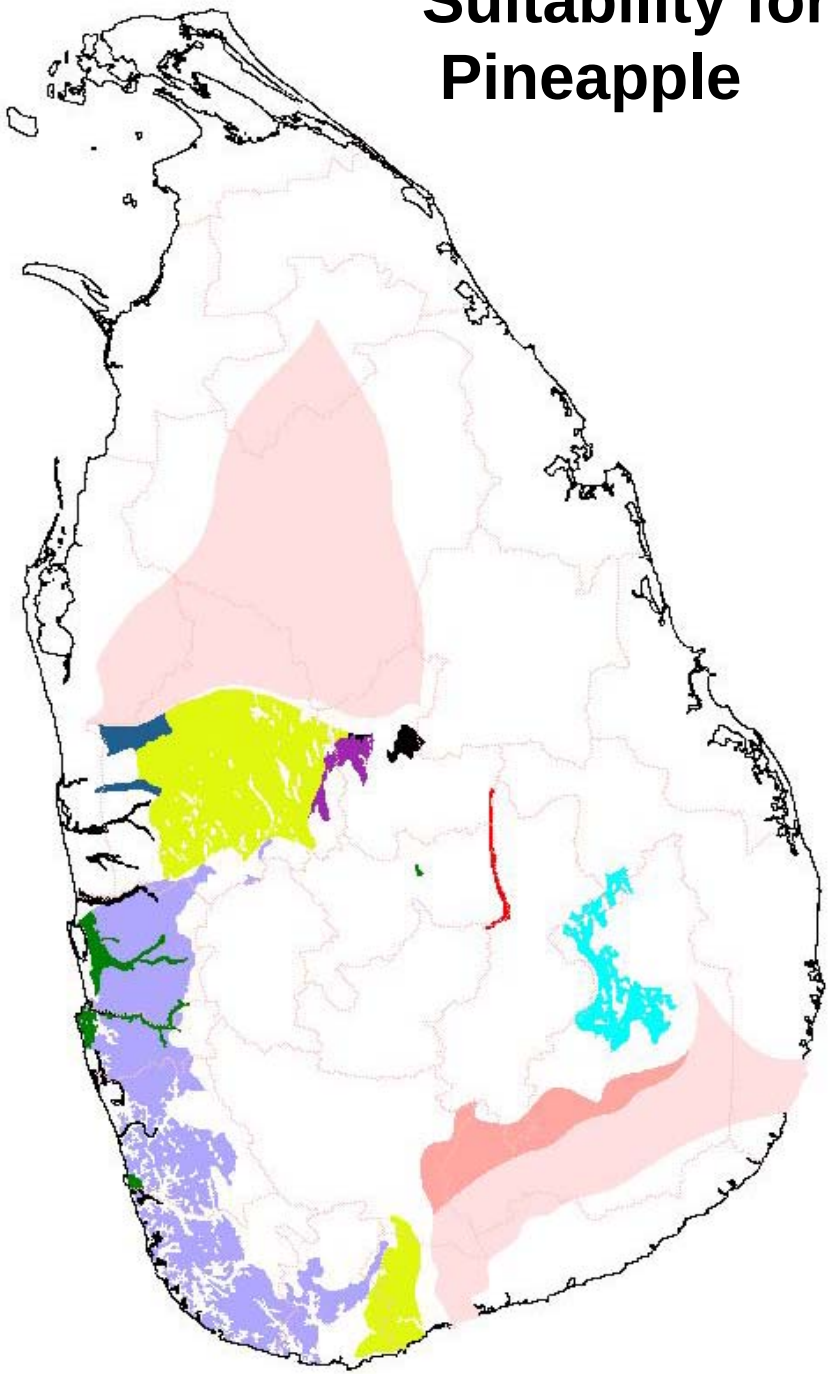
Suitability for Rambutan



Ranking of Suitability

- Rank 1
- Rank 2
- Rank 3
- Rank 4
- Rank 5
- Rank 6

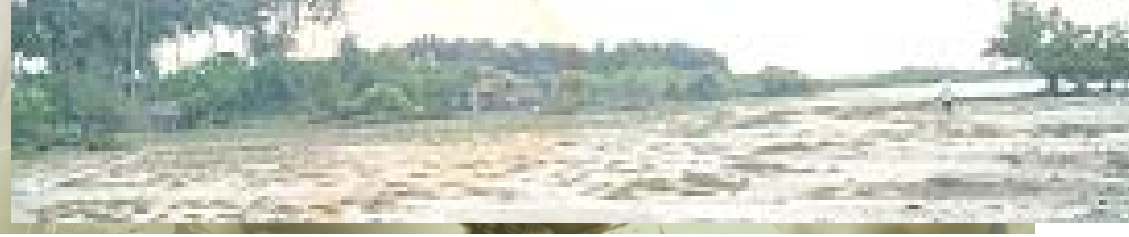
Suitability for Pineapple



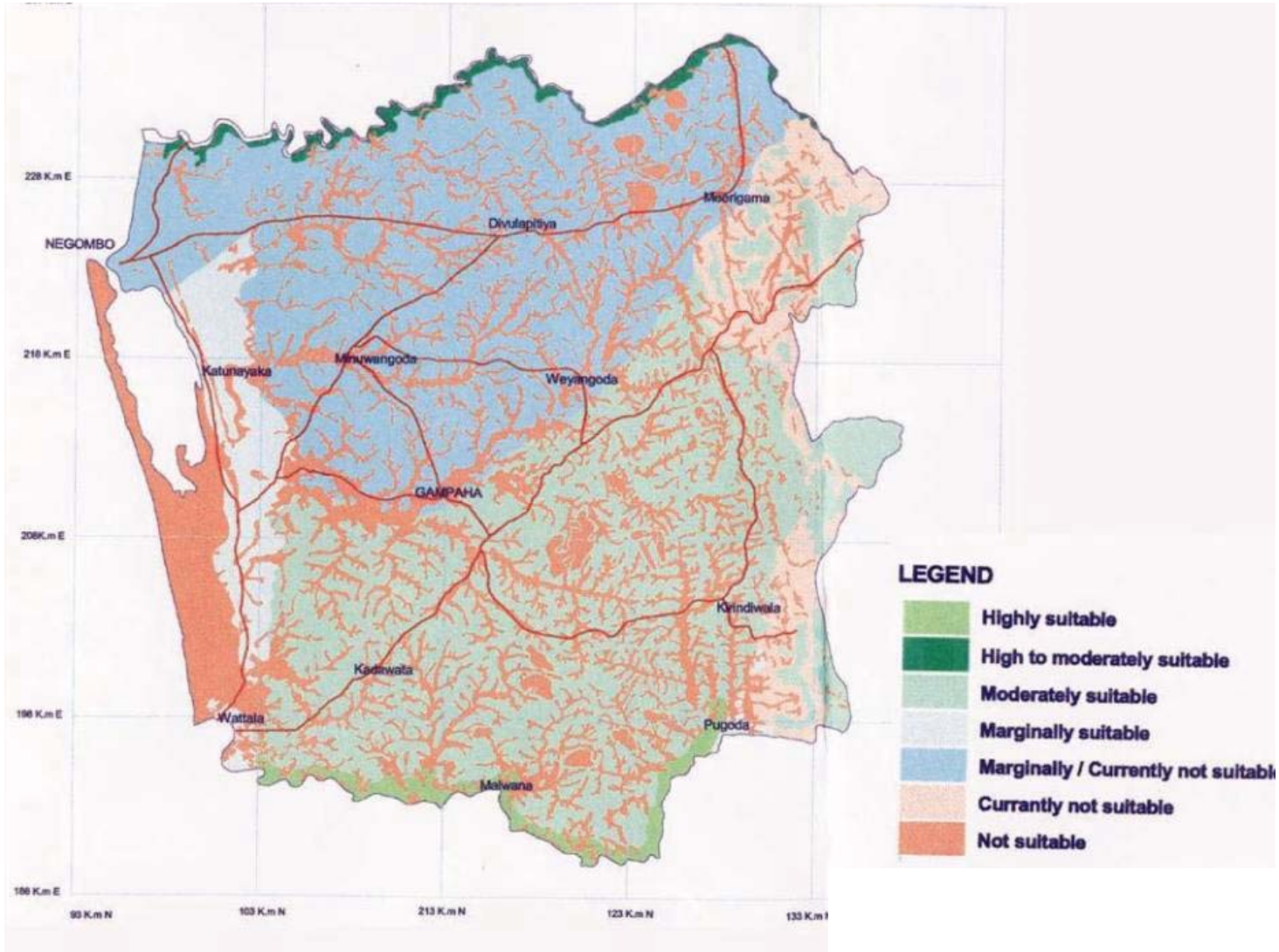
Ranking of Suitability

- Rank 1
- Rank 2
- Rank 3
- Rank 4
- Rank 5
- Rank 6
- Rank 7
- With Irrigation 1
- With Irrigation 2

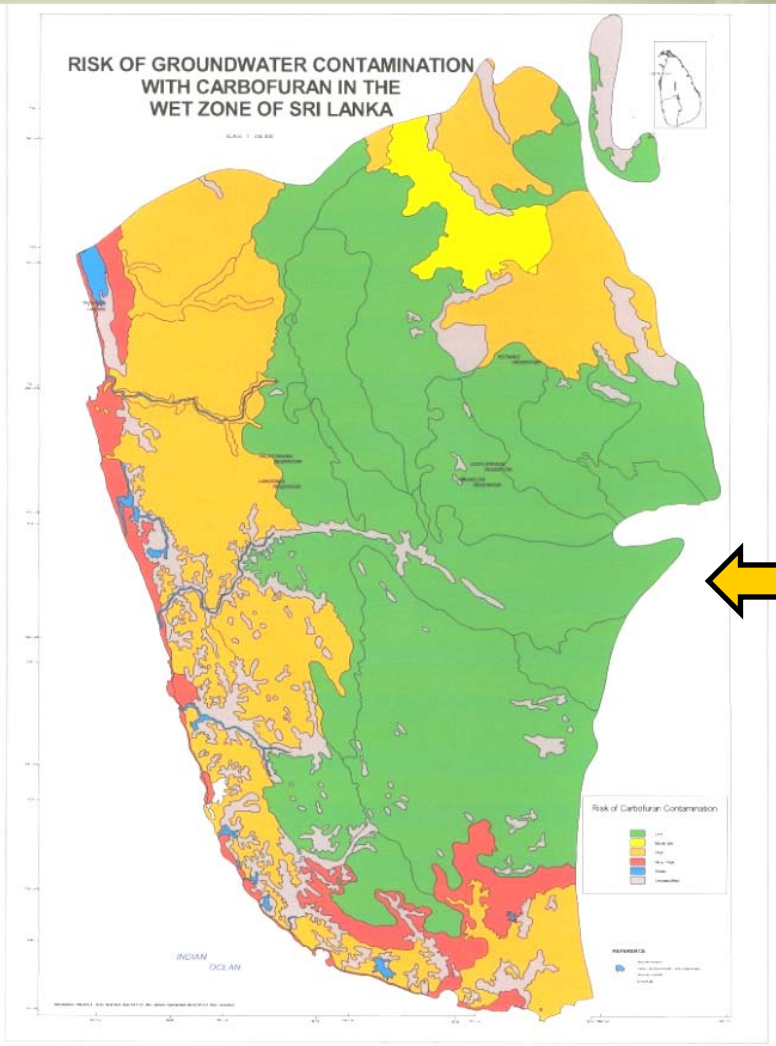
Database Applications



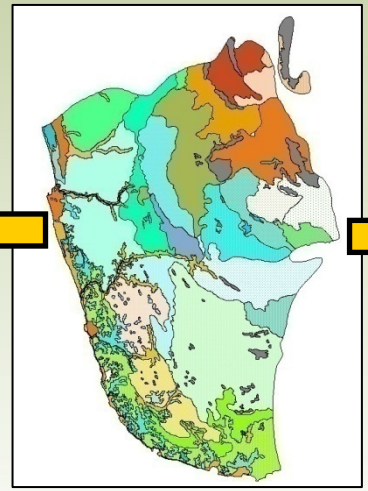
Land suitability for Rambutan – Gampaha District



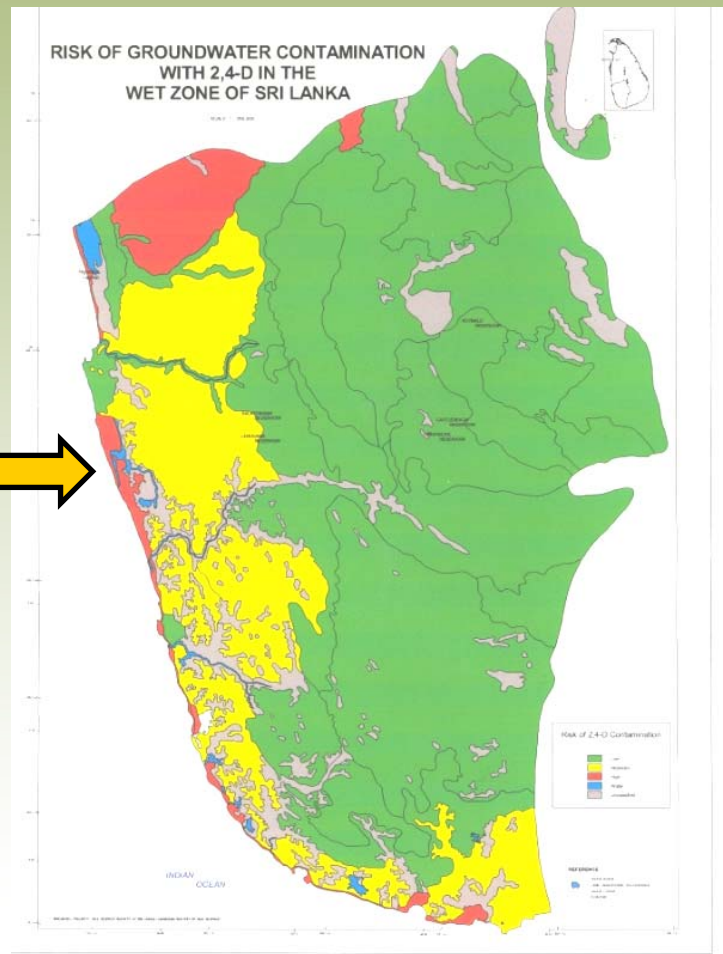
Risk of ground water contamination



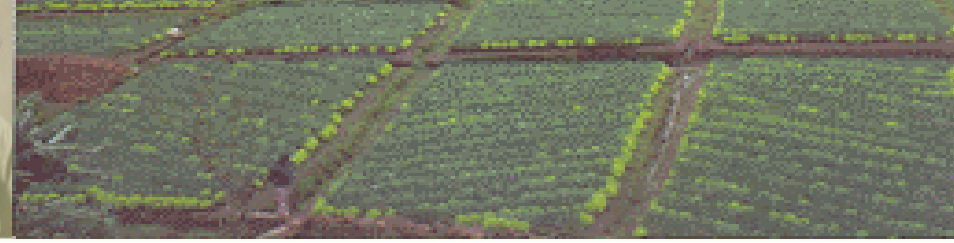
Carbiofuran



2-4 D



Future Needs



- Sri Lanka is a country with diversity
- Out of 12 soils orders in Soil Taxonomy – 6 orders are found in Sri Lanka
- Need to expand the present 117 soil series to cover total land
- Need soil mineralogical data to classify down to family level
- Problems of classifying wetland rice soils according to Soil Taxonomy
- Need to digitize the data base
- Pedologists are endangered species – need training for young Soil Scientist

Conclusions

- Development of soil information in Sri Lanka
- Soils were first classified according to crops – Coffee soils, Tea soils, Rice soils
- Then as Great Soil Groups
- Attempts to classify according to Soil Taxonomy & FAO methods – soil maps and data base produced
- Description of a benchmark site – each series
- Future needs – More detail studies and digitizing

Acknowledgements

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THANK YOU...