

Soil Survey And Land Classification

REPUBLIC OF YEMEN

INTERFACE BETWEEN THE YEMEN SOIL DATABASE AND THE AUTOMATED LAND  
EVALUATION SYSTEM (ALES)

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The conclusions given in this report are considered appropriate at the time of its preparation. They may be modified in the light of further knowledge gained at subsequent stages of this project.

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## ABSTRACT

The Soil Survey and Land Classification Project is developing a computerized land evaluation system for Yemen using an expert system shell (ALES) which is connected to the soil database (SDB).

This report describes the technical and operational aspects of the interface which links the soil database with the expert system shell.

KEYWORDS: Quantified land evaluation, soil database

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## INTRODUCTION

The Soil Survey & Land Classification Project YEM 87/002 is developing a computerized land evaluation system for Yemen. The main components of this system are an expert system shell (ALES), the Yemen Soil Database (SDB software), and an interface to link SDB to ALES (SAL).

This document describes the operational and technical aspects of this interface between SDB and ALES.

An essential part of the interface is the conversion of soil horizon information to standard depth intervals. The method presented in Section 1.2 was tested on a number of profiles with satisfactory results. However, the test profiles are mostly slight and moderate developed soils typical for the alluvial areas in the Yemen Republic, therefore the method presented here does not necessarily apply under different conditions (e.g. deeply weathered tropical soils).

Section 1.3 describes the creation of the actual Ales datafiles. The structures of this files are specific for a single land evaluation model.

General reference is made to the following manuals and reports:

- FAO-ISRIC, 1990; FAO-ISRIC Soil Database (SDB) Manual. World Soils Reports 64. FAO, Rome.
- Rhebergen, 1990; Crop requirements for Potato, Sorghum, Apple and Grapevine. YEM 87/002 field document 3. UNDP/FAO/MAWR-AREA. Dhamar.
- Rossiter & Van Wambeke, 1989; ALES Version 2. User's Manual. Cornell University. Ithaca, N.Y.
- Van Waveren & Rhebergen, 1989; Yemen Soil Database. Guidelines for soil description. YEM 87/002 Field document 1. UNDP/FAO/MAF. Sana'a.

## 1. THE SDB-ALES INTERFACE

### 1.1 SYSTEM OVERVIEW

The SDB-ALES Interface (SAL) allows the Ales user to automatically create external ALES datafiles from the SDB databases. The datafiles consist of sets of soil profile data which can be used as basis for evaluation runs.

The interface between SDB and ALES functions as follows (see also Figure 1):

(1) Selection of relevant soil profiles (in SDB).

The interface requires a subset of soil profile data prepared with the SDB Import/Export or Selection mode (SDB output files). Typically, this will be all soil profiles representative for one, or for a number of mapping units in the area of interest. The SDB output files are in Dbase III/IV format (see the SDB Manual for further instructions).

(2) Creation of a basic datafile (using SAL).

The Interface extracts the relevant site, profile and analytical data for each soil profile from the SDB output files, and converts the soil data to standard depth intervals (0-25, 25-75 and 75-125cm). Availability of soil analytical data is checked, if not, it will use descriptive field information (texture, EC, free carbonates and pH). The results are written to a dbase datafile. This file is the basic datafile for any subsequent evaluation. A printout (summary report) for each processed soil profile is optional.

(3) Creation of evaluation specific datasets (using SAL).

The interface generates ALES datafiles (ASCII format) from the basic datafile created in step 2.

Those files contain only the information that is required to run a particular evaluation model, and therefore are evaluation model specific. Consequently the structures of the ALES datafiles generally consist of a subset of the datafields of the basic datafile.

In addition, classes of some land characteristics may be combined into a smaller number of new classes if the determination of the land qualities does not require the scale of detail given by the original classification.

(4) Prepare data entry templates (in ALES).

See the ALES Manual for further information on this subject.

It is important to realize that the interface generates soil profile data and not the compiled information on mapping units, i.e. it assumes the evaluation to be carried out on the individual soil profiles. Based on this the following methods can be followed:

- (a) A representative soil profile is selected for a soil or mapping unit, or

(b) The whole set of soil profiles is evaluated first (evaluation of point data) and the results are subsequently spatially interpolated in order to obtain information on land or mapping units. If required, synthetic soil profile descriptions could be added to the datasets, representing the average characteristics of the soil units. Those synthetic profiles can be stored directly in Ales using the 'data entry from keyboard' option.

The advantages of the second method are:

a) The evaluation procedure itself is no longer scale dependent and repeatable as basic data are used and not a preselected set for a specific map scale.

b) The results give a good indication of the variability of the suitability of a mapping unit for a specific land use.

The disadvantage is of course that much more data need to be processed. However, a computer is the proper medium to work with large datasets.

Figure 1. SDB-ALES Interface. Dataflow and datafile structures

1. SDB OUTPUT FILES

Dbase III+ format

Created with SDB: Import/Export or Selection modes

SITE DATA  
Database structure: SDBSITE.DBF

HORIZON DATA  
Database structure: SDBHORIZ.DBF

ANALYTICAL DATA  
Database structure: SDBANAL.DBF

2. SAL DATAFILE

Dbase III+ format

Created with SAL: Option 1

YOURNAME.EXT  
Database structure: SUMMSOIL.DBF

3. ALES DATAFILES

Ascii files (delimiter = comma, ascii value 44)

Created with SAL: option 2.

YOURNAME.DEF (= ALES land unit definition file)  
structure: Profile code,soil unit,"h"

YOURNAME.DAT (= ALES land unit data file).  
Evaluation model specific.  
structure: Profile code,variable 1, variable 2, ,variable N  
subset of fields from YOURNAME.EXT

Notes: <YOURNAME> represents any valid filename  
<EXT> represents any valid extension

More than 1 set of ALES datafiles can be created from YOURNAME.EXT in case the soil profile data are to be used in different evaluation models

## 1.2. CREATION OF BASIC DATAFILES

The interface uses SDB output files and extracts for each soil profile a set of site, profile and analytical data. This dataset contains all variables which are presently thought to be relevant for land evaluation procedures for arable farming in Yemen. The analytical dataset only contains the essential parameters as reliable analytical data is presently scarce.

All data is written to a single Dbase datafile in which each soil profile description fills one record. The structure of this file is given in appendix 2.

This file will be the basic datafile for any further evaluation procedures and will be stored on disk under a user defined filename in any required subdirectory. Optionally, a printout of the results can be obtained. See appendix 1.

The basic datafile contains the following variables:

(a) Site description data:

Soil profile code, soil unit, FAO soil unit and phase, UTM grid reference, altitude, landform, land element, position of site, slope gradient and form, micro topography, flood frequency, percentage of surface stones and rockoutcrops, occurrence of surface salts, sealing/crusting, drainage class, occurrence of slow permeable layers, effective soil depth.

(b) Soil horizon data:

Depth of upper and lower boundary, field texture, structure grade and type, total amount of coarse fragments (rocks and nodules), consistence, cementation grade, CaCO<sub>3</sub> (effervescence), field measured pH and EC (both in 1:2.5 soil/water solution), available waterholding capacity.

(c) Analytical data:

Sample depth, percentage of total sand silt and clay, pH and EC in 1:2.5 soil water solution, % free carbonates, extractable Na, CEC.

### Standard depth intervals

The soil profile information is converted to the following standard depth intervals: (I) 0 - 25 cm; (II) 25- 75 cm; (III) 75-125 cm.

If a depth interval includes a single horizon the relevant information of this horizon is used to characterize this depth interval.

Mostly, a depth interval includes (parts of) two or more horizons and then the information on the depth interval is obtained by using two different methods depending on the type of variable:

- For most variables the dominant value within the depth interval is recorded. Dominant values are values measured or described for the major part of the depth interval (see figure 2).

- For other variables the maximum value within the depth interval is recorded. Maximum values are the highest values that are measured or described in the depth interval. Note that (parts of) horizons within the interval that are less than 5cm thick are excluded.

Dominant values are recorded for the following variables:

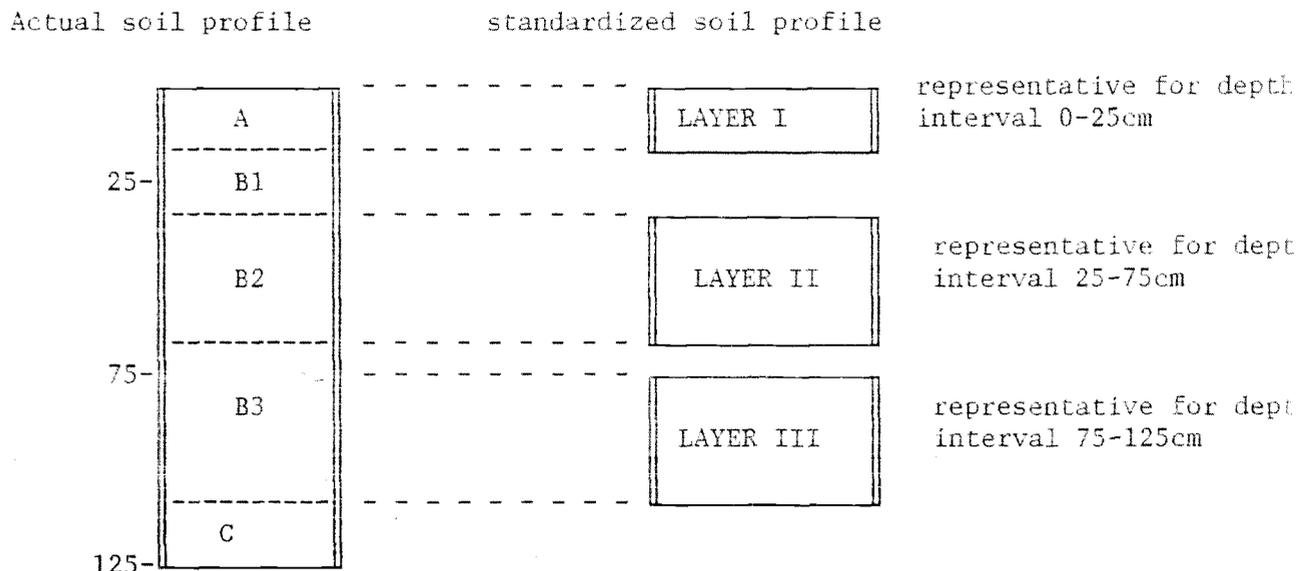
- Texture (field and laboratory data)
- EC (field and laboratory data)
- pH (field and laboratory data)
- Exchangable sodium percentage (ESP)
- Coarse fragments (stones, nodules)
- Free CaCO<sub>3</sub> (field and laboratory data)

Maximum values are recorded for the structural development, and the grade of cementation.

The method described above is crude in the sense that a single horizon is assumed to be representative for an entire depth class, and using weighted averages instead would be more precise. However, the latter requires numeric data (obtained from laboratory analyses), which is frequently not or only partly available. And it is considered more important to process all available observations in order to get more detailed information on the spatial distribution, than to process only observations with analysed samples.

The two evaluation models (potato on the intermontane plains, and sorghum in the Tihamah) show that the results are satisfactory and that the standardized profiles still reflect the relevant characteristics of the soils. This was to be expected for the soils on the montane plains which generally have simple profiles with only a few different horizons within 125cm depth. However, also for the alluvial Tihamah soils the results are acceptable, although these soils are characterized by stratified profiles with often five or more horizons within 125cm.

Figure 2. Conversion of actual soil profile information to a standardized profile with fixed depth intervals.



## Classification of variables

For the horizon variables the classification is identical to the one given the Guidelines for soil profile description for Yemen (Van Waveren & Rhebergen, 1989). Grain size distributions and free calcium carbonate contents derived from laboratory analyses are classified accordingly.

Two land qualities are determined and included in the datasets: available waterholding capacity and structural development.

The available waterholding capacity is estimated using texture, amount of coarse fragments and soil depth.

Structural development combines the original variables structure grade and structure type. The classification of this variable is as follows:

- 0 Includes structureless, massive and very weak structure
- BL Blocky and prismatic/columnar structures (weak to strong)
- PL Platy structures (moderate to strong)

The wide range of structure grades in class BL is justified by the fact that strong structures hardly occur in Yemen, and the fact that some structural development (class BL as opposed to class 0) in a soil is more relevant for land evaluation purposes than the precise grade of this development.

Moderate and strong platy structures are separated because they clearly prevent penetration of roots and consequently limit the effective soil depth.

### 1.3 CREATION OF ALES DATAFILES

The interface generates for each dataset two files, an ALES land unit definition file and an ALES land unit data file.

The interface automatically assigns the following extensions to the generated files:

- DEF for the land unit definition file
- DAT for the land unit data file

The actual filenames for the datasets are defined by the user.

As soil profiles are being evaluated the soil profile is the basic entity and equivalent to the homogeneous land unit in ALES.

The required file formats are described in detail in the ALES Manual, chapter 9. According to these requirements the datafiles generated by the Interface have the following specifications:

- The datafiles are ASCII (DOS text) files. The field delimiter is the comma. (ASCII value 44).
- Each soil profile is one line.

In the land unit definition file each line has the following format:

{Profile Code},{mapping unit},"h"

Note that the soil profiles are considered homogeneous land units ("h" in third data field). The second datafield contains the mapping unit, instead of a descriptive land unit definition. This allows the user to construct compound land units (i.e. mapping units) in ALES, using the soil profiles as basic entities.

In the land unit datafile each line has the following format:

{Profile code},{LcVAL1},LcVAL2}, ,{LcVALn}

Where, LcVALi = value for the land characteristic in field number i (as defined in Ales Data entry template).

In order to limit the complexity of the evaluation model the land unit data files are generated according to the following general principles: :

a) The datafiles only contain those land characteristics that are actually used in the evaluation model. For instance, the evaluation model "Potato on intermontane Plains" uses ten land characteristics (see table 1).

b) The number of classes used to describe a land characteristic does not exceed the number of classes required by the evaluation model, or the maximum number of classes allowed in ALES (16). For instance, for the same evaluation model the textural classes are regrouped into 6 classes related to their available waterholding capacities (see Table 1).

Note that grouping of textural classes is a mere necessity, as the total amount of texture classes exceeds maximum number of classes allowed in Ales.

Table 1. Classification of land characteristics and land qualities

A. Potato, Intermontane plains

Land characteristic	classification	No of classes
1 Slope gradient	YAR-SDB coding system	6
2 Rock outcrops (%)	YAR-SDB coding system	6
3 Drainage	YAR-SDB coding system	7
4 Effective soil depth	YAR-SDB coding system	5
5 Texture 0-25cm	regrouped *	6
6 Texture 25-75cm		6
7 Consistence 0-25cm	YAR-SDB coding system	6
8 Consistence 25-75cm		6
9 Coarse fragments 0-25cm	as YAR-SDB coding system for rock fr.	6
10 Coarse fragments 25-75cm		6
11 CaCO3 0-25cm	YAR-SDB coding system	4
12 CaCO3 25-75cm		4
13 Average EC rootzone	numeric (continuous)	0

## B. Irrigated Sorghum (Seifi) in Wadi Mawr

Land characteristic/quality	classification	No of classes
1 Surface seaking	YAR-SDB coding system	5
2 Drainage	YAR-SDB coding system	7
3 Effective soil depth	YAR-SDB coding system	5
4 Average EC rootzone	numeric (continuous)	0
5 Waterholding cap. 0-25cm		5
6 Waterholding cap. 25-75cm		5
7 Waterholding cap. 75-125cm		5

\*)

Texture classes: A Sands : S, vFS, FS, cS, LcS  
B Loamy sands/coarse sandy loam: LS, LvFS, LFS, cSL  
C Sandy (clay)loams : SL, fSL, vfSL, SCL  
D (Clay-)loam, Sandy clay : CL, SC, L,  
E Silts : SiCL, SiC, SiL, Si  
F clay : C

### 1.4 DEFINING ALES DATA ENTRY TEMPLATES

This topic is discussed in detail in the ALES Manual. Please note the following:

the actual sequence of the land characteristics in the land unit data file and the ALES data entry template should correspond (the sequence is listed in Appendix 2. Structure of SUMMSOIL.PRG). Similarly, the class codes of the land characteristics should correspond with the ALES land characteristic class abbreviations. Keep in mind that all SDB codes are in upper case.

## 2. RUNNING THE SAL INTERFACE PROGRAM

This section gives general instructions to operate SAL. Specific instructions for the setup of the system the computer at AREA, Dhamar are given on a separate leaflet.

SAL is started from DOS using the following command:

**SAL**

Before running the interface the soil profiles to be evaluated should be selected and written to a diskfile with the SDB Import/Export or Selection mode. Write the following information to the disk:

- Site data
- Horizon data
- Standard analytical data

The SDB Import/Export mode provides the quickest and easiest way to write data to diskfiles. The drawback is that it requires you to know the codes of the profiles you want to evaluate. The selection mode should be used if the codes are not known, for instance if you want to evaluate a particular mapping unit and you do not know all the codes of profiles within this unit.

Follow the instructions given in the SDB Manual.

Subsequently run SAL. The basic datafile created with option 1. can be used to prepare one or more ALES datafiles with option 2. Note that option 2 prepares a dataset for a specific evaluation model, for instance: 'spate irrigated sorghum in the Tihama', or 'improved, irrigated potato on the intermontane plains. The Dataflow and datafile structures are summarized in Figure 1.

To run the interface the following files should be in the active subdirectory:

SAL.EXE  
SUMMSOIL.DBF

The structure of SUMMSOIL.DBF is given in appendix 2.

APPENDIX 1. Examples of basic datasets and original soil profile descriptions

APPENDIX 2. Structure of the SAL Basic Datafile (Dbase III+ format)

Fieldname	type	width	decimals	Description
PRNO	C	6	0	Profile code
UNIT	C	6	0	Mapping unit
FAOR	C	6	0	FAO (88) classification unit
PHAS	C	2	0	FAO (88) soil phase
TYPE	C	1	0	soil unit type (homogeneous)
ELEV	N	4	0	elevation
GRID	C	11	0	grid reference
LAFO	C	2	0	landform
LAEL	C	2	0	landelement
POS	C	2	0	position of site
SLGR	C	1	0	slope gradient
SLFM	C	1	0	slope form
MITO	C	2	0	microtopography
FLOO	C	2	0	flood frequency
SEAL	C	2	0	sealing
STON	C	1	0	surface stones
ROCK	C	1	0	rockoutcrops
SALT	C	2	0	surface salts
DRAI	C	2	0	drainage class
DEPT	C	1	0	effective soil depth
PELA	C	1	0	slow permeable layers
FT1	C	4	0	field texture 0-25cm
FT2	C	4	0	field texture 25-75cm
FT3	C	4	0	field texture 75-125cm
LT1	C	4	0	laboratory texture 0-25cm
LT2	C	4	0	laboratory texture 25-75cm
LT3	C	4	0	laboratory texture 75-125cm
ST1	C	2	0	structural development 0-25cm
ST2	C	2	0	structural development 25-75cm
ST3	C	2	0	structural development 75-125cm
CM1	C	1	0	cementation grade 0-25cm
CM2	C	1	0	cementation grade 25-75cm
CM3	C	1	0	cementation grade 75-125cm
RO1	C	1	0	coarse fragments 0-25cm
RO2	C	1	0	coarse fragments 25-75cm
RO3	C	1	0	coarse fragments 75-125cm
FC1	C	2	0	CaCO <sub>3</sub> field estimate 0-25cm
FC2	C	2	0	CaCO <sub>3</sub> field estimate 25-75cm
FC3	C	2	0	CaCO <sub>3</sub> field estimate 75-125cm
LC1	C	2	0	CaCO <sub>3</sub> content (laboratory) 0-25cm
LC2	C	2	0	CaCO <sub>3</sub> content (laboratory) 25-75cm
LC3	C	2	0	CaCO <sub>3</sub> content (laboratory) 75-125cm
FP1	N	3	1	field pH (1:2.5) 0-25cm
FP2	N	3	1	field pH (1:2.5) 25-75cm
FP3	N	3	1	field pH (1:2.5) 75-125cm
LP1	N	3	1	laboratory pH (1:2.5) 0-25cm
LP2	N	3	1	laboratory pH (1:2.5) 25-75cm
LP3	N	3	1	laboratory pH (1:2.5) 75-125cm

APPENDIX 2. Structure of SAL Basic Datafile (Cont'd)

Fieldname	type	width	decimals	Description
CN1	C	6		consistence dry/moist 0-25cm
CN2	C	6		consistence dry/moist 25-75cm
CN3	C	6		consistence dry/moist 75-125cm
FE1	N	4	1	field EC (1:2.5) 0-25cm
FE2	N	4	1	field EC (1:2.5) 25-75cm
FE3	N	4	1	field EC (1:2.5) 75-125cm
LE1	N	4	1	laboratory EC (1:2.5) 0-25cm
LE2	N	4	1	laboratory EC (1:2.5) 25-75cm
LE3	N	4	1	laboratory EC (1:2.5) 75-125cm
ES1	N	2	0	ESP 0-25cm
ES2	N	2	0	ESP 25-75cm
ES3	N	2	0	ESP 75-125cm
WC1	N	2	0	Available waterholding capacity 0-25cm
WC2	N	2	0	Available waterholding capacity 25-75cm
WC3	N	2	0	Available waterholding capacity 75-125cm

### APPENDIX 3. Technical specifications and description of source files

SAL.EXE is created with Clipper (summer 1987 version). SAL needs approximately 350K of the RAM. The executable size of the SAL program is 167K. The database files used and created by SAL are Dbase compatible. The final ALES datafiles are ASCII files.

#### Description of source Code

The major part of the programming code is Dbase III+ compatible, although few Clipper specific functions were used to optimize the menu system. In the following a description of the source files is given.

**SAL.PRG** - Main program. Opening menu.

Datafiles used: none  
Subroutines called: SALSUMM.PRG; SALDATA.PRG

Note: this file contains Clipper specific functions.

**SALSUMM.PRG** - Creates a dbase III/IV datafile (&FTARGET) which contains the basic set of data for any further evaluation procedure. The information in the datafile is arranged as profile data per record.

Opens SDB generated datafiles (&FSITE, &FHORI, &FANAL). Asks for confirmation to process data for each profile code encountered. Writes processed data to dbase III/IV datafile (&FTARGET) under a user specified filename. A printout of processed profile information is optional.

Called by : SALMAIN.PRG  
Datafiles used : A->&FSITE  
                  B->SUMMSOIL.DBF (workfile)  
Datafiles created : &BASEFILE (copy of processed SUMMSOIL.DBF)  
Subroutines called: SALSITE.PRG; SALHORI.PRG; SALANAL.PRG; SALPRNT.PRG

Note: This file includes Clipper specific functions.

**SALSITE.PRG** - Extracts site data from &FSITE and writes data to SUMMSOIL.DBF.

Called by : SALSUMM.PRG  
Datafiles used: A->&FSITE  
                  B->SUMMSOIL.DBF

**SALHORI.PRG** - Extracts horizon data from &FHORI. Selects data for each depth interval and writes it to SUMMSOIL.DBF.

Called by : SALSUMM.PRG  
Datafiles used : B->SUMMSOIL.DBF

C->&FHORI  
Datafile created : C->RAWDATA.DBF (workfile, contains profile data  
copied from &FHORI) '  
Subroutines called: SALRENUM.PRG; SALVARHO.PRG, SALRECOD.PRG

**SALRENUM.PRG** - Replaces character codes of descriptive horizon variables with numbers. Combines abundance of rock fragments and mineral nodules into coarse fragments. Reclassifies structure into structural development.

Called by : SALHORI.PRG  
Datafile used: C->RAWDATA.DBF

**SALRECOD.PRG** - Changes numerical codes generated with SALRENUM.PRG back to codes. Memvars defined in SALHORI.PRG and filled in SALVARHO.PRG.

Called by: SALHORI.PRG

**SALVARHO.PRG** - Fills memvars defined in calling routine with representative horizon data for each depth interval. Data source RAWDATA.DBF. Dominant values are recorded for texture, PH, EC, coarse fragments, and carbonates, and consistence. Maximum values are recorded for structure (primary and secondary), cementation.

Called by : SALHORI.PRG  
Database used: C->RAWDATA.DBF

**SALANAL.PRG** - Extracts analytical data from &FANAL and writes data for standard depth intervals to SUMMSOIL.DBF.

Called by : SALSUMM.PRG  
Databases used : B->SUMMSOIL.DBF  
C->&FANAL  
Database created : C->RAWDATA.DBF (Workfile copied from &FANAL, contains analytical data for a single profile.  
Subroutine called: SALVARAN.PRG

**SALVARAN.PRG** - Selects dominant analytical data for each depth interval from RAWDATA.DBF and stores data in memvars. Reclassifies % CaCO<sub>3</sub> to field classes.

Called by : SALANAL.PRG  
Databases used : C->RAWDATA.DBF  
Subroutine called: SALTXT.PRG

**SALTXT.PRG** - Classifies laboratory textural analysis.

Called by: SALANAL.PRG

SALPRNT.PRG - Prints a summary of processed soil profile data.

Called by : SALSUMM.PRG  
Database used: B->SUMMSOIL.PRG

SALDATA.PRG - Prepares Ales datafiles (ASCII). Master.

\* Specifies filenames of source and target files

Called by : SALMAIN.PRG  
Databases used : A->&BASEFILE  
Calls : SALPO-IP.PRG, SALSO\_TI.PRG, SALPREP.PRG

Note: This file contains Clipper specific functions

SALPREP.PRG -

\* Estimates available waterholding capacity  
\* replaces field data with laboratory data (if available)  
\* Converts EC (1:2.5) to ECe  
\* combines texture classes into a limited number of new classes

Called by : SALDATA.PRG  
Databases used : A->&BASEFILE  
Calls: : -

SALPO\_IP.PRG - Prepares ALES datafiles for potato on intermontane plains.

\* Selects appropriate fields for the evaluation  
\* reclassifies consistence  
\* calculates average EC and pH values for total depth interval  
\* Writes data to ASCII files with user defined names (ALES datafiles).

Called by : SALDATA.PRG  
Databases used : A->&BASEFILE  
Datafile created: &TARGET1, &TARGET2

SALSO\_TI.PRG - Prepares ALES datafiles for irrigated sorghum in the Tihamah

\* Selects appropriate fields for the evaluation  
\* calculates average EC and pH values for total depth interval  
\* Writes data to ASCII files with user defined names (ALES datafiles).

Called by : SALDATA.PRG  
Databases used : A->&BASEFILE  
Datafile created: &TARGET1, &TARGET2

## SUMMARY OF SOIL CHARACTERISTICS

Profile Code: HUA050

-----  
A. General Information On The Soil

Unit	: CL01	FAO Unit/Phase (88)	: CMC
UTM Grid	: 0287017377	Altitude	: 75
Landform	: WT	Landelement	: LE
Position	: IN	Slope Gradient/Form	: 1
Micro Topography	: UN	Floods	: S2
Surface Stones	: 0	Rockoutcrops	: 0
Surface Salts	: 0	Sealing/Crusting	: 0
Drainage	: M	Slow Permeable Layer	: 5
Eff. Soil Depth	: 5		

-----  
B. Profile Characteristics <Standard Depth Intervals>

	Topsoil (0-25cm)	Subsoil (25-50cm)	Subsoil (50-100cm)
Texture (field):	SICL	CL	SL
(lab.):	None	None	None
Struct. Development:	1	1	1
Coarse Fragments :	0	0	0
Cementation :	0	0	0
CaCO <sub>3</sub> (field) :	ST	ST	ST
(lab) :			
pH water (field) :	7.4	7.4	7.5
(lab) :			
EC 1:2.5 (field) :	0.2	0.1	0.5
EC 1:2.5 (lab) :			
ESP :			

\* EC in mS/cm (= mmhos/cm)

\* For Texture, Structure, pH, EC, ESP dominant values  
are given within the standard depth interval\* For Cementation and Rock Fragments maximum values  
are given within the standard depth interval  
-----

## SOIL PROFILE DESCRIPTION

Profile: HUA050 Unit: CL01 Status: 2

Sheet/Grid: 1543A3/0287017377  
 Location : 3km S of As Zuhra.  
 Survey Area :  
 Author(s) : A.A.Ahmed Said M.Hassam Said E.Van Waveren

Coord : N 15-42-45 E 043-00-45  
 Elevation: 75 m  
 Date : 20/12/89

Classification FAO: Calcic Cambisol(1988)  
 ST: Fluventic Camborthid

Soil Climate: aridic isohyperthermic

Topography : almost flat

Element/Pos.: levee- intermediate part

Flooding : seasonal 2x

Land Use : irrigated, medium scale, basin, sprinkler- crops: cereals, cotton

Vegetation :

Species :

Land Form: wadi (Tihama)  
 Slope : 0.1 -2%  
 Micro Top: uneven  
 Grasscover:

Parent Material: alluvium

Rock Outcrops : nil - Surface Stones : nil

Erosion: nil

Surface salts: not observed

Drainage : moderately well, internal drainage: moderate, external drainage: moderate

Watertable: not observed

Moist Cond: dry 0 - 30 , moist 30 - 150cm

Human Infl: irrigation (long continued)

Catchment: W. Haur

Remarks: According to farmer spate water often not sufficient. Infiltration rate 3.8 cm/hour (average of 3 tests over 2.5 hours).

Sealing/Crusting: nil

Eff. Soil Depth: &gt; 150cm

Dpth slow perm layer: &gt; 150cm

Samples: A: 0- 20 B: 40- 60 C: 80-100 D: 130-140 E: 140-150

Ap 0 - 30 cm 10YR 4.5/3 (moist), silty clayloam, weak to moderate medium and coarse subangular blocky structure, slightly sticky (wet), slightly plastic (wet), common fine-medium pores, strongly calcareous, field pH: 7.4, field EC: 0.2, gradual wavy boundary.

B 30 - 60 cm 10YR 4/3 (moist), clayloam, moderate to strong very coarse prismatic structure, sticky (wet), plastic (wet), few faint clay-humus cutans on pedfaces, common fine-medium pores, strongly calcareous, common medium roots, field pH: 7.4, field EC: 0.1, clear wavy boundary.

2C 60 - 130 cm 10YR 3.5/4 (moist), sandy loam, very weak medium and coarse angular blocky structure, slightly sticky (wet), slightly plastic (wet), many fine-medium pores, strongly calcareous, few fine-medium roots, field pH: 7.5, field EC: 0.5, clear smooth boundary.

3C 130 - 140 cm 10YR 2/3 (moist), sandy loam, very weak medium angular blocky structure, non sticky (wet), non plastic (wet), few (very) fine pores, strongly calcareous, very few very fine roots, field pH: 7.5, field EC: 0.3, clear smooth boundary.

4C 140 cm - 10YR 2.5/3 (moist), loamy sand, single grain structure, few very fine pores, strongly calcareous, nil roots, field pH: 7.5, field EC: 0.2,

Print Date: 05/05/90