

CONTENT AND PRESENTATION OF A  
SOIL EXPOSITION

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INTERNATIONAL SOIL REFERENCE AND INFORMATION CENTRE

## Introduction

For more than a decade, ISRIC has encouraged the establishment of soil reference collections through training courses and technical assistance provided by the National Soil Reference Collection and Database (NASREC) programme. The contents of a soil reference collection and its uses for scientific training, planning and general education are discussed in "The case for soil reference collections" (Van Baren and Sombroek, 1981), which mainly addresses aspects of soil expositions. Since then developments have taken place, especially related to data collection and dataprocessing. Therefore, soil reference collections should include, in addition to the soil exposition, a database and accompanying publications. With these three components it is possible for a soil reference collection to serve a wide range of potential users.

The following table summarizes potential user groups and their interest in the three major components of a soil reference collection.

USER GROUP	EXPO- SITION	DATA BASE	PUBLICATIONS	
			SOIL BRIEF	POPULAR LEAFLET
Soil scientists	+	++	++	
Agronomists, ecologist etc.	+	++	++	
Universities				
Soil Science Departments	++	+	++	
Geography/Agronomy Depts.	++	(+)	++	
Ministry of Agriculture				
Extension staff	+		+	++
Information Centre(s)	++		+	++
Agricultural institutions				
provinces, districts	+ <sup>1)</sup>		+	++
Farmer Training Centres	+ <sup>1)</sup>		+	++
Agricultural Societies	+ <sup>1)</sup>		+	++
Secondary Schools (and interested laymen)	+ <sup>1)</sup>		+	++

++ of great interest for the user group

+ of interest

(+) limited interest

1) only when in the locality of the exposition

This Working Paper focuses on the soil exposition. For information on sampling and preservation of soil profiles, reference is made to ISRIC's Technical Paper 1 (Van Baren and Bomer, 1979) and lecture notes on the subject. Information on the ISRIC Soil Information database System is given by Van Waveren and Bos, 1988 and an example of a Soil Brief publication EC06, Reference soil of the Amazon region in Kauffman and Creutzberg, 1991.

The arrangement of soil profiles in the exposition and the content of the accompanying information depends on the interest/needs of the potential users. Strict rules for the organization of an exposition for each of the user groups cannot be given. The soil scientist responsible for establishing the collection should consult main user groups about their requirements to the information to be presented, both in the exposition and in the accompanying publications.



An example of text/diagram posters and techniques required for a soil exposition is presented in ISRIC's Technical Paper 8 (Bomer and Van Baren, 1984). The work presented in that Paper was made with manual lettering techniques. Nowadays, text and graphics can be prepared with regular computer programmes. A selection of text and diagrams for posters, made with such programmes, is presented in this paper. These posters were prepared for the NASREC exposition, part of ISRIC's world soil display. It should be noted that visitors to ISRIC's exposition comprise soil scientists from all over the world, students from agricultural universities in Europe, and students from higher agricultural schools mainly of the Netherlands. The examples provided should therefore be seen as ideas and suggestions for discussion, to be worked out in consultation with the user groups concerned.

### **General information**

An exposition of reference soils should include some small-scale thematic maps showing the major environment parameters. Depending upon the availability of information, the following thematic maps are recommended:

- Topographical map, showing relief by altitude contours or colours.
- Major ecological regions map, of which the units are generally defined by the dominant environmental factors such as altitude, climate and vegetation.
- Generalized soil distribution map, this in combination with a small-scale map showing the distribution of dominant soil limitations such as shallowness, strong acidity, high content of sand/stones/concretions and waterlogging.
- Climate maps, e.g. isohyet map showing annual precipitation, results of water-balance studies, temperature and other general climatic elements. If relevant specific crucial climatic elements should be presented, such as start rainy season, length of growing period, extreme values etc.
- Generalized geology and soil parent material map.
- Vegetation map.
- Land use (historical, actual, potential).

The location of the reference soil profiles should be marked on these maps. The series of thematic maps can be used as an introduction to the soil exposition or linked to specific soils.

### **Arrangement of the soil collection**

The exposition of soil reference profiles should have an organized sequence, depending on the objectives and user groups concerned. Some suggestions of arrangements are given here.

#### **Major ecological regions**

Grouping reference soils according to the major ecological regions of a country is an holistic approach which shows the variety of soils in a specific ecological setting. The information posters presented in this paper, uses Ecuador as example. The first division of Ecuador in three major ecological zones is mainly determined by altitude, landform, climate and vegetation, and include the Coast, Andes Mountains and Amazon Regions. These regions can be further subdivided on climate, altitude or landform, e.g. in Coastal humid and dry areas, the high mountain ranges and central Inter-Andean Valley, and the high and low altitude areas in the Amazon region. Each major ecological region could be introduced by a text, posters and thematic maps.

### Soil Classification

Grouping of soils according to a national or an international soil classification system. Such a grouping is of interest for training courses in soil classification and therefore mainly of interest to soil scientists.

### Agriculture use

Grouping of soils according to the most important economic crops or land uses could be of interest for groups concerned with practical soil/land management.

### Special themes

A part of the exposition might illustrate specific themes, such as

- topo-, chrono-, climate or other soil sequences (catenas).
- influences of soil erosion, irrigation etc. by comparing the affected soils with uneroded, or unirrigated soils.
- limited effective soil depth resulting from compacted layers caused by pedogenetic processes (e.g. duripan) or by human influences (e.g. compacted topsoil, plow-pan), etc.

### Display panel and illumination

A monolith and its accompanying information is generally fixed to a strong wooden panel (the 'unit of display'). The support frames for such display panels can be constructed from different materials. At ISRIC the wooden panels are hooked on a slightly tilted frame made from steel pipes (construction details given in TP8). Such a steel frame is costly and not easy to construct. A less expensive alternative is the easily constructed wooden support of which average dimensions are given in figure 1.

A soil exposition should preferably be illuminated by artificial light (certain types of spotlights and/or fluorescence tubes). (In)direct sunlight has a negative effect on the preserving nitro-cellulose lacquers and may cause changes to soil colours. Sunlight may cause strong black stains to appear on surfaces of dark red soils where there is a high content of ferro-manganese components (e.g. Nitisols). Examples of such photo-chemical induced colouring effects were observed in the soil collections of Kenya and Zimbabwe. Large black stains developed over a period of a few years on the surfaces of some Nitisols displayed in exhibition rooms with large glass windows.

### Information per reference soil

A possible lay-out is presented in figure 1. A part of ISRIC exposition is organized according to the major ecological region approach. In addition to a series of general thematic maps as mentioned before, each monolith is accompanied by text/diagram posters. Information on the Classification, Characterisation and Evaluation of the soil/land is presented in a standard way for each soil. A selection of such standard text and diagram posters is presented in this paper:

1. Soil classification according to FAO-Unesco legend of the Soil Map of the World, USDA-SCS Soil Taxonomy, the national soil classification name and the local vernacular name of the soil, if used.
2. Summarized characterisation of key environment factors, such as: parent material of the soil, landform, vegetation and land-use.
3. Climate diagrams, such as water-balance and temperatures.
4. Summarized field description and analytical data.

5. Property versus depth diagrams of some soil properties.
6. A table summarizing the evaluation of soil/land qualities (example Ecuador 6), a blank table is also included.
7. Classification of some key analytical properties according to some widely used manuals (Landon, 1992 and ILACO, 1981).
8. A climate diagram showing a trend analysis in the annual precipitation of the three major ecological regions of Mali.

In addition an example of the print-out of the data stored in the ISIS database (ISIS datasheet) is provided.

The text was made on a PC with WordPerfect and printed on a HP laser jet printer using the letter type ('font') Helvetica<sup>1</sup> and letter sizes 14 and 18 points (with and without bold). The diagrams were printed on A4 format and enlarged to an A3 format using a photocopying machine.

Diagram for posters were made with the spreadsheet programme LOTUS. Some additional text and hatching was manually applied to the standard printed graph produced. Such adaptations can also be made with a number of more powerful graphic programmes. In addition, enhancement of specific aspects in these graphs with colours is recommended. The diagrams presented in this paper, and other types of graphs can be constructed easily with Soil Data Graph, a graphic programme based on dBase and LOTUS, developed at ISRIC (Brunt and Kauffman, 1992).

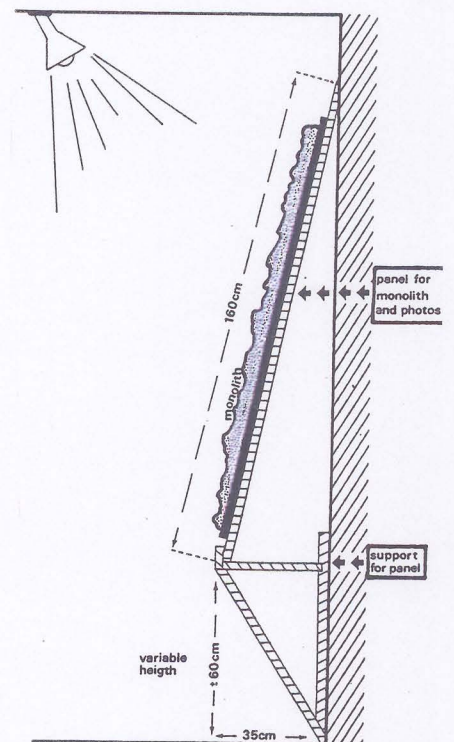
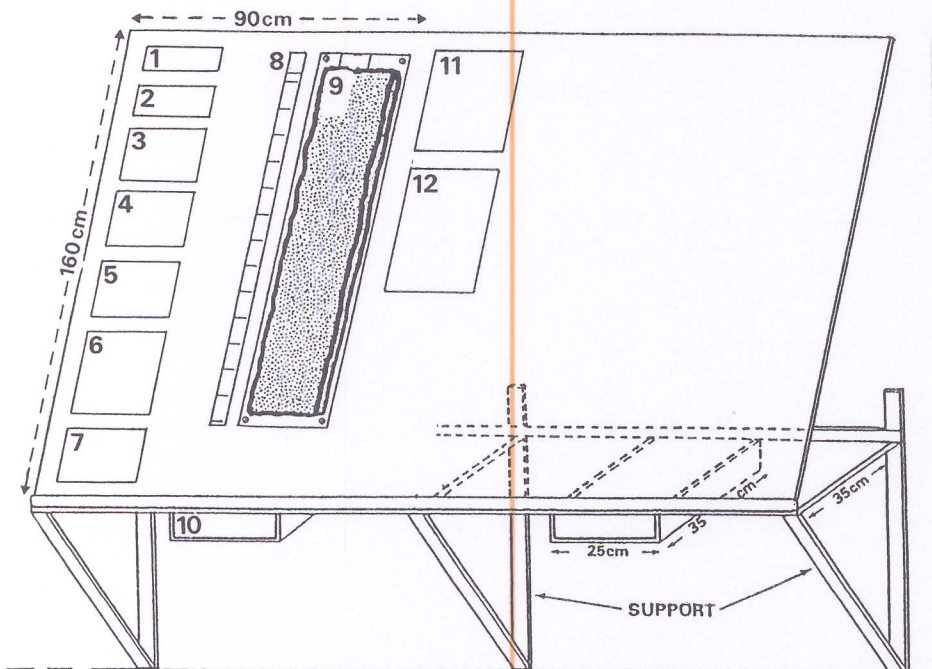
Fixing of the final text and diagrams on sturdy (plastic) board or foam is recommended to guarantee long life-time of the posters and photographs.

#### References

- Bomer, W.C.W.A. and J.H.V van Baren (1984). Aspects of the exhibition of soil monoliths and relevant information. Technical Paper 8 (provisional edition).
- Brunt, J. and J.H. Kauffman (1992). Soil Data Graph. Soil and climate data diagrams and tabular soil/land parameter assessment. ISRIC Working Paper 92/08.
- ILACO (1981). Agricultural compendium for rural development in the tropics and subtropics. Elsevier, Amsterdam.
- Kauffman, J.H. and D. Creutzberg (1991). Ecuador, Reference Soil of the Amazon region, Haplic Nitisol (Typic Kandiodult), Soil Brief EC06, ISRIC.
- Landon J.R. (1991). Booker Tropical Soil Manual, Longman, London.
- Van Baren, J.H.V. and W. Bomer (1979). Procedures for the collection and preservation of soil profiles. ISRIC, Technical Paper 1.
- Van Baren, J.H.V. and W.G. Sombroek (1981). The case for soil reference collections, ISRIC Annual Report 1981.
- Waveren, E.J. van, and A.B. Bos (1988). ISRIC Soil Information System, user manual and technical manual. Technical Paper 15, ISRIC.

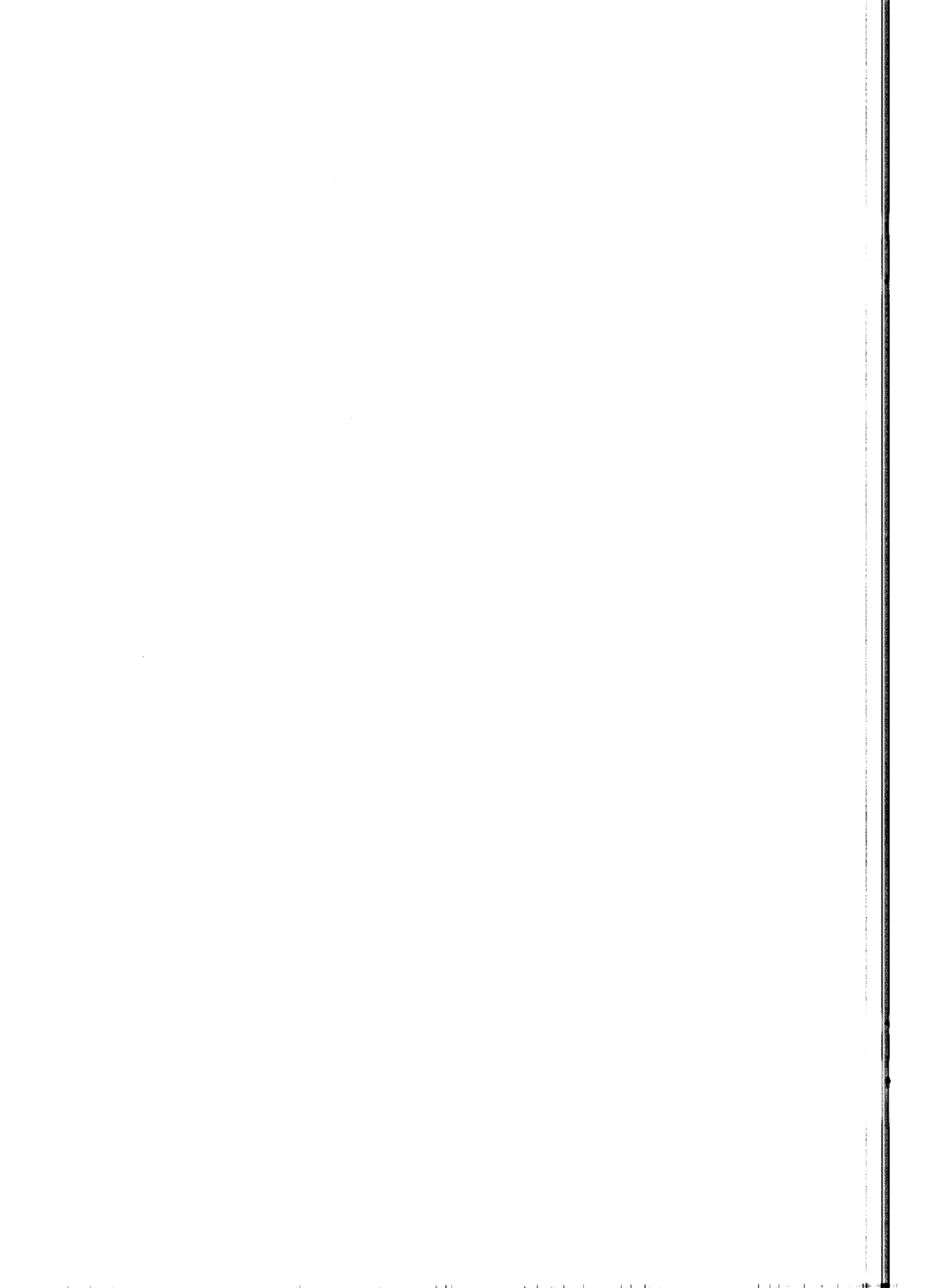
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<sup>1</sup> When other word processors and printers are used, the letter type similar to Helvetica could be differently named, e.g. 'Switzerland', 'Arial' etc.



- |   |                        |                        |
|---|------------------------|------------------------|
| 1. Title                                  | 5. Photo landscape     | 9. Profile             |
| 2. Classification, location               | 6. Soil/landevaluation | 10. Box for datasheets |
| 3. Characterization/<br>field description | 7. Photo vegetation    | 11. Map(s)             |
| 4. Analytical data                        | 8. Ruler               | 12. Special poster(s)  |

Figure 1 Lay-out of a soil reference exposition



Poster 1

*Soil classification according to FAO-Unesco legend of the Soil Map of the World, USDA-SCS Soil Taxonomy and the local name of the soil*

**ECUADOR**

**Profile number : EC06**

## **CLASSIFICATION**

**FAO-Unesco** : Rhodic Nitisol; Dystric Nitosol [1974]

**Soil Taxonomy** : Typic Haploperox

**Local** : Suelo Rojo



EC06

## **PARENT MATERIAL**

Highly weathered conglomerate with enrichment of volcanic ash

## **TOPOGRAPHY/LANDFORM**

Hilly dissected old erosion surface [elevation 250 m]

## **VEGETATION/LAND USE**

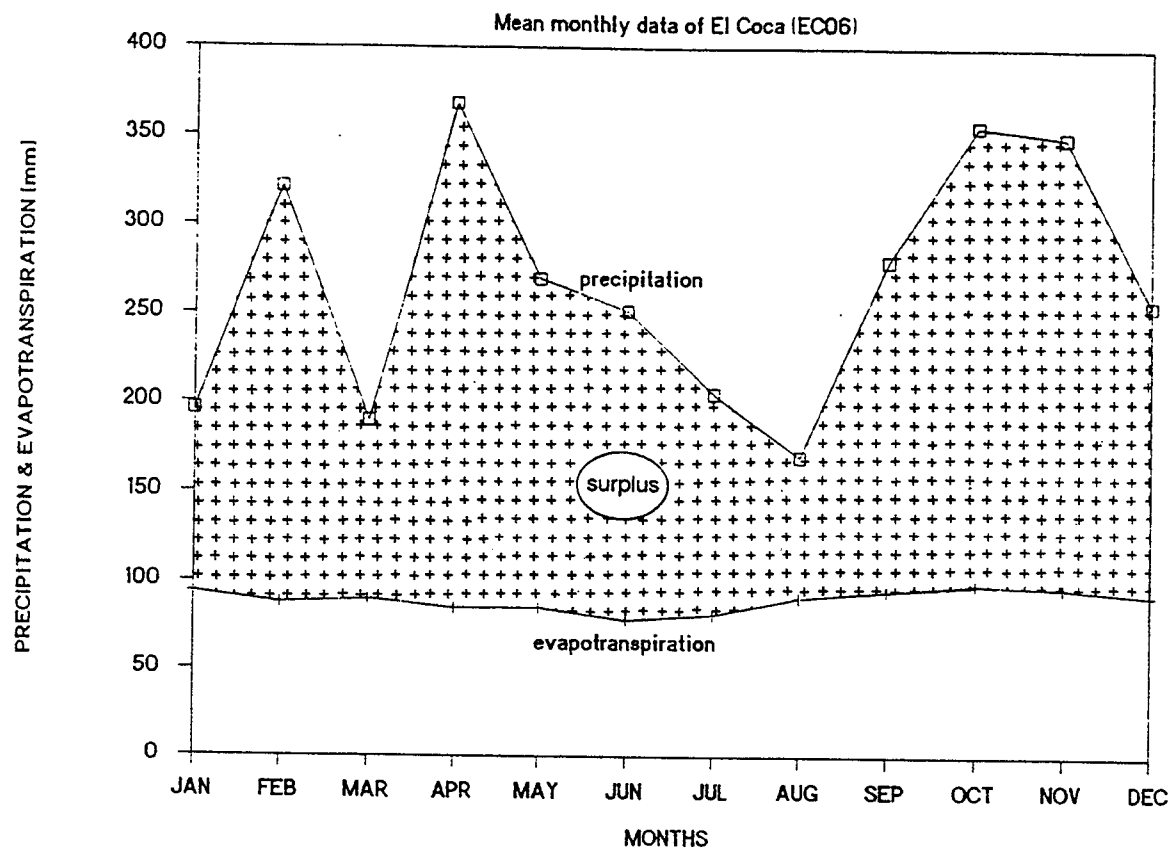
Evergreen tropical rain forest / recently cleared, mainly for the cultivation of coffee

## **CLIMATE**

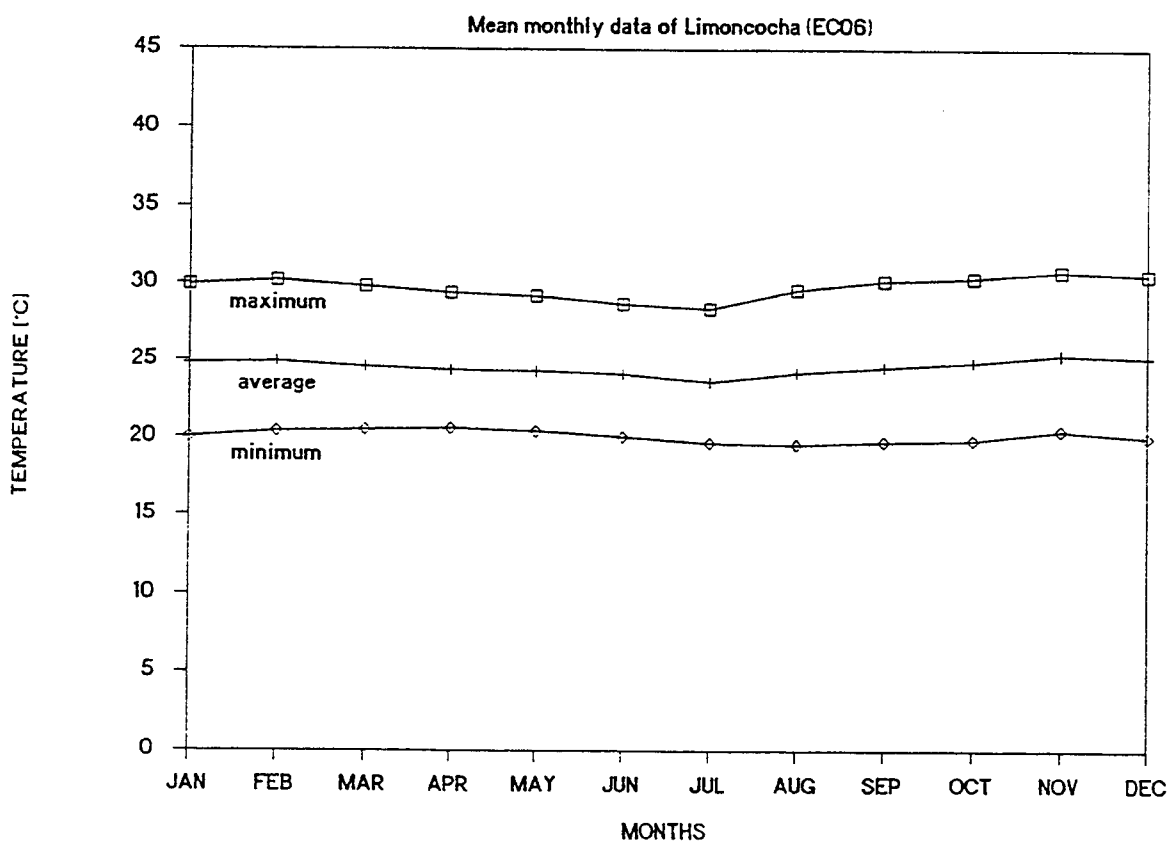
Classification [Köppen] : Af  
Mean annual temperature : 25.4 °C  
Total annual precipitation : 3210 mm  
Potential annual evaporation : 1080 mm

### Poster 3 Climate diagrams

#### PRECIPITATION and EVAPOTRANSPIRATION



#### maximum, average & minimum TEMPERATURE



# CHARACTERIZATION

## FIELD DESCRIPTION

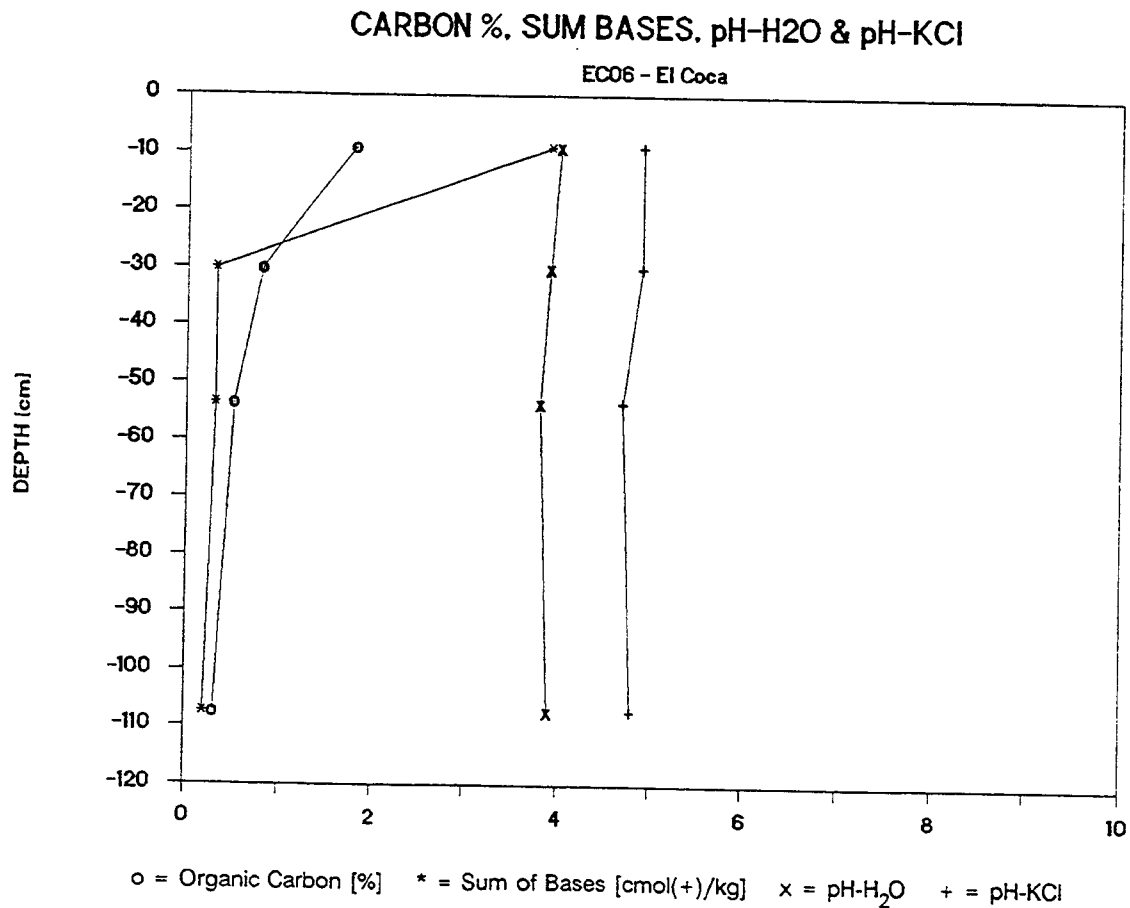
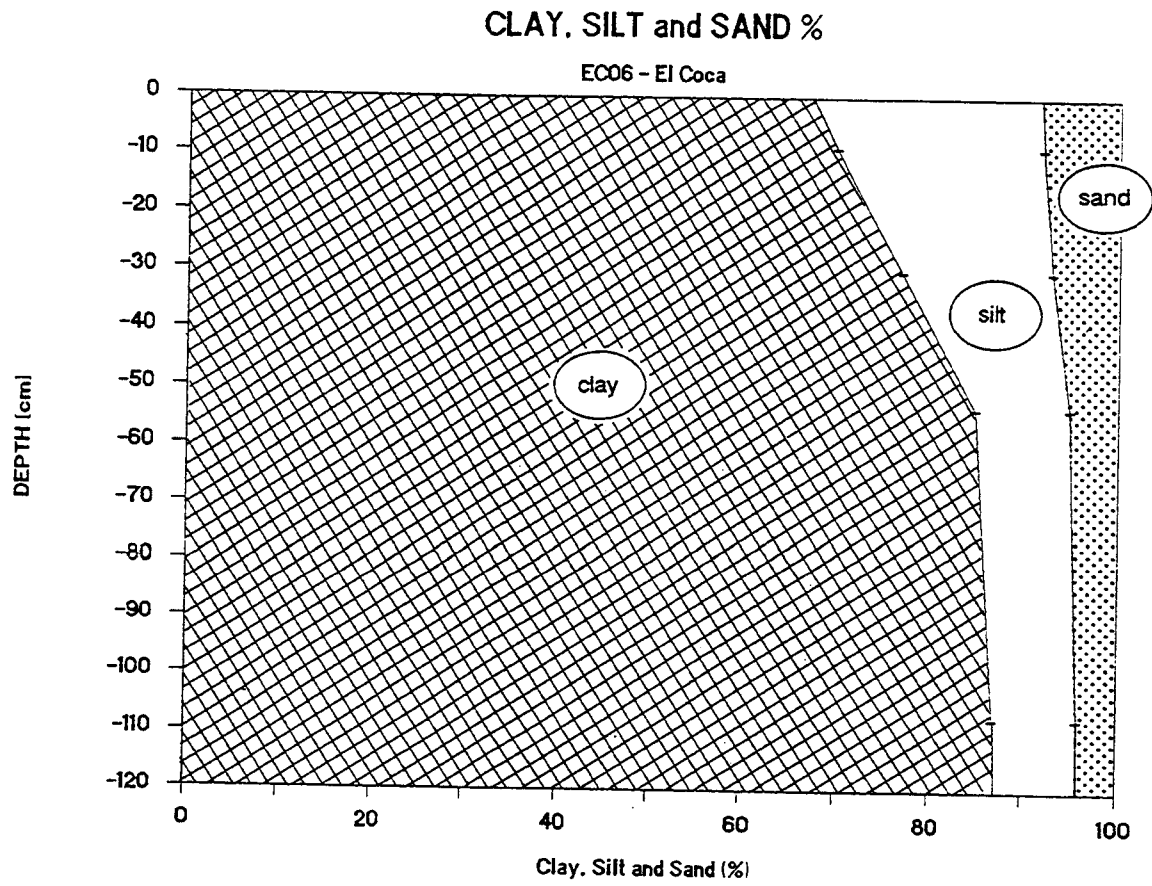
Very deep, (moderately) well-drained, yellowish red, fine clay soil; moderately structured; weak yellowish mottling in the subsoil.

## ANALYTICAL DATA

**Texture** : fine clay; clay content increases with depth from 70 to 90%  
**Organic Carbon** : medium [1.5%] in the upper 25 cm  
**Acidity** : strongly acid [pH-H<sub>2</sub>O 4.9]  
**Sum of bases** : topsoil low [3.9 cmol(+)/kg], subsoil very low [0.3]; the relatively high content in the topsoil is caused by burning of the vegetation  
**Cation Exch. Cap.** : low [about 6 cmol(+)/kg soil] throughout the profile  
**Exch. aluminium** : high [>50%]  
**Clay mineralogy** : kaolinite dominant  
**Air capacity** : topsoil moderate [11%], subsoil very low [5], the low percentage of larger pores in the subsoil causes watersaturation. This is shown by the weak mottling.

**Available soil moisture**: high [15 to 18%].

Poster 5 Diagrams of soil analytical properties





# Poster 6 Evaluation of soil/land qualities of soil Ecuador 6

## Evaluation of soil/land qualities

Profile number: **EC06**

### LAND QUALITY

Availability (1)  
Hazard/Limitation (2)

VH	H	M	L	VL	REMARKS
N	W	M	S	VS	

VH = very high      N = not present  
 H = high            W = weak  
 M = moderate      M = moderate  
 L = low              S = serious  
 VL = very low      VS = very serious

### CLIMATE

Radiation regime:

- total radiation
- day length

Temperature regime

Climatic hazards (hailstorm, wind, frost)

Conditions for ripening

Moisture availability:

- length growing season (GS)
- drought hazard during GS

1						
1						
1						
2						
1						
1						
1						
1						
1						
2						
2						

### SOIL

Moisture availability:

- potential total soil moisture

Oxygen availability

Nutrient availability

Nutrient retention capacity

Rooting conditions

Conditions affecting germination

Excess of salts:

- salinity
- sodicity

Soil toxicities (e.g. high Al sat.)

1						
1						
1						
1						
1						
1						
1						
2						
2						
2						
2						high exch. Aluminium

### LAND MANAGEMENT

Initial land preparation

Workability

Potential for mechanization

Accessibility:

- existing
- potential

Erosion hazard:

- wind
- water

Flood hazard

Pests and diseases

2						
1						
1						
1						
1						slope/relief
1						
2						
2						
2						
2						high rel. humidity

# Evaluation of soil/land qualities

Profile number:

## LAND QUALITY

Availability (1)  
Hazard/Limitation (2)

VH	H	M	L	VL	<b>REMARKS</b>
N	W	M	S	VS	

VH = very high      N = not present  
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## CLIMATE

Radiation regime:

- total radiation
- day length

Temperature regime

Climatic hazards (hailstorm, wind, frost)

Conditions for ripening

Moisture availability:

- length growing season (GS)
- drought hazard during GS

1						
1						
1						
2						
1						
1						
2						

## SOIL

Moisture availability:

- potential total soil moisture

Oxygen availability

Nutrient availability

Nutrient retention capacity

Rooting conditions

Conditions affecting germination

Excess of salts:

- salinity
- sodicity

Soil toxicities (e.g. high Al sat.)

1						
1						
1						
1						
1						
2						
2						
2						

## LAND MANAGEMENT

Initial land preparation

Workability

Potential for mechanization

Accessibility:

- existing
- potential

Erosion hazard:

- wind
- water

Flood hazard

Pests and diseases

2						
1						
1						
1						
1						
2						
2						
2						
2						

**Organic Carbon (%) [average of first 25cm]**

<0.4	very low
0.5 - 0.9	low
1.0 - 1.9	medium
2.0 - 5.0	high
>5.0	very high

**Acidity pH-H<sub>2</sub>O**

<4.0	extremely acid
4.0 - 4.9	strongly acid
5.0 - 5.4	acid
5.5 - 5.9	slightly acid
6.0 - 7.5	neutral
7.6 - 8.4	slightly alkaline
8.5 - 9.4	alkaline
>9.5	strongly alkaline

**CEC [pH7] (cmol(+)/kg soil)**

<4	very low
4 - 9.9	low
10 - 19.9	medium
20 - 39.9	high
>40	very high

**SUM BASES [Ca + Mg + K + Na] (cmol(+)/kg soil)**

<1	very low
1 - 3.9	low
4 - 7.9	medium
8 - 15.9	high
>16	very high

**Base saturation [CEC pH7] (%)**

> 80	very high
50 - 79	high
30 - 49	medium
10 - 29	low
<10	very low

**Exchangeable aluminium (%)**

<5	very low
10 - 24	low
25 - 49	moderate
50 - 79	high
>80	very high

### **Bulk density (kg/dm<sup>3</sup>)**

< 0.9	very low
0.9 - 1.09	low
1.1 - 1.39	medium
1.4 - 1.59	high
> 1.6	very high

### **Air capacity $\phi$ [pF0 - pF2] (%)**

< 5	very low
5 - 9.9	low
10 - 14.9	medium
15 - 20	high
> 20	very high

### **Moisture availability $\phi$ [pF2 - pF4.2] (%)**

< 5	very low
5 - 9.9	low
10 - 14.9	medium
15 - 20	high
> 20	very high

### **Available P [Bray]    Available P [Ohlsen] (mg/kg)**

< 45
45 - 89
90 - 185
> 185



*Climate diagram showing a trend analysis in the annual precipitation of the three major ecological regions of Mali*

# MOVING 5 YEAR-SUM ANNUAL PRECIPITATION

