5. SUMMARY.

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The present investigation was undertaken to study the diagnosis and evaluation of some soils in the North-western coast of Egypt. The studied area is bounded by longitudes 25° 10' and 29° 50' East and latitudes 30° 50' and 31° 10' North. It is characterized by the presence of five physiographic units namely:

1- Marine sediments.
2- Lacustrine sediments.
3- Fluvio-lacustrine deposits.
4- Aeolian plain.
5- Miscellaneous land types.

To get more soil information on such area, twenty soil profiles were chosen to represent the different physiographic units. The soil profiles were morphologically described and subjected to the physical, chemical and mineralogical analyses. The obtained results could be summarized as follows.

1- Physical and chemical properties

1. 1 Soils of marine sediments

These soils have variable texture, sandy clay to clay loam. $CaCO_3$ content varies widely from 6.43 % to 23.10 % indicates that these soils are slightly calcareous to calcareous. High percentage of these carbonates is due to the calcareous nature of the deposits from which the soils are formed. Organic matter content is very low and does not exceed 0.75 % and mostly decreases with depth. Soil reaction is mildly alkaline to moderately alkaline. Soil salinity is non saline to extremely saline EC values are in the range of 0.84-28.2 dSm^{-1}. Soluble cations are dominated by Na^+ followed by

Ca^{2+} and Mg^{2+} while K^{+} is the least abundant soluble cation. Soluble anions are mostly dominated by Cl^{-} followed by SO_4^{2-} and HCO_3^{-}. C.E.C. values range generally from 3.74 to 7.85 me/100g. depending on clay content. Exchangeable Ca^{2+} dominates the exchangeable cations followed by Na^{+} and Mg^{2+}, while K^{+} is the least. Gypsum content ranges from 0.19 to 2.84 %.

1. 2 Soils of lacustrine sediments

Soil texture varies from sand to sand clay loam. These texture variations are due to the modes of deposition together with aeolian sand carried in by wind activities. $CaCO_3$ content ranges between 12.1 to 30.3 % with a tendency of increase with depth. Organic matter content is very low, being in the range 0.10 to o.60 %. Soil reaction is neutral to mildly alkaline as the pH values range from 7.2 to 7.6. EC values range from 0.41 to 7.89 dSm^{-1}, indicating that the soils are non saline to slightly saline. The cationic composition of soluble salts is dominated by Na^{+} followed by Ca^{2+} and Mg^{2+} while Cl^{-} ions is the predominant anions followed by $SO_4^{=}$ and HCO_3^{-}. C.E.C. values range from 5.56 to 11.68 me/100g soils. Exchangeable Ca^{2+} is the predominant cation followed by Mg^{2+}, Na^{+} then K^{+}. Gypsum content is very low ranging from 0.11 to 0.21 %.

1. 3 Soils of fluvio-lacustrine deposits

Soil texture of this physiographic unit ranges from sandy loam to light clay. $CaCO_3$ content varies from 12.5 to 25.0 %. Organic matter content is very low and relatively decreases with depth. The analytical data of soil samples showed that, soil reaction is neutral to mildly alkaline according to the pH values range from 7.1 to 7.8. EC values range from 0.69 to 2.56 dSm^{-1} indicating that the soils are non saline. The cationic composition of the soil saturation extract are dominated by Na^{+} and / or Ca^{2+} followed by Mg^{2+} and K^{+}, while the soluble anions have the descending order

$Cl^- > HCO_3^- > SO_4^=$. C.E.C. values vary from 1.99 to 11.83 me/100g. soil. Exchangeable cations are characterized by the dominance of Ca^{2+} followed by Mg^{2+}, Na^+ and K^+. Gypsum content is very low, ranges between 0.15 and 0.23 %.

1. 4 Soils of aeolian plain

Soil texture of this physiographic unit is restricted between sand to sand clay loam. $CaCO_3$ content varies from 7.9 to 23.5 % with an irregular distribution pattern with depth. Organic matter and gypsum content is extremely low. The analytical data indicate that the soils are neutral to moderately alkaline as the pH values range from 7.0 to 7.9. The soils are non saline to extremely saline as indicated by Ec values which range from 0.42 to 21.7 dSm^{-1}. The soluble cations are dominated with Na^+ followed by Ca^{2+}, Mg^{2+} and K^+, while the anions follow the order $Cl^- > SO_4^= > HCO_3^-$. C.E.C. values range from 2.77 and 10.05 me/100g.soil. The exchangeable cations are dominated by Ca^{2+} followed by Mg^{2+}, Na^+ and K^+.

2- A field morphological rating scale for evaluating pedological development

The morphology rating scales was applied to determine the relative distinctness of horizons (RHD) and to determine the relative profile development (RPD). The determination of relative distinctness of horizons was made by a comparison of adjacent horizons, while the determination of the relative profile development was made by a comparison of the C horizon to the above horizons in the same profile. The data show that the high RHD and RPD rating in the studied area may be due to some environmental factors such as sedimentation pattern of recent materials and activity of cultivation processes in this area.

3- Trace elements studies

Total contents of some trace elements "Fe, Mn, Zn and Cu" were determined in the subsequent layers of the studied soil profiles in a trial to assess their distribution. Moreover, statistical analysis is performed to evaluate the role of soil variables in controlling trace elements content. Data indicate that soil texture, mineral composition and $CaCO_3$ content are the most important factors that correlate with total content of such elements. Furthermore, statistical measures of ***Oertel and Giles (1963)*** reveal the role of parent material and soil forming processes in affecting trace elements distribution.

4- Soil mineralogy

4. 1- Mineralogy of the sand fraction

a) Light minerals:

Data indicate that the light fraction is composed almost entirely of quartz which constitutes 95.0 – 98.0 %. Other associated minerals are feldspars which are detected in minute amounts (2.0 -5.0 % of total light minerals).

b) Heavy minerals:

Heavy minerals are dominated by opaques. Non-opaque minerals are dominated by pyroxenes, amphiboles, zircon and epidote while tourmaline, rutile, staurolite, biotite, kyanite, garnet and monazite are present in moderate amounts and the remaining minerals are of less pronounced occurrence or even absent.

4. 2- Clay mineralogy

Mineralogical identification of ten representative clay samples reveals that, the soils of marine sediments and fluvio-lacustrine soils dominated with palygorskite followed by kaolinite with less pronounced occurrence of smectite, illite, vermiculite, chlorite and interstratifed minerals while kaolinite and / or palygorskite

are the predominant clay mineral in the lacustrine soils. The identified accessory minerals are dominantly quartz and feldspars, while calcite and dolomite are detected in trace amounts.

The mineralogical constitution of the clay fraction suggests the inheritance of clay minerals from parent materials, except of palygorskite which is either inherited or neo-genetically. formed under the prevailed soil formation processes, stimulated by the presence of higher contents of $CaCO_3$ and soluble salts.

5- Uniformity of soil parent material

This was tackled through statistical size parameters and heavy minerals ratios, especially those related to the ultra stable minerals.

Compilation of data of both approaches indicates the multi-origin of most soils.

6- Soil classification

Application of the American system ***"Soil Taxonomy (1999)"*** indicates that most of the studied soils are related to the order ***Aridisols*** and ***Entisols.*** The obtained soil classification could be introduced as follows:-

1- Order: ***Aridisols***
- Sub-order: ***Calcids***
  - Great group: ***Haplocalcids.***
    - Sub-group: ***Sodic Haplocalcids***
      (as profiles 6 and 7).
    - Sub-group: ***Lithic Haplocalcids.***
      (as profile 5).
- Sub-order: ***Gypsids***
  - Great group: ***Haplogypsids***

Sub-group: ***Typic Haplogypsids***
(as profiles 8,16, 17, 18, 19, 20, 1, 2 and 4).

2- **Order:** ***Entisols***
Sub-order: ***Orthents***
Great group: ***Torriorthents.***
Sub-group: ***Typic Torriorthents.***
(as profiles 3,and15).
Sub-order: ***Psamments***
Great group: ***Torripsamments***
Sub-group: ***Typic Torripsamments***
(as profiles 10, 11, 12, 13 and 14).

7- Land Evaluation

On the bases of the previously mentioned presentation concerning the soil environments in addition to water and qualities, one can out-puts land capability information according to the different soil limitations.

Application of the capability index for the studied soil profiles reveals that the studied soils are placed between (II) and (V) grades follows:

1- Grade (II) Good soils, represented by profile 8.
2- Grade (III) Fair soils, represented by profile 18 (marine sediments), profiles 1, 2 and 4 (fluvio-lacustrine) and profiles 3, 9, 11, 12 and 14 (aeolian plain).
3- Grade (IV) Poor soils, represented by profiles10, 13 and 15 (aeolian plain) and profiles 17, 19 and 20 (marine sediments).
4- Grade (V) Very poor soils, represented by profile 5 (lacustrine) and profile 16 (marine).

The studied soil profiles related to the capability classification of grades (II) and (III) only are evaluated to determine thier suitability for growing 18 crops (6 field crops, 6 vegetable crops and 6 fruit trees).

Results reveal that the studied soil profiles include all the suitable classes (S_1, S_2, S_3 and N).