

5. SUMMARY AND CONCLUSION

The aim of the current investigation is to evaluate some soils located in north Delta for the agricultural purpose. These soils occupy an area runs generally from Damietta branch in the east to Rosetta branch in the west, penetrating the old cultivated lands in the south and stretching between longitudes $30^{\circ} 20'$ and $31^{\circ} 50'$ east and latitudes $31^{\circ} 10'$ and $31^{\circ} 36'$ north.

The area is characterized by three geomorphic units, namely, coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits. To fulfill the purpose of this study, thirty one soil profiles were dug along five transects within the studied area to represent all the possible variations between the soils consisting the three geomorphic units. Soil profiles were morphologically described and subjected to the physical and chemical analyses required to attain qualitative and quantitative evaluation for the studied area. The following is a brief summary of the obtained results:

- 1- Soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits were sandy, clay and clay loam to clay, respectively.
- 2- CaCO_3 content ranged from 0.08 to 0.84; 0.17 to 8.38 and 0.22 to 2.94% whereas gypsum content varied from 0.11 to 3.65; 0.11 to 2.09 and 0.09 to 0.52% in the soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively.

- 3- Organic matter content was very low in all soil profiles and ranged from 0.06 to 0.72; 0.55 to 2.40 and 0.10 to 2.66% in the soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively.
- 4- Bulk densities ranged from 1.67 to 1.78; 1.14 to 1.51 and 1.20 to 1.60 g/cm³ in soils of the abovementioned three geomorphic units, respectively.
- 5- Total porosity ranged from 32.32 to 36.98; 44.49 to 58.09; and 40.30 to 55.71 % in the soils of the respective three geomorphic units.
- 6- Hydraulic conductivity varied widely from one geomorphic unit to another. It fluctuated between 11.375 and 19.960 in soils of the coastal barrier plains and beaches; 0.025 and 0.614 in the fluvio marine deposits and 0.053 and 2.285 cm/hr in the soils of the recent Nile alluvial deposits.
- 7- Soil moisture contents at field capacity, wilting point and available water increased by increasing silt, clay and organic matter contents. The highest values of moisture contents at field capacity, wilting point and available water were 45.73, 25.85 and 21.07% in the soils of fluvio marine deposits, while the lowest ones were 6.14, 3.28 and 2.02% in the soils of coastal barrier plains and beaches.
- 8- Soil salinity differed widely from one locality to another. EC values ranged between 1.3 and 78.9; 1.1 and 27.8 and 1.1 and 3.7 in the soils of the coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively. Soluble cations were dominated by Na⁺ followed by Mg⁺⁺, Ca⁺⁺ and K⁺ in the soils of the coastal barrier plains and beaches and fluvio marine deposits. In the soils representing

the recent Nile alluvial deposits, Ca^{++} dominated over magnesium. Soluble anions generally followed the descending order: $\text{Cl}^- > \text{SO}_4^{--} > \text{HCO}_3^-$. CO_3^{--} was not found in any detectable amount.

- 9- Soil reaction of the studied soils (pH) was slightly to moderately alkaline conditions of all the soils representing the different geomorphic units where these values fluctuated between 7.4 and 8.2.
- 10- SAR values ranged from 2.1 to 93.1; 1.6 to 69.1 and 1.3 to 9.7 in the soils representing the coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively.
- 11- The values of cation exchange capacity were in the order of fluvio marine deposits > recent Nile alluvial deposits > coastal barrier plains and beaches and had the averages of 48.80, 35.08 and 2.38 me/100g soil, respectively. The exchangeable cations of the soils of coastal barrier plains and beaches and fluvio marine deposits followed the descending order: $\text{Mg}^{++} > \text{Ca}^{++} > \text{Na}^+ > \text{K}^+$. However, calcium dominated over magnesium in the soils of the recent Nile alluvial deposits. ESP values of soils representing the recent Nile alluvial deposits were less than 15% whereas the ESP values of the soils representing the other two geomorphic units exceeded 15% (except for the soil profiles No. 2, 8 and 13 in the coastal barrier plains and beaches and profiles No 4, 9, 10 and 17 in the fluvio marine deposits).
- 12- Total nitrogen content ranged from 39.7 to 272.2; 179.8 to 1655.8 and 124.7 to 1740.2 with the averages of 96.9; 556.3 and 555.6 ppm in the soils of coastal barrier plains and beaches, fluvio marine deposits and

recent Nile alluvial deposits, respectively. Highly significant positive correlations were established between total N and organic matter content of all the soils representing the three geomorphic units. Available nitrogen ranged between minimum values of 3.5; 21.4 and 22.9 and maximum ones of 32.9; 167.8 and 175.1 and averaged 14.7; 61.6 and 63.9 ppm in the soils of the respective three geomorphic units. Highly significant positive correlations were found also between total and available N contents of the soils representing the three geomorphic units.

- 13- Total phosphorus content ranged from 172.5 to 401.2; 683.4 to 1312.2 and 505.9 to 1148.2 with averages of 280.8; 863.7 and 761.9 ppm in the soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively. Highly significant positive correlation were established between total P and clay content in the soils of the three geomorphic units. Available P ranged from 1.3 to 8.7; 4.5 to 28.4 and 4.8 to 23.5 corresponding to averages of 4.0, 12.1 and 12.6 ppm in the soils of the respective three geomorphic units. Significant negative correlation was found between available P and soluble Mg^{++} in the soils representing the coastal barrier plains and beaches.
- 14- Total potassium content ranged from 2.1 to 7.1; 17.4 to 30.6 and 12.8 to 23.9 with averages of 3.9, 24.1 and 18.9 me/100g in the soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively. Highly significant positive correlations were found between total K and soil clay content of all the geomorphic units. Available K content ranged from 0.09 to 0.88; 0.74 to 5.0 and 0.38 to

1.41 and averaged 0.39; 2.46 and 0.91 me/100g in the soils representing the respective three geomorphic units. Significant positive correlations were established between available K and soil clay content of all the geomorphic units.

- 15- Total iron content ranged from 1.12 to 2.15; 5.30 to 6.95 and 4.13 to 6.60% in the soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively. The corresponding computed weighted mean of total Fe ranged from 1.15 to 2.00; 5.52 to 6.76 and 4.89 to 6.37%. Highly significant positive correlations were found between total Fe and each of clay, sum of clay + silt and organic matter content. In contrast, total Fe was negatively highly significantly correlated with soil sand content of all the geomorphic units. The DTPA-extractable Fe ranged from 2.1 to 5.1; 2.1 to 25.1 and 2.9 to 26.7 ppm in the soils representing the respective three geomorphic units.
- 16- Total manganese content ranged from 73.5 to 187.4; 599.0 to 1143.0 and 483.0 to 976.0 ppm in the soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively. The corresponding computed weighted mean ranged from 83.07 to 169.78; 759.17 to 1068.11 and 555.33 to 880.83 ppm. Total Mn was positively highly significantly correlated with sum of clay + silt and negatively highly significantly correlated with soil sand content of all the geomorphic units. The DTPA-extractable Mn ranged from 0.5 to 4.7; 2.6 to 11.6 and 2.1 to 5.4 ppm in the soils representing the three geomorphic units, respectively.

- 17- Total zinc content ranged from 38.9 to 68.9; 96.7 to 179.1 and 89.9 to 158.1 in the soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively. The corresponding computed weighted mean ranged from 43.21 to 58.83; 98.15 to 164.68 and 99.01 to 154.48 ppm. Highly significant positive correlations were established between total Mn and soil clay content of all the studied geomorphic units. In contrast, total Mn was negatively highly significantly correlated with soil sand content. The DTPA-extractable Mn ranged from 0.2 to 1.6; 0.8 to 4.2 and 1.1 to 4.4 ppm in the soils representing the three geomorphic units, respectively.
- 18- Total copper content ranged from 28.4 to 46.8; 69.4 to 92.4 and 62.1 to 88.5 ppm in the soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively. The corresponding computed weighted mean ranged from 29.03 to 39.99; 69.65 to 87.47 and 66.60 to 85.98 ppm. Highly significant positive correlations were established between total Cu and each of clay and sum of clay + silt. In contrast, total Cu was negatively highly significantly correlated with sand content of all the soils representing the three geomorphic units. The DTPA-extractable Cu ranged from 0.1 to 1.1; 3.4 to 8.2 and 2.5 to 8.1 ppm in the soils representing the respective three geomorphic units.
- 19- Total boron content ranged from 12.5 to 38.1; 70.5 to 110.3 and 47.7 to 69.5 ppm in the soils of coastal barrier plains and beaches, fluvio marine deposits and recent Nile alluvial deposits, respectively. The corresponding computed weighted mean ranged from 13.34 to 32.74; 73.32 to 100.38
-

and 49.70 to 58.60 ppm. Total B was positively highly significantly correlated with total soluble salts content of the soils of the coastal barrier plains and beaches and fluvio marine deposits. The hot water soluble boron ranged from 0.9 to 7.4, 1.0 to 7.1 and 0.5 to 1.5 ppm in the soils representing the three geomorphic units, respectively.

- 20- Based on the abovementioned soil characteristics and recognized agricultural limitations, qualitative land capability classification was performed according to the USDA system (1973) and FAO framework of land suitability classification (1976). Qualitative land capability classification was also worked out following both the modified Storie index (Nelson, 1963) and Sys and Verheye's system (1978).

According to these systems, the soils of the studied area could be classified as follows:

A. The area suitable for agriculture utilization.

1. Using the USDA system, an area equals 204449 feddans, representing 96.63 % of the studied area, is suitable.
 2. Using the FAO system, an area equals 191949 feddans, representing 90.72 % of the studied area, is suitable.
 3. Applying modified Storie index, the suitable area equals 120799 feddans, representing 57.09 % from the studied area.
 4. Applying Sys and Verheye's system, an area amounting to 142289 feddans, representing 62.25 % from the studied area, is suitable.
-

B. The non suitable area recorded with the different systems can be summarized as follows:

1. Using the USDA system, the non suitable area equals 7141 feddans, representing 3.37% of the studied area.
2. Using the FAO system, the non suitable area equals 19641 feddans, representing 9.28% of the studied area.
3. Applying modified Storie index, an area equals 90791 feddans, representing 42.91% of the studied area, is non suitable.
4. Applying Sys and Verheye's system, an area equals 69301 feddans, representing 32.75% of the studied area, is non suitable.

C. Results may suggest that the quantitative systems more suitable under the Egyptian conditions, where their results are compatible with the studied area conditions.

D. Sys and Verheye's system, could be considered as favourable system under the conditions prevailing in the soils of Egypt.

As a general conclusion, it can be said that the soils of north Delta vary widely in their suitability for the agricultural purpose. A consequent detailed or semi detailed survey is required to attain reliable evaluation for such a wide area.