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## 5. SUMMARY

The current investigation aims to assessing land utilization of El- Hasainya plain soils to the dominate agricultural exploitation types . The study area lies North – East of Delta between latitudes  $30^{\circ} 51'$  and  $31^{\circ} 03'$  north and longitudes  $31^{\circ} 57' 36''$  and  $32^{\circ} 13' 30''$  east .The most important agricultural exploitation types of the studied area and management have been recognized .

The existing soil mapping units were checked , verified and corrected through digging soil profile pits and making auger holes .Eighteen sites were chosen and profiles were dug to depth of 150 cm. and discribed. Fifty three soil samples representing layers of these profiles were collected. . Physical and chemical were carried out .

### 1- Soil classification (Taxonomy of soils) :

According to the soil Taxonomy system (USDA ( 1975 and 1999 ) , the soils were of two orders ( Vertisols and Entisols ). The soils were further classified to the family level which was further differentiated to the series level .The identified soil families identified were as follows :

a- *Very fine , montmorillonitic , thermic , Halic Endoaquerts ( mapping unit VA1 ) .*

\* It represent the relatively low elevation of the fluviomarine marshes that lies below 1 m. asl. It consists of deep heavy clay soil and represented by 4 soil profiles . The typical profile is very dark grayish brown ( moist ) in the surface and dark grey in the subsurface layer ( for bad drainage ) . Soil structure is weak subangular blocky in surface to strong medium and coarse angular blocky in subsurface with deep wide surface cracks and clear slickensides in subsurface . Soil constituents varied as follows : clay: 47.50 – 67.68 % , silt: 14.70 – 37.58 % and sand : 1.00 – 24. 62 % . Calcium Carbonate: 0.40 – 7.60% with no gypsum . Soluble salts : 0.43 – 1.88% ( w/w related to soil weight ) .

**b- *Fine , montmorillonitic , thermic ; Halic Endoaquerts* ( mapping unit VA2 )**

It represents the clay flats of the Fluvio – marine marshes , and located along the southern boundaries of the VA1 unit ,and is represented by 4 soil profiles. Soils are almost similar to the VA1 unit but with less clay , higher elevation and has the same colour ,with gley phenomena ; firm and sticky consistency ,blocky structure with surface deep crackes and clear slikensides in the subsurface . There were lime segregations in the surface and few gypsum in the subsoil . With exception of one profile , the soil constituents were as follow :

\*Clay : 45.25 – 57 % silt : 5.25 – 42.95 % and sand : 14.25 – 23 .75% . The calcium carbonate : 0. 48- 7.68 % , gypsum nil - 2 .77% , soluble salts 0.67 – 1.61 % .

**C-** *fine , montmorillonitic ;thermic typic Haplotorrerts ( mapping unit : VT).*

It represents the old reclaimed soil of the fluvio marine soils ; with a relatively higher elevation and lies generally around 2 m. asl and occupies the south western part of the studied area , with craked deep clayey texture and is represented by one profile . Colour is mostly very dark grayish brown in the surface, very dark gray and gleyed in subsurface . The clayey texture is less homogeneous; in the subsoil ; consistency is firm and sticky; with depth ; blocky structure with clear slickensides in the subsurface . Soil constituents vary as follows :

clay: 34.83- 60.20 % ,silt : 17.60- 42.95 % , sand :12. 22- 28.70% . calcium carbonate as well as gypsum: 0. 64 – 2 % , soluble salts : 0.15 – 0.21 % (w/w).

**d-Clayey , montmorillonitic , thermic , Vertic Fluvaquents . ( mapping unit AV ) .**

It represents the relatively higher parts of the fluvio – marine clay flats and occupies most of the southern and western parts of the area, and represented by 5 profiles . Colour is mostly very dark grayish brown in surface ,very dark gray in subsurface

. \*Weak to moderate the subangular and angular blocky structure with weak slickensides. Soil constituents were as follows :

clay : 35.63 – 57.18 % , silt : 8.88- 54.05 % , sand 7.72 – 39.82 % ; Calcium carbonate : 0. 64 – 3. 44 % , gypsum : nil – 1. 61 % ; soluble salts 0.16 – 2.25% (w/w)..

*e-Loamy over clayey, mixed , thermic ; Typic Fluvaquents ( mapping unit : AT ) .*

It represents the fluvio – marine clay flats with irregular relief elevation of 1 to 3 m asl , occupied the middle part of the area and is represented by 4 profiles . Colour is dark gleyed in subsurface Consistency friable to firm and sticky to very sticky with depth . Weak subangular and angular blocky structure . Soil constituents are as follows :

clay : 22.55- 61 .68 % , silt 3.25- 46.38 % , sand 20.47-45.47%. calcium carbonate 0.4 – 2.5 % , gypsum : nil - 0.65%; soluble salts 0.25 – 0.91 % (w/w).

## II –Soil properties :

- Soil salinity EC ( of saturation extract): 3.19- 46.3 dS/m ,
- Soluble cations :  $\text{Na}^+ > \text{Mg}^{++} > \text{Ca}^{++} > \text{K}^+$  in VA1 and VA2 , but  $\text{Na}^+ > \text{Ca}^{++} > \text{Mg}^{++} > \text{K}^+$  in some of the VA and AT.

-- \*Soluble anions :  $Cl^- > SO_4^{2-} > HCO_3^-$  except in some soil of VA2 where  $SO_4^{2-}$  dominated .

-- Soil pH was slightly to strongly alkaline : 7.38- 8.53 .

-- Organic matter 0.51 – 2.80 % .

--- CEC : 32.50 – 54 . 70 cmolc/ kg soil , with the high values in VA then VT , while AV and AT soil had lower values .

-- Exchangeable cations in all soils of VA1 , VA2 and most of AV and AT followed the order :  $Mg^{++} > Ca^{++}$  or  $Na^+ > K^+$  . The order

$Ca^{++} > Mg^{++} > Na^+ > K^+$  was in the old reclaimed ( soils of VT , AT and AV units).

### III - Available macro nutrients :

N [( ammonium + nitrate) N] : 14 – 115 mg / kg soil . The highest values in the surface ; P ( Na – bicarbonate extractable ) : 1- 11 mg/ kg ; K ( ammonium acetate extractable ) : 160 – 733 mg/kg .

IV- Available micro nutrients ( DTPA- extractable ) Fe : 5.5- 17.6 mg/ Kg decreasing with depth ; Mn : 1.62 – 12.0 mg/ kg ; decreasing with depth ; Cu : 2.3 – 6.8 mg/ kg ; Zn : 0.8 – 4.3 mg/kg ( mostly between 2 and 3 mg/kg ).

### V- Other properties :



-- Bulk density : 1.20 – 1.58 g/ cm<sup>3</sup> .

\*Total porosity : 39.24 – 74.12 % ; quickly drainable pores: 3.86 – 16.75% ; slowly drainable pores 0.35- 7.45 % ; water holding pores 9.32- 24.66% ; fine capillary pores 12.56- 37.87 % ; moisture (w/v): field capacity 19.8 – 42.9 % ,wilting point : 11.6- 25.9 % , available water 7.45- 17.9% ; Hydraulic conductivity : 0.15 – 4.46 cm/hour .

#### **VI- Mineralogy :**

Smectite ( montmorillonite ) was the predominate mineral followed by kaolinite , then illite (traces) , few palygorskite and traces of inter stratified (traces)

+minerals . Accessory minerals “ Quartz . Feldspars , Dolomite , Gypsum “ (traces and few) ; calcite (traces in subsurface some profiles ) .

#### **IV-Land evaluation :**

The FAO Framework ,1976, the rating system of Sys and Verheye , 1978 and Sys et al. 1993 were used in this study.

. Most soils had from no to slight limitations for topography ; soil depth ; calcium carbonate and gypsum ; soil texture , except of moderately intensity in VA1 . The most effective characteristics are wetness and salinity / alkalinity . The intensity of their limitation varied widely from slight to very severe.

The following land suitability unit , were identified :

**S2wsn land unit** : limitation mainly are moderately severe in old reclaimed clay soils (VT soil).

**S3wsn -1 land unit** : More severl limitation than S2 unit; in stratified loamy and clayey soils ( AT soil ); limitations are mainly moderate for wetness and salinity .

**S3wsn -2 land unit**: limitations are as in S3wsn -1 soils , but differ in severity and it includes the less fine clayey soils ( AV soil unit) .

**N1 wsn-1 land unit** : limitations are mainly severe and soils are not suitable in their present condition ;these unit includes the low- lying clayey soils (VA2 soil unit) ; limitations are sever due to wetness , salinity for as well as physical conditions. .

**N1 wsn-2 land unit**: This unit is almost the same as N1 wsn-1, it includes VA.1 soils; with more severe limitations then N1 wsn-1 unit. .

### **VIII- Water quality :**

E1 - salam canal water had an EC of between 1.2 and 1.76 dS/ m ,with slight to moderate restrictions for use with no permeability problems. Ion toxicity is mainly for boron , chloride and sodium ions ; for B: suitable for the boron sensitive crops , for Cl<sup>-</sup> and Na<sup>+</sup> suitable for sensitive trees and woody plants using surface irrigation .

## **iX – Potential suitability for crops : (Sys et . al 1993 ) :**

The evaluation of these soils for producing some crops could be described as follows :

-- **Produce** : mainly vegetables and fruits .

-- **Management** : irrigation method , farm size , capital density , labour intensity . farm power and market orientation also are recognized .

The climatic requirement indicate high suitability for most crops with exception to sorghum and millets which are moderately suitable . Potential suitability is variable for as :

**Grain crops** : Barley (S1) followed by rice ,wheat , maize (S2) .

**Cash Crops** : Cotton and sugar beet (S2) followed by sunflower and soyabean (S3) .

**Forage crops** : Sorghum ( S2) followed by alfalfa , maize , clover and millets (S2) .

**Vegetable crops** : Cabbage (S2) followed by tomato , green pepper and watermelon (S3) followed by onion (S3) by carrots and beans (N1).

**Fruit crops** : Olives ( S2) followed by guava and citrus ( S3/ N1) .