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MINISTRY OF AGRICULTURE

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NORTH - WEST REGION AGRICULTURAL DEVELOPMENT PROJECT

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FEASIBILITY STUDY AND TECHNICAL ASSISTANCE

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AGRICULTURAL DEVELOPMENT PROGRAMME

Soil Survey

SOGREAH
Consulting Engineers
GRENOBLE - FRANCE

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CONTENTS

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SOCIETE D'ETUDES ET D'APPLICATIONS HYDRAULIQUES
SOGREAH
6, Rue de Lorraine
38130 ECHIROLLES

SUMMARY AND CONCLUSIONS

The Government of the Democratic Republic of Somalia wishes to develop irrigated and rainfed agriculture in the North-West Region of the country, and has accordingly appointed SOGREAH to study and prepare:

- a soil classification map,
- a land suitability map for irrigated and rainfed cultivation, in order to assess the areas suitable for agricultural development.

The soil survey in the North-West Region, which was begun in October 1980 and March 1981, covers an area of about 3 350 000 ha, in which the soil and land were mapped at a scale of 1/500 000.

This region, extending between latitudes 9° and 11°30 North and longitudes 42°30 and 45° East, is characterised by a climate that is arid (coastal plain) to semi-arid (plateau) and a rainfall regime which shows marked differences from one point to another (cf. report on hydrology and climatology), with mean annual precipitation ranging from 50 mm (coastal plain) to 500 mm (plateau).

On the plateau (Hargeysa-Boorama), the mean monthly temperatures vary only slightly from one month to the next: 19°C in November to 25°C in May, the temperature range being 5.6°, with a mean annual temperature of the order of 23°C. The absolute maximum temperatures are always lower than 33°C, ranging from 27°C in December to 33°C in May, whereas the absolute minimum temperatures are always greater than 10°C.

On the other hand, the coastal plain is characterised by a much hotter and more arid climate, with mean montly temperatures always greater than 25°C, reaching 35°C in July, absolute maximum temperatures ranging between 30°C (January) and 42°C (June) and absolute minimum temperatures ranging between 18°C (January) and 28°C (August).

The mean annual relative humidity is 65% on the coastal plain and 56% on the plateau.

The potential evapotranspiration (BLANEY-CRIDDLE) is high on the coastal plain, the mean annual value amounting to 2300 m/m, with mean monthly values ranging between 142 m/m in February and 252 m/m in July, whereas on the plateau much lower values are recorded: mean annual value 2037 mm, with monthly values ranging between 115 mm in December and 222 mm in June.

Table No 1

PHYSICAL AND CHEMICAL CHARACTERISTICS

Soil subgroup	Soil series	Depth (cm)	Grain size % FE*						pH H_2O	$CaCo_3$ Total (%)	OM (%)	C (%)	N (%)	C/N	Available P ppm	P_2O_5 %		Absorption complex Meq/100 g					EC extract 1/5 mmhos cm/25°C
			2 µ	20µ	50µ	200µ	2000 µ									Avail.	Total	Ca	Mg	K	Na	T	
Typic Salorthids	1a	0-50	40	50	2	4	4	0	7.7	-	-	-	-	-	-		-	-	-	-	-	-	21.9
	1b	0-50	60	30	4	2	4	0	8.1	-	-	-	-	-	-		-	-	-	-	-	-	9.2
Typic Torrifluvents	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
Ustic Torrifluvents	3	0-50	6	4	6	32	52	0	8.7	-	0.48	0.28	0.28	10.0	-		-	-	-	-	-	-	-
Typic Ustifluvents	4	0-50	20	10	5	25	30	1	8.3	10.5	1.23	0.71	0.69	10.3	0.05		-	8.7	1.82	0.70	0.53	11.5	-
	5	0-50	24	14	3	14	45	0	8.3	-	0.74	0.43	0.43	10.0	-		-	-	-	-	-	-	-
	6	0-50	42	32	7	12	7	0	8.3	15.0	2.35	1.36	1.27	10.7	-		-	-	-	-	-	-	-
Typic Torripsamments	7	0-50	9	5	4	36	46	1	8.7	5.6	0.19	0.11	0.16	6.9	-		-	7.1	1.00	0.27	0.12	9.0	0.26
Ustic Torriorthents	8	0-50	15	7	2	22	54	0	8.2	-	0.90	0.57	0.55	10.4	-		-	-	-	-	-	-	-
Lithic Torriorthents	9	0-50	17	9	6	22	47	13	8.4	9.3	0.87	0.55	0.85	7.5	-		-	5.3	1.13	0.86	0.46	7.1	-
Lithic Ustorthents	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-
Typic Argiustolls	11	0-50	41	18	2	9	30	0	8.4	17.5	1.71	0.99	0.94	10.5	27.5	0.045	0.67	19.9	3.0	1.10	0.16	21.2	-
	12	0-50	53	22	2	6	17	0	8.1	-	2.6	1.52	1.31	11.6	18.0	0.04	0.84	26.6	6.2	1.78	0.54	32.6	-
Typic Chromusterts	13	0-50	64	22	3	6	5	0	8.4	7.5	3.1	1.81	1.64	11.0	4.0	0.015	0.66	25.8	8.1	1.04	1.29	35.1	0.20
Rock land	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

F.E. = Fine elements.

Table No 2

HYDRODYNAMIC CHARACTERISTICS

Soil subgroup	Soil series	Depth (cm)	Hydrodynamic characteristics											Land classification	
			Moisture as % of weight of dry soil			Bulk density (average)	Total available moisture (m3/ha) (0-50 cm)	Readily available moisture (m3/ha) (0-50 cm)	Infiltration (cm/time in mn)					Rainfed cultivation	Rainfed cultivation
			1/3 Atm	15 Atm	1/3-15 Atm				5 mn	10 mn	20 mn	30 mn	60 mn		
Typic Salorthids	1a	0-50	-	-	-	-	-	-	-	-	-	-	-	4	VI
	1b	0-50	-	-	-	-	-	-	-	-	-	-	-	4	VI
Typic Torrifluvents	2	-	-	-	-	-	-	-	-	-	-	-	-	4	VI
Ustic Torrifluvents	3	0-50	11.6	5.4	6.2	1.45	450	300	3.5	4.5	7.0	11.0	22.0	4	IV ✓
	4	0-50	17.9	7.0	10.9	1.45	790	520	3.0	4.0	6.5	9.0	16.0	4	I ✓
Typic Ustifluvents	5	0-50	15.5	6.5	9.0	1.45	650	430	2.7	4.0	6.0	7.9	12.0	2-4*	V-I
	6	0-50	31.6	15.2	16.4	1.40	1150	737	0.6	0.8	1.5	2.0	3.2	2	I-V
Typic Torripsamments	7	0-50	9.9	3.9	6.0	1.43	430	285	3.0	4.0	6.5	9.0	16.0	4	V
Ustic Torriorthents	8	0-50	11.7	4.5	7.2	-	-	-	-	-	-	-	-	4	VI
Lithic Torriorthents	9	0-50	10.2	5.3	4.9	-	-	-	-	-	-	-	-	4	VI
Lithic Ustorthents	10	-	-	-	-	-	-	-	-	-	-	-	-	4	VI
Typic Argiustolls	11	0-50	28.2	14.1	14.1	1.40	960	670	0.6	0.8	1.5	2.0	3.0**	1	(V)
	12	0-50	28.0	12.4	15.6	1.40	1090	730	0.4	0.6	1.0	1.5	2.5	2	(V)
Typic Chromusterts	13	0-50	34.9	18.3	16.6	1.40	1160	770	0.2	0.4	0.5	0.8	1.5	3	(V)
Rock land	14	-	-	-	-	-	-	-	-	-	-	-	-	4	VI

* Ruqi and Ceel Bardaale areas.

(V) Classed in land class V because the water resources from ground water table are very few or inexisting.

** Infiltration of compacted soil is more or less than 30 to 40 %.

Rounded figure

The studied region is made up essentially of metamorphic formations (psaminites, schists, gneiss), jurassic formations (limestone with basalt sandstones), cretaceous formations (nubian sandstones), volcanic and alluvial formations (pliocene to recent), and to a lesser extent by granitic-gneiss, rhyallitic and calcareous formations (Auradu series: Paleocene to Eocene).

The soils derived from these materials, taking into account their origin, type of deposit and degree of weathering as expressed by the morphological characteristics observed on all the profils, are classified into four orders (plus rock-land) as follows:

- Aridisols,
- Entisols,
- Mollisols,
- Vertisols,
- + Rock-land,

and into 10 subgroups, the general characteristics of which are given in the following tables:

Table 1: Physical and chemical characteristics (see the following page),

Table 2: Hydrodynamic characteristics (see the following page).

Given this classification of the soils (cf. map B), the areas covered by each subgroup are distributed as follows:

Table 3

Order	Subgroup	General distribution	
		ha	%
ARIDISOLS	Typic Salorthids	65 000	1.94
	Total	65 000	1.94
ENTISOLS	Typic Torrifluvents	164 000	4.90
	Ustic Torrifluvents	2 500	0.08
	Typic Ustifluvents	175 500	5.24
	Typic Torripsamments	656 000	19.58
	Ustic Torriorthents	24 000	0.72
	Lithic Torriorthents	101 000	3.02
	Lithic Ustorthents	309 000	9.22
	Total	1 432 000	42.76
MOLLISOLS	Typic Argiustolls	219 000	6.54
	Total	219 000	6.54
VERTISOLS	Typic Chromusterts	44 000	1.31
	Total	44 000	1.31
ROCK LAND		1 590 000	47.40
	Total	1 590 000	47.40
GENERAL TOTAL		3 350 000	100.00

The Entisols and Rock-land cover respectively about 43% and 47% of the mapped areas.

The Mollisols represent 6.5% (219 000 ha), located in the plateau area, and 45% of this area corresponds to sectors that are cultivated or part-cultivated (crops + fallow).

The Vertisols (Tog Wajale area) cover an area of 44 000 ha, corresponding to 1.3% of the studied region.

The proposed agricultural development requires the presentation of two land classifications, taking into account the results of the soil survey and the role of the climate (precipitation) in the development of agriculture in the North-West Region. These two classifications are as follows:

- Classification of the land with a view to its use for rainfed agriculture (cf. map 2);
- Classification of the land with a view to its use for irrigated agriculture (cf. map 2).

The following table summarises the surface areas per classification:

Table 4

Classification for	Land class	Suitability		Land distribution	
		Crop		ha	% (rounded figures)
Rainfed Cultivation	1	Good	G	99 000	3.0
	2	Medium	M	292 000	8.7
	3	Poor	P	44 000	1.3
	4	Unsuitable	N	2 915 000	87.0
TOTAL 1 TO 4				3 350 000	100.0

Classification for	Land class	Class irrigability	Land distribution	
			ha	% (rounded figures)
Irrigated cultivation	I	Good	3 500	0.1
	IV	Restricted to good for special crop	2 500	0.1
	V	Under conditions	1 091 000	32.6
	VI	Non irrigable	2 253 000	67.2
TOTAL I TO VI			3 350 000	100.0

The areas which would lend themselves to the development of rainfed cultivation or to the development of grazing land cover 391 000 ha (11.7%), of which an area amounting to 99 000 ha, or 3% of the North-West Region, is of good cropping suitability (cf. map 2).

The areas which are at present cultivated or fallow (cf. agronomic report No 7) represent approximately 69% of the land in class 1. There would therefore appear to be some suitable land available that has not yet been developed for agriculture. This land is at present used for grazing.

The land classified as being of average suitability corresponds to soils in which the clay content generally ranges between 50 and 60% of particles smaller than 2 microns, or to soils of coarser texture (sandy clay loam), but which cannot be brought under cultivation in the immediate future. Cultivation could only be envisaged after experimentation to determine which varieties would give economically acceptable yields.

The land of poor (Tog Wajale) to zero suitability covers approximately 88% of the study area in the North-West Region.

As far as irrigated farming is concerned, only limited areas would be likely to lend themselves to development for irrigation in the immediate future, the total gross area involved representing only 0.2%, or 6000 ha (classes I and IV) of the study area. Such land is generally situated on the edge of the toggas and especially at Ceel Bardaale and at Ruqi.

The class V land, the irrigability of which depends on the availability of ground water resources, covers a very substantial area: 1 091 000 ha, or 32.6% of the study area. Thic class includes various types of soil, essentially the Mollisols and Vertisols on the plateau and the Entisols on the coastal plain (Typic Torripsamments).

The land in class VI, non-irrigable, represents 67% of the area of the North-West Region.

In conclusion, there are soils of good potential in the North-West Region, but one of the major limiting factors, and not the least, would appear to be the availability of water resources: rainfall and ground water.

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INTRODUCTION

The study was performed according to the specifications set by the "Revised Proposal" which mentions page 19 under the heading land resources and general inventory:

- Soil reconnaissance aimed at correlating soil characteristics with land forms and vegetation;
- Identification of areas where soils are suitable for the development of irrigation, rainfed crops or grazing.

The following maps will be produced:

- soil map,
- land capability map (land classification map).

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Chapter 1

SOIL CLASSIFICATION

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1.1 MAIN FACTORS AFFECTING THE FORMATION OF THE SOILS

The evolution of the soils basically reflects the different stages of development of the original mineral material, which is derived from the decomposition of the mineral rocks through the active effects of the environmental factors, climate and vegetation.

1.1.1 CLIMATE

The present climatic conditions of soil moisture and temperature are not those which contributed to the development of the soil in the study area during the first degradation cycles.

The complete degradation of the primary mineral rocks (feldspar, mica, etc.) and the compound material formation (particularly hydroxides and iron oxydes) within the studied soils took place in a warm and humid climatic environment during the latter part of the Quaternary.

Nevertheless, as far as the development possibilities of the soils are concerned the present climate can be considered an important factor in their production. In particular the productivity of the soils will be directly affected by the soil moisture and soil temperature regimes.

1.1.1.1 Soil moisture regime

In the study area, the soil moisture regime may be defined:

- as "ustic"; on the plateau (Hargeysa, Boorama) characterised by a wet period which coincides with the period favourable for plant growth. The soil remains humid for, at least, 90 consecutive days.

. as "aridic" or "torric" in the coas
characterised by a dry period in al
time (cumulative).

n, and other areas
nore than a half

Soils that have an aridic or a torric mc
in areas of arid climate.

egime are normally

1.1.1.2 Soil temperature regime

The estimate of the soil temperature reg
the mean annual temperature of the air,
the mean annual temperature of the soil
the air temperature. This gives a mean a
more than 22°C (plateau and coastal plai
estimate, the regime can be defined as b
plateau and "isohyperthermic" on the coa
of temperature between two seasons of 5
plain.

made on the basis
for the fact tha
ally 1°C higher t
il temperature of
ne basis of this
perthermic" on th
in with differenc
r more for the co

On the plateau, this "hyperthermic" regi
growth.

vourable for plan

On the coastal plain, the soil temperatu
one of the limiting factors for developm
being the possibility of an irrigation s
crops or perrenial plantations would be

e may be considere
in the case of the
he choice of annu
ited.

1.1.2 VEGETATION

The fact that the climate varies little
zone (plateau or coastal plain) shows th
directly affecting the vegetation and so
to the soil itself and to man's activiti
over-grazing, cultivation, etc.).

single geographic
nly ecological fac
tion are those re
anting, erosion,

The vegetation of the region which is cc
and some crops, may on the whole be cons
the current climate.

bush, rangeland
be in balance wi

1.1.3 PARENT MATERIAL

Most of the study area is constituted b

. sandy aeolian deposits composed of
flakes, covering finer textured loa
deposits;

rticles and mica
yey recent alluv

. coarser formations (colluvial depo

vel, pebbles;

- alluvial deposits of varying texture (loamy to clayey) covering most of the plateau, depression areas and the banks of toggas, which were probably washed down from the high plateaux or mountains;

- stony and rocky formations.

To summarise thefore, the parent material which make up most of the soil within the region is either even textured (sandy to sandy loam) wind blown deposit, or uneven textured (sand to clayey) alluvial deposit.

1.2 PRINCIPLES OF SOIL CLASSIFICATION

The deposition process and the degree of development are the main factors on which soil classification is based.

The factors are expressed by the morphological characteristics observed in all the soil profiles.

The characteristics which are relevant to classification vary according to the degree of development,. Soils formed on alluvial deposits may be characterised by the origin of the material. Other practical factors influencing water retention and permeability, such as texture or the organic matter contained in the horizon, are also used in the classification.

All the characteristics observed are tested by physical and chemical analyses, carried out on all the samples taken.

The proposed classification from the results of North-West Region soil study follows the classification system of the US Department of Agriculture, December 1975 (Soil Taxonomy, Agriculture Handbook, No 436).

1.3 LEVEL OF SOIL CLASSIFICATION

The distinction between orders and suborders is based on the dominating fundamental criteria, which characteris soil development at the highest level. The sub-orders include important properties that influence genesis and that are vital for plant growth (for example soil moisture regime, soil material).

Great groups are characterised by moisture and temperature regimes.

Subgroups are characterised by the secondary development processes (for example colour mottles, aquic moisture regime. etc.).

Family and series complete the classification. These involve factors such as profile thickness, texture of the various horizons, etc.).

Four orders may be differentiated:

- Aridisols
- Entisols
- Mollisols
- Vertisols

1.3.1 ARIDISOLS

The temperature regime of aridisols is isohyperthermic and the dominant moisture regime is aridic.

The Aridisols are mineral soils.

When an Aridisol exhibits one of the following,

- an aridic moisture regime,
- a salic horizon whose upper boundary is within 75 cm of the surface and saturation at a depth within 1 m of the surface for 1 month or more in most years,

it is termed:

- Suborder - Orthids
- Great group - Salorthids
- Subgroup - Typic salorthids

Salorthids: there are the very salty soils of wet places in the alluvial plain, where capillary rise and evaporation of water concentrate the salt into a salic horizon.

1.3.2 ENTISOLS

The central concept of Entisols is that of soils that have little or no evidence of development of a pedogenic horizon (suffix "ent").

Entisols are mineral soils.

By reason of their development in an unsaturated or only slightly saturated medium, the recent deposits forming the alluvial plain are generally classified as Fluvents (suborder).

The Fluvents are mostly brownish to reddish soils that have formed on recent water deposited sediment.

When the Fluvents have a torric or ustic moisture regime, two great groups are defined:

- Torrifluvents,
- Ustifluvents.

For Torrifluvents, two subgroups are distinguished:

- Typic Torrifluvents,
- Ustic Torrifluvents.

For Ustifluvents, one subgroup is distinguished:

- Typic Ustifluvents.

Other Entisols

These soils are classified in the suborders:

- Psamments (sand),
- Orthents.

a) The Psamments:

The Psamments have a torric regime and this is why the great group is called Torripsamments.

The central concept or typic great group of Torripsamments is determined by the sand to loamy sand texture and the deep water table.

Torripsamments (sand):

These are the Psamments that have a torric moisture and a warmer soil temperature regime. These soils are freely drained sand and they have mostly grass or savanna vegetation.

One subgroup is distinguished: Typic Torripsamments.

- Typic Torripsamments:

  These soils have a torric moisture regime. The typic subgroup consists of the Torripsamments that have little available moisture.

In general Psamments are mainly Entisols in poorly graded sand on shifting or stabilised sand dunes and in cover sand.

The Psamments have low water holding capacity, and when dry and bare, they are subject to blowing and drifting and support wheeled vehicles poorly.

b) The Orthents:

The Orthents are primarily Entisols on recent erosional surfaces.

When Orthents have a torric moisture regime two great groups are distinguished:

- Torriorthents,
- Ustorthents.

Torriorthents:

These are the dry Orthents of hot arid regions. They have a torric moisture regime. Many of the gently sloping soils are on rock pediments. These soils are used mainly for "grazing".

Two subgroups are distinguished: Lithic Torriorthents, Ustic Torriorthents.

- Lithic Torriorthents:

  These soils have a lithic contact that is within 50 cm of the surface and commonly is at a depth much less than 50 cm.

- Ustic Torriorthents:

  These soils have a moisture regime that borders on ustic. These soils are fixed on the driest Torriorthents that are moderately deep to hard rock.

Ustorthents:

Ustorthents are the Orthents that:

- have a warmer soil temperature regime,
- have an ustic moisture regime.

One subgroup is distinguished:

Lithic Ustorthents.

These soil have a lithic contact within 50 cm of the soil surface. Generally, the lithic contact is appreciably shallower than 50 cm and a depth less than 25 cm is the most common.

1.3.3 MOLLISOLS

Mollisols are mineral soils that either have a mollic epipedon or have a surface horizon that after mixing to a depth of 18 cm meets all requirements for a mollic epipedon except thickness.

When these Mollisols have an ustic moisture regime, one great group is distinguished:

. USTOLLS:

The Ustolls are the more or less freely drained Mollisols of middle to low latitudes and semi arid climates. Rainfall comes mainly during the growing season.

Ustolls that have an argillic horizon are called:

. Argiustolls:

These are the Ustolls that have an argillic horizon in or below the mollic epipedon. Most of then have a Ca horizon or a calcic horizon. The hue in the matrix is redder than 10 YR and the chroma is higher than 4.

One subgroup is distinguished:

- Typic Argiustolls:

The central concept or typic subgroup of Argiustolls is fixed on deep, freely drained soils that have some available moisture during most of the growing season, have carbonates at shallow depth, have a brownish surface horizon and have a moderately thick epipedon.

1.3.4 VERTISOLS

The central concept of Vertisols is that of clayey soils that have deep wide cracks at some time of year.

When these Vertisols have an ustic moisture regime, one suborder is distinguished:

USTERTS:

The Usterts are the Vertisols of warmer areas, and that have cracks that remain open for 90 cumulative days or more in most years but that are closed for at least 60 consecutive days.

One great group is distinguished:

- Chromusterts:

And one subgroup:

- Typic chromusterts:

The central concept or typic subgroup of Chromusterts is fixed on soils which are mostly on slopes on which water never stands. These soils are clayey and have deep wide cracks at some season. They mostly support a closed vegetation of grass or savanna, and the dark epipedon is considered normal.

SUMMARY

A summary is given hereunder of the nomenclature, from order to subgroups, for the soils studied in the North-West Region.

Orders

- Aridisols: arid to desertic soils;
- Entisols: very slightly developed soils;
- Mollisols: soils with mollic surface horizon;
- Vertisols: soils with swelling clay.

Suborders

The suborders are designated using a suffix composed of two or three letters representing the orders (ent, ert, oll, id) and a prefix indication a characteristic (very often pedo climatic) of suborder, for example ust = hot climate, torri = aridic climate, etc.

General classification of the main soils encountered during the study

a) Aridisols:

. Orthids:

- Typic Salorthids;

b) Entisols:

. Fluvents:

- Typic Torrifluvents,
- Ustic Torrifluvents,
- Typic Ustifluvents,

. Psamments:

- Typic Torripsamments,

. Orthents:

- Ustic Torriorthents,
- Lithic Torriorthents,
- Lithic Ustorthents;

c) Mollisols:

. Ustolls:

- Typic Argiustolls;

d) Vertisols:

. Usterts:

- Typic Chromusterts;

e) Rock Land.

1.4 CARTOGRAPHIC REPRESENTATION (cf. Map No 1)

The various soil types are shown on soil map No 1 by the use of symbols corresponding to great group to series (see key to soil table No.1.4.1); eg symbol:

. Order: Entisols;

. Suborder: Psamments;

. Great group: Torripsamments;

. Subgroup: Typic Torripsamments;

. Family: Sand.

1.5 SOIL CLASSIFICATION (cf. Map No 1)

Using the factors previously indicated the soil classification represented in the following table was formulated.

Table 1.4.1

Order	Suborder	Great group	Subgroup	Family	Series
ARIDISOLS	Orthids	Salorthids	Typic Salorthids	Clay	1 (1a-1b)
ENTISOLS	Fluvents	Torrifluvents	Typic Torrifluvents	Sand gravel	2
			Ustic Torrifluvents	Loamy sand over sand	3
		Ustifluvents	Typic Ustifluvents	Sandy loam over sandy clay loam	4
				Sandy clay loam	5
				Clay	6
	Psamments	Torripsamments	Typic Torripsamments	Sand over loamy sand to sandy loam	7
	Orthents	Torriorthents	Ustic Torriorthents	Sandy loam over sandy clay loam	8
			Lithic Torriorthents	Sandy loam to sandy clay loam over gravel cobbles	9
		Ustorthents	Lithic Ustorthents	Sandy loam over cobbles	10
MOLLISOLS	Ustolls	Argiustolls	Typic Argiustolls	Clay (about 50% clay)	11
				Clay (more than 50% clay)	12
VERTISOLS	Usterts	Chromusterts	Typic Chromusterts	Heavy clay (more than 60% clay)	13
ROCK LAND				Rock, gravel, cobbles (eroded areas)	14

Chapter 2

DESCRIPTION OF SOIL SERIES

(cf. Map No 1)

-

2.1 ARIDISOLS

ORTHIDS

Typic Salorthids: Soil series No 1

- Profile No 16;
- Alluvial plain - Sebbkra coastal area;
- Bare soil - Powdery surface - Very poorly permeable;
- Annual precipitation: 50 to 100 mm.

Description

- 0 - 30 cm:

  Dark brown (7.5 YR 4/4) - moist - silt - massive structure - porous - friable - alkaline (pH = 7.6) - EC on 1/5 extract = 25.9 mmhos/cm at 25°C.

- 30 - 70 cm:

  Dark brown (7.5 YR 4/4) - moist - heavy clay - massive structure - non-porous - poor plasticity - sticky - alkaline (pH = 7.8) - EC on 1/5 extract = 18 mmhos/cm at 25°C.

2.2 ENTISOLS

2.2.1 FLUVENTS

2.2.1.1 Typic Torrifluvent: Soil series No 2

The soils in series No 2 correspond to flood spreading areas and togga beds. They are sandy or gravelly.

These soils are classed as non-arable uncultivable and unirrigable land.

2.2.1.2 Ustic Torrifluvent: Soil series No 3

- Profile No 6 - Qabri Baxar;
- Alluvial plain - Togga terrace - Temporary submersion by water course;
- Pasture - Rangeland - Maize and fruit plantations (oranges, guavas, etc.) in places;
- Very permeable soil - Very permeable subsoil;
- Annual precipitation: 150 to 200 mm.

Description

- 0 - 20 cm:

  Light brownish grey (10 YR 6/2) - moist - organic debris - sand to coarse sand - particular structure - very porous - shifting - many fine and fat roots - very alkaline (pH = 9.0).

- 20 - 100 cm:

  Light brownish grey (10 YR 6/2) - wet - sand to coarse sand - particular structure - very porous - roots - very alkaline (pH = 9.0).

Analysis (Soil profile 22 + 41)

USTIC TORRIFLUVENTS (loamy sand over sand)														
Depth (cm)	Grain size % FE						pH H_2O	$CaCo_3$ total (%)	OM (%)	C (%)	N (‰)	C/N	Moisture as % of weight of dry soil	
	2 µ	20 µ	50µ	200 µ	2000 µ								1/3 Atm	15 Atm
0-20	6	5	7	33	49	0	8.9	-	0.48	0.28	0.29	10	9.9	5.3
20-50	6	4	5	30	55	0	8.7	-	-	-	-	-	13.3	5.6

Comments

Ustic Torrifluvents (series No 3) are alluvial soils bordering toggas, for example in the Qabri Baxar region. They are deep, very permeable, sandy with a high percentage of coarse sand, very calcareous (pH = 8.7) and very poor in organic matter and nitrogen.

Their total water holding capacity (at 1/3 Atm and 15 Atm) is relatively low, in the region of 6% over the first 50 cm. Their bulk density is about 1.45 g/cm3.

The poor intrinsic value of these soils means that they are classed as limited arable land (land class IV), being of limited suitability for cultivation. They are irrigable but require a great deal of water.

2.2.1.3 Typic Ustifluvents: Soil series No 4

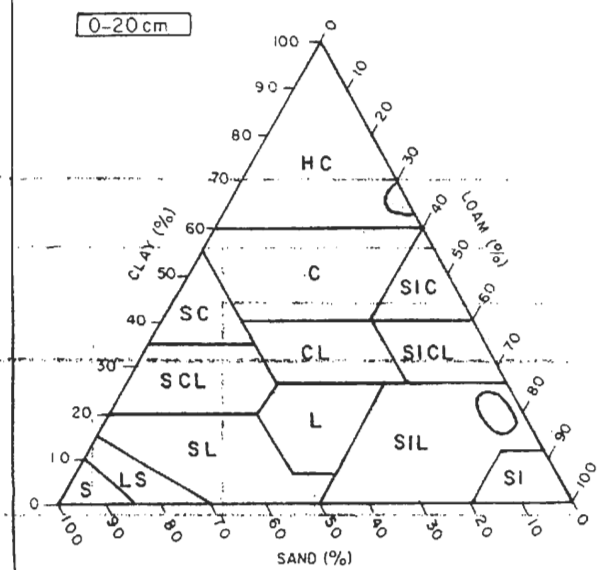
- Profile No 22 - Ceel Bardaale Valley;
- Flat valley with terraces along togga - Loamy alluvial soil - Temporary submersion during rainy season - Maize cultivated with spate irrigation - Gully erosion - Permeable soil;
- Annual precipitation: 250 to 300 mm.

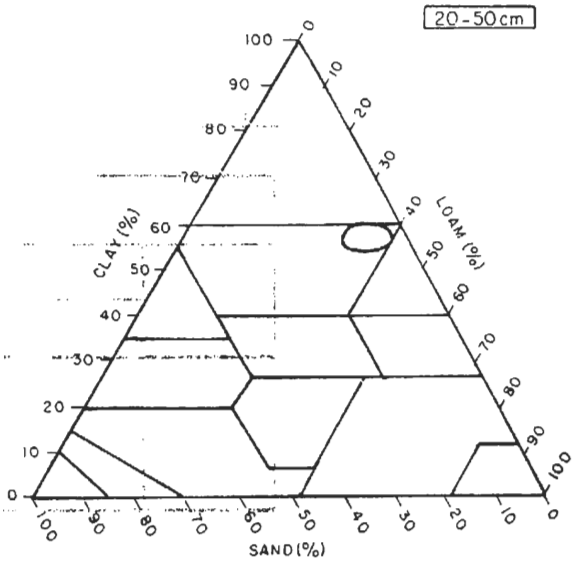
Description

0 - 20 cm:

Dark brown (10 YR 3/3) - wet - much organis debris - loamy sand clear fragmentary, polyhedral, subangular structure - porous - cohesive - very friable - fine to medium sized roots - alkaline (pH = 8.2).

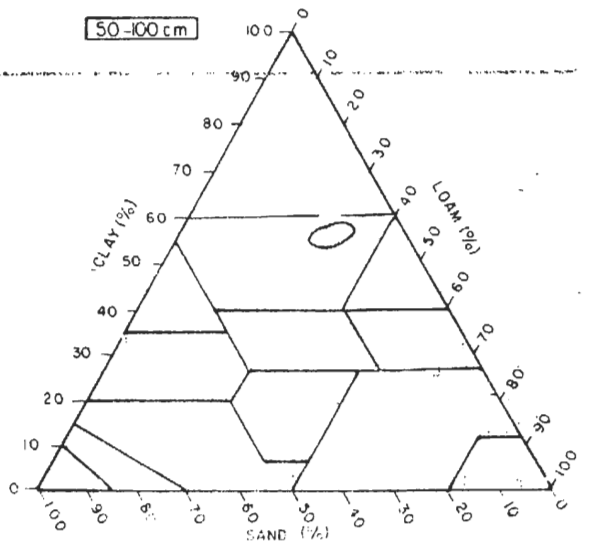
TEXTURE





ARIDISOLS

Typic Salorthids (soil series No 1)



HC	:	Heavy clay
C	:	Clay
SC	:	Sandy clay
CL	:	Clay loam
SIC	:	Silty clay
SICL	:	Silty clay loam
SIL	:	Silty loam
SI	:	Silt
L	:	Loam
SCL	:	Sandy clay loam
SL	:	Sandy loam
LS	:	Loamy sand
S	:	Sand

20 - 50 cm:

Dark yellowish brown (10 YR 3/4) - wet - fine carbonate elements (pseudomycelium) - sandy clay loam - fragmentary, polyhedral, subangular structure - cohesive - friable - fine and medium sized roots - alkaline (pH = 8.4).

50 - 100 cm:

Dark yellowish brown (10 YR 3/4) - moist - fine carbonate elements (pseudomycelium) - sandy clay loam - massive structure - cohesive - hardly fragile - alkaline (pH = 8.4).

Analysis

TYPIC USTIFLUVENTS
(sandy loam over sandy clay loam)

Depth (cm)	Grain size % FK						pH H_2O	$CaCO_3$ total (%)	OM (%)	C (%)	N (%)	C/N	Avail. P ppm	P_2O_5 %		Absorption Complex (meq/100 g)					EC on 1/5 extract at 25°C (mmhos/cm)	Moisture as % of weight of dry soil	
	2 µ	20 µ	50 µ	200 µ	2000 µ									Avail.	Total	Ca	Mg	K	H_A	T		1/3 Atm	15 Atm
0-20	17	10	5	28	40	0	8.3	8.0	1.23	0.71	0.69	10.3	0.06			7.7	1.54	0.76	0.3	10.3		15.5	6.0
20-50	23	11	5	22	39	1	8.3	13.0					0.04					0.65	0.6	12.3		20.3	8.0
50-100	26	13	6	19	36	1	8.4	15.0					0.05			10.3	1.05	0.54	0.76	13.1		20.5	8.1

Comments

Typic Ustifluvents (soil series No 4) are alluvial soils which border the toggas (terraces). They are deep and of variable texture according to the nature of successive alluvial deposits, but in general they are sandy loamy to clayey loamy sandy. They are alkaline (pH of 8 to 8.5), calcareous to moderately calcareous and poor in both organic matter and fertilising elements (phosphorus, nitrogen). On the other hand, the C/N ratio indicates good transformation of organic matter.

The total exchange capacity of these soils is relatively low at 10 to 15 meq/100 g.

Their total water holding capacity is average and varies from horizon to horizon (0 - 20 cm = 9.5%, 20 - 100 cm = 12.3%).

These soils may be classed as arable land, being well suited for irrigation and the cultivation of crops, especially fruit and vegetables.

Their bulk density is about 1.45 g/cm3 on average.

2.2.1.4 Typic ustifluvents: Soil series No 5

. Profile No 35 (Bandar Wanaag);

Depression plain - Alluvial deposits - Uncultivated area - Trees and bushes of various sizes (Acacia bussei) - Woodland - Permeable soil - Shifting surface;

Annual precipitation: 250 to 300 mm.

Description

. 0 - 20 cm:

Brown (7.5 YR 5/4) - dry - some organic debris - sandy clay loam - localised fragmentary, polyhedral, subangular structure - porous - cohesive - roots - alkaline (pH = 8.5).

. 20 - 100 cm:

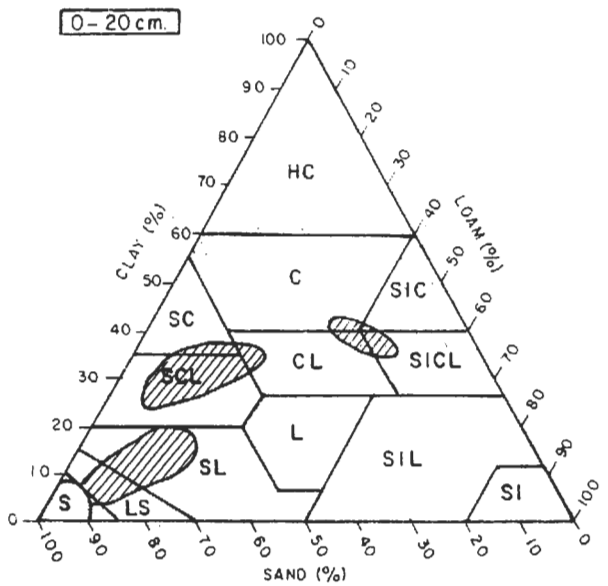
Brown (7.5 YR 5/4) - dry - sandy clay loam - massive structure - porous - cohesive - roots - alkaline (pH = 8.5).

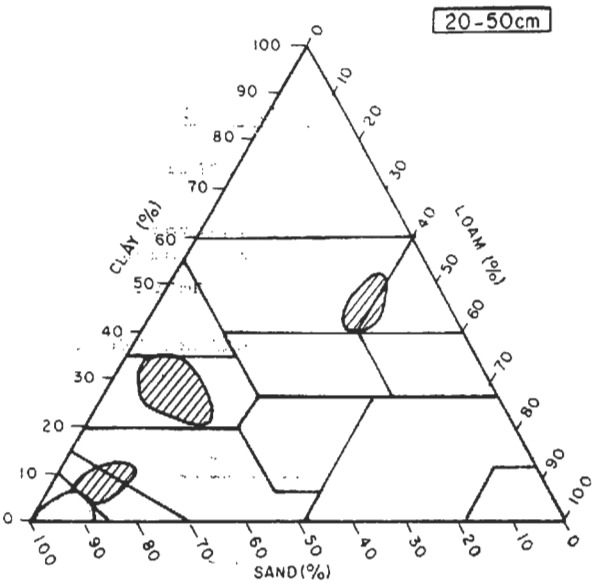
Analysis

TYPIC USTIFLUVENTS (sandy clay loam) (soil serie no 5)

Depth (cm)	Grain size % FE						pH H_2O	$CaCO_3$ total (%)	OM (%)	C (%)	N (‰)	C/N	Avail. P ppm	P_2O_5 % Avail.	P_2O_5 % Total	Absorption Complex (meq/100 g) Ca	Mg	K	Na	T	EC on 1/5 extract at 25°C (mmhos/cm)	Moisture as % of weight of dry soil 1/3 Atm	15 Atm
	2 µ	20 µ	50 µ	200 µ	2000 µ																		
0-20	23	14	[illegible]	15	46	[illegible]	8.5		0.74	0.43	[illegible]	[illegible]		-		-		-	-			14.4	6.7
20-60	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]											-	-			16.4	[illegible]
60-100	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]					[illegible]		[illegible]						[illegible]	7.5

TEXTURE



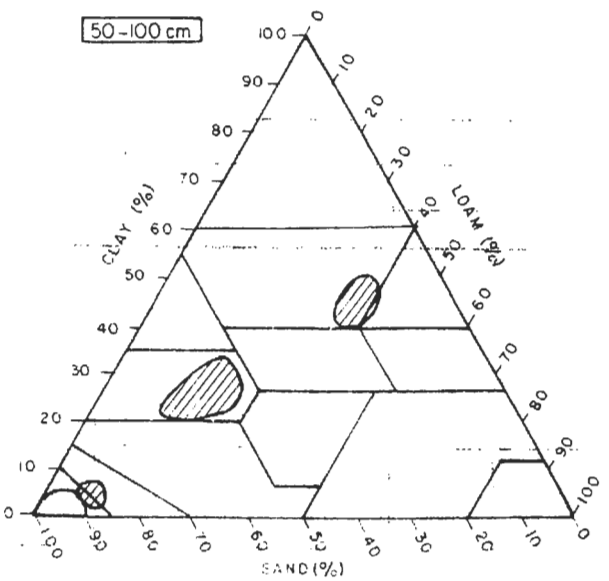


ENTISOLS

Ustic Torrifluvents (soil series No 3)

Typic Ustifluvents (soil series No 4 to 6)

HC : Heavy clay
C : Clay
SC : Sandy clay
CL : Clay loam
SIC : Silty clay
SICL : Silty clay loam
SIL : Silty loam
SI : Silt
L : Loam
SCL : Sandy clay loam
SL : Sandy loam
LS : Loamy sand
S : Sand



Comments

Soil series No 5 covers Typic Ustifluvents. Like those of soil series No 4 these are alluvial soils, generally located in wide gently sloping depressions with natural woodland vegetation and little cultivation. These soils are deep of mainly sandy clay loam texture, with a predominance of coarse sand. They are calcareous and alkaline and very poor in organic matter and nitrogen.

The average bulk density of these ustifluvents is about 1.45 g/cm3.

The intrinsic value of these soils leads to their classification as arable land. However, their agricultural development naturally depends on the potential amount of water from underground resources or precipitation.

The potential value of these soils is good; they are well suited to cultivation (fruit vegetables and other food crops) and irrigation.

2.2.1.5 Typic Ustifluvents: Soil series No 6

- Profile No 26 (Ruqi area);
- Flat valley - Togga terrace - Fine alluvium in places - Controlled submersion from water course - Cultivated area - Irrigation as complement (spate irrigation or pumping in the toggas) - Permeable soil;
- Annual precipitation: 250 to 300 mm.

Description

- 0 - 20 cm:

  Dark yellowish brown (10 YR 4/4) - wet - organic debris - clay loam - calcareous - clear fragmentary, polyhedral, subangular, fine structure - porous - friable - fine and medium sized roots - alkaline (pH = 8.5).

- 20 - 50 cm:

  Yellowish brown (10 YR 5/4) - moist - calcareous - clayey - clear fragmentary, polyhedral, subangular structure - porous - cohesive - friable - fine and medium sized roots - alkaline (pH = 8.3).

50 - 100 cm:

Brown (10 YR 5/3) - dry - calcareous - clayey - clear massive structure - hardly porous - compact - cohesive - hardly fragile Alkaline (pH = 8.3).

Analysis

TYPIC USTIFLUVENTS (clay) (soil series No 6)																						
Depth (cm)	Grain size % FE						pH H_2O	$CaCO_3$ total (%)	OM (%)	C (%)	N (‰)	C/N	Avail. P ppm	P_2O_5 ‰		Absorption Complex (meq/100 g)					EC on 1/5 extract at 25°C (mmhos/cm)	Moisture as % of weight of dry soil	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]								Avail.	Total	Ca	Mg	K	N_a	T		1/3 Atm	15 Atm
0-20	[illegible]	[illegible]	[illegible]	[illegible]	7	[illegible]	[illegible]	15	2.3[illegible]	1.36	1.[illegible]7	[illegible]0.7		-	-	-	-	[illegible]	[illegible]	-	-	36.9	17.7
20-50	47	[illegible]	[illegible]	[illegible]	7	0	[illegible]	15	-		-		-	-			-	-	-	-	-	39.4	16.7
50-100	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15	-	-	-	-	-	-	-		-	-	-	-	-	36.7	16.9

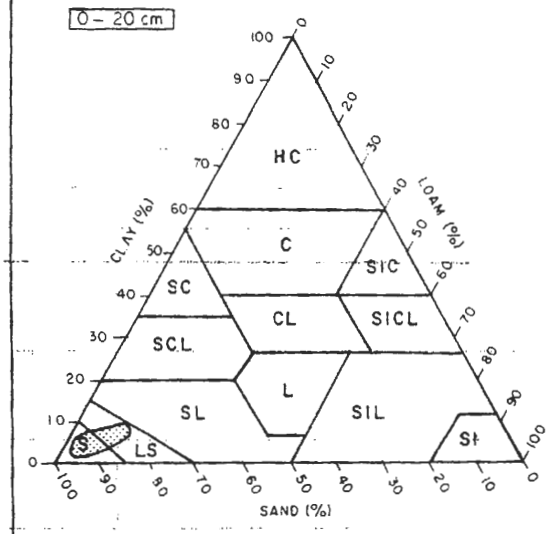
Comments

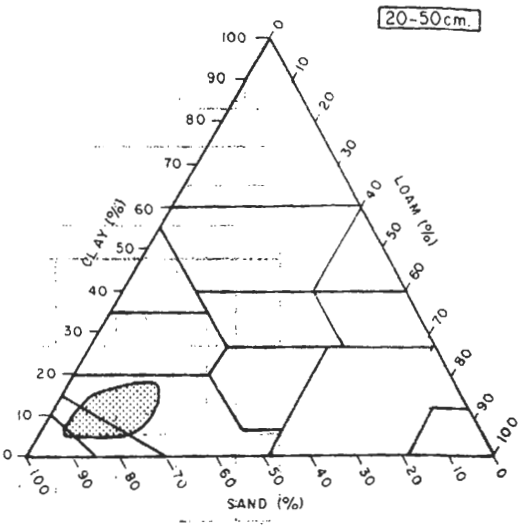
Like the previous series, the soils in series No 6 represent the Typic Ustifluvents. They are soils of alluvial or colluvial origin (togga terraces - Ruqi, for example), deep, generally with loamy clay over clay, very calcareous, alkaline (pH of 8 to 8.5) and moderately rich in organic matter and nitogen.

Their total water holding capacity is very high and varies according to the horizon from 18 to 24% depending on the weight of dry soil. Their bulk density is 1.40 g/cm3 on average.

The intrinsic value of these soils leads to their classification as arable land, well suited for irrigation and crops (fruit, vegetables, maize and other food crops). Their development nevertheless remains closely linked to potential surface water (spate irrigation) and groundwater resources.

TEXTURE

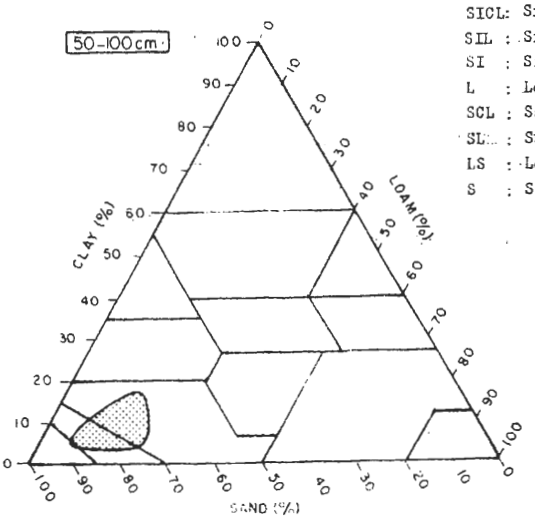




ENTISOLS

Typic Torripsamments (soil series No. 7)

Hc : Heavy clay
C : Clay
SC : Sandy clay
CL : Clay loam
SIC : Silty clay
SICL : Silty clay loam
SIL : Silty loam
SI : Silt
L : Loam
SCL : Sandy clay loam
SL : Sandy loamy
LS : Loamy sand
S : Sand



2.2.2 PSAMMENTS

2.2.2.1 Typic Torripsamments: Soil series No 7

- Profile No 4 (Lughaye);
- Coastal plain - Rolling country - Sandy alluvial deposits - Rangeland with small ligneous and herbaceous plants (Acacia spirocarpa) and near open grassland (Panicum Turgidium) - Very permeable soil;
- Annual precipitation: 50 to 150 mm.

Description

- 0 - 20 cm:

  Light yellowish brown (10 YR 6/4) - dry - loamy sand to coarse sand - particular structure - very porous - shifting - fine and medium sized roots - very alkaline (pH = 8.8).

- 20 - 40 cm:

  Yellowish brown (10 YR 5/4) - moist - loamy sand to coarse sand - calcareous - particular structure - very porous - shifting to poorly cohesive - fine and medium sized roots - very alkaline (pH = 8.7).

- 40 - 100 cm:

  Light brown (7.5 YR 6/4) - moist - sandy loam to coarse sand - calcareous - massive structure - porous - hardly cohesive - very alkaline (pH = 8.6).

Analysis

TYPIC TORRIPSAMMENTS

Depth (cm)	Grain size %						pH	CaCO3 total %	OM (%)	C (%)	N (‰)	C/N	Avail. P ppm	P_2O_5 ‰		Absorption Complex (meq/100 g)					EC on 1/5 extract at 25°C (mmhos/cm)	Moisture as % of weight of dry soil	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]								Avail.	Total	Ca	Mg	K	Na	T		1/3 Atm	15 Atm
		[illegible]		[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	-		-	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.7	[illegible]
[illegible]	12	7	4	33	45	[illegible]	[illegible]	7.4			-					10.2	1.47	[illegible]	[illegible]	[illegible]	0.16	13.1	4.6
[illegible]	12	[illegible]	[illegible]	3	41	[illegible]	[illegible]	[illegible]							-		-				[illegible]	10.1	4.4

Comments

Soil series No 7 represents rather sandy soils of aeolian or alluvial origin. They are deep and of loamy sandy texture with a proportion of coarse and medium sized sand varying from 75 to 90%. They are slightly calcareous, extremely alkaline (pH of 8.5 to 9.0) and very poor in organic matter and nitrogen.

Salinity, expressed by the conductivity of the 1/5 extract, is low.

Their total water holding capacity is also relatively low. The amount of moisture as a percentage of the weight of dry soil, 1/3 Atm - 15 Atm = 5.9% (0 - 50 cm). Given present knowledge of these soils, they should be classed as non-arable (Land class No. V - USBR) but it is possible that in the light of complementary studies (evaluation of potential groundwater resources), they be reclassified in isolated areas in one of the arable land classes or a different non-arable class (Class VI).

As far as crops are concerned, these soils are bound to be limited to vegetables (in relation with the climate) and fruit (date palm), but only an economic analysis can reveal whether they should be developed.

Soils of this type would probably be irrigable under certain conditions (choice of irrigation system bearing in mind the small applications of water - less than 400 m3/ha).

2.2.3 ORTHENTS

2.2.3.1 Ustic Torriorthents: Soil series No 8

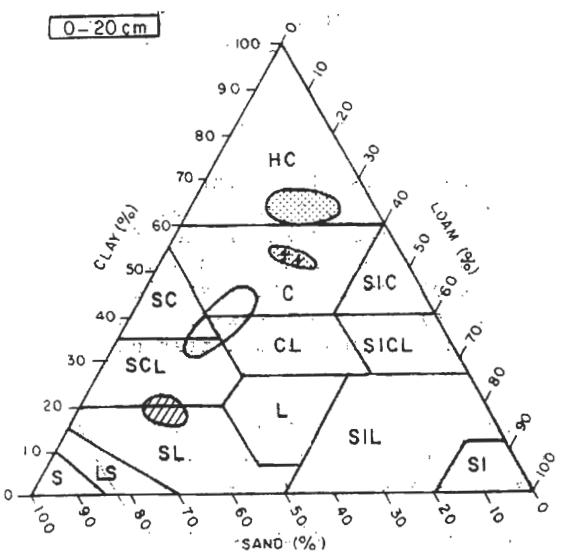
- Profile No 40;
- Plateau with aeolian cover - Gradient 3% - Coarse colluvial deposits - Vegetation of low trees and bushes (Acacia Bussei, Acacia misera) and grasses - Sheet erosion and wind erosion - Permeable soil;
- Annual precipitation: 300 to 400 mm.

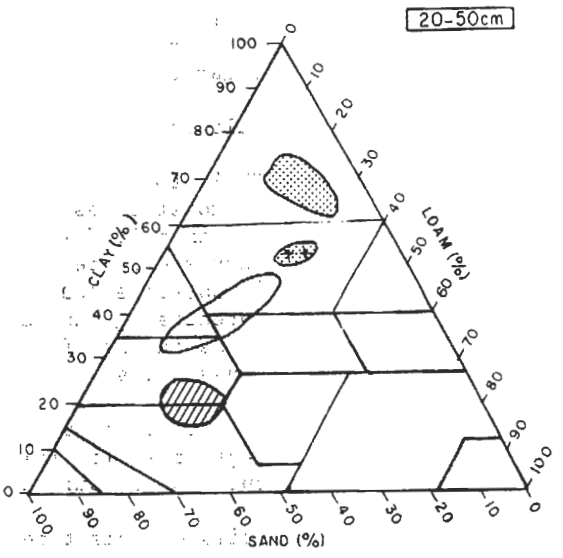
Description

0 - 20 cm:

Strong brown (7.5 YR 5/6) - dry - sandy loam with high proportion of coarse sand - calcareous - particular and fragmentary structure not very clear - hardly cohesive - fine and medium sized roots - alkaline (pH = 8.5).

TEXTURE



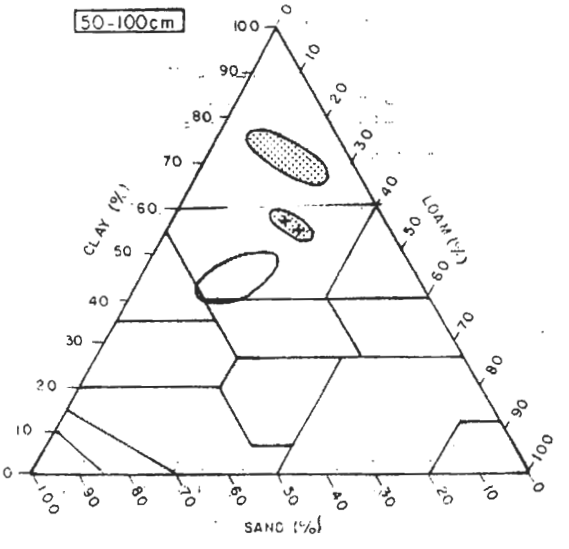


ENTISOLS { Lithic Torriortents (soil series No 9)
Lithic Ustorthents (soil series No 10)

MOLLISOLS: Typic Argiustolls (soil series No 11)

MOLLISOLS: Typic Argiustolls (soil series No 12)

VERTISOLS: Typic Chromusterts (soil series No 13)



HC	:	Heavy clay
C	:	Clay
SC	:	Sandy clay
CL	:	Clay loam
SIC	:	Silty clay
SICL	:	Silty clay loam
SIL	:	Silty loam
SI	:	Silt
L	:	Loam
SCL	:	Sandy clay loam
SL	:	Sandy loam
LS	:	Loamy sand
S	:	Sand

. 20 - 40 cm:

Strong brown (7.5 YR 5/6) - dry - sandy loam with high percentage of coarse sand - calcareous - massive structure - cohesive - very fine roots - alkaline (pH = 8.2).

. 40 - 100 cm:

Strong brown (7.5 YR 5/6) - moist - sandy loam with high percentage of coarse sand - calcareous - massive structure - cohesive - alkaline (pH = 8.2).

Analysis

USTIC TORRIORTHENTS																								
Depth (cm)	Grain size % FE						pH H_2O	$CaCO_3$ total (%)	OM (%)	C (%)	N (‰)	C/N	Avail. P ppm	P_2O_5 ‰		Absorption Complex (meq/100 g)					EC on 1/5 extract at 25°C (mmho/cm)	Moisture as % of weight of dry soil	
	2 µ	20 µ	50 µ	200 µ	2000 µ									Avail.	Total	Ca	Mg	K	H_2	T		1/3 Atm	15 Atm
0-20	15	7	2	23	53		8.5		0.30	0.57	0.1	-	-	-		-	-	-	-	-	-	9.9	4.0
20-40	16	7	2	21	54	-	8.0		-			-		-	-	-		-			-	13.6	[illegible]
40-100	21	9	2	20	48	-	8.1	-			-		-		-	-		-	-		-	-	-

Comments

These coarse-textured Ustic Torriorthents are sandy loam to sandy clay loam at depth, containing a high proportion of coarse sand (> 50%). They vary in depth according to geomorphological location but are generally less than 1 m thick overlying rocks, gravel or stones. They are calcareous with friable nodules, alkaline and very poor in organic matter and nitrogen.

They have poor total water holding capacity; 1/3 Atm - 15 Atm = 7% of weight of dry soil.

In conclusion, these soils are of poor to moderate intrinsic value. Their agricultural potential is considered mediocre. They are classed as non-arable land (land class V or VI for irrigated crops); they are totally unsuitable for rainfed cultivation.

2.2.3.2 Lithic Torriorthents: Soil series No 9

. Profile No 5 (Gat Gaara);

. Very eroded colluvial glacis (eroded in gullies) - Colluvial deposits - Loamy sandy to stony - Low bushes to Acacia Sp. - Permeable soil;

. Annual precipitation: 150 to 200 mm.

Description

. 0 - 20 cm:

Yellowish red (5 YR 5/6) - dry - sandy loam with much coarse sand and calcareous gravel - particular structure - very porous shifting - very fragile - very alkaline (pH = 8.7).

. 20 - 60 cm:

Reddish brown (5 YR 5/4) - dry - sandy clay loam with much coarse sand and calcareous gravel - particular structure - very porous - shifting - very alkaline (pH = 8.7).

. ≥ 60 cm:

Extremely gravelly horizon.

2.2.3.3 Lithic Ustorthents: Soil series No 10

. Profile No 25;

. Hillsides with a gradient of about 3% - Shallow, loamy sandy colluvial deposits - Cultivation of sorghum - Permeable soil;

. Annual precipitation: 450 to 500 mm.

Description

. 0 - 30 cm:

Dark brown (7.5 YR 3/2) - dry - sandy loam, slightly calcareous - not very clear structures - cohesive - roots - very alkaline (pH = 8.6).

. 30 - 50 cm:

Pale brown (10 YR 6/3) - dry - sandy loam, very gravelly (40% of gravels 2 mm in dia.) - massive structure - roots - alkaline (pH = 8.3);

. > 50 cm:

Gravelly horizon with 80% coarse-elements (gravel, stones, etc.).

Analysis

LITHIC TORRIORTHENTS LITHIC USTORTHENTS (soil series No 9,10)

Depth (cm)	Grain size % FE						pH H_2O	$CaCO_3$ total (%)	OM (%)	C (%)	N (‰)	C/N	Avail. P ppm	P_2O_5 ‰		Absorption Complex (meq/100 g)					EC on 1/5 extract at 25°C (mmhos/cm)	Moisture as % of weight of dry soil	
	2 µ	20 µ	50 µ	200 µ	2000 µ									Avail.	Total	Ca	Mg	K	Na	T		1/3 Atm	15 Atm
0-20	17	[illegible]	[illegible]	24	44	6	[illegible]	7.[illegible]	1.26	0.73	[illegible]	[illegible].5	-	-	-	[illegible].0	1.2	1.15	0.66	[illegible]		11.[illegible]	6.0
20-40	18	[illegible]	[illegible]	[illegible]	49	20	[illegible]	[illegible].2	0.4[illegible]	0.27	0.36	7.5		[illegible]	-	[illegible]	1.04	0.5[illegible]	[illegible]	[illegible].4	-	[illegible].5	4.7

Comments on soil series Nos 9 and 10

According to their geographical locations, the soils in series 9 and 10 are named Lithic Torriorthents and Lithic Ustorthents respectively. Their main morphological characteristic is their depth (30 to 60 cm).

They are generally located on more or less eroded plateaux or eroded hillsides. The dominant texture is sandy loam with a high proportion of coarse sand (40 to 50%). These soils are gravelly (> 20% of gravel below a depth of 20 cm), calcareous, alkaline (pH of 8.4) and poor in organic matter and nitrogen. They have a low total exchange capacity of less than 10 meq/100 g.

These soils are unirrigable and uncultivable.

2.3 MOLLISOLS

USTOLLS

Typic Argiustolls: Soil series No 11

Profile No 21;

Plateau with a gradient of about 1% - Clayey and calcareous colluvial deposits - Cultivation of sorghum - Permeable soil;

Annual precipitation: 400 to 450 mm.

Description

0 - 20 cm:

Dark yellowish brown (10 YR 3/4) - moist - organic and calcareous residue - sandy clay - clear fragmentary, polyhedral subangular structure - porous - cohesive - friable - very fine roots - regular limits - alkaline (pH = 8.2).

20 - 60 cm:

Brown to dark brown (7.5 YR 4/4) - wet - calcareous - clay - not very clear fragmentary structure, tending to be polyhedral and subangular - porous - cohesive - fine roots - regular limits - very alkaline (pH = 8.6).

60 - 100 cm:

Dark reddish brown (5 YR 3/4) - wet - calcareous - clay - massive structure - not very porous - cohesive - not very friable - a few rootlets - alkaline (pH = 8.3).

Analysis

TYPIC ARGIUSTOLLS (clay ≤ 50%)

Depth (cm)	Grain size % FE						pH H_2O	$CaCO_3$ total (%)	OM (%)	C (%)	N (‰)	C/N	Avail. P ppm	P_2O_5 ‰		Absorption Complex (meq/100 g)					EC on 1/5 extract at 25°C (mmhos/cm)	Moisture as % of weight of dry soil	
	2µ	20µ	50µ	200µ	2000µ									Avail.	Total	Ca	Mg	K	Na	T		1/3 Atm	15 Atm
0-20	41	19	3	[illegible]	29	[illegible]	8.3	16.5	1.71	[illegible]	[illegible]	10.5	27	0.06	0.82	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		27.5	13.0
20-50	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]		[illegible]	16	[illegible]	0.52	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
50-100	47	20	[illegible]	6	25	0	8.4	[illegible]			[illegible]	[illegible]	26	0.02		17.6	5.4	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]

Comments

This series is represented for the most part by soils under rainfed cultivation. These soils are defined as Mollisols and their main morphological characteristic (clayey texture) leads to them being classed as Argiustolls. They are deep, clayey (40 - 50% fine elements less than 2 microns) and well structured at the surface (0 - 30 cm) except for 1 cm of shifting material on uncultivated land. They are calcareous (friable nodules), alkaline (pH of 8.3 to 8.5), lacking in organic matter, nitrogen and phosphorous and very poor in assimilable potassium.

Their total exchange capacity is very high on average being between 20 and 25 meq/100 g. They are saturated in calcium (S/T ≃ 100).

Their total water holding capacity is relatively high, between 13 and 14% (1/3 - 15 Atm) of the weight of dry soil.

The bulk density varies from 1.40 to 1.45 g/cm3 (average = 1.42 g/cm3).

On the whole, permeability of these soils is average. The infiltration rate varies from 2 to 3 cm/hour. But the formation of a film by rainfall compaction effect on cultivated land tends to reduce this permeability and thus limit infiltration in areas left fallow for considerable periods, increasing runoff and encouraging erosion.

This erosion may be rationally countered by contour cultivation (ploughing, sowing) or by the construction of bunds in areas of steep gradient.

In conclusion, soils in series 11 have righ intrinsic value and constitute the best land on the plateau and possibly of the entire North-West Region. They are highly suitable for cultivation but their productivity still depends on rainfall; that is, one can have good land but without rainfall production would be nil. These soils are also well suited for irrigation but, given the potential of groundwater resources (for example), they might well never be irrigated. The improvement of such land would thus be conditioned by the farming techniques employed as well as by the use of mineral and organic fertiliser (cf. Agronomic Report No 7).

Typic Argiustolls: Soil series No 12

- Profile No 30 (SW Aburriin);
- Plateau - Gradient 1% - Clayey colluvial deposits - Tree, bush and grass cover (basically Acacia etbaica); open woodland - 40% vegetation cover - A few sorghum fields in places - Sheet erosion - Rangeland - Wood production - Many dead trees - Poorly permeable soil:
- Annual precipitation: 400 to 450 mm.

Description

0 - 20 cm:

Strong brown (7.5 YR 4/6) - dry - organic debris - clayey - fragmentary, polyhedral, subangular structure - cohesive - fine roots - regular transition - alkaline (pH = 7.7).

20 - 60 cm:

Dark brown (7.5 YR 4/4) - dry - clayey - massive structure - very cohesive - some fat roots - regular transition - alkaline (pH = 8.2).

60 - 100 cm:

Idem except very alkaline (pH = 8.5).

Analysis

TYPIC ARGIUSTOLLS (clay > 50% < 60%)																					
Depth (cm)	Grain size % FE							pH H_2O	$CaCO_3$ total (%)	OM (%)	C (%)	N (‰)	C/N	Avail. P ppm	P_2O_5 ‰		Absorption Complex (meq/100 g)					FC on 1/5 extract at 25°C (mmhos/cm)	Moisture eq % of weight of dry soil	
	2 µ	20 µ	50 µ	0 200 µ	200-2000 µ										Avail.	Total	Ca++	Mg	K	H_3	T		1/3 Atm	15 Atm
0-20	52	22	2	7	17	0	7.9			1.52	1.31	11.4	1-		0.04	0.07	27.0	4.	1.17	0.44	32.7			11.3
20-50	59	22	2	6	17	0	8					-	1-		0.04	0.02	25.0	7.7	1.23	0.64	35.0			15.5
50-100	57	22	1	5	15	0	8.4					-			-		19.4	12.1	1.70	1.21	32.0	-	9.5	11.5

Comments

The classification applied to soil series 11 remains true for this series, except that these soils are more clayey. In fact, the clay content (i.e. elements of less than 2 microns) is always greater than 50% (being between 52 and 60%).

These soils are hardly cultivated, except in very localised spots by semi-settled nomads. Currently, this area is a forestry reserve.

These soils are calcareous at depth (pH of 8.4), are well supplied with organic matter and nitrogen and assimilable potassium but very poor in assimilable phosphorus.

Their average water holding capacity is 15 to 16% of the weight of dry soil.

Their very poor permeability (infiltration rate of less than 2 cm/h), due in for the most part to high clay content, compactness and the formation of film by rainfall compaction effect helps accentuate the stagnation of water on the soil during heavy storms and thus limit infiltration of water at depth.

In the present situation series 12 soils mostly have a cover of trees, which wither when precipitation is less than 350 mm/year.

In conclusion, land in series 12 which has a high clay content and poor permeability, are moderately to marginally suitable for rainfed cultivation. However, such land cannot be entirely dismissed for development under rainfed cultivation until experimentation has been carried out with a few sorghum plots (which currently provide poor yields of 3 - 5 q/ha), carefully chosen according to the above criteria. This experimentation should be undertaken under the strict control of the manager of the new research station and rainfed cultivation extension service.

It is only after agronomic and economic analysis that it will be possible to conclude finally whether it would be reasonable to include this land in the extension of rainfed cultivation areas.

With irrigation, these soils should be classed as arable land with good potential, but unfortunately groundwater resources are practically non-existent.

2.4 VERTISOLS

USTERTS

Typic Chromusterts: Soil series No 13

Profile No 8 (Tog Wajale);

Plain - Gradient less than 1% - Clayey alluvial deposits - Grass cover, basically Chrysopogon aucheri; edaphic grassland - Cultivation of sorghum in very isolated spots - Poor yields (200 kg of grain per ha) - Sheet erosion - Practically impermeable soil - Powdery surface and shrinkage cracks in places;

Annual precipitation: 450 to 500 mm.

Description

. 0 - 20 cm:

Dark brown (10 YR 4/3) - dry - organic debris - heavy clay - clear fragmentary, polyhedral, subangular structure; fine - cohesive - fragile - fine to medium-sized roots - regular transition - alkaline (pH = 8.3).

. 20 - 50 cm:

Dark brown (7.5 YR 4/4) - moist - heavy clay - clear fragmentary, polyhedral, subangular structure - cohesive - friable - compact - a few roots - regular transition - alkaline (pH = 8.4).

50 - 100 cm:

Dark brown (7.5 YR 3/2) - dry - heavy clay - massive structure, not very friable - compact - no roots - alkaline (pH = 8.4).

Analysis

TYPIC CHROMUSTERTS (clay > 60%)																							
Depth (cm)	Grain size % FE						pH H_2O	$CaCO_3$ total (%)	OM (%)	C (%)	N (‰)	C/N	Avail. P ppm	P_2O_5 ‰		Absorption Complex (meq/100 g)					EC on 1/5 extract at 25°C (mmhos/cm)	Moisture as % of weight of dry soil	
	2 µ	20 µ	50 µ	200 µ	2000 µ									Avail.	Total	Ca	Mg	K	Na	T		1/3 Atm	15 Atm
0-20	62	23	[illegible]	[illegible]	5	0	[illegible]	[illegible]	[illegible]	1.81	1.64	11.0	[illegible]	[illegible]	0.65	29.[illegible]	[illegible]	[illegible].33	0.33	35.7	[illegible]	[illegible].8	[illegible].7
20-50	65	22	3	[illegible]	4	0	[illegible]	[illegible]	[illegible]				[illegible]	0.01	0.54	21.9	10.1	0.7[illegible]	2.25	34.6	0.20	24.9	18.0
50-100	68	21	3	[illegible]	4	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	13.3	14.4	0.76	5.70	31.8		19.3	22.7

Comments

Classed as Vertisols, the Typic Chromusterts are very clayey (heavy and clay); with a clay content of over 60%. These soils are deep, cracked, compact, poorly permeable (infiltration rate of about 1 cm/hour). They are slightly calcareous, alkaline (pH of 8.2 to 8.8), well supplied with organic matter and nitrogen and assimilable potassium but very poor in assimilable phosphorus. Their total exchange capacity is high, being over 30 meq/100 g. They are saturated in calcium (S/T ≃ 100%).

They are not very saline. They become progressively more alkaline with depth (Na/T > 15), reducing permeability even further.

Their total water holding capacity is high, varying from 16 to 23% according to the horizon (average 16.8%).

The bulk density of these soils is about 1.40 g/cm3.

Moisture retention is good and the soils are slightly moist below 30 cm even at the end of the dry season.

The main limitation to agriculture is water availability. The amount and reliability of the rainfall are such that the land is classed as marginal for rainfed cultivation. There are no nearby sources for an irrigation system.

2.5 ROCK LAND: SOIL SERIES No 14

Rock land constitutes most of the studied area. It is unsuitable for cultivation.

2.6 "SOIL CLASSIFICATION, GENERAL DISTRIBUTION"

See table on the following page.

SOIL CLASSIFICATION - GENERAL DISTRIBUTION

Order	Suborder	Great group	Subgroup	Family	Series	Area	
						ha	%
ARIDISOLS	Orthids	Salorthids	Typic Salorthids	Clay	1	65 000	1.94
ENTISOLS	Fluvents	Torrifluvents	Typic Torrifluvents	Sand-gravel	2	164 000	4.90
			Ustic Torrifluvents	Loamy sand/sand	3	2 500	0.02
		Ustifluvents	Typic Ustifluvents	Sandy loam/sandy clay loam	4	2 500	0.08
				Sandy clay loam	5	39 000	1.16
				Clay	6	134 000	4.00
	Psamments	Torripsamments	Typic Torripsamments	Sand/loamy sand to sandy loam	7	656 000	19.58
	Orthents	Torriorthents	Ustic Torriorthents	Sandy loam/sandy clay loam	8	24 000	0.72
			Lithic Torriorthents	Sandy loam to SCL/gravel cobble	9	101 000	3.02
		Ustorthents	Lithic Ustorthents	Sandy loam/cobble	10	309 000	9.22
MOLLISOLS	Ustolls	Argiustolls	Typic Argiustolls	Clay (< 50% clay)	11	99 000	2.96
				Clay (50 to 60% clay)	12	120 000	3.59
VERTISOLS	Usterts	Chromusterts	Typic Chromusterts	Heavy clay (> 60% clay)	13	44 000	1.31
ROCK LAND				Rock, cobble, eroded areas	14	1 590 000	47.46
GROSS TOTAL						3 350 000	100.00

Chapter 3

LAND CLASSIFICATION

Two classifications were considered in the course of the soil study of the North West Region:

- Classification of the land with a view to its use for rainfed farming, for which four classes of suitability are defined hereafter, taking into account the morphological characteristics of the soils and the intensity of rainfall (see map 2);
- Classification of the land with a view to its use for irrigated farming, for which six classes of suitability for irrigation are described hereafter, taking into account the morphological characteristics of the soils and especially the potential ground water resources (see map 2).

3.1 RAINFED CULTIVATION

3.1.1 CLASS 1 - GOOD CROPPING SUITABILITY

Good arable land capable of producing high yields at minimum production costs. This class corresponds to deep soils (> 50 cm) of medium to fine texture (loam to clay), the clay content representing less than 50% of fine particles smaller than 2 microns, with moderate to normal drainage, a moderate level of fertility, low salinity, optimum pH in the range of 5.5 to 8.2 (limits 5.2 and 8.5) and a lime content of less than 25%.

The mean annual precipitation must be greater than 350 mm, falling for the most part during the cropping cycle, from April to September inclusive.

3.1.2 CLASS 2 - MEDIUM CROPPING SUITABILITY

Arable land likely to give operating results significantly less favourable than those obtained with class 1 land, on account of lesser yields.

This class corresponds to deep soils (> 50 cm) of very fine (clayey) texture, the clay content representing between 50 and 60% of fine particles smaller than 2 microns, or to soils of balanced texture, sandy clay loam.

Drainage is imperfect to excessive.

The mean annual precipitation must be in the range of 350 to 400 mm, falling for the most part during the cropping cycle, from April to September inclusive.

3.1.3 CLASS 3 - POOR CROPPING SUITABILITY

Arable land from which only very marginal results can be expected. This class corresponds to soils the morphological characteristics of which exclude rainfed agricultural development:

soils of very fine texture (heavy clay) with more than 60% of fine particles smaller than 2 microns, mediocre drainage and a tendency to be alkaline at depth (> 50 cm),

soils of coarse texture (loamy sand to sandy loam) of varying depth (30 to 100 cm).

3.1.4 CLASS 4 - CROPPING UNSUITABILITY

This class covers land which receives less than 200 mm of rain per year. It may consist in clayey, sandy or gravelly soils or it may represent rock land.

3.2 IRRIGATED CULTIVATION (US Bureau of Reclamation)

3.2.1 CLASS I

Arable land capable of producing high yields at minimum production cost for a wide range of crops.

3.2.2 CLASS II

Arable land likely to give operating results significantly less favourable than those obtained with class I land, on account of lesser yields and/or higher development and operating costs.

3.2.3 CLASS III

Arable land from which only marginal operating results may be expected. All land presenting more marked deficiencies will therefore be considered as non-arable.

3.2.4 CLASS IV (particular case)

Land which could be arable under certain particular condition. Such land should be considered as non-arable but is characterised by a physical and economic environment which allows its development to be envisaged under special conditions which would be strictly defined (for example orchards, vegetable growing, etc). In view of the economic and/or technological environment, the limiting factors relating to the soil characteristics are not considered to be significant, and the anticipated operating results may exceed those obtained by development of the land classes described previously.

3.2.5 CLASS V

Land which is "non-arable" in the present state of knowledge and of the projects in progress. In the light of further agronomic, hydrogeological, economic or engineering design studies, it could prove possible to reclassify this land in one of the arable land classes (alternatively in the non-arable class VI). A pilot project could be recommended if necessary.

3.2.6 CLASS VI

Non-arable land. Non-irrigable.

3.3 LAND DISTRIBUTION

3.3.1 RAINFED CULTIVATION

Class	Cropping suitability	Area	
		ha	%
1	Good	99 000	2.96
2	Medium	292 000	8.72
3	Poor	44 000	1.32
4	Unsuitable	2 915 000	87.81
TOTAL		3 350 000	100.00

3.3.2 IRRIGATED CULTIVATION

Land class		Irrigability	Area	
Class	Group		ha	%
I	Arable	Excellent	3 500	0.10
II	Arable	Good	0	0
III	Arable	Fair to restricted	0	0
IV	Limited arable	Restricted to good for special crop	2 500	0.08
V	Temporarily non-arable	Under conditions	1 091 000	32.57
VI	Non-arable	Non-irrigable	2 253 000	67.25
TOTAL			3 350 000	100.00

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Appendix

SOIL DESCRIPTIONS AND ANALYSIS

297 PROFILE 0001

USTIFLUVENT

*TERRACE , GRADIENT LESS THAN 1 % , SAND , SILT , ALLUVIAL DEPOSIT , UNDER CULTIVATION *TREE CROPS *HORTICULTURE , VERY RECENT USE *WITHOUT LIVESTOCK , SUPPLEMENTARY IRRIGATION , FLOOD IRRIGATION , CHANGES IN THE RELIEF BY LEVELLING *HAND CULTIVATION , ORGANIC MANURE *PERMEABLE SOIL

0/ 20 *DRY *COLOUR : 7,5 YR 6/4 *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : SANDY LOAM *COHERENT *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

20/ 50 *FRESH *COLOUR : 7,5 YR 6/4 *NO COARSE ELEMENTS *TEXTURE : SANDY CLAY LOAM *COHERENT *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

50/100 *FRESH *COLOUR : 7,5 YR 5/4 *NO COARSE ELEMENTS *TEXTURE : SANDY CLAY LOAM *COHERENT *COMMON ROOTS , FINE AND MEDIUM

297 PROFILE 0002

TORRIPSAMMENT

*PLAIN *AEOLIAN DRESSING , SAND , ALLUVIAL DEPOSIT *HERBACEOUS VEGETATION , WITHOUT CULTIVATION *PASTURE LAND OR RANGELAND *WIND EROSION *VERY PERMEABLE SOIL

0/ 30 *DRY *COLOUR : 10 YR 6/4 *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH FINE SAND *SINGLE GRAIN STRUCTURE *VERY POROUS *QUICKSAND *FEW ROOTS

30/ 70 *DRY *COLOUR : 10 YR 6/4 *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH FINE SAND *SINGLE GRAIN STRUCTURE *VERY POROUS *QUICKSAND *FEW ROOTS

70/100 *DRY *COLOUR : 10 YR 6/4 *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH FINE SAND *MASSIVE STRUCTURE *VERY POROUS

PROFILE	297 0001				297 0002			
HORIZON	0/ 20	20/ 50	50/100		0/ 30	30/ 70	70/100	
CLAY 0/2 MCR, % F.C	15	28	32		6	8		
FINE SILT 2/20	6	12	14		3	11		
COARSE SILT 20/50	1	4	4		4	10		
FINE SAND 50/200	24	19	15		62	49		
COAR. SAND 200/2000	54	37	35		25	22		
>2 MM % SOIL	1	3	2		0	0		
PH 1/2,5 H2O	8,7	8,4	8,4		8,5	8,8		
CALCIUM CARBONATE %	9,4	19	19		3,4	7,7		
ORGANIC MATTER %	0,76				0,21			
ORGANIC CARBON %	0,44				0,12			
TOTAL NITROGEN 0/00	0,40				0,23			
DIL. ACID P PPM								
DIL. ACID P2O5 0/00	0,06	0,04	0,04					
TOTAL P2O5 0/00								
EXCH. CA MEQ/100 G.	4	8	10,1					
EXCH. MG MEQ/100 G.	2,1	3	2,2					
EXCH. K MEQ/100 G.	0,44	0,38	0,28					
EXCH. NA MEQ/100 G.	0,03	1,29	1,7					
EXCH. CAP.MEQ/100 G	6,6	12,6	12,7					
1/5 EC MMHOS 25C					0,12	0,19		
MOIST. 1/3 ATM. %	11,7	22,9	23,1					
MOIST. 15 ATM. %	6,3	10,8	11,8					

297 PROFILE 0003

TORRIPSAMMENT - Soil Series N° 7
*PLAIN *UNDULATING LANDSCAPE *AEOLIAN DRESSING , SAND , ALLUVIAL DEPOSIT *HERBACEOUS VEGETATION , WITHOUT CULTIVATION *PASTURE LAND OR RANGELAND *WIND EROSION

0/ 15 *DRY COLOUR : 7,5 YR 5/6 *NO COARSE ELEMENTS *TEXTURE : SAND *SINGLE GRAIN STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS *QUICKSAND , VERY FRAGILE *SMOOTH TRANSITION

15/ 45 *FRESH *COLOUR : 7,5 YR 5/6 , LOCALISED , FINE ELEMENTS *CARBONATES IN FRIABLE NODULES *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH FINE SAND *SINGLE GRAIN STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS *QUICKSAND , VERY FRIABLE *SMOOTH TRANSITION

45/100 *DRY *COLOUR : 7,5 YR 5/4 , LOCALISED , FINE ELEMENTS *CARBONATES IN FRIABLE NODULES *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH FINE SAND *SINGLE GRAIN STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS , FRAGILE

297 PROFILE 0004

TORRIPSAMMENT Soil Series N° 7
*PLAIN *UNDULATING LANDSCAPE , GRADIENT LESS THAN 1 % , SAND , ALLUVIAL DEPOSIT *LOW WOODY VEGETATION HERBACEOUS VEGETATION *VERY SPARSE VEGETATION , WITHOUT CULTIVATION *PASTURE LAND OR RANGELAND *VERY PERMEABLE SOIL

0/ 15 *DRY *COLOUR : 10 YR 6/4 *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH COARSE SAND *SINGLE GRAIN STRUCTURE VERY POROUS *QUICKSAND *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

15/ 40 *FRESH *COLOUR : 10 YR 5/4 *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH COARSE SAND , CALCAREOUS LIMESTONE *SINGLE GRAIN STRUCTURE *VERY POROUS *QUICKSAND *SLIGHTLY COHERENT *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

40/100 *FRESH *COLOUR : 7,5 YR 6/4 *NO COARSE ELEMENTS *TEXTURE : SANDY LOAM WITH COARSE SAND , CALCARECUS LIMESTONE *MASSIVE STRUCTURE *POROUS *SLIGHTLY COHERENT

PROFILE	297 0003			297 0004		
HORIZON	0/ 15	15/ 45	45/100	0/ 15	15/ 40	40/100
CLAY 0/2 MCR, % F.E	6	18	18	6	6	14
FINE SILT 2/20	3	11	12	5	5	8
COARSE SILT 20/50	2	6	6	5	4	4
FINE SAND 50/200	36	35	35	34	35	23
COAR. SAND 200/2000	53	30	29	50	50	51
>2 MM % SOIL	4	2	0	0	0	0
PH 1/2,5 H20	8,6	8,7	8,7	8,8	8,7	8,6
CALCIUM CARBONATE %	5,5	9	9			
ORGANIC MATTER %	0,12			0,19		
ORGANIC CARBON %	0,07			0,11		
TOTAL NITROGEN 0/00	0,14			0,21		
DIL. ACID P PPM						
DIL. ACID P205 0/00						
TOTAL P205 0/00						
EXCH. CA MEQ/100 G.	4	10,2	10,8			
EXCH. MG MEQ/100 G.	0,58	1,42	1,2			
EXCH. K MEQ/100 G.	0,23	0,31	0,21			
EXCH. NA MEQ/100 G.	0,02	0,22	0,3			
EXCH. CAP.MEQ/100 G	5	13	13			
1/5 EC MMHOS 25C	0,13	0,11	0,14	0,13	0,14	0,14
MOIST. 1/3 ATM. %						
MOIST. 15 ATM. %						

297 PROFILE 0005

TORRIORTHENT Soil Series No 9

*COLLUVIAL GLACIS , 03% GRADIENT , PEBBLE , COLLUVIAL DEPOSIT *LOW WOODY VEGETATION *VERY SPARSE VEGETATION *BARE SOIL , WITHOUT CULTIVATION *PASTURE LAND OR RANGELAND *GULLY EROSION *PERMEABLE SOIL

0/ 20 *DRY *COLOUR : 5 YR 5/6 *VERY MUCH GRAVEL *TEXTURE : SANDY LOAM WITH COARSE SAND *SINGLE GRAIN STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS *QUICKSAND , VERY FRAGILE *SMOOTH TRANSITION

20/ 60 *DRY *COLOUR : 5 YR 5/4 *VERY MUCH GRAVEL *TEXTURE : SANDY CLAY LOAM WITH COARSE SAND *SINGLE GRAIN STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS *QUICKSAND , VERY FRAGILE

297 PROFILE 0006

TORRIFLUVENT Soil Series No 3

*ALLUVIAL PLAIN *TERRACE , GRADIENT LESS THAN 1 % , SAND , ALLUVIAL DEPOSIT *FLOODING *TEMPORARY FLOODING BY STREAM *HERBACEOUS AND HIGH AND LOW WOODY VEGETATION , UNDER CULTIVATION *PASTURE LAND OR RANGELAND FOOD CROPS *TREE CROPS , VERY RECENT USE , SUPPLEMENTARY IRRIGATION , FLOOD IRRIGATION *MIXED CULTIVATION , ORGANIC MANURE VERY PERMEABLE SOIL *VERY PERMEABLE SUBSOIL

0/ 20 *FRESH *COLOUR : 10 YR 6/2 *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : SAND WITH COARSE SAND *SINGLE GRAIN STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS *QUICKSAND *FREQUENT ROOTS , FINE AND COARSE

20/100 *MOIST *COLOUR : 10 YR 6/2 *NO COARSE ELEMENTS TEXTURE : SAND WITH COARSE SAND *SINGLE GRAIN STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS *QUICKSAND *COMMON ROOTS , FINE AND COARSE

PROFILE	297 0005				297 0006	
HORIZON	0/ 20	20/ 60			0/ 20	20/100
CLAY 0/2 MCR, % F.E	21	24			4	2
FINE SILT 2/20	11	13			2	1
COARSE SILT 20/50	3	3			3	1
FINE SAND 50/200	15	15			29	22
COAR. SAND 200/2000	50	45			62	74
>2 MM % SOIL	10	6			0	0
PH 1/2,5 H2O	8,7	8,7			9	9
CALCIUM CARBONATE %	9,8	14				
ORGANIC MATTER %	0,26				0,23	
ORGANIC CARBON %	0,15				0,14	
TOTAL NITROGEN 0/00	0,24				0,19	
OIL. ACID P PPM						
OIL. ACID P205 0/00						
TOTAL P205 0/00						
EXCH. CA MEQ/100 G.						
EXCH. MG MEQ/100 G.						
EXCH. K MEQ/100 G.						
EXCH. NA MEQ/100 G.						
EXCH. CAP. MEQ/100 G						
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %						
MOIST. 15 ATM. %						

297 PROFILE 0007

USTORTHENT Soil Series No 10

*SLOPE , GRADIENT LESS THAN 1 % , PROFILE AT THE FOOT OF THE BODY , SAND , SILT , COLLUVIAL DEPOSIT , UNDER CULTIVATION *TREE CROPS , SYSTEMATIC IRRIGATION , GRAVITY IRRIGATION *MIXED CULTIVATION *PERMEABLE SOIL

0/ 20 *FRESH *COLOUR : 7,5 YR 6/4 *ORGANIC DEBRIS *SOME GRAVEL (QUARTZITE) *TEXTURE : SANDY LOAM *STRUCTURE IN PEDS , SUBANGULAR BLOCKY , THIN SIZE *POROUS *COHERENT *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

20/ 50 *FRESH *COLOUR : 7,5 YR 6/4 *SOME GRAVEL (QUARTZITE) *TEXTURE : SANDY LOAM *STRUCTURE IN PEDS , SUBANGULAR BLOCKY , MEDIUM SIZE *POROUS *COHERENT *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

50/100 *DRY *COLOUR : 7,5 YR 5/6 *SOME STONES (QUARTZITE) *TEXTURE : SANDY LOAM *MASSIVE STRUCTURE *POROUS *COHERENT

297 PROFILE 0008

CHROMUSTERT Soil Series No 13

*PLAIN , GRADIENT LESS THAN 1 % , PROFILE IN THE MIDDLE OF THE BODY , CLAY , ALLUVIAL DEPOSIT HERBACEOUS VEGETATION , UNDER CULTIVATION *PASTURE LAND OR RANGELAND *FOOD CROPS , VERY RECENT USE , NO CHANGES IN THE RELIEF *PLOUGHING *MIXED CULTIVATION *SHEET EROSION *ALMOST IMPERMEABLE SOIL *CRACKS *POWDERY SURFACE

0/ 20 *DRY COLOUR : 10 YR 4/3 *WITHOUT MOTTLES *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : CLAY *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , THIN SIZE *POROUS *COHERENT , FRAGILE *FREQUENT ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

20/ 50 *FRESH *COLOUR : 7,5 YR 4/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , MEDIUM SIZE *COHERENT , FRIABLE *FEW ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

50/100 *DRY COLOUR : 7,5 YR 3/2 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *COHERENT , SLIGHTLY FRIABLE

PROFILE	297 0097				297 0098			
HORIZON	0/ 20	20/ 50	50/100		0/ 20	20/ 50	50/100	
CLAY 0/2 MCR, % F.E	14	12	18		61	63	68	
FINE SILT 2/20	7	4	13		24	24	20	
COARSE SILT 20/50	4	2	4		4	3	3	
FINE SAND 50/200	15	10	13		5	5	4	
COAR. SAND 200/2000	60	72	52		6	5	5	
>2 MM % SOIL	4	9	6		0	0	0	
PH 1/2,5 H20	8	8,2	8		8,3	8,4	8,4	
CALCIUM CARBONATE %	5,7	5,5	9,3		7,3	7,7	7,6	
ORGANIC MATTER %	1,35	0,47			3,5			
ORGANIC CARBON %	0,78	0,27			2			
TOTAL NITROGEN 0/00	0,79	0,36			1,9			
DIL. ACID P PPM								
DIL. ACID P205 0/00					0,03	0,01		0,03
TOTAL P205 0/00								
EXCH. CA MEQ/100 G.	7	3,6	8,9		30,9	20,6		
EXCH. MG MEQ/100 G.	1,2	1,06	1		4,5	10,6		
EXCH. K MEQ/100 G.	1,15	0,58	1,04		1,72	0,69		
EXCH. NA MEQ/100 G.	0,66	0,27	0,83		0,11	1,21		
EXCH. CAP.MEQ/100 G	8,9	5,4	9,8		34,8	33,9		
1/5 EC MMHOS 25C					0,2	0,2		
MOIST. 1/3 ATM. %	11,9	8,5	19		38,4	39,1	40,3	
MOIST. 15 ATM. %	6	4,7	9,1		21,3	23,1	22,7	

297 PROFILE 0009

USTIFLUVENT

*FLAT VALLEY , CLAY , ALLUVIAL DEPOSIT *HERBACEOUS AND HIGH AND LOW WOODY VEGETATION *WOOD PRODUCTION PASTURE LAND OR RANGELAND SHEET EROSION *SLIGHTLY PERMEABLE SOIL

0/ 20 *FRESH *COLOUR : 7,5 YR 4/4 *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : CLAY LOAM *STRUCTURE IN PEDS , SUBANGULAR BLOCKY , THIN SIZE *COHERENT , VERY FRIABLE

20/ 60 *MOIST *COLOUR : 7,5 YR 4/4 *NO COARSE ELEMENTS *TEXTURE : CLAY *STRUCTURE IN PEDS , SUBANGULAR BLOCKY , MEDIUM SIZE *COHERENT , FRIABLE

60/100 *MOIST *COLOUR : 7,5 YR 4/6 *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE *COHERENT

297 PROFILE 0010

ARGIUSTOLL

*TABLE-LAND , 01% GRADIENT , SILT , CLAY , CALCAREOUS , COLLUVIAL DEPOSIT *FOOD CROPS , RECENT USE , CURRENTLY EXTENSIVE , WITHOUT DEFINED ROTATION , CHANGES IN THE RELIEF BY BENCHES *PLOUGHING *HARNESSED CULTIVATION *MECHANIZED CULTIVATION *PERMEABLE SOIL

0/ 20 *COLOUR : 10 YR 4/4 *ORGANIC DEBRIS *COMMON EFFERVESCENCE , GENERALISED , FINE ELEMENTS *CARBONATES IN FRIABLE NODULES *NO COARSE ELEMENTS *TEXTURE : SANDY CLAY LOAM *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , EVERYWHERE , SUBANGULAR BLOCKY *VERY POROUS *COHERENT , FRIABLE *COMMON ROOTS *SMOOTH TRANSITION

20/ 50 *COLOUR : 7,5 YR 4/4 *COMMON EFFERVESCENCE , GENERALISED , FINE ELEMENTS *CARBONATES IN FRIABLE NODULES *NO COARSE ELEMENTS *TEXTURE : SANDY CLAY *STRUCTURE IN PEDS , WEAK GRADE OF DEVELOPEMENT , EVERYWHERE , SUBANGULAR BLOCKY *POROUS *COHERENT , FRIABLE *COMMON ROOTS *SMOOTH TRANSITION

50/100 *COLOUR : 5 YR 4/4 *COMMON EFFERVESCENCE , GENERALISED , FINE ELEMENTS *CARBONATES IN FRIABLE NODULES *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE , EVERYWHERE *POROUS *COHERENT , SLIGHTLY FRIABLE *FEW ROOTS

PROFILE	297 0009			297 0010		
HORIZON	0/ 20	20/ 60	60/100	0/ 20	20/ 50	50/100
CLAY 0/2 MCR, % F.E	40	50	48	33	37	40
FINE SILT 2/2u	31	32	34	14	12	15
COARSE SILT 20/50	5	3	4	2	2	2
FINE SAND 50/200	16	7	8	12	10	9
COAR. SAND 200/200	8	8	6	39	39	34
>2 MM % SOIL	0	0	0	0	0	0
PH 1/2,5 H20	8,3	8,4	7,9	8,5	8,6	8,5
CALCIUM CARBONATE %						
ORGANIC MATTER %	2,2			1,39		
ORGANIC CARBON %	1,28			0,81		
TOTAL NITROGEN 0/00	1,08			0,76		
OIL. ACID P PPM						
OIL. ACID P205 0/00				0,04	0,01	0,01
TOTAL P205 0/00						
EXCH. CA MEQ/100 G.				15,8	13	11,1
EXCH. MG MEQ/100 G.				2,5	3,6	5,8
EXCH. K MEQ/100 G.				0,46	0,35	0,29
EXCH. NA MEQ/100 G.				0,07	0,02	0,07
EXCH. CAP.MEQ/100 G				18,4	17	17,3
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %				24,4	21,9	24,7
MOIST. 15 ATM. %				11,3	12,7	12,5

297 PROFILE 0011

ARGIUSTOLL Soil Series N° 11

*TABLE-LAND , GRADIENT LESS THAN 1 % , CLAY , CALCAREOUS , COLLUVIAL DEPOSIT , UNDER CULTIVATION *FOOD CROPS , VERY RECENT USE , NO IRRIGATION , CHANGES IN THE RELIEF BY BENCHES *PLOUGHING *MECHANIZED CULTIVATION *SLIGHTLY PERMEABLE SOIL

0/ 20 *FRESH *COLOUR : 7,5 YR 4/4 *WITHOUT MOTTLES *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : CLAY STRUCTURE IN PEDS , SUBANGULAR BLOCKY , THIN SIZE *COHERENT , FRIABLE *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

20/ 40 *FRESH *COLOUR : 5 YR 3/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *STRUCTURE IN PEDS , SUBANGULAR BLOCKY , MEDIUM SIZE *COHERENT , FRIABLE *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

40/ 80 *FRESH *COLOUR : 5 YR 3/3 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE *COHERENT

297 PROFILE 0012

TORRIPSAMMENT Soil Series N° 7

*ALLUVIAL PLAIN , 03% GRADIENT , SAND , SILT , ALLUVIAL DEPOSIT *HERBACEOUS VEGETATION *PASTURE LAND OR RANGELAND *SHEET EROSION *VERY PERMEABLE SOIL

0/ 15 *DRY COLOUR : 7,5 YR 5/6 *ORGANIC DEBRIS *SOME GRAVEL *TEXTURE : LOAMY SAND *SINGLE GRAIN STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS *QUICKSAND *COMMON ROOTS , VERY FINE *SMOOTH TRANSITION

15/ 60 *DRY COLOUR : 7,5 YR 5/6 *SOME GRAVEL *TEXTURE : LOAMY SAND *SINGLE GRAIN STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS *QUICKSAND *COMMON ROOTS , VERY FINE *SMOOTH TRANSITION

60/100 *DRY COLOUR : 7,5 YR 5/6 *SOME GRAVEL *TEXTURE : LOAMY SAND *MASSIVE STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY POROUS

PROFILE	297 0011			297 0012		
HORIZON	0/ 20	20/ 40	40/ 80	0/ 15	15/ 60	60/100
CLAY <2 MCR, % F.E	45	50	50	9	13	
FINE SILT 2/20	19	21	21	6	5	
COARSE SILT 20/50	3	2	2	4	3	
FINE SAND 50/200	8	5	5	22	17	
COAR. SAND 200/20	25	22	22	59	62	
>2 MM % SOIL	0	0	0	2	3	
PH 1/2,5 H2O	8,2	8,5	8,5	8,4	8,7	
CALCIUM CARBONATE %	19	20	20			
ORGANIC MATTER %	1,69			0,24		
ORGANIC CARBON %	1,1			0,14		
TOTAL NITROGEN 0/	1,05			0,19		
DIL. ACID P PPM						
DIL. ACID P2O5 0/	0,05	0,03	0,03			
TOTAL P2O5 0/00						
EXCH. CA MEQ/100 G.	21,2	19,3	15,3			
EXCH. MG MEQ/100 G.	3,6	5	6,3			
EXCH. K MEQ/100 G.	1,8	0,87	0,58			
EXCH. NA MEQ/100 G.	0,06	0,29	0,35			
EXCH. CAP.MEQ/100 G	22,4	23,3	24,2			
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %	30,4	30,6	33,1			
MOIST. 15 ATM. %	15,4	16,9	17,7			

297 PROFILE 0013

Soil Series No 1

SALORTHID

•ALLUVIAL PLAIN , GRADIENT LESS THAN 1 % , CLAY , ALLUVIAL DEPOSIT •FLOODING •TEMPORARY FLOODING BY STREAM , UNDER CULTIVATION •TREE CROPS , VERY RECENT USE •SLIGHTLY PERMEABLE SOIL •SCALY SURFACE

0/ 20 •DRY •COLOUR : 7,5 YR 6/4 •ORGANIC DEBRIS •NO COARSE ELEMENTS •TEXTURE : CLAY •STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , THIN SIZE •VERY SLIGHTLY POROUS •COHERENT •COMMON ROOTS , FINE AND MEDIUM •SMOOTH TRANSITION

20/ 60 •FRESH •COLOUR : 7,5 YR 3/4 •NO COARSE ELEMENTS •TEXTURE : CLAY •MASSIVE STRUCTURE , MODERATE GRADE OF DEVELOPEMENT •VERY SLIGHTLY POROUS •COHERENT •COMMON ROOTS , FINE AND MEDIUM •SMOOTH TRANSITION

60/100 •MOIST •COLOUR : 7,5 YR 3/4 •NO COARSE ELEMENTS •TEXTURE : SAND •MASSIVE STRUCTURE , MODERATE GRADE OF DEVELOPEMENT •VERY POROUS •COHERENT

297 PROFILE 0014

Soil Series No 7

TORRIPSAMMENT

•AEOLIAN DRESSING •ALLUVIAL PLAIN , GRADIENT LESS THAN 1 % , SAND , ALLUVIAL DEPOSIT •HIGH AND LOW WOODY VEGETATION PASTURE LAND OR RANGELAND •WIND EROSION VERY PERMEABLE SOIL

0/ 20 •FRESH •COLOUR : 5 YR 5/6 •NO COARSE ELEMENTS •TEXTURE : SAND •SINGLE GRAIN STRUCTURE •QUICKSAND •COMMON ROOTS , FINE AND MEDIUM

20/ 50 •FRESH •COLOUR : 7,5 YR 4/4 •NO COARSE ELEMENTS •TEXTURE : SAND •SINGLE GRAIN STRUCTURE •MASSIVE STRUCTURE QUICKSAND •COMMON ROOTS , FINE AND MEDIUM

50/100 •DRY COLOUR : 7,5 YR 4/4 •NO COARSE ELEMENTS TEXTURE : SAND •MASSIVE STRUCTURE

PROFILE	297 0013			297 0014		
HORIZON	0/ 20	20/ 60	60/100	0/ 20	20/ 50	50/100
CLAY <2 MCR, % F.E	64	55				
FINE SILT 2/20	31	30				
COARSE SILT 20/50	3	5				
FINE SAND 50/200	1	2				
COAR. SAND 200/2000	1	8				
>2 MM % SOIL	0	0		0	3	
PH 1/2,5 H2O	7,9	8,4		9,5	9,9	
CALCIUM CARBONATE %						
ORGANIC MATTER %						
ORGANIC CARBON %						
TOTAL NITROGEN 0/00						
DIL. ACID P PPM,						
DIL. ACID P2O5 0/00						
TOTAL P2O5 0/00						
EXCH. CA MEQ/100 G.						
EXCH. MG MEQ/100 G.						
EXCH. K MEQ/100 G.						
EXCH. NA MEQ/100 G.						
EXCH. CAP.MEQ/100 G						
1/5 EC MMHOS 25C	12,3	6,23		0,44	0,67	
MOIST. 1/3 ATM. %						
MOIST. 15 ATM. %						

297 PROFILE 0015

TORRIPSAMMENT Soil Series N° 7

*ALLUVIAL PLAIN , GRADIENT LESS THAN 1 % , SAND , ALLUVIAL DEPOSIT , UNDER CULTIVATION *TREE CROPS , VERY RECENT USE , SYSTEMATIC IRRIGATION , GRAVITY IRRIGATION , CHANGES IN THE RELIEF *VERY PERMEABLE SOIL

0/100 *DRY COLOUR : 7,5 YR 4/4 *TEXTURE : SAND *SINGLE GRAIN STRUCTURE *QUICKSAND *COMMON ROOTS

297 PROFILE 0016

SALORTHID Soil Series N° 1

*ALLUVIAL PLAIN *SERKHA , GRADIENT LESS THAN 1 % , SILT , CLAY , ALLUVIAL DEPOSIT *BARE SOIL *ALMOST IMPERMEABLE SOIL *POWDERY SURFACE

0/ 30 *FRESH *COLOUR : 7,5 YR 4/4 *NO COARSE ELEMENTS *TEXTURE : SILT LOAM *MASSIVE STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *POROUS , FRIABLE *SMOOTH TRANSITION

30/ 70 *FRESH *COLOUR : 7,5 YR 4/4 , FINE ELEMENTS *GYPSUM *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *NON POROUS , SLIGHTLY PLASTIC , STICKLY *SMOOTH TRANSITION

70/100 *MOIST *COLOUR : 7,5 YR 4/6 , FINE ELEMENTS *GYPSUM *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *NON POROUS , PLASTIC , STICKLY

PROFILE	297 0015	297 0016		
HORIZON	0/100	0/ 30	30/ 70	70/100
CLAY <2 MCR, % F.S		20	60	58
FINE SILT 2/20		71	30	20
COARSE SILT 20/50		2	1	5
FINE SAND 50/200		3	6	5
COAR. SAND 200/200		4	3	12
>2 MM % SOIL		0	0	0
PH 1/2,5 H2O		7,6	7,8	7,9
CALCIUM CARBONATE %				
ORGANIC MATTER %				
ORGANIC CARBON %				
TOTAL NITROGEN 0/0				
DIL. ACID P PPM				
DIL. ACID P2O5 0/00				
TOTAL P2O5 0/00				
EXCH. CA MEQ/100 G.				
EXCH. MG MEQ/100 G.				
EXCH. K MEQ/100 G.				
EXCH. NA MEQ/100 G.				
EXCH. CAR.MEQ/100 G				
1/5 EC MMHOS 25C		25,9	18	21,9
MOIST. 1/3 ATM. %				
MOIST. 15 ATM. %				

297 PROFILE 0017

TORRIPSAMMENT Sol dunes N° 7

*UNDULATING LANDSCAPE *AEOLIAN DRESSING *ALLUVIAL PLAIN , GRADIENT LESS THAN 1 % , SAND , CALCAREOUS , ALLUVIAL DEPOSIT *HERBACEOUS VEGETATION , WITHOUT CULTIVATION *PASTURE LAND OR RANGELAND *VERY PERMEABLE SOIL

0/ 30 *DRY *COLOUR : 10 YR 4/4 *COMMON EFFERVESCENCE , GENERALISED *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND *TEXTURE : SAND WITH FINE SAND , CALCAREOUS LIMESTONE *SINGLE GRAIN STRUCTURE , EVERYWHERE *VERY POROUS *COMMON ROOTS *SMOOTH TRANSITION

30/ 80 *DRY COLOUR : 10 YR 3/1 *COMMON EFFERVESCENCE , GENERALISED *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH FINE SAND , CALCAREOUS LIMESTONE *SINGLE GRAIN STRUCTURE , EVERYWHERE *VERY POROUS *COMMON ROOTS *SMOOTH TRANSITION

80/ + *FRESH *COLOUR : 10 YR 6/5 *COMMON EFFERVESCENCE , GENERALISED *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH FINE SAND , CALCAREOUS LIMESTONE *SINGLE GRAIN STRUCTURE , EVERYWHERE *VERY POROUS *COMMON ROOTS

297 PROFILE 0018

TORRIPSAMMENT Sol dunes N° 7

*UNDULATING LANDSCAPE *AEOLIAN DRESSING *ALLUVIAL PLAIN , GRADIENT LESS THAN 1 % , SAND , CALCAREOUS , ALLUVIAL DEPOSIT *HERBACEOUS AND LOW WOODY VEGETATION , WITHOUT CULTIVATION *PASTURE LAND OR RANGELAND *WIND EROSION *PERMEABLE SOIL

0/30 *DRY *COLOUR : 5 YR 6/6 *ORGANIC RESIDUES *COMMON EFFERVESCENCE *TEXTURE : LOAMY SAND WITH COARSE SAND , CALCAREOUS LIMESTONE *SINGLE GRAIN STRUCTURE *VERY POROUS *QUICKSAND *COMMON ROOTS , FINE *SMOOTH TRANSITION

30/70 *DRY COLOUR : 7,5 YR 5/6 *COMMON EFFERVESCENCE *TEXTURE : SANDY LOAM WITH COARSE SAND , CALCAREOUS LIMESTONE *SINGLE GRAIN STRUCTURE *VERY POROUS *QUICKSAND *COMMON ROOTS , FINE *SMOOTH TRANSITION

70/100 *DRY *COLOUR : 7,5 YR 5/6 *COMMON EFFERVESCENCE *TEXTURE : SANDY LOAM WITH COARSE SAND , CALCAREOUS LIMESTONE *SINGLE GRAIN STRUCTURE *VERY POROUS *QUICKSAND *COMMON ROOTS , FINE

PROFILE	297 0017			297 0018		
HORIZON	0/ 30	30/ 80	80/	0/ 30	30/ 70	70/100
CLAY 0/2 MCR, % F.E				9	14	16
FINE SILT 2/20				5	6	9
COARSE SILT 20/50				3	4	4
FINE SAND 50/200				29	24	21
COAR. SAND 200/2000				54	52	50
>2 MM % SOIL	0	0	0	4	4	2
PH 1/2,5 H2O	8,7	8,8	8,9	8,5	9,3	9,5
CALCIUM CARBONATE %						
ORGANIC MATTER %	0,16			0,28		
ORGANIC CARBON %	0,09			0,16		
TOTAL NITROGEN %	0,16			0,15		
OIL. ACID P PPM						
OIL. ACID P2O5 %						
TOTAL P2O5 %						
EXCH. CA MEQ/100 G.						
EXCH. MG MEQ/100 G.						
EXCH. K MEQ/100 G.						
EXCH. NA MEQ/100 G.						
EXCH. CAP. MEQ/100 G						
1/5 EC MMHOS 25C	0,59	0,19	0,14			
MOIST. 1/3 ATM. %	6,7	13,1	10,1			
MOIST. 15 ATM. %	3,3	4,6	4,4			

297 PROFILE 0019

Soil Series No 7

TORRIPSAMMENT

•UNDULATING LANDSCAPE •AEOLIAN DRESSING •ALLUVIAL PLAIN , GRADIENT LESS THAN 1 % , SAND , ALLUVIAL DEPOSIT HERBACEOUS VEGETATION •COVERING 10 % •PASTURE LAND OR RANGELAND •WIND EROSION •VERY PERMEABLE SOIL •UNDULATIONS

0/ 30 •DRY •COLOUR : 10 YR 1/3 •ORGANIC RESIDUES •COMMON EFFERVESCENCE •TEXTURE : SAND WITH COARSE SAND , CALCAREOUS LIMESTONE •SINGLE GRAIN STRUCTURE , EVERYWHERE •VERY POROUS •QUICKSAND •FEW ROOTS •SMOOTH TRANSITION

30/ 60 •DRY •COLOUR : 10 YR 6/4 •COMMON EFFERVESCENCE •TEXTURE : LOAMY SAND WITH COARSE SAND , CALCARECUS LIMESTONE •SINGLE GRAIN STRUCTURE , EVERYWHERE •VERY POROUS •QUICKSAND •FEW ROOTS •SMOOTH TRANSITION

60/100 •DRY •COLOUR : 10 YR 6/4 •COMMON EFFERVESCENCE •TEXTURE : LOAMY SAND WITH COARSE SAND , CALCARECUS LIMESTONE •SINGLE GRAIN STRUCTURE , EVERYWHERE •VERY POROUS •QUICKSAND •FEW ROOTS

297 PROFILE 0020

Soil Series No 9

TORRIORTHENT

•GLACIS , COLLUVIAL DEPOSIT •LOW WOODY VEGETATION •PASTURE LAND OR RANGELAND •SHEET EROSION •RILL EROSION •VERY PERMEABLE SOIL •NUMEROUS STONES

0/ 20 •DRY •WATER LEVEL AT 95 M •SOME STONES •TEXTURE : SAND

PROFILE	297 0019			297 0020
HORIZON	0/ 30	30/ 60	60/100	0/ 20
CLAY <2 MCR, % F.E	4	9	9	
FINE SILT 2/20	1	4	4	
COARSE SILT 20/50	2	3	3	
FINE SAND 50/200	50	45	44	
COAR. SAND 200/2000	43	39	40	
>2 MM % SOIL	0	0	0	
PH 1/2,5 H2O	9,1	8,8	8,8	
CALCIUM CARBONATE %	3,4	6,5	2,6	
ORGANIC MATTER %	0,14			
ORGANIC CARBON %	0,08			
TOTAL NITROGEN 0/00	0,1			
DIL. ACID P PPM				
DIL. ACID P2O5 0/00				
TOTAL P2O5 0/00				
EXCH. CA MEQ/100 G.				
EXCH. MG MEQ/100 G.				
EXCH. K MEQ/100 G.				
EXCH. NA MEQ/100 G.				
EXCH. CAP.MEQ/100 G.				
1/5 EC MMHOS 25C				
MOIST. 1/3 ATM. %				
MOIST. 15 ATM. %				

297 PROFILE 0021

ARGIUSTOLL Sol Deros Nº 11

*TABLE-LAND , 01% GRADIENT , CLAY , CALCAREOUS , ALLUVIAL DEPOSIT , UNDER CULTIVATION *FOOD CROPS , FORMER USE , CURRENTLY EXTENSIVE *SINGLE CROP , NO CHANGES IN THE RELIEF *PLOUGHING *HARNESSED CULTIVATION MECHANIZED CULTIVATION , NO AMENDMENT *PERMEABLE SOIL

0/ 20 *FRESH *COLOUR : 10 YR 3/4 *ORGANIC RESIDUES *COMMON EFFERVESCENCE *NO COARSE ELEMENTS *TEXTURE : SANDY CLAY *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY *POROUS *COHERENT , FRIABLE *COMMON ROOTS , VERY FINE *SMOOTH TRANSITION

20/ 60 *MOIST *COLOUR : 7,5 YR 4/4 *COMMON EFFERVESCENCE *NO COARSE ELEMENTS *TEXTURE : CLAY *STRUCTURE IN PEDS , WEAK GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY *POROUS *COHERENT , FRIABLE *COMMON ROOTS , FINE *SMOOTH TRANSITION

60/100 *MOIST *COLOUR : 5 YR 3/4 *COMMON EFFERVESCENCE *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE SLIGHTLY POROUS *COHERENT , SLIGHTLY FRIABLE *FEW ROOTS

297 PROFILE 0022

USTIFLUVENT Sol Deros Nº 4

*FLAT VALLEY *TERRACE , 03% GRADIENT , SILT , ALLUVIAL DEPOSIT *FLOODING *TEMPORARY FLOODING , UNDER CULTIVATION *FOOD CROPS , VERY RECENT USE , WITHOUT DEFINED ROTATION , SUPPLEMENTARY IRRIGATION , FLOOD IRRIGATION , CHANGES IN THE RELIEF BY RIDGING BY BENCHES *GULLY EROSION *PERMEABLE SOIL

0/ 20 *MOIST *COLOUR : 10 YR 3/3 *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND WITH FINE SAND *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , THIN SIZE *POROUS *COHERENT , VERY FRIABLE *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

20/ 50 *MOIST *COLOUR : 10 YR 3/4 , FINE ELEMENTS *CARBONATES IN PSEUDOMYCELIUMS *NO COARSE ELEMENTS *TEXTURE : SANDY CLAY LOAM WITH FINE SAND *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , MEDIUM SIZE *POROUS *COHERENT , FRIABLE *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

50/100 *FRESH *COLOUR : 10 YR 3/4 , FINE ELEMENTS *CARBONATES IN PSEUDOMYCELIUMS *NO COARSE ELEMENTS *TEXTURE : SANDY CLAY LOAM WITH FINE SAND *MASSIVE STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *POROUS *COHERENT , SLIGHTLY FRAGILE

PROFILE	297 0021			297 0022		
HORIZON	0/ 20	20/ 60	60/100	0/ 20	20/ 50	50/100
CLAY 0/2 MCR, % F.E	39	40	46	17	20	24
FINE SILT 2/20	16	17	18	10	11	13
COARSE SILT 20/50	3	4	2	11	9	9
FINE SAND 50/200	11	9	8	46	33	31
COAR. SAND 200/20	31	30	26	16	27	23
>2 MM % SOIL	0	0	0	0	0	8
PH 1/2,5 H2O	8,2	8,6	8,3	8,2	8,4	8,4
CALCIUM CARBONATE %	14	17	19	6,5	7,4	11
ORGANIC MATTER %	1,46			1,78		
ORGANIC CARBON %	0,85			1,03		
TOTAL NITROGEN 0/0	0,79			1,02		
DIL. ACID P PPM						
DIL. ACID P2O5 0/00	0,06	0,03	0,02	0,07	0,05	0,06
TOTAL P2O5 0/00						
EXCH. CA MEQ/100 G.	16,6	20,2	17,5	10,6	10,6	10,6
EXCH. MG MEQ/100 G.	2,2	2,5	4,7	1,5	1,9	2,1
EXCH. K MEQ/100 G.	1,16	0,52	0,5	0,75	0,53	0,34
EXCH. NA MEQ/100 G.	0,18	0,1	0,59	0,03	0,1	0,07
EXCH. CAR.MEQ/100 G	19,3	21,2	21,8	13,4	12,2	13,9
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %	27,7	28,2	30,7	19,5	22,7	23
MOIST. 15 ATM. %	13,4	14,9	17	8,7	9,7	10,3

297 PROFILE 0023

USTORTHENT Sol Series N° 10

*HUMMOCKY LANDSCAPE , QUARTZITE *LOW WOODY VEGETATION *COVERING 20 % *PASTURE LAND OR RANGELAND *SHEET EROSION *GULLY EROSION *DEFLATION PAVING

0/ 10 *DRY *VERY MANY STONES (QUARTZITE)

297 PROFILE 0024

USTIFLUVENT Sol Series N° 4

*TERRACE , SAND , SILT , ALLUVIAL DEPOSIT , UNDER CULTIVATION *TREE CROPS *HORTICULTURE , RECENT USE , SUPPLEMENTARY IRRIGATION , GRAVITY IRRIGATION , FLOOD IRRIGATION , DRIP IRRIGATION , CHANGES IN THE RELIEF *HAND CULTIVATION *PERMEABLE SOIL

0/ 30 *FRESH *COLOUR : 7,5 YR 6/4 *TEXTURE : SANDY LOAM *TEXTURE : SAND *COHERENT *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

30/ 70 *FRESH *COLOUR : 7,5 YR 5/4 *TEXTURE : SANDY CLAY LOAM *TEXTURE : SAND *COHERENT *COMMON ROOTS , FINE AND MEDIUM SMOOTH TRANSITION

70/100 *FRESH *COLOUR : 7,5 YR 5/4 *TEXTURE : SANDY CLAY LOAM *TEXTURE : SAND *COHERENT *COMMON ROOTS , FINE AND MEDIUM

PROFILE	297 0023	297 0024		
HORIZON	0/ 10	0/ 30	30/ 70	70/100
CLAY <2 MCR, % F.E		19	21	22
FINE SILT 2/20		13	10	12
COARSE SILT 20/50		4	3	4
FINE SAND 50/200		13	13	11
COAR. SAND 200/2000		51	53	51
>2 MM % SOIL				
PH 1/2,5 H2O		8	8,2	8,5
CALCIUM CARBONATE %				
ORGANIC MATTER %		1,14		
ORGANIC CARBON %		0,66		
TOTAL NITROGEN 0/00		0,57		
DIL. ACID P PPM				
DIL. ACID P2O5 0/00				
TOTAL P2O5 0/00				
EXCH. CA MEQ/100 G.		8,8	10,2	10,1
EXCH. MG MEQ/100 G.		1,04	1,39	1,57
EXCH. K MEQ/100 G.		1,09	1,04	0,99
EXCH. NA MEQ/100 G.		1,08	0,65	0,52
EXCH. CAP.MEQ/100 G		12,4	12,2	12,6
1/5 EC MMHOS 25C				
MOIST. 1/3 ATM. %		15,3	15,4	15,5
MOIST. 15 ATM. %		3,1	3,4	2,1

297 PROFILE 0025

USTHORTHENT Soil Serie N°10

*SLOPE , 03% GRADIENT , SAND , COLLUVIAL DEPOSIT , UNDER CULTIVATION *FOOD CROPS *PERMEABLE SOIL

0/ 30 *FRESH *COLOUR : 7,5 YR 3/2 *TEXTURE : SANDY LOAM *STRUCTURE IN PEDS , WEAK GRADE OF DEVELOPEMENT *VERY POROUS *COHERENT *COMMON ROOTS *SMOOTH TRANSITION

30/ 50 *FRESH *COLOUR : 10 YR 6/3 *WATER LEVEL AT 40 M *TEXTURE : SANDY LOAM WITH COARSE SAND , CALCAREOUS LIMESTONE *MASSIVE STRUCTURE *VERY POROUS *COHERENT *COMMON ROOTS

50/ * *WATER LEVEL AT 80 M

297 PROFILE 0026

USTIFLUVENT Soil Serie N° 6

*FLAT VALLEY *TERRACE , 03% GRADIENT , CLAY , ALLUVIAL DEPOSIT *CONTROLLED FLOODING *TEMPORARY FLOODING BY STREAM , UNDER CULTIVATION *FOOD CROPS *TREE CROPS , VERY RECENT USE , SUPPLEMENTARY IRRIGATION , GRAVITY IRRIGATION , FLOOD IRRIGATION , CHANGES IN THE RELIEF BY BENCHES *MIXED CULTIVATION *SLIGHTLY PERMEABLE SOIL *PERMEABLE SOIL *SCALY SURFACE

0/ 20 *MOIST *COLOUR : 10 YR 4/4 *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : SILTY CLAY LOAM *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , THIN SIZE *POROUS *COHERENT , FRIABLE *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

20/ 50 *FRESH *COLOUR : 10 YR 5/4 *NO COARSE ELEMENTS *TEXTURE : CLAY *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , MEDIUM SIZE *POROUS *COHERENT , FRIABLE *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

50/100 *DRY COLOUR : 10 YR 5/3 *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE , MODERATE GRADE OF DEVELOPEMENT *VERY SLIGHTLY POROUS *COHERENT , SLIGHTLY FRAGILE

PROFILE	297 0025			297 0026		
HORIZON	0/ 30	30/ 50	50/	0/ 20	20/ 50	50/100
CLAY 0/2 MCR, % F.E	18	18		36	43	41
FINE SILT 2/20	9	11		33	29	30
COARSE SILT 20/50	10	10		12	10	12
FINE SAND 50/200	41	32		13	12	11
COAR. SAND 200/2000	22	29		6	6	6
>2 MM % SOIL	3	43		0	0	0
PH 1/2,5 H20	8,6	8,3		8,5	8,3	8,3
CALCIUM CARBONATE %	7,1	14		15	15	15
ORGANIC MATTER %	2,17			2,5		
ORGANIC CARBON %	1,26			1,44		
TOTAL NITROGEN 0/	1,28			1,47		
DIL. ACID P PPM						
DIL. ACID P205 0/						
TOTAL P205 0/						
EXCH. CA MEQ/100 G.						
EXCH. MG MEQ/100 G.						
EXCH. K MEQ/100 G.						
EXCH. NA MEQ/100 G.						
EXCH. CAP.MEQ/100 G						
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %				36,9	39,4	36,7
MOIST. 15 ATM. %				17,7	16,7	16,9

297 PROFILE 0027

soil series N° 13

CHROMUSTERT

*TABLE-LAND , 02% GRADIENT , COLLUVIAL DEPOSIT *HERBACEOUS AND LOW WOODY VEGETATION , UNDER CULTIVATION *PASTURE LAND OR RANGELAND *FOOD CROPS , RECENT USE *SINGLE CROP , NO IRRIGATION *PLOUGHING HARNESSED CULTIVATION *MECHANIZED CULTIVATION *SLIGHTLY PERMEABLE SOIL

0/ 20 *DRY *COLOUR : 5 YR 4/3 *WITHOUT MOTTLES *ORGANIC DEBRIS *TEXTURE : CLAY *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , MEDIUM AND THIN SIZE *POROUS *COHERENT , FRIABLE *FREQUENT ROOTS , VERY FINE *SMOOTH TRANSITION

20/ 50 *DRY *COLOUR : 5 YR 3/2 *WITHOUT MOTTLES *TEXTURE : CLAY *STRUCTURE IN PEDS , WEAK GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY *POROUS *COHERENT , SLIGHTLY FRIABLE *FEW ROOTS *SMOOTH TRANSITION

50/100 *DRY *COLOUR : 5 YR 3/2 *WITHOUT MOTTLES *TEXTURE : CLAY *MASSIVE STRUCTURE *POROUS *COHERENT , SLIGHTLY FRIABLE *FEW ROOTS

297 PROFILE 0028

ARGIUSTOLL

*TABLE-LAND , 02% GRADIENT , REGULAR SLOPE , COLLUVIAL DEPOSIT , UNDER CULTIVATION *PASTURE LAND OR RANGELAND FOOD CROPS , VERY RECENT USE , NO IRRIGATION *PLOUGHING *MECHANIZED CULTIVATION *PERMEABLE SOIL

0/ 20 *DRY *COLOUR : 7,5 YR 4/4 *WITHOUT MOTTLES *ORGANIC RESIDUES *NO COARSE ELEMENTS *TEXTURE : SANDY LOAM *STRUCTURE IN PEDS , BLOCKY , VERY THIN SIZE *VERY POROUS *LIGHT , FRAGILE *COMMON ROOTS , FINE *SMOOTH TRANSITION

20/ 50 *FRESH *COLOUR : 7,5 YR 3/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : SANDY LOAM *STRUCTURE IN PEDS VERY POROUS *COHERENT , FRIABLE *SMOOTH TRANSITION

50/100 *FRESH *COLOUR : 7,5 YR 3/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY LOAM *MASSIVE STRUCTURE POROUS *COHERENT

PROFILE	297 0027			297 0028		
HORIZON	0/ 20	20/ 50	50/100	0/ 20	20/ 50	50/100
CLAY 0/2 MCR. % F.E	63	66	67			
FINE SILT 2/20	21	20	22			
COARSE SILT 20/50	4	4	3			
FINE SAND 50/200	8	6	5			
COAR. SAND 200/2000	4	4	3			
>2 MM % SOIL						
PH 1/2,5 H2O	8,2	8,8	9,3	8,5	8,7	8,6
CALCIUM CARBONATE %						
ORGANIC MATTER %	2,8			1,77		
ORGANIC CARBON %	1,62			1,03		
TOTAL NITROGEN 0/	1,39			0,98		
DIL. ACID P PPM	5	3				
DIL. ACID P2O5 0/00	0,01	0,01				
TOTAL P2O5 0/00	0,65	0,58				
EXCH. CA MEQ/100 G.	28,6	23,2	13,3			
EXCH. MG MEQ/100 G.	7,8	9,6	14,4			
EXCH. K MEQ/100 G.	0,94	0,81	0,76			
EXCH. NA MEQ/100 G.	0,55	3,29	5,7			
EXCH. CAP.MEQ/100 G	37,2	35,3	31,8			
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %	31	30,7		17,8	22,3	
MOIST. 15 ATM. %	12,9	13		6,5	8,5	

297 PROFILE 0029

Soil Series N° 12

ARGIUSTOLL

*TABLE-LAND , 02% GRADIENT , REGULAR SLOPE , CLAY , COLLUVIAL DEPOSIT *HIGH AND LOW WOODY VEGETATION *COVERING 6. % *WOOD PRODUCTION PASTURE LAND OR RANGELAND *WIND EROSION *POWDERY SURFACE

0/ 10 *DRY *COLOUR : 7,5 YR 5/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , MEDIUM AND THIN SIZE *POROUS *COHERENT *FEW ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

10/ 50 *DRY *COLOUR : 7,5 YR 5/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE *POROUS *COHERENT *FEW ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

50/100 *FRESH *COLOUR : 7,5 YR 4/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE *POROUS *COHERENT

297 PROFILE 0030

Soil Series N° 13

ARGIUSTOLL

*TABLE-LAND , 01% GRADIENT , REGULAR SLOPE , CLAY , COLLUVIAL DEPOSIT *HERBACEOUS AND HIGH AND LOW WOODY VEGETATION COVERING 40 % *WOOD PRODUCTION *SHEET EROSION *SLIGHTLY PERMEABLE SOIL

0/ 2[illegible] *DRY *COLOUR : 7,5 YR 4/6 *WITHOUT MOTTLES *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : CLAY *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY *POROUS *COHERENT *COMMON ROOTS , FINE *SMOOTH TRANSITION

20/ 60 *DRY COLOUR : 7,5 YR 4/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE *SLIGHTLY POROUS *VERY COHERENT *FEW ROOTS , COARSE *SMOOTH TRANSITION

60/100 *DRY COLOUR : 5 YR 4/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *MASSIVE STRUCTURE *SLIGHTLY POROUS *VERY COHERENT *FEW ROOTS , COARSE

PROFILE	297 0029			297 0030		
HORIZON	0/ 10	10/ 50	50/100	0/ 20	20/ 60	60/100
CLAY 0/2 MCR, % F.E	52	54	58	52	52	55
FINE SILT 2/20	21	24	22	22	21	22
COARSE SILT 20/50	3	1	1	1	2	2
FINE SAND 50/200	7	5	5	7	6	5
COAR. SAND 200/2000	17	16	14	18	19	16
>2 MM % SOIL						
PH 1/2,5 H2O	8,2	8,5	8,4	7,7	8,2	8,5
CALCIUM CARBONATE %						
ORGANIC MATTER %	2,6			2,6		
ORGANIC CARBON %	1,53			1,52		
TOTAL NITROGEN 0/00	1,41			1,21		
DIL. ACID P PPM	15	18		22	20	
DIL. ACID P2O5 0/00	0,03	0,04		0,05	0,05	
TOTAL P2O5 0/00	0,82	0,8		0,92	0,84	
EXCH. CA MEQ/100 G.	23,2	27,2		27,6	23,4	19,4
EXCH. MG MEQ/100 G.	4,2	7,1		5,5	8,2	12,1
EXCH. K MEQ/100 G.	0,95	0,72		2,8	2,7	1,74
EXCH. NA MEQ/100 G.	0,39	0,67		0,5	0,62	1,21
EXCH. CAP.MEQ/100 G	33	34		31,9	31,8	32,9
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %	26,8	27,8		27,5	30	29,5
MOIST. 15 ATM. %	11	13		11,6	14	14,5

297 PROFILE 0031

Soil Serie N° 1.

ARGIUSTOLL
*FLAT VALLEY , CLAY , ALLUVIAL DEPOSIT , UNDER CULTIVATION *FOOD CROPS , RECENT USE , CURRENTLY EXTENSIVE , NO IRRIGATION , CHANGES IN THE RELIEF BY BENCHES *HARNESSED CULTIVATION *MECHANIZED CULTIVATION *PERMEABLE SOIL

0/ 30 *DRY *COLOUR : 7,5 YR 5/4 *WITHOUT MOTTLES *COMMON EFFERVESCENCE *NO COARSE ELEMENTS *TEXTURE : CLAY STRUCTURE IN PEDS , SUBANGULAR BLOCKY , VERY THIN SIZE *POROUS *COHERENT *COMMON ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

30/ 60 *FRESH *COLOUR : 5 YR 4/6 *WITHOUT MOTTLES *COMMON EFFERVESCENCE *NO COARSE ELEMENTS *TEXTURE : SANDY CLAY LOAM *MASSIVE STRUCTURE *COHERENT *FEW ROOTS , FINE AND MEDIUM *SMOOTH TRANSITION

60/100 *FRESH *COLOUR : 5 YR 3/4 *COMMON EFFERVESCENCE IN FRIABLE NODULES *NO COARSE ELEMENTS *TEXTURE : CLAY MASSIVE STRUCTURE *COHERENT

297 PROFILE 0032

USTIFLUVENT
*TABLE-LAND , 02% GRADIENT , CLAY , ALLUVIAL DEPOSIT *HIGH AND LOW WOODY VEGETATION , WITHOUT CULTIVATION COVERING 10 % *WOOD PRODUCTION *PASTURE LAND OR RANGELAND *SHEET EROSION *PERMEABLE SOIL

0/ 20 *DRY *COLOUR : 7,5 YR 4/4 *WITHOUT MOTTLES *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : LOAM *STRUCTURE IN PEDS , MODERATE GRADE OF DEVELOPEMENT , SUBANGULAR BLOCKY , MEDIUM AND THIN SIZE *POROUS *COHERENT , FRAGILE *FEW ROOTS , FINE *SMOOTH TRANSITION

20/ 50 *DRY *COLOUR : 7,5 YR 4/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : CLAY *STRUCTURE IN PEDS *POROUS *COHERENT *FEW ROOTS , FINE *SMOOTH TRANSITION

50/100 *FRESH *COLOUR : 7,5 YR 5/4 *FEW STONES (LIMESTONE) *TEXTURE : CLAY *MASSIVE STRUCTURE *POROUS *COHERENT

PROFILE	297 0031			297 0032		
HORIZON	0/ 30	30/ 60	60/100	0/ 20	20/ 50	50/100
CLAY 0/2 MCR, % F.E	45	32	48			
FINE SILT 2/20	18	11	18			
COARSE SILT 20/50	2	1	1			
FINE SAND 50/200	9	12	6			
COAR. SAND 200/2000	26	44	27			
>2 MM % SOIL						
PH 1/2,5 H2O	8,2	8,4	8,3	8,3	8,5	8,5
CALCIUM CARBONATE %						
ORGANIC MATTER %	2,4			2,2		
ORGANIC CARBON %	1,38			1,27		
TOTAL NITROGEN 0/0	1,26			1,13		
DIL. ACID P PPM	29	26				
DIL. ACID P2O5 0/00	0,07	0,06				
TOTAL P2O5 0/00	0,82	0,56				
EXCH. CA MEQ/100 G.	25,6	19,3	26,7			
EXCH. MG MEQ/100 G.	3,3	2,3	4,8			
EXCH. K MEQ/100 G.	2,5	1,19	1,17			
EXCH. NA MEQ/100 G.	0,15	0,13	0,19			
EXCH. CAP.MEQ/100 G	28,4	19,6	32,1			
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %	26,1	20,2	26,4	29,6	31,6	
MOIST. 15 ATM. %	9,6	7	12,2	12,3	16,5	

297 PROFILE 0033

USTIFLUVENT Sols series N° 5

• TABLE-LAND , 04% GRADIENT , SAND , SILT , COLLUVIAL DEPOSIT , UNDER CULTIVATION • TREE CROPS , SUPPLEMENTARY IRRIGATION , CHANGES IN THE RELIEF BY BENCHES • PERMEABLE SOIL

0/ 30 • DRY COLOUR : 7,5 YR 4/4 • WITHOUT MOTTLES • ORGANIC DEBRIS • NO COARSE ELEMENTS • TEXTURE : SANDY CLAY LOAM WITH COARSE SAND • STRUCTURE IN PEDS • POROUS • COHERENT • FREQUENT ROOTS • SMOOTH TRANSITION

30/ 60 • FRESH • COLOUR : 7,5 YR 4/4 • WITHOUT MOTTLES , FINE ELEMENTS IN NODULES • NO COARSE ELEMENTS • TEXTURE : SANDY LOAM WITH COARSE SAND • MASSIVE STRUCTURE • POROUS • COHERENT • COMMON ROOTS • SMOOTH TRANSITION

60/100 • FRESH • COLOUR : 7,5 YR 4/4 • WITHOUT MOTTLES • NO COARSE ELEMENTS • TEXTURE : SANDY CLAY LOAM WITH COARSE SAND • MASSIVE STRUCTURE • POROUS • COHERENT • FEW ROOTS

297 PROFILE 0034

TORRIORTHENT Sols series N° 8

• TABLE-LAND , 02% GRADIENT , SAND , SILT , COLLUVIAL DEPOSIT • HIGH AND LOW WOODY VEGETATION , WITHOUT CULTIVATION • COVERING 4? % • WOOD PRODUCTION • PASTURE LAND OR RANGELAND • WIND EROSION • SHEET EROSION • VERY PERMEABLE SOIL

0/ 30 • DRY COLOUR : 5 YR 5/3 • WITHOUT MOTTLES • FEW GRAVEL (LIMESTONE) (QUARTZITE) • TEXTURE : LOAMY SAND WITH COARSE SAND • SINGLE GRAIN STRUCTURE • POROUS • QUICKSAND • FREQUENT ROOTS , FINE AND MEDIUM • SMOOTH TRANSITION

30/ 60 • DRY COLOUR : 7,5 YR 5/4 • WITHOUT MOTTLES , FINE ELEMENTS • CARBONATES IN NODULES • FEW GRAVEL (LIMESTONE) (QUARTZITE) • TEXTURE : LOAMY SAND WITH COARSE SAND • MASSIVE STRUCTURE • POROUS • COHERENT • FEW ROOTS , FINE AND MEDIUM • SMOOTH TRANSITION

60/100 • DRY COLOUR : 7,5 YR 6/4 • WITHOUT MOTTLES , FINE ELEMENTS • CARBONATES IN NODULES • FEW GRAVEL (LIMESTONE) (QUARTZITE) • TEXTURE : SANDY CLAY LOAM WITH COARSE SAND • MASSIVE STRUCTURE • POROUS • COHERENT • FEW ROOTS

PROFILE	297 0033			297 0034		
HORIZON	0/ 30	30/ 60	60/100	0/ 30	30/ 60	60/100
CLAY 0/2 MCR, % F.E	26	17	28			
FINE SILT 2/20	11	8	14			
COARSE SILT 20/50	1	1	2			
FINE SAND 50/200	14	16	12			
COAR. SAND 200/20	48	58	44			
>2 MM % SOIL						
PH 1/2,5 H20	8,4	8,4	8,6	8,5	7,8	7,9
CALCIUM CARBONATE %						
ORGANIC MATTER %	0,99			1,31		
ORGANIC CARBON %	0,58			0,76		
TOTAL NITROGEN 0/00	0,52			0,7		
DIL. ACID P PPM						
DIL. ACID P205 0/00						
TOTAL P205 0/00						
EXCH. CA MEQ/100 G.	12,2	10,6	12,6			
EXCH. MG MEQ/100 G.	2,8	1,52	4,4			
EXCH. K MEQ/100 G.	0,45	0,63	0,33			
EXCH. NA MEQ/100 G.	0,13	0,11	0,14			
EXCH. CAP.MEQ/100 G	13,7	10,9	14,6			
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %	19,1	14		9,9	13,6	
MOIST. 15 ATM. %	7,3	5,4		4	5,1	

297 PROFILE 0035

Soil desc No 5

USTIFLUVENT

•PLAIN , 2% GRADIENT , SAND , SILT , ALLUVIAL DEPOSIT •HIGH AND LOW WOODY VEGETATION , WITHOUT CULTIVATION COVERING 30 % WOOD PRODUCTION •PASTURE LAND OR RANGELAND •PERMEABLE SOIL •SPLASH SURFACE

0/ 20 •DRY COLOUR : 7,5 YR 5/4 •WITHOUT MOTTLES ORGANIC DEBRIS •NO COARSE ELEMENTS •TEXTURE : SANDY CLAY LOAM STRUCTURE IN PEDS , WEAK GRADE OF DEVELOPEMENT , IN SPOTS , SUBANGULAR BLOCKY •POROUS •COHERENT COMMON ROOTS , MEDIUM •SMOOTH TRANSITION

20/ 60 •DRY COLOUR : 7,5 YR 5/4 •WITHOUT MOTTLES •NO COARSE ELEMENTS •TEXTURE : SANDY CLAY LOAM MASSIVE STRUCTURE , EVERYWHERE POROUS •COHERENT •COMMON ROOTS , FINE •SMOOTH TRANSITION

60/100 •DRY COLOUR : 7,5 YR 5/4 •WITHOUT MOTTLES NO COARSE ELEMENTS TEXTURE : SANDY CLAY LOAM •MASSIVE STRUCTURE , EVERYWHERE •POROUS COHERENT •FEW ROOTS , COARSE

297 PROFILE 0036

Soil desc No 6

USTIFLUVENT

•PLAIN , 03% GRADIENT , CLAY , COLLUVIAL DEPOSIT •HERBACEOUS VEGETATION •PASTURE LAND OR RANGELAND SHEET EROSION •CRACKS

0/ 20 •DRY COLOUR : 5 YR 4/4 •WITHOUT MOTTLES •ORGANIC DEBRIS •NO COARSE ELEMENTS •TEXTURE : CLAY •STRUCTURE IN PEDS , SUBANGULAR BLOCKY , MEDIUM SIZE •POROUS •COHERENT , FRAGILE •COMMON ROOTS , MEDIUM •SMOOTH TRANSITION

20/ 50 •DRY •COLOUR : 5 YR 4/6 •WITHOUT MOTTLES •NO COARSE ELEMENTS •TEXTURE : CLAY •MASSIVE STRUCTURE •SLIGHTLY POROUS •COHERENT •FEW ROOTS •SMOOTH TRANSITION

50/100 •FRESH •COLOUR : 5 YR 4/6 •WITHOUT MOTTLES •NO COARSE ELEMENTS •TEXTURE : CLAY •MASSIVE STRUCTURE •SLIGHTLY POROUS •COHERENT •FEW ROOTS

PROFILE	297 0035			297 0036		
HORIZON	0/ 20	20/ 60	60/100	0/ 20	20/ 50	50/100
CLAY D/2 MCR, % F.E	23	25	32	44	48	59
FINE SILT 2/20	14	15	15	23	28	27
COARSE SILT 20/50	2	3	3	3	2	2
FINE SAND 50/200	15	13	13	8	6	5
COAR. SAND 200/2000	46	44	37	22	16	16
>2 MM % SOIL						
PH 1/2,5 H2O	8,5	8,2	8,1	8,3	8,3	8,5
CALCIUM CARBONATE %						
ORGANIC MATTER %	0,74			1,35		
ORGANIC CARBON %	0,43			0,79		
TOTAL NITROGEN 0/00	0,43			0,72		
DIL. ACID P PPM						
DIL. ACID P205 0/00						
TOTAL P205 0/00						
EXCH. CA MEQ/100 G.						
EXCH. MG MEQ/100 G.						
EXCH. K MEQ/100 G.						
EXCH. NA MEQ/100 G.						
EXCH. CAP.MEQ/100 G						
1/5 EC MMHOS 25C						
MOIST. 1/3 ATM. %	14,4	16,6	18,4	25,3	27,3	
MOIST. 15 ATM. %	6,2	7	7,5	13	14,8	

297 PROFILE 0037

Ustorthent ~~USTIPSAMMENT~~ Soil Series No 10

•UNDULATING LANDSCAPE •BUMPY LANDSCAPE •SLOPE , PEBBLE , SAND , COLLUVIAL DEPOSIT •LOW WOODY VEGETATION COVERING 20 % •PASTURE LAND OR RANGELAND •SHEET EROSION •RILL EROSION •GULLY EROSION OF HIGH INTENSITY

0/150 •DRY •VERY MUCH GRAVEL •MANY STONES (QUARTZITE) (GRANITE) •TEXTURE : LOAMY SAND •TEXTURE : SAND

297 PROFILE 0038

TORRIORTHENT Soil Serie 9-E7

•PLAIN , PEBBLE , SAND , COLLUVIAL DEPOSIT •BARE SOIL SHEET EROSION •GULLY EROSION OF HIGH INTENSITY

0/10 •VERY MUCH GRAVEL •SOME STONES •TEXTURE : SAND

PROFILE	297 0037	297 0038
HORIZON	0/150 *	0/100 *
CLAY 1/2 MCR, % F.S		
FINE SILT 2/20		
COARSE SILT 20/50		
FINE SAND 50/200		
COAR. SAND 200/2000		
>2 MM % SOIL		
PH 1/2.5 H2O		
CALCIUM CARBONATE %		
ORGANIC MATTER %		
ORGANIC CARBON %		
TOTAL NITROGEN 0/00		
DIL. ACID P PPM		
DIL. ACID P2O5 0/00		
TOTAL P2O5 0/00		
EXCH. CA MEQ/100 G.		
EXCH. MG MEQ/100 G.		
EXCH. K MEQ/100 G.		
EXCH. NA MEQ/100 G.		
EXCH. CAP.MEQ/100 G		
1/5 EC MMHOS 25C		
MOIST. 1/3 ATM. %		
MOIST. 15 ATM. %		

297 PROFILE 0039 Sol Sous N° 7

TORRIPSAMMENT
•PLAIN AEOLIAN DRESSING , SAND , ALLUVIAL DEPOSIT •LOW WOODY VEGETATION •VERY SPARSE VEGETATION , WITHOUT CULTIVATION •WIND EROSION •VERY PERMEABLE SOIL

0/10 •DRY •COLOUR : 10 YR 5/4 •COMMON EFFERVESCENCE •SOME GRAVEL •SOME STONES •TEXTURE : SAND •SINGLE GRAIN STRUCTURE •VERY POROUS

297 PROFILE 0040

Sol Sous N° 8

TORRIORTHENT
•TABLE-LAND AEOLIAN DRESSING , 03% GRADIENT , COLLUVIAL DEPOSIT •LOW WOODY VEGETATION •HERBACEOUS VEGETATION , WITHOUT CULTIVATION •COVERING 50 % •PASTURE LAND OR RANGELAND •WIND EROSION •SHEET EROSION •PERMEABLE SOIL

0/ 2 •DRY •COLOUR : 7,5 YR 5/6 •WITHOUT MOTTLES •NO COARSE ELEMENTS •TEXTURE : SANDY LOAM WITH COARSE SAND SINGLE GRAIN STRUCTURE •STRUCTURE IN PEDS , WEAK GRADE OF DEVELOPEMENT •SLIGHTLY COHERENT , FRAGILE •COMMON ROOTS , FINE AND MEDIUM •SMOOTH TRANSITION

2 /1 •DRY •COLOUR : 7,5 YR 5/6 •WITHOUT MOTTLES •NO COARSE ELEMENTS •TEXTURE : SANDY LOAM WITH COARSE SAND MASSIVE STRUCTURE •COHERENT •COMMON ROOTS , VERY FINE •SMOOTH TRANSITION

4 /10 •FRESH •COLOUR : 7,5 YR 4/6 •WITHOUT MOTTLES •NO COARSE ELEMENTS •TEXTURE : SANDY CLAY LOAM WITH COARSE SAND MASSIVE STRUCTURE •COHERENT

PROFILE	297 0039	297 0040		
HORIZON	0/100	0/ 20	20/ 40	40/100
CLAY 0/2 MCR. % F.E		15	16	21
FINE SILT 2/20		7	7	9
COARSE SILT 20/50		2	2	2
FINE SAND 50/200		23	21	20
COAR. SAND 200/2000		53	54	48
>2 MM % SOIL				
PH 1/2,5 H20		8,5	8,2	8,2
CALCIUM CARBONATE %				
ORGANIC MATTER %		0,65		
ORGANIC CARBON %		0,38		
TOTAL NITROGEN 0/00		0,4		
DIL. ACID P PPM				
DIL. ACID P205 0/00				
TOTAL P205 0/00				
EXCH. CA MEQ/100 G.				
EXCH. MG MEQ/100 G.				
EXCH. K MEQ/100 G.				
EXCH. NA MEQ/100 G.				
EXCH. CAP. MEQ/100 G				
1/5 EC MMHOS 25C				
MOIST. 1/3 ATM. %				
MOIST. 15 ATM. %				

297 PROFILE 0041

USTIFLUVENT Soil Series N° 3

*TERRACE , GRADIENT LESS THAN 1 % , SAND , ALLUVIAL DEPOSIT , UNDER CULTIVATION *FOOD CROPS , SYSTEMATIC IRRIGATION , CHANGES IN THE RELIEF *PLOUGHING *HAND CULTIVATION *MECHANIZED CULTIVATION *VERY PERMEABLE SOIL

0/ 30 *FRESH *COLOUR : 10 YR 5/4 *WITHOUT MOTTLES *ORGANIC DEBRIS *NO COARSE ELEMENTS *TEXTURE : SANDY LOAM MASSIVE STRUCTURE *VERY POROUS *COHERENT , VERY FRAGILE *SMOOTH TRANSITION

30/ 70 *FRESH *COLOUR : 10 YR 5/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : SANDY LOAM *MASSIVE STRUCTURE *VERY POROUS *COHERENT , VERY FRAGILE *SMOOTH TRANSITION

70/100 *FRESH *COLOUR : 10 YR 5/4 *WITHOUT MOTTLES *NO COARSE ELEMENTS *TEXTURE : LOAMY SAND *MASSIVE STRUCTURE *VERY POROUS *COHERENT , VERY FRAGILE

PROFILE 297 0041

HORIZON	0/ 30	30/ 70	70/100
CLAY 0/2 MCR, % F.E	3	11	7
FINE SILT 2/20	8	8	5
COARSE SILT 20/50	11	9	5
FINE SAND 50/200	37	39	42
COAR. SAND 200/2000	36	34	41
>2 MM % SOIL			
PH 1/2,5 H20	8,6	8,5	8,4
CALCIUM CARBONATE %			
ORGANIC MATTER %	0,73		
ORGANIC CARBON %	0,42		
TOTAL NITROGEN 0/00	0,37		
DIL. ACID P PPM			
DIL. ACID P2O5 0/00			
TOTAL P2O5 0/00			
EXCH. CA MEQ/100 G.	15,6	12,4	
EXCH. MG MEQ/100 G.	1,69	2,2	
EXCH. K MEQ/100 G.	0,46	0,19	
EXCH. NA MEQ/100 G.	0,18	0,36	
EXCH. CAP.MEQ/100 G	18,3	14,5	
1/5 EC MMHOS 25C			
MOIST. 1/3 ATM. %	9,9	13,3	
MOIST. 15 ATM. %	5,3	5,6	

PROFIL No.42-43

SOIL DESCRIPTION AND ANALYSIS - TOG WAJALE (John DICKINSON, Oxfam, April 1980)

Description

- Land form: level to very gently sloping plain;
- Surface: newly cultivated;
- Vegetation: umplanted;
- 0-20 cm: very dark brown (10 YR 2/2), clay, dry, very firm, very calcareous, pH 7.7;
- 20-50 cm: dark brown (10 YR 3/3), clay, slightly moist, very firm, very calcareous, pH 8.2;
- 50-100 cm: strong brown (7.5 YR 5/6), clay, slightly moist, very firm, very calcareous, pH 8.1.

Analysis

Profile No	Depth (cm)	pH H_2O	OM (%)	Grain size % FE			Texture	Soluble cations Me/100 g				Soluble anions (me/l)	
				Sand	Silt	Clay		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	cL^{-}
42	0	7.7	3.8	22	19	59	Clay	0.20	0.40	0.037	0.005	6.0	3.5
	50	8.2	2.5	14	11	75	Clay	0.115	0.23	0.248	0.003	7.2	4.5
	100	8.0	-	16	15	69	Clay	0.645	0.43	2.243	0.006	5.6	39.0
43	0	7.8	4.5	20	17	63	Clay	0.07	0.14	0.037	0.004	5.8	2.3
	50	8.2	3.8	20	11	69	Clay	0.375	0.50	0.399	0.003	9.0	3.2
	100	8.1	-	16	7	77	Clay	0.315	0.611	1.930	0.008	8.0	40.6

PROFIL No.44 to 47

SOIL ANALYSIS AGABAR (p. 44, 45, 46 and 47) (John DICKINSON, Oxfam, August 1980)

Profile No	Depth (cm)	pH H_2O	OM (%)	Grain size % fE			Texture	Soluble cations Me/100 g				Soluble anions (me/l)	
				Sand	Silt	Clay		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}
44	0	7.6	-	84	7	9	Loamy sand	0.56	0.32	0.042	0.054	11.0	4.0
	50	8.0	-	-	-	-		0.45	1.90	0.068	1.169	5.4	75.0
45	0	7.8	-	45	25	31	Gravelly loam	0.085	0.34	0.071	0.063	13.0	10.0
	50	7.7	-	56	11	33	Sandy clay	0.48	1.080	0.626	0.030	6.0	64.0
46	0	7.7	-	-	-	-		0.070	0.210	0.015	0.016	5.0	5.0
	50	7.8	-	76	13	11	Sandy loam	0.233	0.078	0.032	0.015	4.6	4.0
47	0	8.0	-	70	13	17	Sandy loam	0.115	0.311	0.027	0.025	5.6	3.7

PROFILE No.48

SOIL DESCRIPTION AND ANALYSIS (John DICKINSON, Oxfam, August 1980)

- Site: Damka farm at SE of farm;
- Land form: shelf on valley sicle;
- Slope: gently sloping;
- Surface: recently ploughed;
- Vegetation: umplanted;
- Ap - 0-15 cm: brown (7.5 YR 5/4), dry, dark brown (7.5 YR 3/4), moist, SCL, dry, loose, few fine roots, very calcareous, pH 7.2, boundary abrupt and smooth;
- B_1 - 15-50 cm: brown (7.5 YR 5/4), dry, dark brown (10 YR 3/3), moist, sandy clay loam, dry, moderately firm, moderately developed coarse prismatic, few very fine: fissures, 1% very fine to medium pores commun very fine to fine roots; very calcareous, pH 7.7, boundary-clear and smooth;

. B_2Ca - 50-160 cm: dark yellowish brown (10 YR 4/4), dry, dark brown (7.5 YR 4/4), moist, sandy clay, dry, very firm, weakly developed medium angular blocky; 1 to 2% very fine to medium pores, common very fine to fine pores, very calcareous, few to common fine to medium salf calcium carbonate deposits, pH 7.5.

Profile No	Depth (cm)	pH H_2O	OM (%)	Grain size % FE			Texture	Soluble cations Me/100 g				Soluble anions (me/l)	
				Sand	Silt	Clay		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}
1	0-10	7.7	-	44	13	43	Clay	0.168	0.210	0.292	0.010	4.0	9.5
	10-30	7.8	-	62	9	29	Sandy CL	0.270	0.338	0.021	0.003	5.0	4.0
	30-60	7.7	-	66	4	30	SC	0.413	0.248	0.039	0.004	4.0	4.0
2	0-15	7.2	-	61	16	23	SCL	0.180	0.225	0.014	0.010	11.0	6.0
	15-50	7.7	-	64	11	25	SCL	0.225	0.150	0.313	0.006	5.4	3.0
	50-105	7.5	-	50	13	37	SC	0.350	0.952	0.704	0.005	5.0	57.0
	105-160	7.6	-	50	11	39	SC	1.070	0.743	0.861	0.005	6.0	65.0

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