Remote Sensing and GIS Based Physiography and Soils Mapping of the Idku–Brullus Area, North Delta, Egypt

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The current investigation was carried out to recognize and delineate the physiography soils mapping of the IDKU – Brullus areas, North Delta, Egypt.

The studied area is located in the North Western part of the Nile Delta.

Landsat ETM+ (path 176/row 39) images (2003) and digital elevation model (DEM) was used in ERDAS Imagine 8.4 software to produce the physiographic maps of the study area.

From the physiographic point of view, the landscapes include: Flood plain, Lacustrine plain and Marin plain.

The soil map of the studied area was produced depending on the given data and the use of Arc-GIS 9.0 software.

The studied areas were classified according to the American Soil Taxonomy System (2006).

Keywords: Egypt, North Delta, Idku, Brullus, Remote Sensing, GIS, Physiography and soils mapping.

Remote sensing techniques were frequently used in identifying the most suitable lands for agricultural expansion.

The Rosetta Nile branch (East of Alexandria) is still discharging into the Mediterranean Sea through four coastal lakes: Manzala, Brullus, Mariut and Edko. These lakes could be considered as transitional sinks for the majority of anthropogenic wastes of Egypt (Awad and Yousef, 2002).

Ground water tables, as influenced by topography is one of the most important local factors that play an active role in the formation of different soils.
In Egypt for example, shallow ground water has been responsible for soil salinity and alkalinity in considerable areas especially in the northern part of the Nile Delta, along the Mediterranean coast.

The extraction of data from digital elevation model (DEM) and landsat ETM image generates a preliminary physiographic map which must be checked and completed through field observation.

A semi detailed survey was made throughout the investigated area. The interview forms were completed and detailed macro-morphological description was recorded using FAO guidelines (1990). Representatives soil samples have been collected and used for physical, chemical and fertility studies.

The keys to Soil Taxonomy (2006) were used to classify the different soil profiles. Arc – GIS software version 9.0 has been used as the main Geographic Information System (GIS) software for this study. Land quality classes were defined according to Sideruis (1989) guidelines.

Location

The studied area is located in the North Western part of the Nile Delta, it extends from longitudes 30° 17' 0"and 30° 43' 00"N and latitudes 31° 10' 00" and 31° 30' 00"E, with total area 12064 km² (i.e., 301048.9 Feddans) (Fig.1).

![Fig. 1. Location map of the study area.](image-url)
Geology

The surface of the area is essentially occupied by formation of the Quaternary and Holocene epochs (Said, 1962, Abo-El-Izz, 1971 and Shata et al., 1978).

Ibrahim (2001) reported that the geological history of the Nile Valley and Delta showed that these area were formed in the latter part of the Miocene and the beginning of Pliocene Periods.

The quaternary formations

Generally, these formations were formed during the Pleistocene and Holocene epochs and cover a large part of Egypt.

Alluvial deposits: Their uppermost part is about 9.8 meters in thickness and is composed of very fine materials with little sand.

Fluvio-marine deposits: These deposits dominate in the surface of the plain to the North and are particularly noted at the Southern edge of the North lakes.

Aeolian deposits: These deposits are mainly loose quartzitic sand making forms such as sand-duns (shifting sand), hummocks and sheets. Aeolian deposits, as these, are seen in areas at the North coastal plain.

Geomorphology

FAO Staff (1964), El Nahal et al. (1977) and Shata et al. (1978) indicated that three geomorphic units of the Delta can be distinguished namely:

Topography of the studied area
The northern half of the Delta region has an elevation of less than 5 m.a.s.l. (El Toukhry, 1995).

Temperature

The given data by Climatologically Normal of Egypt (2002) of Al-Brullus and Idko stations as shown in Table 1 and 2. According to the American Soil Taxonomy (USDA, 2006) and the above data the soil temperature regime of the Brullus and Idko stations is Thermic and soil moisture regime of the Brullus and Idko stations is Torric.

Water Resources

El Nahry (2001) said that the national water balance in Egypt is presented as:
TABLE 1. Climatological data of Brullus Area during the period (1960 - 2006).

<table>
<thead>
<tr>
<th>Element</th>
<th>Average Temperature (°C)</th>
<th>Evaporation (mm/month)</th>
<th>Relative humidity (%)</th>
<th>Rainfall (mm)</th>
<th>Wind speed knots</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max.</td>
<td>Min.</td>
<td>Mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan.</td>
<td>17.2</td>
<td>9.2</td>
<td>13.2</td>
<td>100</td>
<td>57</td>
</tr>
<tr>
<td>Feb.</td>
<td>17.4</td>
<td>9.7</td>
<td>13.5</td>
<td>112</td>
<td>55</td>
</tr>
<tr>
<td>Mar.</td>
<td>19.3</td>
<td>11.1</td>
<td>15.2</td>
<td>129</td>
<td>51</td>
</tr>
<tr>
<td>Apr.</td>
<td>22.1</td>
<td>13.2</td>
<td>17.7</td>
<td>134</td>
<td>51</td>
</tr>
<tr>
<td>May.</td>
<td>25.3</td>
<td>16.2</td>
<td>20.8</td>
<td>139</td>
<td>52</td>
</tr>
<tr>
<td>Jun.</td>
<td>27.5</td>
<td>19.3</td>
<td>23.4</td>
<td>140</td>
<td>53</td>
</tr>
<tr>
<td>Jul.</td>
<td>28.2</td>
<td>22.4</td>
<td>25.3</td>
<td>143</td>
<td>58</td>
</tr>
<tr>
<td>Aug.</td>
<td>30.1</td>
<td>23.0</td>
<td>26.6</td>
<td>145</td>
<td>58</td>
</tr>
<tr>
<td>Sep.</td>
<td>28.4</td>
<td>21.3</td>
<td>24.9</td>
<td>132</td>
<td>55</td>
</tr>
<tr>
<td>Oct.</td>
<td>26.0</td>
<td>18.1</td>
<td>22.0</td>
<td>128</td>
<td>56</td>
</tr>
<tr>
<td>Nov.</td>
<td>22.1</td>
<td>15.0</td>
<td>18.6</td>
<td>110</td>
<td>57</td>
</tr>
<tr>
<td>Dec.</td>
<td>19.0</td>
<td>10.6</td>
<td>14.8</td>
<td>91</td>
<td>58</td>
</tr>
</tbody>
</table>

TABLE 2. Climatological data of Idko Area during the period (1960 - 2006).

<table>
<thead>
<tr>
<th>Element</th>
<th>Average Temperature (°C)</th>
<th>Evaporation (mm/month)</th>
<th>Relative humidity (%)</th>
<th>Rainfall (mm)</th>
<th>Wind speed knots</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max.</td>
<td>Min.</td>
<td>Mean</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jan.</td>
<td>17.0</td>
<td>9.0</td>
<td>13.0</td>
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<td>110</td>
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<tr>
<td>Mar.</td>
<td>18.8</td>
<td>10.3</td>
<td>14.6</td>
<td>120</td>
<td>51.2</td>
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<td>Apr.</td>
<td>21.6</td>
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<td>Jun.</td>
<td>26.9</td>
<td>18.2</td>
<td>22.6</td>
<td>142</td>
<td>53.4</td>
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<tr>
<td>Jul.</td>
<td>28.0</td>
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<td>144</td>
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<td>10.1</td>
<td>14.2</td>
<td>83</td>
<td>58.4</td>
</tr>
</tbody>
</table>

Natural vegetation and land use

The main cultivated crops in the studied area are cotton (Gossypium Spp.), rice, corn (Zea mays), clover (Triflum alex) barley (Horidium vulgare) and beans (Vicia faba), meanwhile the common cultivated orchards are citrus, guava, banana and date palm trees. Vegetables represent small scattered areas including tomatoes, eggplant, potatoes, water melon and others.

The Delta region is totally deoveds of the natural vegetation, except. The better drained flats with a deeply cracked top soil generally have a cover of

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scattered Salicornia fruticosa, mixed with Halimione portulacoides and Atriplex sp. The clay flats with a fluffy top soil have in general no vegetation. Isolated areas are mostly covered with Halochnemon strobilaceum. The shallown swamps, bordering the lakes, are covered with Salicornia fruticosa, whereas Phragmites sp. occurs in the deeper ones. The sandy coastal plain and beaches have no vegetation. The stabilized sand dunes have a cover of Salicornia sp. (El-Badawi, 1986).

Abdel Rahman and Sadek (1995) concluded that landsat satellite data of years 1972, 1985 and 1988 provide variable information about the changes on land cover and land use of the northern part of the Nile Delta.

Soils of the study area

El Bogdady et al. (1968) and El-Gabaly et al. (1969) reported that in the northern part of The Nile delta, ground water is affected by water intrusion from the sea. In such cases the chemical composition of ground water, as well as, that of the soil solution reflects the influence of sea water.

It could be said that the major problem facing the agricultural development in Egypt is the secondary salinization which should be monitored regularly. Remote sensing procedures are tools which could fulfil this task timely and accurately.

Mustafa (1993) reported that results of paleontological study of shells and snails spread in the soils around Idko Lake indicated the presence of different species of marine, lacustrine, alluvial and terrestrial and plant shells. Accordingly this soil could be developed from a mixture of alluvium (River Nile), marine (Mediterranean Sea) and lacustrine (Idko Lake) deposits, He added that light textured soils around Idko lake are characterized by low values of moisture content, saturation percent, bulk density, and coefficient of linear extensibility (COLE), and high values of real density, total porosity and void ratio. On the contrary, heavy textured soils nearly have an opposite trend for all these properties.

Hussain (2004) concluded that: 1-Erosion and accretion phenomena still occur at east and west of Boughaz El-Brullus, 2-Lake’s area shrinkage, still occur (especially at southern west north, northern east and east of lake’s margin). The lake area during 1995 is 445.62 km², 442.78 km² during 1997 and 438.92 km² during 2000, 3-Rooted plants and many of islands inside the lake increased in size over the years 1997 to 2000, 4-Reclaimed areas has changed from fish farm, at the northern west part of lake’s margin and represented clearly from period1997 to 2000, 5-Part of the lake body changed to private fish farm as is clearly shown at the south western of lake’s margin. And 6-Sand and sediments accumulation inside the lake inlet decreased its depth. This affects water exchange between the lake and sea, increased rooted plant growth inside the lake, and increased sedimentation all over.

Soil properties

Agarwala and Ramamoorthy (1974) found that heavy textured soils showed more salinity hazard as compared with the light textured ones.

Nashed (1991) stated that the texture of the soil located around Lake Idko is ranging between sandy and clayey. The total available water is ranging between 13.07 and 20.80 cm. The value of hydraulic conductivity was ranging between 0.01 and 7.38 cm/hr. He added that the value of electric conductivity in the saturation extract is ranging between 3.38 and 96.61 dS/m in the soils around Lake Idko. Cation exchange capacity ranged between 4.2 and 19.87 meq/100 gm soil and the percentage of the exchangeable sodium was ranging between 7.17 and 61.91%. The percentage of organic matter in these soils was ranging between 0.04 and 2.90%.

Soil mineralogy

Mineralogical composition of five profiles representing the gley soils in northern part of the Nile Delta was investigated by Abdu et al. (1980), he found that the area was limited to uncultivated lands adjacent to Brullus Lake and the Mediterranean see is mainly occupied by three land forms mainly the Fluvio-lacustrine marine flats, the coastal barrier plain and swamps. Montmorillonite is the dominant clay mineral in the soils of swamps and the poorly drained gley soils followed by kaolinite, while illite is found in less amounts. In the fairly drained gley soils, kaolinite is dominant clay mineral and illite is the second mineral. The low content of clay in the coastal barrier plain and beaches dominated by kaolinite, while illite and montmorillonite are found in less proportion.

Soil classification

Abdel-Aal et al. (1989), evaluated the reclamation progress on the salt affected lands adjacent to Idko and Manzala lakes. Salt affected soils of the Northern Nile Delta are classified as aridisols (Aquolic Salorthids) and Entisols (Vertic Fluvaquepts and Typic Torrifluvents).

Material and Methods

Land inventory captures several data streams corresponding to land use and land cover, geopedologic units and institutional context. Above all other information about natural and cultural features can be georeferenced to them.

Pre-field work

Pre-field work was started by training on soil survey methodology, collection of all existing data and information on topography, geology, land resource maps, digital elevation model and satellite image about the study area. Then preliminary interpretation of image, selection of sample areas and preparation of working sheets was carried out.

Physiographic mapping of the study area

Topographic maps of the area under investigation (no. NH36-MID Rashid and NH36-M2c Idfina) of scale 1:50000 and Landsat ETM image (path 176/row39) taken during the year (2003) were used in this study for physiographic mapping. The extracted data from topographic maps are contour line, roads, urban areas, drains and canals where the land use/land cover were extracted from the landsat image. The physiography of the study area was defined throughout the following steps:

Digital elevation model (DEM) of the study area have been generated from the vector contour lines, the elevation points (which recorded during the field survey by (GPS) were also used to enhance the digital elevation model, ArcGIS software were used for this function.

Landsat ETM+ (path 176/row 39) images (2003) Fig.(2) and digital elevation model (DEM) was used in ERDAS Imagine 8.4 software to produce the physiographic map of the study area (Dobos et al., 2002).

![Fig.2. Landsat ETM+ (path 176/row 39) images (2003).](image-url)
Field work

The extraction of data from digital elevation model (DEM) and Landsat ETM image generates a preliminary physiographic map which must be checked and completed through field observation. Observation and description of soils on the landscape remain and irreplaceable source of information.

A semi detailed survey was made throughout the investigated area in order to discover precise soil patterns as well as the land types and the characteristic landscape based on the profiles study.

The field work have been planned to include the following: 1. Two sample areas represent 10% of the total area 126.4 km, 2. Fifteen detailed soil profiles (Fig. 3), 3. Sixteen mini-pits were taken for checking the validity of the physiographic map boundaries, and 4. Ten interview forms were completed and detailed macromorphological description was recorded using the FAO guidelines (1990). Representatives (48) soil samples have been collected from the studied soil profiles according to the morphological variation and used for physical and chemical studies.

![Legend](image)

Fig. 3. Location of the studied soil profile.

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**Laboratory analyses**

Soil sample of the profiles (4 to 15) were mechanically analyzed according to the international method Piper (1950) using NH₄ OH as dispersing agent.

Sample of the soil profiles (1 to 3), grain size distribution was carried out by sieving diameters and classified according to Trask method (1950).

Soil colour in both wet and dry samples was determined with the aid of Munssel Colour Charts (Soil Survey Staff, 1975).

The following analyses were carried out using the “soil survey laboratory methods manual” (USDA, 2004): Calcium carbonate, organic matter.

The water extract components were determined in the soil paste for the samples of the soil profiles (4 to 15), and in the extract 1:1 for samples of the profiles (1 to 3), the following determinations were carried out: Soluble carbonates and bicarbonates, Chlorides, Sulphates, Calcium and magnesium, Sodium and Potassium and Electric conductivity (EC) was determined conductometrically, Soil reaction (pH) was determined in 1:2.5 soil water suspension for profiles (1-3), and in soil paste for profiles (4-15).

Cation exchange capacity, (Piper, 1950) as modified by (Goher, 1954). Exchangeable cations (Na⁺, K⁺, Mg²⁺ and Ca²⁺) Soil Lab. Staff (1984) and available potassium was extracted by 1 N NH₄OAC solution (pH 7.0) (Kundsen et al., 1982).

**Integration of the data in a soil Map**

The Keys to Soil Taxonomy (2006), were used to classify the different soil profiles.

Arc - GIS software version 9.0 has been used as the main Geographic Information System (GIS) software for this study.

The main purpose for using such tool is to use the capability of the system for data input; analysis data output and prepare data base liner for the study area. The used hardware in the study area IBM compatible Intel Pentium LXE, 166 MHZ, with 32 MB RAM, 2,1 GB Hard disk, graphic monitor high resolution 1024*768 unlimited colors display.

**The used thematic maps are**


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Physiography of the studied area

Based on Landsat ETM+, digital elevation model (DEM) and field check, the physiography of the studied area has been identified. The obtained results as shown in Table 3 and Map 1 reveal that, the flood plain is the main landscape in this area. This landscape dominates the southern parts of the studied area, covering an area of 805.30 km². This landscape was resulted from the Nile deposits, during the flood periods before construction of the high dam. It is characterized by alluvial sediments, which belong to Holocene era. Relief types in the flood plain are flat, almost flat and gently undulating. The lacustrine dominate the middle parts of the area; covering an area of 288.98 km². This landscape was formed from the interaction between the river Nile and the lakes of Brullus and Idko deposits during the flooding periods. The fluvial-lacustrine plain in the studied area is characterized by alluvial -lacustrine sediments, which belongs to Holocene era. The dominant relief type in this plain is flat or almost flat to gently undulating except small areas of convex slope, which are undulating and belongs to the old deltaic deposits. The marine plain is found in the northern part of the area dominating an area of 169.32 km². It include areas of flat to almost flat and gently undulating topography, which represented by the land forms of sand sheets, hummocks and depressions.

**TABLE 3. Particle size distribution.**

<table>
<thead>
<tr>
<th>Profile No.</th>
<th>Mapping unit</th>
<th>Depth in (cm)</th>
<th>* V.C.S. 2-1 mm</th>
<th>C.S. 1-0.5 mm</th>
<th>M.S. 0.5-0.25 mm</th>
<th>F.S. 0.25-0.1 mm</th>
<th>V.F.S. 0.1-0.05 mm</th>
<th>Si.+C &lt;0.05 mm</th>
<th>Texture class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L222</td>
<td>0-20</td>
<td>0.5</td>
<td>1.6</td>
<td>26.4</td>
<td>69.1</td>
<td>1.9</td>
<td>0.3</td>
<td>sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20-50</td>
<td>0.0</td>
<td>0.6</td>
<td>21.7</td>
<td>75.0</td>
<td>2.2</td>
<td>0.5</td>
<td>sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>50-150</td>
<td>0.0</td>
<td>0.0</td>
<td>22.2</td>
<td>73.0</td>
<td>4.2</td>
<td>0.6</td>
<td>sand</td>
</tr>
<tr>
<td>2</td>
<td>M112</td>
<td>0-40</td>
<td>0.0</td>
<td>0.4</td>
<td>14.6</td>
<td>82.3</td>
<td>2.7</td>
<td>0.0</td>
<td>sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40-80</td>
<td>0.0</td>
<td>1.9</td>
<td>13.4</td>
<td>81.2</td>
<td>3.3</td>
<td>0.2</td>
<td>sand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80-150</td>
<td>0.0</td>
<td>1.0</td>
<td>24.5</td>
<td>72.0</td>
<td>2.2</td>
<td>0.3</td>
<td>sand</td>
</tr>
</tbody>
</table>

*V.S.C. = very coarse sand. C.S. = coarse sand, M.S. = medium sand. F.S. = fine sand, V.F.S. = very fine sand, Si. = silt, C. = clay

From the physiographic point of view these landscapes includes the following units:

1- Flood plain : a. River terraces: these land forms cover an area of 409.96 km², it has an elevation that ranges between 6.5 to 8.5 m. a.s.l. It includes high, moderately high and low terraces, The differences between them are fluctuated in the range of 0.5 to 1.5 meter. b. River levees: the total area of these types is 117.4 km² these areas are closely adjacent to the river banks and has an elevation of 5.0 to 7.0 m. a.s.l. Difference between the high ,moderately and low levees does not exceed 1.0 meter. It includes overflow (F125) and (F126) , representing an area of 260.99 km², decantation. c- Basins: basins the elevation of these types range between 6.0 and 8.75 m. a.s.l . d- Swales: they represent a small area of Egypt. J. Soil. Sci. 49, No. 3 (2009)
16.02 km², it have an elevation of 7 to 8.5 m. a.s.l. and found mainly adjacent to the river banks. And e- Isolated hills: this type is found in scattered areas as it represent the old deltaic deposits, it cover an area of 0.93 km².

2-Lacustrine plain: a. Fish ponds/ dried fish ponds: these land forms are found adjacent to the lakes, it covers an area of 88.43 km², and they have an elevation ranges between 0.0 to 0.5 meter a.s.l. b. Dry and wet sabkhas: the dry and wet sabkhas are found in small patches in the north of the studied area, they cover an area of 39.46 km² with an elevation located in the range of 0.0 to 1.0 m above sea level. c. Wet land, swamps and dried lake bed: these unites area associated with the area adjacent to the lakes covering an area of 100.35 km², they have an elevation of 0.0 in above sea level. And d. Sand dunes: this type includes high, moderately high and low sand dunes, it found in the north of the Brullus and Idko lakes covering an area of 60.76 km². They have an elevations differ from 4.0 to 20 m above sea level.

3-Marine plain: a. Sand sheets: this land form is found in the northern parts of the studied area, covering an area of 102.13 km², it have an elevation located in the range of 1.0 to 8.0 m above sea level. b. Hummocks: this type is found in a many strips parallel to the shore line, covering an area of 59.99 km² and have an elevation of 1.0 to 2.0 m above sea level. And c. Depressions: this type covers small parts (i.e., 7.2 km²) in the north of the studied area, the elevation of this land form differ from -1.0 to 1.0 m. above sea level (Map 1).

Map 1. The main physiographic units of the studied area.

Soils of the studied area

The morpho - pedological study and analytical data of the physiographic units in the studied area reveals the following:

Soils of the flood plain: As above mention the flood plain includes different land forms (i.e., river terraces, levees and basins) each land form were represented by a soil profile morphological description and laboratory analyses of these profiles were carried out the obtain data reveals that the soils of the flood plain differ from land form to another as the following:

Soils of the river terraces (F111, F112, F113): These soils are represented by soil profile 7. Based on the American soil taxonomy system (2006) these soils could be classified as, Typic Torrifluvents (profile 7). Tables 4, 5, 6 and 7 represent some physical and chemical analyses of representative soil profile. The morphological description of this soil profile 7 is given in the following

<table>
<thead>
<tr>
<th>Profile No.</th>
<th>Location Description</th>
<th>Soil Taxonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>2Km. North Izbet Duwidar</td>
<td>Typic Torrifluvents</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mapping unit</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation</th>
<th>Topography</th>
<th>Land Form</th>
<th>Land use</th>
<th>Parent Material</th>
<th>Drainage</th>
<th>Ground water Table</th>
<th>Soil Taxonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>F111</td>
<td>31° 11' 33&quot; N</td>
<td>30° 26' 58&quot; E</td>
<td>1.5 m.a.s.l.</td>
<td>Almost flat</td>
<td>Flood plain</td>
<td>Cultivated with field crops (cotton)</td>
<td>Well drained</td>
<td>&gt; 150 cm</td>
<td>Typic Torrifluvents</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 30</td>
<td>Brown (10 YR 3/4) moist, yellowish brown (10 YR 5/4) dry; clay; moderate to strong medium to coarse granular structure; sticky, plastic, firm, hard; common fine discontinuous random interstitial pores, very few fresh and humified residuals of organic matter; many fine to medium roots; very few fine irregular yellowish brown hard concretion of (CaCO₃); slightly effervescence with HCl; clear smooth boundary.</td>
</tr>
<tr>
<td>30 - 80</td>
<td>Dark brown (10 YR 3/2) moist, dark grayish brown (10 YR 5/2) dry; clay; moderate sub-angular blocky structure; very sticky, very plastic, very firm, very hard; common fine to medium continuous and discontinuous random interstitial pores; very few; very fine soft segregation of (CaCO₃); slightly effervescence with HCl; clear smooth boundary.</td>
</tr>
</tbody>
</table>

Soils of the Basins (F125 & F126) : These soils are represented by soil profile no. 4. Based on the American soil taxonomy system (2006) these soils could be classified as, *Vertic Natragids* (4). Tables 4, 5, 6 and 7 represent some physical and chemical analyses of representative soil profile. The morphological descriptions of the profile 4 are shown in the following:

<table>
<thead>
<tr>
<th>Profile No.</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mapping unit</td>
<td>F126</td>
</tr>
<tr>
<td>Location</td>
<td>1.5Km. South Village No.6</td>
</tr>
<tr>
<td>Latitude</td>
<td>31° 15' 59&quot; N</td>
</tr>
<tr>
<td>Longitude</td>
<td>30° 21' 10&quot; E</td>
</tr>
<tr>
<td>Elevation</td>
<td>1.5 m.a.s.l.</td>
</tr>
<tr>
<td>Topography</td>
<td>Almost flat</td>
</tr>
<tr>
<td>Land Form</td>
<td>Fluvio-Marine plain</td>
</tr>
<tr>
<td>Land use</td>
<td>Cultivated with field crops (cotton)</td>
</tr>
<tr>
<td>Parent material</td>
<td>Fluvio-Marine deposits</td>
</tr>
<tr>
<td>Drainage</td>
<td>Well drained</td>
</tr>
<tr>
<td>Ground water Table</td>
<td>&gt; 150 cm</td>
</tr>
<tr>
<td>Soil taxonomy</td>
<td><em>Vertic Natragids</em></td>
</tr>
</tbody>
</table>

**Depth (cm)**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 30</td>
</tr>
<tr>
<td>Very dark brown (10 YR 2/2) moist, dark brown (10 YR 3/3) dry; common patches of iron oxides, reddish brown (2.5 YR 4/8) dry; silty clay; moderate to strong medium granular structure; slightly sticky, slightly plastic, friable, slightly hard; common fine discontinuous random interstitial pores; few fresh and humified residues of organic matter; many fine to medium roots; very few residuals of shell fragments; very few fine hard angular yellowish brown concretion of Ca CO₃; slightly effervescence with HCl; clear smooth boundary.</td>
</tr>
<tr>
<td>30 - 70</td>
</tr>
<tr>
<td>Very dark grayish brown (10 YR 3/2) moist, dark grayish brown (10 YR 4/2) dry; clay; moderate to strong medium sub-angular blocky structure; sticky, plastic, firm, hard; common fine to medium</td>
</tr>
</tbody>
</table>
continuous and discontinuous vughs, thin shiny continuous clay films lining the voids distinct platy intersecting slicken sides; very few humified patches of organic matter; many fine to medium roots; very few residuals of shell fragments; slightly effervescence with HCl; clear smooth boundary.

70 - 150

| Dark brown (10 YR 3/3) moist, dark brown (10 YR 3/3) dry; clay; moderate to strong medium angular to sub-angular blocky structure; sticky, plastic, firm, hard; common fine to medium continuous and discontinuous random interstitial pores; few residuals of shell fragments; slightly effervescence with HCl. |

Soils of the lacustrine plain: The morpho-pedological study and analytical data of the physiographic units in the studied area reveal the following: Soils of dried fish ponds (L111) and dried lake bed (L117). These soils are represents by profiles no. 9. Based on the American soil taxonomy system (2006) these soils could be classified as Typic Haplosalids (profile no. 9). Tables 4, 5, 6 and 7 represent some physical and chemical analyses of representative soil profile. The morphological descriptions of the profile 9 are shown in the following:

| Profile No. | 9 |
| Mapping unit | L117 |
| Location | 2Km. East Izbet El-Kadra |
| Latitude | 31°23'35" N |
| Longitude | 30°31'15" E |
| Elevation | 2 m.a.s.l. |
| Topography | Almost flat |
| Land Form | Lacustrine plain |
| Land use | Barren |
| Parent material | Fluvio-lacustrine deposits |
| Drainage | Moderately well drained |
| Ground water table | < 110 cm. |
| Soil taxonomy | Typic Haplosalids |

| Depth (cm) | Description |
| 0 - 30 | Dark grayish brown (10 YR 4/2) dry; dark brown (10 YR 3/3) moist; many, medium, faint, clear, light gray (10 YR6/1) motles; many shell fragments; clay; moderate, medium, angular blocky structure; medium, common pores; hard, very firm, very sticky, very plastic; slightly effervescence with HCl; gradual, smooth boundary. |
| 30 - 60 | Light brownish gray (10 YR 6/2) dry; brown (10 YR 4/3) moist, abundant, fine, prominent, defuse, dark, gray (10 YR4/1) motles; many shell fragments; few, |

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fine, faint, clear, light gray (10YR6/1) mottles; clay; strong coarse, angular blocky structure; few fine pores; very hard, very firm, very sticky, very plastic; slightly effervescence with HCl; gradual, smooth boundary

60 – 90

Dark greyish brown (10 YR 4/2) dry; very dark brown (10 YR 3/2) moist; large pocket of grayed clay; many shell fragments; clay; massive; very few pores; extremely hard, extremely firm, very sticky, very plastic; slightly effervescence with HCl; gradual, smooth boundary

90 - 110

Dark greyish brown (10 YR 4/2) dry; very dark brown (10 YR 3/3) moist; large pocket of grayed clay; many shell fragments; clay massive; extremely hard, extremely firm, very sticky, very plastic; slight effervescence with HCl.

*Sand dunes (L222)*: These soils are representative by the soil profile no. 1. Based on the American soil taxonomy system (1999) these soils could be classified as *Typic Torripsamments*. Tables 4, 5, 6 and 7 represent some physical and chemical analyses of representative soil profile. The morphological descriptions of this profile 1 are shown in the following:

<table>
<thead>
<tr>
<th>Profile No.</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mapping unit</td>
<td>L222</td>
</tr>
<tr>
<td>Location</td>
<td>1Km. North Idku city</td>
</tr>
<tr>
<td>Latitude</td>
<td>31°18′48″ N</td>
</tr>
<tr>
<td>Longitude</td>
<td>30°17′22″ E</td>
</tr>
<tr>
<td>Elevation</td>
<td>2 m.a.s.l.</td>
</tr>
<tr>
<td>Topography</td>
<td>Almost flat</td>
</tr>
<tr>
<td>Land Form</td>
<td>Coastal plain</td>
</tr>
<tr>
<td>Land use</td>
<td>Cultivated with palm trees and Guava</td>
</tr>
<tr>
<td>Parent material</td>
<td>Marine deposits</td>
</tr>
<tr>
<td>Drainage</td>
<td>well drained</td>
</tr>
<tr>
<td>Ground water Table</td>
<td>&lt; 150 cm</td>
</tr>
<tr>
<td>Soil taxonomy</td>
<td><em>Typic Torripsamments</em></td>
</tr>
</tbody>
</table>

**Depth (cm)**

0 – 20

Light olive brown (2.5 Y 5/4) moist, pale yellow (2.5 Y 7/6) dry; common very fine spherical hard dark black sand, olive black (7.5 Y2/1) moist, black (7.5 Y2/1) dry; sand; single grains non sticky, non plastic, loose; common fine discontinuous random expend pores; many fine to coarse roots; common residuals of shell fragments; strong effervescence with HCl; clear smooth boundary.

Olive brown (2.5 Y 4/4) moist, light olive brown (2.5 Y 5/4) dry; common very fine spherical dark black sand, olive black (7.5 Y 2/1) moist, black (7.5 Y 3/1) dry; sand; single grains non sticky and non plastic, firm, hard, common fine to medium continuous and discontinuous pores; few fine to coarse roots; common residuals of shell fragments; strong effervescence with HCl; clear smooth boundary.

Soils of the marine plain: Soils of sand sheets (M111, M112 and M113): These soils are represents by profile no. 2. Based on the American soil taxonomy system (2006) these soils could be classified as, Typic Torripsamments. Tables 3, 4, 5 and 6 represent some physical and chemical analyses of representative soil profile. The morphological descriptions of this profile 2 are shown in the following:

<table>
<thead>
<tr>
<th>Profile No.</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mapping unit</td>
<td>M112</td>
</tr>
<tr>
<td>Location</td>
<td>1.5Km. South Iduki city</td>
</tr>
<tr>
<td>Latitude</td>
<td>31°18'06&quot; N</td>
</tr>
<tr>
<td>Longitude</td>
<td>30°18'25&quot; E</td>
</tr>
<tr>
<td>Elevation</td>
<td>1.6 m.a.s.l.</td>
</tr>
<tr>
<td>Topography</td>
<td>Almost flat</td>
</tr>
<tr>
<td>Land Form</td>
<td>Coastal plain</td>
</tr>
<tr>
<td>Land use</td>
<td>Cultivated with palm trees and Guava.</td>
</tr>
<tr>
<td>Parent material</td>
<td>Marine deposits</td>
</tr>
<tr>
<td>Drainage</td>
<td>Well drained</td>
</tr>
<tr>
<td>Ground water Table</td>
<td>&gt; 150 cm.</td>
</tr>
<tr>
<td>Soil taxonomy</td>
<td>Typic Torripsamments</td>
</tr>
</tbody>
</table>

0 – 40

Olive brown (2.5 Y 4/4) moist, light yellowish brown (2.5 Y 6/4) dry; common very fine spherical hard black sand, olive black (7.5 Y 3/1) moist, black (7.5 Y 2/1) dry; sand; single grains non sticky, and non plastic, loose; common fine discontinuous random expand vertical pores; many coarse to coarse roots; few residuals of shell fragments; slight effervescence with HCl; clear smooth boundary.
20 - 80
Light olive brown (2.5 Y 5/4) moist, pale yellow (2.5 Y 7/4) dry; common very fine spherical hard dark black sand, olive black (7.5 Y 3/1) moist, black (7.5 Y 2/1) dry; sand; single grains; non sticky, non plastic; loose; common fine to medium continuous and discontinuous random pores; few medium to coarse roots; few residuals of shell fragments; slight effervescence with HCl; clear smooth boundary.

80 - 150
Olive brown (2.5 Y 4/4) moist, light yellow brown (2.5 Y 6/4) dry; common very fine spherical hard dark black sand, olive black (7.5 Y 3/1) moist, black (7.5 Y 2/1) dry; sand; single grains; non sticky, non plastic, loose, common fine and to medium continuous and discontinuous random; vertical pores; common residuals of shell fragments; moderate effervescence with HCl.

**TABLE 4. Particle size distribution.**

<table>
<thead>
<tr>
<th>Profile No.</th>
<th>Mapping unit</th>
<th>Depth (cm)</th>
<th>C.sand %</th>
<th>F.sand %</th>
<th>Silt %</th>
<th>Clay %</th>
<th>Texture class</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>F126</td>
<td>0-30</td>
<td>0.3</td>
<td>8.4</td>
<td>47.5</td>
<td>43.8</td>
<td>Silty clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30-70</td>
<td>0.6</td>
<td>6.2</td>
<td>38.7</td>
<td>43.8</td>
<td>Clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>70-150</td>
<td>3.4</td>
<td>8.3</td>
<td>35.9</td>
<td>52.4</td>
<td>Clay</td>
</tr>
<tr>
<td>7</td>
<td>F111</td>
<td>0-30</td>
<td>0.7</td>
<td>6.7</td>
<td>39.3</td>
<td>53.3</td>
<td>Clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30-80</td>
<td>0.0</td>
<td>7.2</td>
<td>35.2</td>
<td>57.6</td>
<td>Clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>80-150</td>
<td>0.0</td>
<td>5.0</td>
<td>38.0</td>
<td>57.0</td>
<td>Clay</td>
</tr>
<tr>
<td>9</td>
<td>L117</td>
<td>0-30</td>
<td>0.2</td>
<td>21.9</td>
<td>21.5</td>
<td>56.4</td>
<td>Clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30-60</td>
<td>0.0</td>
<td>22.7</td>
<td>16.2</td>
<td>61.1</td>
<td>Clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60-90</td>
<td>0.2</td>
<td>22.2</td>
<td>20.1</td>
<td>57.5</td>
<td>Clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90-110</td>
<td>0.0</td>
<td>22.2</td>
<td>23.5</td>
<td>54.0</td>
<td>Clay</td>
</tr>
</tbody>
</table>

**TABLE 5. Some chemical characteristics.**

<table>
<thead>
<tr>
<th>Profile No.</th>
<th>Depth cm</th>
<th>Sp%</th>
<th>Caco3 %</th>
<th>Soluble Cations mg/100g soil</th>
<th>Soluble Anions meq/100g soil</th>
<th>O.M. %</th>
<th>pH 1:2.5</th>
<th>EC ds/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-20</td>
<td>16</td>
<td>5.9</td>
<td>0.04 0.06 0.17 0.02 0.00 0.06 0.15 0.08</td>
<td>0.51 7.4 1.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20-50</td>
<td>17</td>
<td>7.22</td>
<td>0.07 0.04 0.20 0.02 0.00 0.07 0.17 0.09</td>
<td>0.42 7.5 1.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50-150</td>
<td>17</td>
<td>4.65</td>
<td>0.07 0.13 0.27 0.03 0.00 0.13 0.23 0.14</td>
<td>0.62 7.5 2.85</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0-40</td>
<td>19</td>
<td>3.50</td>
<td>0.07 0.08 0.19 0.02 0.00 0.08 0.17 0.11</td>
<td>0.60 7.4 1.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>40-80</td>
<td>20</td>
<td>3.50</td>
<td>0.06 0.07 0.17 0.02 0.00 0.07 0.15 0.10</td>
<td>0.50 7.5 1.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>80-150</td>
<td>19</td>
<td>5.15</td>
<td>0.07 0.11 0.25 0.04 0.00 0.11 0.22 0.14</td>
<td>0.40 7.7 2.8</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0-30</td>
<td>85</td>
<td>1.6</td>
<td>1.02 1.07 3.47 0.19 0.00 1.7 3.09 1.59</td>
<td>2.30 7.7 5.2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-70</td>
<td>100</td>
<td>3.5</td>
<td>1.22 1.35 3.93 0.31 0.00 1.35 3.54 1.92</td>
<td>1.80 8.2 5.7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>70-150</td>
<td>82</td>
<td>3.5</td>
<td>1.26 1.39 3.55 0.30 0.00 1.39 3.16 1.95</td>
<td>1.70 8.4 5.4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>0-30</td>
<td>101</td>
<td>1.8</td>
<td>1.30 0.69 2.82 0.23 0.00 0.99 2.66 1.39</td>
<td>2.10 7.8 4.94</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-80</td>
<td>103</td>
<td>1.8</td>
<td>2.62 0.33 1.36 0.11 0.00 0.48 1.27 0.67</td>
<td>1.80 7.8 2.57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>80-150</td>
<td>105</td>
<td>2.7</td>
<td>2.19 1.17 4.81 0.39 0.00 1.70 4.49 2.37</td>
<td>1.55 7.9 7.07</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>0-30</td>
<td>83.2</td>
<td>2.40</td>
<td>4.53 7.72 43.24 0.66 0.00 0.28 37.84 18.04</td>
<td>1.14 7.8 6.57</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>30-60</td>
<td>80.5</td>
<td>1.90</td>
<td>2.24 3.98 51.68 0.80 0.00 0.54 44.83 13.31</td>
<td>0.93 7.7 7.29</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>60-90</td>
<td>81.7</td>
<td>1.90</td>
<td>5.23 11.73 50.00 0.82 0.00 0.31 53.71 19.75</td>
<td>0.88 7.7 8.87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>90-110</td>
<td>102.2</td>
<td>1.00</td>
<td>5.39 17.54 102.47 1.84 0.00 0.57 95.61 31.08</td>
<td>0.41 7.8 116.41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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TABLE 6. C.E.C. Exchangeable cations and E.S.P.

<table>
<thead>
<tr>
<th>Depth cm</th>
<th>C.E.C meq/100g soil</th>
<th>Exchangeable cations meq / 100 g soil</th>
<th>E.S.P %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ca++</td>
<td>Mg++</td>
<td>Na</td>
</tr>
<tr>
<td>1 0-20</td>
<td>3.89</td>
<td>2.45</td>
<td>1.05</td>
</tr>
<tr>
<td>20-50</td>
<td>4.06</td>
<td>2.57</td>
<td>1.10</td>
</tr>
<tr>
<td>50-150</td>
<td>3.94</td>
<td>2.50</td>
<td>1.07</td>
</tr>
<tr>
<td>2 0-40</td>
<td>10.43</td>
<td>6.43</td>
<td>2.83</td>
</tr>
<tr>
<td>40-80</td>
<td>8.32</td>
<td>5.28</td>
<td>2.25</td>
</tr>
<tr>
<td>80-150</td>
<td>7.80</td>
<td>4.97</td>
<td>2.11</td>
</tr>
<tr>
<td>4 0-30</td>
<td>41.76</td>
<td>10.90</td>
<td>17.77</td>
</tr>
<tr>
<td>30-70</td>
<td>46.56</td>
<td>12.87</td>
<td>19.00</td>
</tr>
<tr>
<td>70-150</td>
<td>41.30</td>
<td>11.09</td>
<td>17.74</td>
</tr>
<tr>
<td>7 0-30</td>
<td>50.00</td>
<td>20.00</td>
<td>19.49</td>
</tr>
<tr>
<td>30-80</td>
<td>49.02</td>
<td>18.83</td>
<td>17.30</td>
</tr>
<tr>
<td>80-150</td>
<td>53.70</td>
<td>23.36</td>
<td>18.40</td>
</tr>
<tr>
<td>9 0-30</td>
<td>47.11</td>
<td>17.45</td>
<td>4.80</td>
</tr>
<tr>
<td>50-60</td>
<td>52.27</td>
<td>23.67</td>
<td>4.76</td>
</tr>
<tr>
<td>60-90</td>
<td>48.36</td>
<td>12.37</td>
<td>4.15</td>
</tr>
<tr>
<td>90-110</td>
<td>44.43</td>
<td>14.78</td>
<td>4.71</td>
</tr>
</tbody>
</table>

The examination of the soils provides the basis for placing them into taxonomic and mapping units. Each mapping unit was identified on the map by a symbol, and each of them must have an identifying name within the general system of soil classification. The correlation between physiographic and taxonomic units were worked out as given in Table 7, consequently the main soils sets the area of the studied were identified (Table 8).

TABLE 7. Correlation scheme between the physiographic and taxonomic units.

<table>
<thead>
<tr>
<th>Mapping unit</th>
<th>Aridisols</th>
<th>Soil taxonomy</th>
<th>Entisols</th>
<th>Sum of profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Argids</td>
<td>Salids</td>
<td>Torripsammens</td>
<td>Torrifluvents</td>
</tr>
<tr>
<td>F 111</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>7.12,14</td>
</tr>
<tr>
<td>F 112</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>13</td>
</tr>
<tr>
<td>F 113</td>
<td>10</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>F 123</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>15</td>
</tr>
<tr>
<td>F 125</td>
<td>--</td>
<td>8</td>
<td>--</td>
<td>5</td>
</tr>
<tr>
<td>F 126</td>
<td>4.6</td>
<td>--</td>
<td>--</td>
<td>11</td>
</tr>
<tr>
<td>L 117</td>
<td>--</td>
<td>9</td>
<td>3</td>
<td>--</td>
</tr>
<tr>
<td>L 222</td>
<td>--</td>
<td>--</td>
<td>1</td>
<td>--</td>
</tr>
<tr>
<td>M 112</td>
<td>--</td>
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<td>2</td>
<td>--</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>7</td>
</tr>
</tbody>
</table>

The soil map of the studied area were produced depend on the above mentioned data, Arc-GIS 9.0 software was used for this function. Map 2 represents the different great groups in the studied soils. The given data indicate that the most of the area is dominated by the Torrifluvents great group as the 46.6 % of the studied profiles, which representative with profile (7) located in Egypt. J. Soil. Sci. 49. No. 3 (2009)
this group. Three profiles representing 20% of the studied profiles are classified as Typic Torrifluvents; which representative with profile (1), which located in the lacustrine and marine plain. Profile 4 is locate in the gret group of Argids they represent 20% of the studied soil profiles. The rest of studied profiles (13.4%) are classified as Typic Haplosalids.

**TABLE 8. Legend of physiographic - Soil map of the studied area.**

<table>
<thead>
<tr>
<th>Landscape</th>
<th>Origin</th>
<th>Relief</th>
<th>Land forms</th>
<th>Mapping Unit</th>
<th>Area km²</th>
<th>Taxonomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood plain</td>
<td>Alluvial deposits (1)</td>
<td>Flat to gently undulating (1)</td>
<td>High terraces</td>
<td>F 111</td>
<td>128.93</td>
<td><strong>Typic Torrifluvents</strong></td>
</tr>
<tr>
<td>(F)</td>
<td></td>
<td></td>
<td>Moderately high terraces</td>
<td>F 112</td>
<td>151.49</td>
<td><strong>Typic Torrifluvents</strong></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Low terraces</td>
<td>F 113</td>
<td>129.54</td>
<td><strong>Typic Haplosalids</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gently slope (2)</td>
<td>High levees</td>
<td>F 121</td>
<td>33.00</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderately high levees</td>
<td>F 122</td>
<td>43.99</td>
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<tr>
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<td></td>
<td></td>
<td>Low levees</td>
<td>F 123</td>
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<tr>
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<td></td>
<td></td>
<td>Swales</td>
<td>F 124</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Overflow basins</td>
<td>F 125</td>
<td>117.85</td>
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<tr>
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<td>Decantation basins</td>
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<tr>
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<td>Old deltaic deposits (2)</td>
<td>Gently to Undulating (3)</td>
<td>Isolated hills</td>
<td>F 231</td>
<td>0.93</td>
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<tr>
<td>Lacustrine</td>
<td>Lacustrine Deposits (1)</td>
<td>Flat to Almost flat</td>
<td>Dried fish ponds</td>
<td>L 111</td>
<td>32.67</td>
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</tr>
<tr>
<td>Plain L</td>
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<td>55.74</td>
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<td>Dry sakhhas</td>
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<td></td>
<td>Wet sakhhas</td>
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<td>Swamps</td>
<td>L 116</td>
<td>2.85</td>
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<td></td>
<td>Dried lake bed</td>
<td>L 117</td>
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<td><strong>Typic Haplosalids</strong></td>
</tr>
<tr>
<td></td>
<td>Aolian deposits (2)</td>
<td>Undulating</td>
<td>Low sand dunes</td>
<td>L 221</td>
<td>34.84</td>
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<td></td>
<td>High sand dune</td>
<td>L 222</td>
<td>25.92</td>
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</tr>
<tr>
<td>Marine</td>
<td>Aolian deposits (1)</td>
<td>Flat to almost flat (1)</td>
<td>High sand sheet</td>
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<td>49.47</td>
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<tr>
<td>plain (M)</td>
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<td>Moderately high sand sheet</td>
<td>M 112</td>
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<td>Low levels sand sheets</td>
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<td>46.95</td>
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<td>Gently Undulating (1)</td>
<td>Hummocks</td>
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<td>Marine deposits (2)</td>
<td>Gently slope (3)</td>
<td>depressions</td>
<td>M 231</td>
<td>7.20</td>
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</tr>
</tbody>
</table>

*Egypt. J. Soil. Sci. 49, No.3 (2009)*
Map 2. Soil classification of the studied area.

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*Egypt. J. Soil Sci. 49*, No. 3 (2009)
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استخدام تقنيات الاستشعار من البعيد ونظم المعلومات الجغرافية في تحديد الملامح الفيزيوجرافية وعمل خرائط النبتة لمنطقة إدكو

البرلس بشمال الدلتا، مصر

محمد عبد الرحيم عبد الرحمن، رافت رمضان علي، محمد عبد السلام حسين
و محمود عبد الرحيم السمرى
قسم الأراضي واستغلال الموارد - المركز القومي للبحوث - الجيولوجيا والجيوفيزيوجرافيا - جامعة الأزهر، القاهرة - مصر.

هدف هذه الدراسة إلى تمييز وتحديد الأنواع المختلفة في أراضي منطقة إدكو - البرلس بشمال الدلتا، مصر.

تغذى منطقة الدراسة من خيال طول 30°00′00″ - 30°30′00″ شرقاً وشمالاً بقطر 10 كم. وتغذى تغذى من محاافظتي الحيرة وكفر الشيخ وتبعد مساحتها الكلية 126 كم².

مادة الأصيل الرئيسية في المنطقة تتخلل أكثر من واحدة وهي: ترسيات طينية، ترسيات بحرية، ترسيات نهرية، ترسيات مлина، وترسيات بحرية بحرية بحرية. تعتبر مياه الصرف الزراعي للمصرفر الريفي في منطقة الدراسة ويتربوا على مقاومة الري في منطقة الدراسة. ويتربوا على مقاومة الري في منطقة الدراسة.


قبل البدء في العمل الحقيق، تم تجميع البيانات المتاحة عن منطقة الدراسة، المعلومات الخاصة بالطبوغرافيا، الجيولوجيا، خرائط الموارد الأرضية، ETM و صورة الارتفاع الرقمي (DEM) لمنطقة الدراسة. و استخدمت الخرائط الطبوغرافية بنقيض رسم 1:5000، و صورة الارتفاع الرقمي (path176/row39) لمنطقة الدراسة الملتقطة في عام 2003 و كذلك لعمل الخرائط الفيزيوجرافية.

تم عمل حصر نصف تفصيلي لكل منطقة الدراسة بعرض الانتشار المنتمي لإتباع الأراضي، وا_Floats الموقع، ومعتمدة على دراسة القطاعات الأرضية وتقسيم صور المرصد الصناعي كما تم استعمال الإشغالات (Forms) الذين تم عرضهم FAO مع تسجيل الوضع المورفولوجي باستخدام دليل منظمة الغذاء والزراعة و إعداد و اعتماد 150 رأساً أرضياً تمثل الوحدات المورفولوجية مع وصفها مورفولوجي، و تجميع 48 عينة لتحليتها بالمعمل وإجراء الدراسات الطبيعية والكيميائية عليها.

ويتم استخدام نموذج الإرتفاع الرقمي (DEM) بالاسترشاد بالخطوط الكبيرة وتلك نقاط الإرتفاع أثناء الحصر الحقيقي. ويستخدم جهاز ال GPSوالذي استخدم أيضاً لتحقيق نموذج الإرتفاع الرقمي. كما تم الاستعانة برامج Arc-GIS 9.0 من أجل هذا العمل كما أستخدمت ERDAS Imagine 8.4 ونموذج الإرتفاع الرقمي (DEM) الصور الصناعي لانسانات (39) في برنامج Dobos et al. (2002).

وللمعالجة النزعة التربوية وجد أن الموقع بصفة عامة يشمل (Landscape) جميع الوحدات التالية:
- السهل القبدي، الشوائب النهرية، الأكاكف النهرية، الأراضي الصحراوية، النهر، التلال المعرقلة.
- السهل البحري، الشوائب السماوية، المزارع الساحلية، السهوب الجافة، الأرضية (المائدة)، الأراضي الرمية، المستنقعات، رقائق السحب، النخيل الرملي.
- السهل البحري، الشوائب السماوية، مصاوغ أو الفرقانات الرمية (Sandy), (Hummocks).
- الروائي (sheets).

وعلى أساس صورة النموذج الصناعي لانسانات ونموذج الإرتفاع ETM+ ونموذج الإرتفاع الرقمي (DEM) والمعايير المحلية تم تحديد النماذج الفيزيولوجية وعمل الخرائط الخاصة بمنطقة الدراسة.