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# Spatiotemporal Changes in Alexandria Governorate, Egypt

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THE CURRENT study aimed to build-up an integrated digital georeference database for Alexandria Governorate that includes the different aspects of human development, which will help the decision makers, as well as quantifying the spatial and temporal changes of land use. Alexandria governorate is located in northern part of Egypt, having a total area of about 2300 $km^2$ and divided into 7 districts, with total population of about 3.5 million inhabitants. The total acreage of the Governorate was doubled due to merging of Borg El-Arab district in the west. The south western part of the Alexandria is occupied by Lake Maruit. The main land use is diverse and comprised of residential, industrial, as well as agricultural activities. Remote Sensing (RS) data are of great importance as a modern and effective tool in providing information on variations over time essential for environmental monitoring. Different satellite images were collected from the internet, covering a wide span of time (MSS 1972, TM 1984 and ETM 2002) and having different spatial resolutions, to study the changes in industrial, agricultural, urban land uses, as well as the change in the area of Lake Maruit. Topographic analysis indicated that elevation ranges between 0 and 150m ASL, with almost flat slope (0-0.15% occupies about 83.5% of the total area) and slope direction to the west. Eight land use/land cover classes were identified from digital image processing, namely calcareous soils, sandy soils, cultivated lands, sand beaches, sabkhas, urban areas, water bodies, and quarries which appeared in the recent satellite image (ETM 2002). The changes that have taken place to the agricultural lands, as they encroached by the urban sprawl, were identified and quantified. Some districts were mainly industrial (El-Gomrok) and the rest have a mix land uses. The study indicated that lake Maruit was diminished in the east due to land filling for utilization in different activities, but expanded to the west due to discharge of agricultural drainage water. Generally, the acreage of the cultivated lands was increased due to the intensive reclamation process in the western and southern parts of Alexandria. The lacustrine soils in the east were decreased in acreage due to the urban

encroachment on the account of agricultural lands. It is recommended that the cultivated lands close to the urban areas in the south and southeast should be preserved and urban encroachment being directed to the west in the newly added district (Borg El-Arab), and pollution and contamination to Lake Maruit to be controlled.

**Keywords:** Alexandria Governorate, GIS, RS, Land use changes, Digital databas.

Alexandria Governorate is situated in the northern part of Egypt, between latitudes 30° 31\ 54.84" and 31 ° 19\ 31.57" N and longitudes 35 ° 17\ 34.93" and 36 ° 09\ 8.89" E, as shown in map 1. Alexandria governorate has an area of about 2300 $km^2$, representing 0.23% from total area of Egypt. Alexandria governorate consists of 7 districts, 3 main villages, 14 divisions and 127 subvillages (Shyakha). The total population is about 3.5 million inhabitants. The Governorate is covered by 7 topographic map sheets at 1:50000 scale.

Building an accurate GIS database of spatial entities is a challenging task; raw geographical data are available in many different analogue or digital forms, such as maps, aerial photographs, satellite images or tables. In all cases the data must be geometrically registered to a defined coordinate system (Burrough and McDonnell, 1998).

Remote sensing (RS) has become widely applied using the uniqueness reflected or emitted electro-magnetic radiation from the object (Japan Association of Remote Sensing, 2003). Mulders (1987) suggested that it is possible to obtain direct information about the surface of soils and rocks or about vegetation covering of soil from RS. Fieldwork is necessary to estimate the properties of the three-dimensional soil profile.

The RS data can be used to map and quantify crop responses to variable soil and weather conditions and farm management. GPS for positioning and navigation in the field and GIS are required for the computation of geo-coded field data .

Grenzdorffer (1997) indicated that RS in general provides an inexpensive and valuable tool to detect long-term variability. It is clear that many earth surface features of interest can be identified, mapped, and studied on the basis of their spectral characteristics.

Balaselvakumar & Saravanan (2002) emphasized the utmost need of timeliness and accuracy of the output generated by RS techniques and its calibration with ground-truth and other information systems like aerial photography and satellite imagery etc. ..

Bose & Gupta (2003) indicated that the usage of RS and GIS technologies may be considered as the essential prerequisite for careful physical spatial planning to make optimum use of the landform and drainage pattern analysis for safety of infrastructure designs in the planning stage.

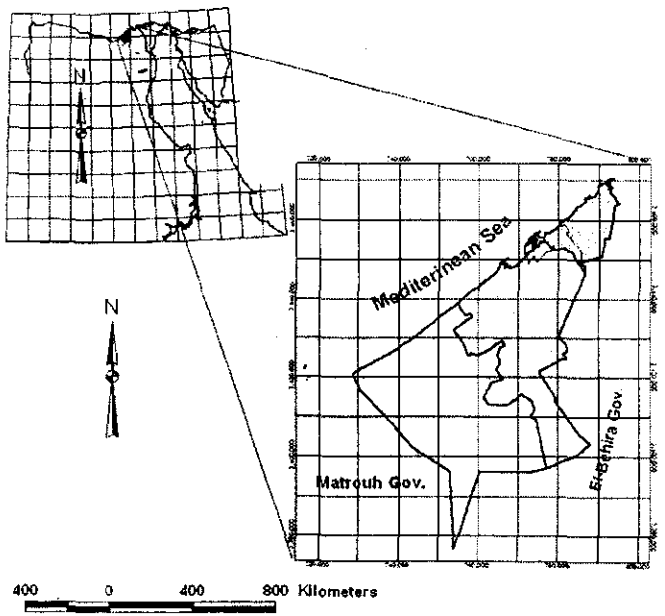
Natural Resources Canada (2003) stated that the results from a classification of RS dataset in map format could also be used in a GIS as another data source to update existing map data. In essence, by analyzing diverse data sets together, it is possible to extract better and more accurate information in a synergistic manner than by using a single data source alone.

The present study aimed to build-up an integrated digital georeference database for Alexandria Governorate, that includes the different aspects such as land use, population, economy, human development and labors force indicators, which will help the decision makers; as well as quantifying the spatial and temporal changes of land use for each district at different temporal scales (1972, 1984 and 2003).

## Methodology

*The Study Site*

Alexandria Governorate is located at the northern part of Egypt and lies along the Mediterranean coast. It is considered as a long narrow strip, where it extends about 70 km on the Mediterranean Sea, with about 40 km maximum depth. The Governorate is located between latitudes 30° 31\' 54.84" and 31 ° 19\' 31.57" N and longitudes 35 ° 17\' 34.93" and 36 ° 09\' 8.89" E (Map 1). Alexandria is characterized by the dominance of different agricultural, industrial and urban land uses. It is composed of three main cities, namely, Alexandria, Borg El-Arab and El-Ameriya, where Alexandria is the largest and most populated one. The total population of Alexandria Governorate is estimated as 3.5 million according to 2002 survey.




**Map.1. General location of Alexandria Governorate.**

*Soil sampling design and analysis*

The fieldwork aimed to characterize the soil properties of each land use/ land cover in Alexandria Governorate. Six soil profiles were dug, with total number 21 soil samples. The soil profiles were morphologically described in the field according to FAO (1990) and geo-referenced to UTM coordinate system. The soil samples were prepared and analyzed for chemical, physical and fertility characterization according to page *et al.* (1982) and klute (1986).

*Remote sensing data analysis*

*Image pre-processing:* Alexandria Governorate is covered by one Landsat MSS image acquired on (1972), three Landsat TM images acquired on (1984) and Landsat ETM images acquired on (2002). (path 177, raw 38 and path 177, raw 39). The images were downloaded from the website that belongs to Global Land Cover Facility, University of Maryland, USA. (GLCF, 2006).

*Geometric correction:* The images were geometrically corrected using Ground Control Points (GCPs) from the topographic map sheets and represent the intersection of roads, tracks and irrigation-drainage networks, which are recognizable on the image. ENVI software was used to carry out the registration and the resultant Root Mean Square Error (RMSE) was 0.31, (Research Systems Inc., 2003).

*Image mosaic:* This step for mosaicking two or more image files to produce one image file. The mosaicking process works with rectified and/or calibrated images.

*Image clipping:* The boundary of Alexandria Governorate was extracted from the GIS Database and used for cutting the area covering the governorate on the image (ESRI, 2000 & 2001).

*Digital image processing*

*Supervised classification*

This step was done using Find-like-Areas option in Arc View Image Analyst extension, which identifies areas with similar characteristics throughout a theme. Find-Like-Areas locates those areas regardless of where they are in the image and uses only the bands that are displayed in the view to locate similar areas throughout the image, using a parallelepiped classifier. If the class name already exists, areas are added to the class in the output theme. If the class name does not exist in the output theme, it is created as a new class in the output theme.

*GIS Analysis*

*Topographic data input (digitizing)*

Topographic map sheets (spatial data) were digitized using TerraSoft GIS software (Digital Resource System, 1991). Attribute data"non-spatial data" was maintained in database management system represented by dBase IV and by Excel spreadsheet.

*a. Coordinates conversion and geo-referencing:* ENVI software was used to convert the geographic coordinates (lat.-long.) system to Universal Transverse Mercator (UTM) coordinates (Easting-Northing) system. All the topographic maps had Transverse Mercator Projection, Ellipsoid: Helemert 1906, Horizontal datum: the National Geodetic Net, point Venus 1874 and Vertical datum: mean sea level at Alexandria (1906).

*b. Building up spatial database:* maps were layered into a group of features each of them comprises a homogenous dataset. This step yields a digital vector database for the study area. Table 1 illustrates the features and their description and types. The most important step in the map digitizing is to allocate the governorate boundary and its centers from other features to calculate the area of each center as well as that of the governorate.

**TABLE 1. Features character, descriptions and types.**

| Features | Description | Types |
|---|---|---|
| Frame | Frame of topographic maps | Polygon |
| Profile | Profiles location | Point |
| Profile | Profiles identifiers | Text |
| Contour | Contour lines | Line |
| Spot-height | Elevation point location | Point |
| Main road | Alex-Cairo desert road | Line |
| Tracks | Tracks | Line |
| Wadi | Dry valley | Polygon |
| Drainage lines | Drainage lines | Line |
| Boundary | Governorate and centers | Line |

The data entered into the GIS environment require some kinds of pre-processing in order to make it uniform and errorless before carrying out further analysis. Some of the essential preprocessing procedures include (Digital Resource Systems, 1991):

*c. Edge matching:* Seven map sheets at scale 1:50.000, covering the study area were used for the edge matching process. This step is mainly to connect contour lines, roads, railways, irrigation drainage networks, governorate and centers boundary and other features that extend through the map boundaries.

*d. Merging:* merging is the process of building more complex objects from the elemental points. The Seven map sheets covering the study area were merged together to get all the data in one map file, which contains all the digitized features in their correct connection by snapping the ends of two lines together.

*DEM generation and analysis*

The contour lines and spot heights were exported from Arc/Info (ESRI, 1996) Version 3.5 to PCI software to generate the DEM (PCI, 1999). The DEM generated in PCI was exported to Arc View GIS software for further processing and manipulation. The pixel size of the study area is 10x10 m. The produced DEM was exported as a grid file to be analyzed throughout the generation of slope and aspect layers.

*a. Slope* identifies the maximum rate of change in value from each cell to its neighbors and could be calculated as percent slope or degree of slope. Table 2 shows the slope's classes in percent according to FAO (1990).

**TABLE 2. Slope's classes according to FAO (1990).**

| Type of class | Slope % |
|---|---|
| Flat | 0-0.2% |
| Level | 0.2-0.5 % |
| Nearly level | 0.5-1.0 % |
| Very gently slope | 1 - 2 % |
| Gently slope | 2 - 5 % |
| Sloping | 5 -10 % |
| Strongly sloping | 10-15 % |
| Moderately sloping | 15-30 % |
| Steep | 30-60 % |
| Very steep | > 60 % |

*b. Aspect* identifies the down-slope direction of the maximum rate of change in value from each cell to its neighbors. Aspect can be thought of as the slope direction. The values of the output grid are the compass directions of the aspect. It is divided into 360 degrees and then grouped into eight classes centered on the compass directions shown in Table 3.

**TABLE 3. Aspect classes and their Azimuth ranges.**

| Aspect (class) | Compass direction | Azimuth range (degree) |
|---|---|---|
| 1 | North | 0.0-22.5 and 337.5-360.0 |
| 2 | Northeast | 22.5-67.5 |
| 3 | East | 67.5-112.5 |
| 4 | Southeast | 112.5-157.5 |
| 5 | South | 157.5-202.5 |
| 6 | Southwest | 202.5-247.5 |
| 7 | West | 247.5-292.5 |
| 8 | Northwest | 292.5-337.5 |

## Resultes and Discussion

*Alexandria database*

*Soil samples analysis*

Based on the fieldwork, the digital processing of Landsat images and laboratory analysis of soil profiles. The major subgroups are *Typic Torripsamments* for sandy soil (profiles 1 and 2), *Typic Haplocalcids* for calcareous soil (profiles 3 and 4), *Typic aquisalids* for sabkha (profile 5) and *Typic Haplotorrerts* representing alluvial agricultural land (profile 6).

*Statistical characterization of soil profile attributes*

Table 4 indicates the statistical parameters of the soil chemical, physical and nutritional properties. It's clear that salinity, SAR, Clay %, Zn, Fe and Cu are the characteristics which showed most variation due to high coefficient of variation (more than 100%).

**TABLE 4. Main statistical parameters of soil profiles samples.**

| Characteristics | Statistical parameters | | | | |
|---|---|---|---|---|---|
| | Min. | Max. | Mean | St. Dev. | C. V.% |
| pH (1:2.5) | 7.75 | 8.80 | 8.19 | 0.27 | 3.30 |
| EC dS/m | 0.51 | 203 | 21.71 | 50.46 | 232.53 |
| SAR % | 0.37 | 190.3 | 21.78 | 44.97 | 206.47 |
| $CaCO_3$% | 1.02 | 31.70 | 8.68 | 7.88 | 90.78 |
| Sand% | 3.00 | 98.50 | 77.03 | 31.34 | 40.68 |
| Silt% | 0.40 | 20.10 | 6.58 | 6.28 | 95.47 |
| Clay% | 1.00 | 82.40 | 16.21 | 25.96 | 160.15 |
| SP % | 26.00 | 95.20 | 40.20 | 19.45 | 48.38 |
| Av. Water % | 3.54 | 69.23 | 29.04 | 28.77 | 99.07 |
| O. M. % | 0.02 | 1.02 | 0.36 | 0.36 | 100.89 |
| Fe, ppm | 0.01 | 6.80 | 1.74 | 1.80 | 103.44 |
| Zn, ppm | 0.01 | 3.38 | 0.41 | 0.71 | 173.17 |
| Mn, ppm | 0.05 | 1.82 | 0.52 | 0.42 | 80.77 |
| Cu, ppm | 0.01 | 0.56 | 0.13 | 0.15 | 125.00 |

*Administrative boundaries*

Alexandria Governorate consists of 7 districts, 5 main villages, 24 divisions and 127 sub villages (Shyakha) having a total area of 2300 $Km^2$, with Borg El-Arab district being the largest one (1183.89 Km2) and El-Gomrok the smallest one (6.37 Km2). Table 5 shows the area of districts comprising the governorate.

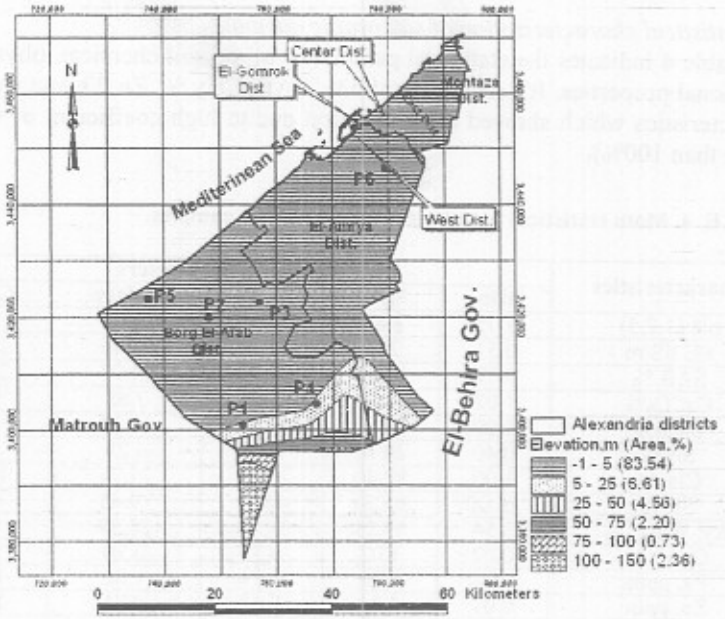
**TABLE 5. Area and population of districts comprising Alexandria Governorate.**

| District | Area $km^2$ | Area % | Population |
|---|---|---|---|
| El-Montaza | 91.52 | 3.99 | 981000 |
| East | 58.35 | 2.54 | 919000 |
| West | 15.95 | 0.69 | 496000 |
| Center | 39.89 | 1.73 | 477000 |
| El-Gomrok | 6.37 | 0.28 | 180000 |
| El-Amyria | 904.00 | 39.30 | 429000 |
| Borg El-Arab | 1183.89 | 51.47 | 33000 |
| Total | 2299.97 | 100 | 3515000 |

*Terrain components*

*a. Digital Elevation Model (DEM)*

The analysis of DEM indicated that the elevations ranged between -1 m B.S.L. to 150 m A.S.L. The northern part of the governorate has an elevation between sea level and 5 m A.S.L. On the other hand, the southern part of the governorate is very complex in elevation and ranges from 5 m to 150 m A.S.L. as shown in Map 2. Table 6 shows the area representing the different elevation slices.




**Map 2. Digital Elevation Model (DEM), its areas and profiles location for Alexandria Governorate.**

**TABLE 6. DEM classes, area percentages of Alexandria Governorate.**

| Elevation, m | Area, Km$^2$ | Area % |
|---|---|---|
| -1 – 25 | 2073.63 | 90.21 |
| 25 - 50 | 104.93 | 4.56 |
| 50 - 75 | 50.61 | 2.20 |
| 75 - 100 | 16.24 | 0.73 |
| 100 - 150 | 54.22 | 2.36 |
| **Total** | 2299.97 | 100 |

*b. Slope*

It is clear that the dominant slope class is 0-0.15% covering 83.50% of the total area of the governorate. Table 7 indicates the percentage of slope classes covering the Governorate.

**TABLE 7. Slope classes and area percentage of Alexandria Governorate.**

| Slope Class | Area, Km$^2$ | Area % |
|---|---|---|
| 0 - 0.15 | 1920.57 | 83.50 |
| 0.15 - 0.30 | 220.90 | 9.60 |
| 0.30 - 0.45 | 116.75 | 5.08 |
| 0.45 - 0.60 | 33.55 | 1.46 |
| 0.60 - 0.80 | 7.90 | 0.36 |
| **Total** | 2299.97 | 100 |

*c. Aspect*

Table 8 indicates the percentage of each aspect class. It is noticeable that the north facing directions (N, NE, NW) is the dominant aspect representing 47.13% of the total area, followed by the west facing direction with 30.68% of the total area.

**TABLE 8. Direction and area percentage of aspect.**

| Direction | Area % |
|---|---|
| Flat | 13.01 |
| North | 19.60 |
| North East | 1.83 |
| East | 3.28 |
| South East | 1.86 |
| South | 1.85 |
| South West | 2.21 |
| West | 30.66 |
| North West | 25.70 |
| Total | 100 |

*Economic or human development indicators*

*a. Unemployment rate*

The integrated digital georeference database shows that the lower rate of the unemployment was found in Borg El-Arab, El-Amyria and El-Gomrok districts (0.01 - 9.33%) comprising about 91.05% of the total area, due to the high agricultural and industrial activities and lower population density in the first two districts, whereas El-Gomrok district have a smaller area and higher population density and include the western and eastern ports of Alexandria and the fishing activities. For the other districts such as East and West districts, the unemployment rate varied from (9.33% to 18.76%) with an area (2.43%). The maximum unemployment rate was found at El-Montaza and the downtown (Center) districts (18.76% to 28.01%) due to increasing in the commercial activities and dense residential areas, which need less labor more than the industrial and agricultural activities (Map 3) (EHDR, 2003).

*b. Employment activities*

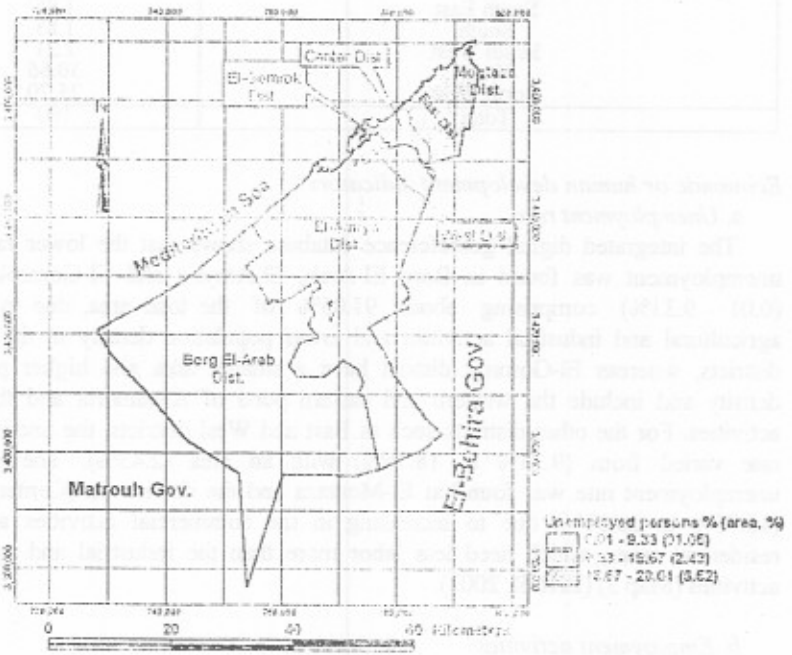
The employment is distributed between different activities such as agricultural, industrial and other activities:

*1. Agricultural activities:* The results show that the higher employment rate for Borg El-Arab and El-Amyria districts (46% and 19.5%) respectively due to the increase of agricultural land reclamation areas in these districts, followed by El-Montaza district (5.80%) due to the decrease of the agricultural land which transformed into random residential areas. Finally, El-Gomrok district (1.70%) has no agricultural activities (Fig .1).

*2. Industrial activities:* From the integrated digital georeference database El-Amyria and part of West district have the higher rate of industrial employment (25%) due to the high industrial activities in these districts especially the petroleum and gas complex (Map 4).

3. *Professional technical staff:* Due to the dense industrial and petroleum activities found at Borg El-Arab and El-Amyria districts, professional technical staff are increasing in these districts (51.70% and 33.70%) respectively (Fig. 2).

4. *Women employment:* The results show that the employment in Alexandria Governorate doesn't depend on males only but there is main role for the females in the employment rate. The women percentage in labor force is high in Borg El-Arab (51.47%), followed by downtown and East districts (23.20% and 22.10%) respectively (Fig. 3).




Map. 3. Unemployment rate of Alexandria Governorate.

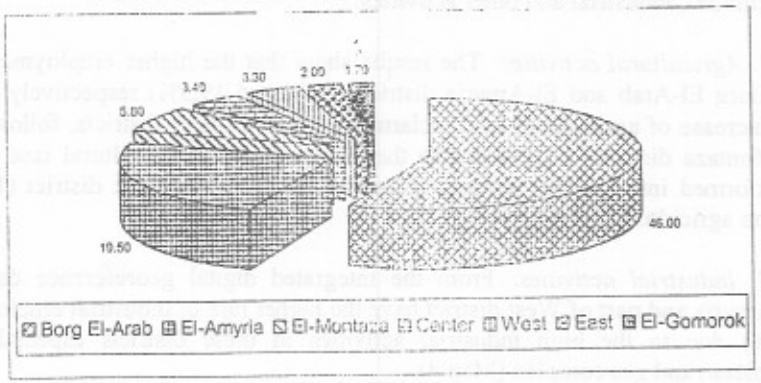
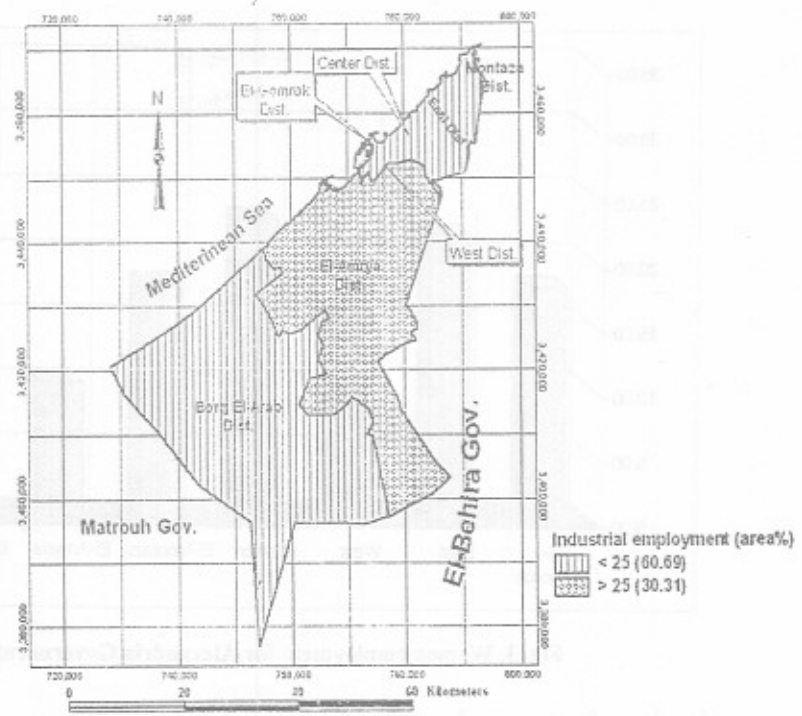



Fig. 1. Agricultural labor in different Alexandria Governorate districts.




**Map. 4. Industrial employment for Alexandria Governorate.**

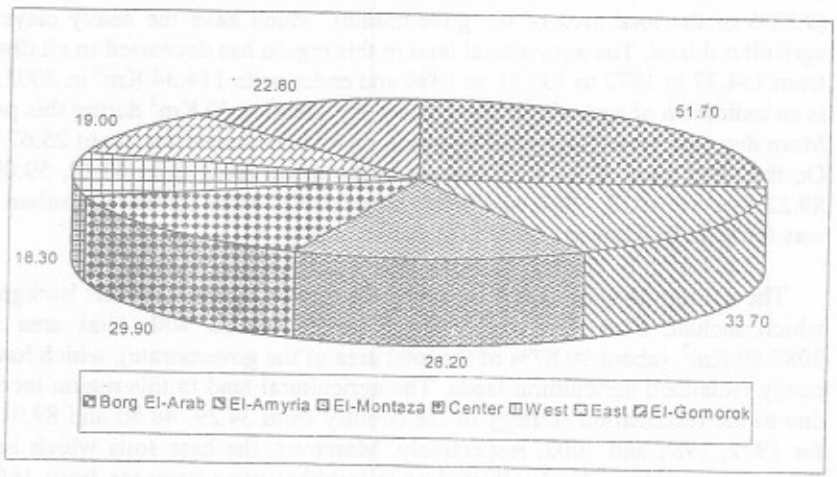



**Fig. 2. Professional technical staff for Alexandria Governorate.**

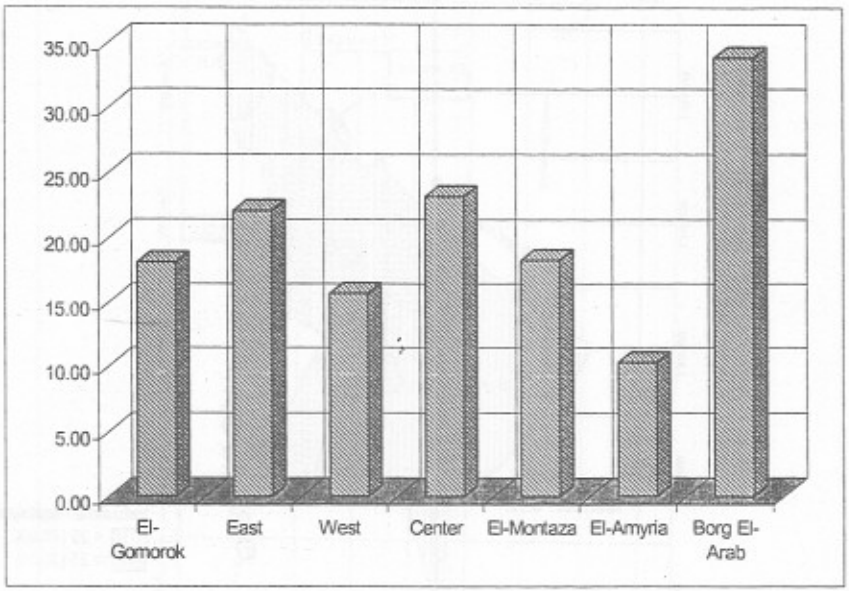



**Fig. 3. Women employment for Alexandria Governorate.**

*Land use/ land cover change*

The results showed that Alexandria Governorate maight be divided into two divisions. The first one might be called old region that include El-Montaza, Downtown, West, East and El-Gomrok districts with total area about 212 $Km^2$ (9.22% of the total area of the governorate), which have the heavy clayey old agricultural land. The agricultural land in this region has decreased in all districts, from 154.37 in 1972 to 135.51 in 1984 and ended with 114.34 $Km^2$ in 2002. This is an indication of agricultural land losses amounted at 40 $Km^2$ during this period. More decrease was found in El-Montaza district accounted for about 25.67 $Km^2$. On the other hand, there are increases in the urban areas from 43.22, 59.09 and 89.22 $Km^2$ for 1972, 1984, and 2002, respectively. More increase in urban areas was found in El-Montaza district, as shown in (Fig. 4).

The second division might be called the newly region or desert background, which include El-Amyria and Borg El-Arab districts with total area about 2087.89 $Km^2$, (about 90.87% of the total area of the governorate), which have the newly reclaimed agricultural lands. The agricultural land in this region increased due to the reclamation strategy of the country from 34.29, 48.50 and 89.91 $Km^2$ for 1972, 1984 and 2002, respectively. Moreover, the bare soils which include calcareous, sandy and salt affected soils (sabkha) were decrease from 1608.32, 1343.19 and 836.94 $Km^2$ for 1972, 1984 and 2002, respectively, as shown in Fig. 5 and Table 10. Also the water bodies were increased in this region due to agricultural drainage in Maruit Lake.

In general, the agricultural land and urban areas were increasing in Alexandria Governorate due to the land reclamation and development strategy. The results show that the agricultural land was increased in general, but having low soil quality due to low fertility, whereas the old cultivated lands with high quality were lost to urban areas as shown in Maps (5, 6 and 7) and Table 9.

**TABLE 9. Land use/ land cover changes in Alexandria Governorate.**

| Land use/ land cover | Area % | | |
|---|---|---|---|
| | MSS (1972) | TM (1984) | ETM (2002) |
| Agricultural land | 20.45 | 25.96 | 44.44 |
| Calcareous soil | 43.83 | 40.33 | 28.49 |
| Sandy soil | 24.03 | 15.66 | 7.64 |
| Beach sand | 2.73 | 3.36 | 1.39 |
| Sabkha | 2.07 | 2.41 | 0.26 |
| Water bodies | 3.56 | 5.59 | 7.08 |
| Urban areas | 3.33 | 6.69 | 9.96 |
| Quarry | 0.00 | 0.00 | 0.75 |

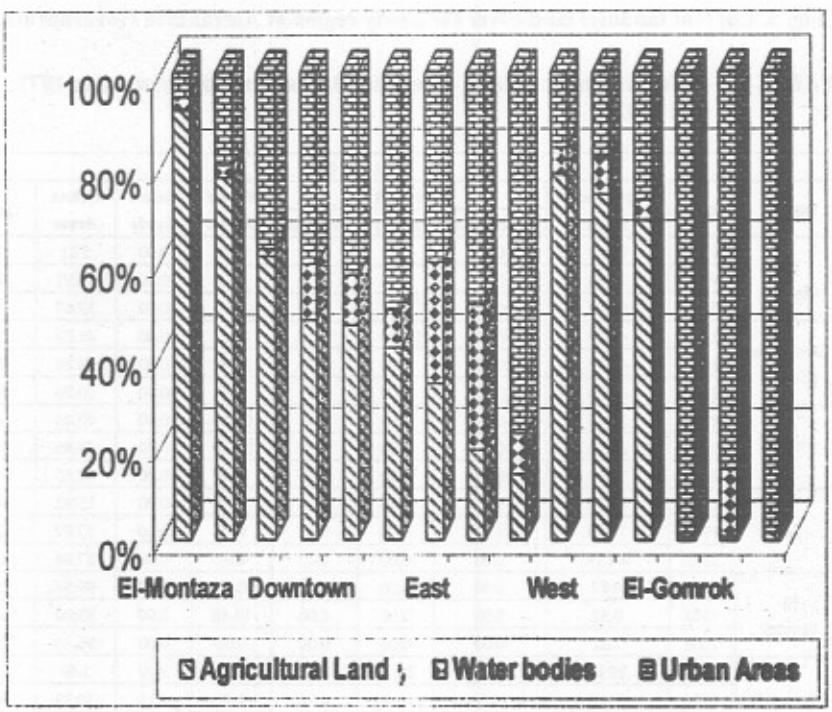



**Fig. 4. Current landuse/ land cover for old region of Alexandria Governorate.**

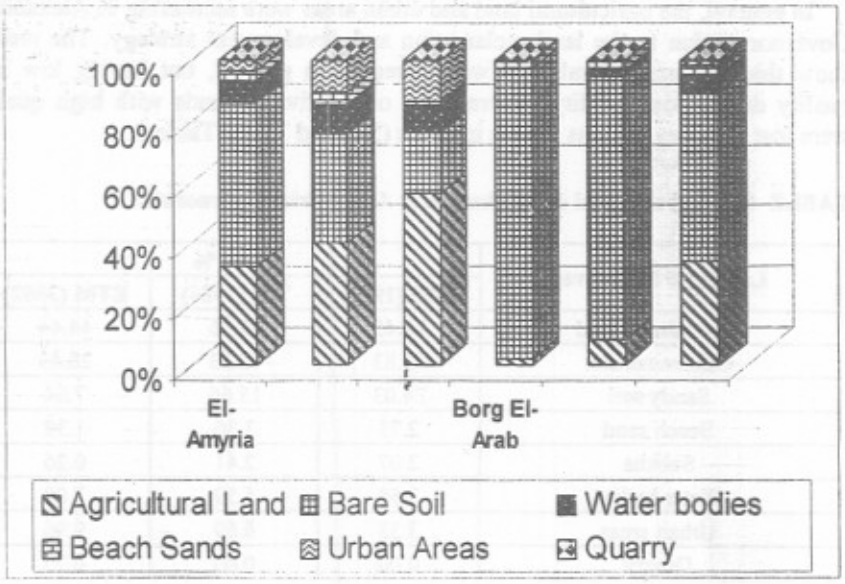
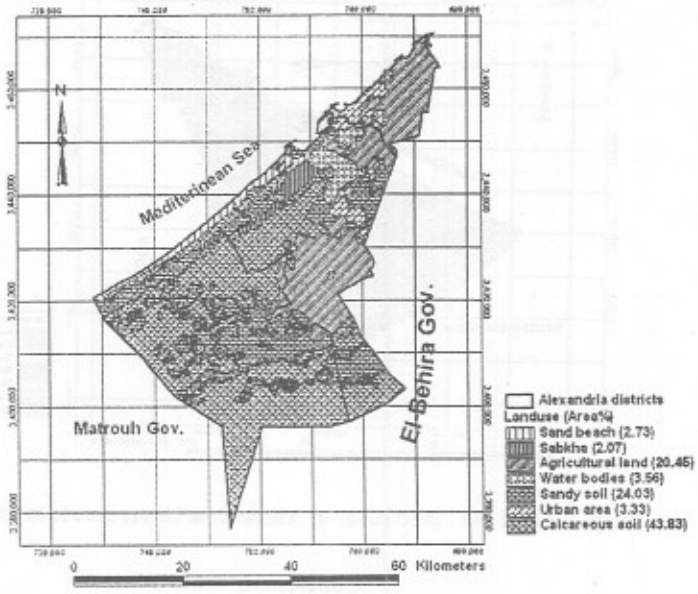


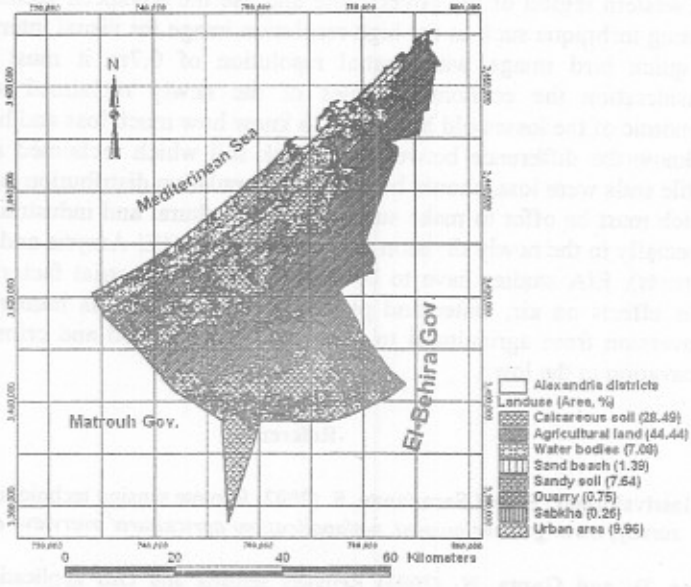

**Fig. 5. Current landuse/ land cover for newly region of Alexandria Governorate.**

**TABLE 10. Different land use/ land cover for Alexandria Governorate in 1972, 1984 and 2002.**

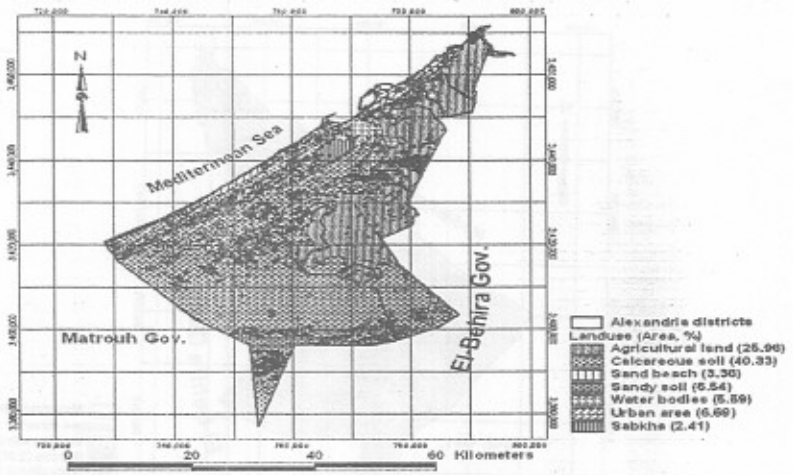
| District | Year | Land Use | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Agricultural Land | Bare Soil | | | Water Bodies | Beach Sands | Urban Areas | Quarry |
| | | | Calcareous | Sandy | Sabkha | | | | |
| El-Montaza | 1972 | 92.13 | 0.00 | 0.00 | 0.00 | 2.66 | 0.00 | 5.21 | 0.00 |
| | 1984 | 77.64 | 0.00 | 0.00 | 0.00 | 2.65 | 0.00 | 19.71 | 0.00 |
| | 2002 | 60.81 | 0.00 | 0.00 | 0.00 | 1.52 | 0.00 | 37.67 | 0.00 |
| Downtown (Center) | 1972 | 47.29 | 0.00 | 0.00 | 0.00 | 11.68 | 0.00 | 41.03 | 0.00 |
| | 1984 | 45.92 | 0.00 | 0.00 | 0.00 | 10.82 | 0.00 | 43.26 | 0.00 |
| | 2002 | 41.29 | 0.00 | 0.00 | 0.00 | 7.75 | 0.00 | 50.96 | 0.00 |
| West | 1972 | 33.45 | 0.00 | 0.00 | 0.00 | 26.10 | 0.00 | 40.45 | 0.00 |
| | 1984 | 18.92 | 0.00 | 0.00 | 0.00 | 31.59 | 0.00 | 49.49 | 0.00 |
| | 2002 | 14.04 | 0.00 | 0.00 | 0.00 | 8.46 | 0.00 | 77.50 | 0.00 |
| East | 1972 | 78.54 | 0.00 | 0.00 | 0.00 | 5.54 | 0.00 | 15.92 | 0.00 |
| | 1984 | 73.84 | 0.00 | 0.00 | 0.00 | 8.19 | 0.00 | 17.97 | 0.00 |
| | 2002 | 68.35 | 0.00 | 0.00 | 0.00 | 4.61 | 0.00 | 27.04 | 0.00 |
| El-Gomrok | 1972 | 0.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 99.53 | 0.00 |
| | 1984 | 0.52 | 0.00 | 0.00 | 0.00 | 14.48 | 0.00 | 85.00 | 0.00 |
| | 2002 | 1.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 98.48 | 0.00 |
| El-Amyria | 1972 | 32.17 | 27.01 | 22.11 | 4.47 | 7.46 | 3.09 | 3.69 | 0.00 |
| | 1984 | 40.28 | 19.36 | 11.46 | 4.73 | 9.63 | 4.15 | 10.39 | 0.00 |
| | 2002 | 55.98 | 10.28 | 10.09 | 0.00 | 9.28 | 0.62 | 13.75 | 0.00 |
| Borg El-Arab | 1972 | 2.12 | 64.52 | 29.80 | 061 | 0.00 | 2.95 | 0.00 | 0.00 |
| | 1984 | 8.23 | 63.57 | 21.67 | 1.07 | 2.03 | 3.35 | 0.08 | 0.00 |
| | 2002 | 33.93 | 47.50 | 7.14 | 0.50 | 5.95 | 2.22 | 1.31 | 1.45 |




**Map. 5. Land use/ land cover of Alexandria Governorate in 1972.**




**Map. 6. Land use/ land cover of Alexandria Governorate in 1984.**




**Map .7. Land use / land cover of Alexandria Governorate in 2002.**

## Conclusion

Should be taken into consideration the environmental impact assessment studies (EIA) of the agricultural and industrial development strategy especially in the western region of the governorate and use the advanced facilities of remote sensing technique such as the high resolution image for visual interpretation such as quick bird image with spatial resolution of 0.7m it must be take into consideration the economic studies of the newly reclaimed areas and the economic of the losses old heavy soil to know how much loss and how much gain to know the difference between the weak soil which reclaimed and the heavy fertile soils were loss, should be study the population distribution and the services which must be offer to make sustainable agricultural and industrial development especially in the newly division of the governorate (El-Amyria and Borg El-Arab districts). EIA studies have to be carried out for industrial factories to indicate their effects on air, water and plant pollution, as well as human health. Land conversion from agricultural to urban has to be treated and criminated as land excavation in the low.

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# دراسة التغيرات الزمنية والمكانية لمحافظة الاسكندرية – مصر

**هيثم عبد اللطيف يحيى ، ايهاب محرم مرسى ومحمد إحسن بهنسى***
معمل بحوث الاراضى الملحية والقلوية – معهد بحوث الاراضى والمياه والبيئة – مركز البحوث الزراعية – القاهرة و* قسم علوم الاراضى والمياه – كلية الزراعة (الشاطبى) – جامعة الاسكندرية – الأسكندرية – مصر .

تهدف الدراسة الى بناء قاعدة معلومات رقمية متكاملة لمحافظة الاسكندرية تشتمل على الاتجاهات المختلفة للتنمية البشرية واستخدامات الاراضى ودراسة التغيرات الزمنية والمكانية لاستخدامات الاراضى المختلفة وذلك بهدف مساعدة ودعم متخذى القرار. تقع محافظة الاسكندرية فى الجهة الشمالية من جمهورية مصر العربية بمساحة ٢٣٠٠ كم٢ تقريبا وتقسم الى ٧ مراكز باجمالى عدد سكان ٣,٥ مليون نسمة. وتنقسم اراضى المحافظة الى ثلاث استخدامات اساسية وهى المناطق السكنية والمناطق الصناعية الى جانب الاراضى الزراعية. تعتبر تقنيات الاستشعار عن بعد وصور الاقمار الصناعية من الادوات الهامة والضرورية والحديثة لدراسة وتتبع التغيرات فى النظم البيئية وهو ما تم استخدامة فى هذا البحث. لقد تم استخدام ثلاث صور اقمار صناعية لمحافظة الاسكندرية تم التقاطها فى ازمنة مختلفة (١٩٧٢، ١٩٨٤، ٢٠٠٢) وذلك لدراسة التغيرات فى الاستخدامات الارضية المختلفة كالاستخدامات الصناعية والزراعية والسكنية.

وأوضحت النتائج ان نموذج الارتفاعات الرقمية يتراوح من صفر الى ١٥٠م فوق سطح البحر كذلك وجد ان الميل الساند يتراوح من صفر الى ٢٠,١٥٪ ويشغل حوالى ٨٣,٥٠٪ من اجمالى مساحة المحافظة وقد وجد ان اتجاة الميل الساند فى اتجاه الشمال ومن خلال تحليل صور الاقمار الصناعية وجد ان هناك ٨ استخدامات ارضية اساسية وهى الاراضى الزراعية والاراضى الجيرية والرملية ورمال الشواطئ والسبخات او الملاحات والمياه والمناطق السكنية والمحاجر والتى ظهرت فى صورة القمر الصناعى الخاصة بعام ٢٠٠٢ وفى مركز برج العرب فقط لا غير. ومن خلال النتائج وجد ان مساحة الاراضى الزراعية عموما بالمحافظة قد حدث لها زيادة وذلك نتيجة لسياسة الاستصلاح التى تنتهجها الدولة وخاصة فى الجزء الغربى الذى يتضمن حى العامرية وبرج العرب وهذا قابله تقلص فى مساحات الاراضى الرملية والجيرية اما بالنسبة للجزء الشرقى الذي يتضمن احياء المنتزة ووسط وغرب وشرق والجمرك فقد حدث تقلص لمساحة الرقعة الزراعية يقابلة زيادة فى مساحة الرقعة السكنية.

اما بالنسبة لمؤشرات التنمية البشرية فقد وجد ان اقل معدل للبطالة وجد فى حى العامرية وبرج العرب وذلك نظرا للتوسعات الزراعية والصناعية فى هذه الاحياء يليهم أحياء وسط والجمرك وغرب ثم حى المنتزة وشرق الذين يتمتعا بوجود اعلى نسبة من البطالة. اما بالنسبة لدور المرأه فى قوة العمل فى محافظة الاسكندرية فقد وجد من خلال الدراسة ان النسبة المئوية للمرأه العاملة تصل الى فى (٥١,٤٧٪) فى حى برج العرب يلية حى وسط بنسبة (٢٣,٢٠٪) ثم حى شرق بنسبة (٢٢,١٠٪).