INTRODUCTION

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1.General Outline:

Groundwater is one of the most valuable natural resources. Surprisingly, for a resource that so widely used and so important to the health and to the economy of the country, the occurrence of groundwater is not only poorly understood but is also, in fact, the subject of many widespread misconceptions. Common misconceptions include the belief that groundwater occurs in underground rivers resembling surface streams whose presence can be detected by certain individuals. These misconceptions and others have hampered the development and conservation of groundwater and have adversely affected the protections of its quality. The developing countries are vitally concerned with national development. Consequently, they are much more concerned with economic development than environmental control. However, it should recognized that there is a trade-off when the priorities of uses of the environment changes with the stage of development of the country and the environmental quality requirements of the uses tend to become more stringent as the economy improves.

Economic development with no environmental control leads to ecological and environmental impacts, which reduce the quality of life. The major impacts of development activities should be assessed and environmental management strategies be drawn for balanced development. In order to receive maximum benefit from its groundwater resource, it is essential that anyone, from the rural homeowner to managers of industrial and municipal water supplies to heads of the

Egyptian Environmental Affairs Agency, become more knowledgeable about the occurrence, development, and protection of groundwater.

The north of Giza Governorate presently is fast urban growth with uncontrolled rates. This is reflected on a great shortage in water supplies especially during the summer time. The population density in the whole Governorate that was 220,000 persons in 1947, became 1,850,000 persons by the year 1982 and is expected to reach 3,000,000 persons by the end of this century (Draft final Plan Giza South, 1983). To meet the increasing demands of water at the north of Giza Governorate, intensive studies, to evaluate the Quaternary aquifer, are urgently needed in order to provide the expected population density with a comparable sufficient quantity of water. This water should have good qualities to meet the requirements of public health and human usage. To achieve this goal approximately 800,000 m^3/day of water are required above the quantity presently supplied. In order to ascertain, whether this additional demand for water can be covered by ground water, the study has been started. Its aim to investigate the main factors affecting groundwater quantity and quality. The increasing demand for potable water to supply domestic and commercial needs has necessitated the growing use of ground water, along with other sources, due to the flexibility and low costs of production and their high reliability during emergencies.

Tabark area represents as one of land reclamation projects on both sides of Cairo-Alexandria Desert Road that has been accelerated during the last decade. Groundwater plays an essential role for satisfying water requirements for different purposes. Groundwater discharges in and around Tabark area exceeds natural recharge, thereby causing a water lowering and water deterioration.

Green Belt around Six of October City represents a part of Oligo-Miocene aquifer. This Belt is constructed to protect the city from dusty winds and reuse treated sewage water in the irrigation woody trees and desalinated water in cultivation vegetables and fruits.

2. Location of the study area:

The area under consideration lies on the southwestern side of the Nile Delta. It is bounded by 30° 10', 30° 14' latitudes N and 30° 14', 30° 46' longitudes E. (Fig.1). The study area includes the north of Giza Governorate, Tabark area at km 56 Cairo – Alexandria Desert Road and Green Belt project around Six of October City (Fig. 1).

3. Climatic conditions:

The area under study occupies climatic condition ranges from arid to desert. A long hot summer, short warm winter, low rainfall and high evaporation intensities characterize its climate. Data on the climatology of the study area and its vicinities are providing by Meteorological Authority for the stations, starting at the north by south El Tahrir and ends at south by El Giza station.

Data on the Meteorological Authority for El Giza, South El Tahrir, and Wadi El Natrun stations. The obtained data are collected during the period from 1988 to 1994 (Table 1). The climatic elements of the studied area are summarized as follows (Figs.2, 3, 4, and 5)

- The mean annual rainfall increases northwards (64.85 mm/year) at South El Tahrir station area, and decrease gradually southwards (44 mm/year) at El Giza station (Fig. 2). During summer no rainfall were observed.

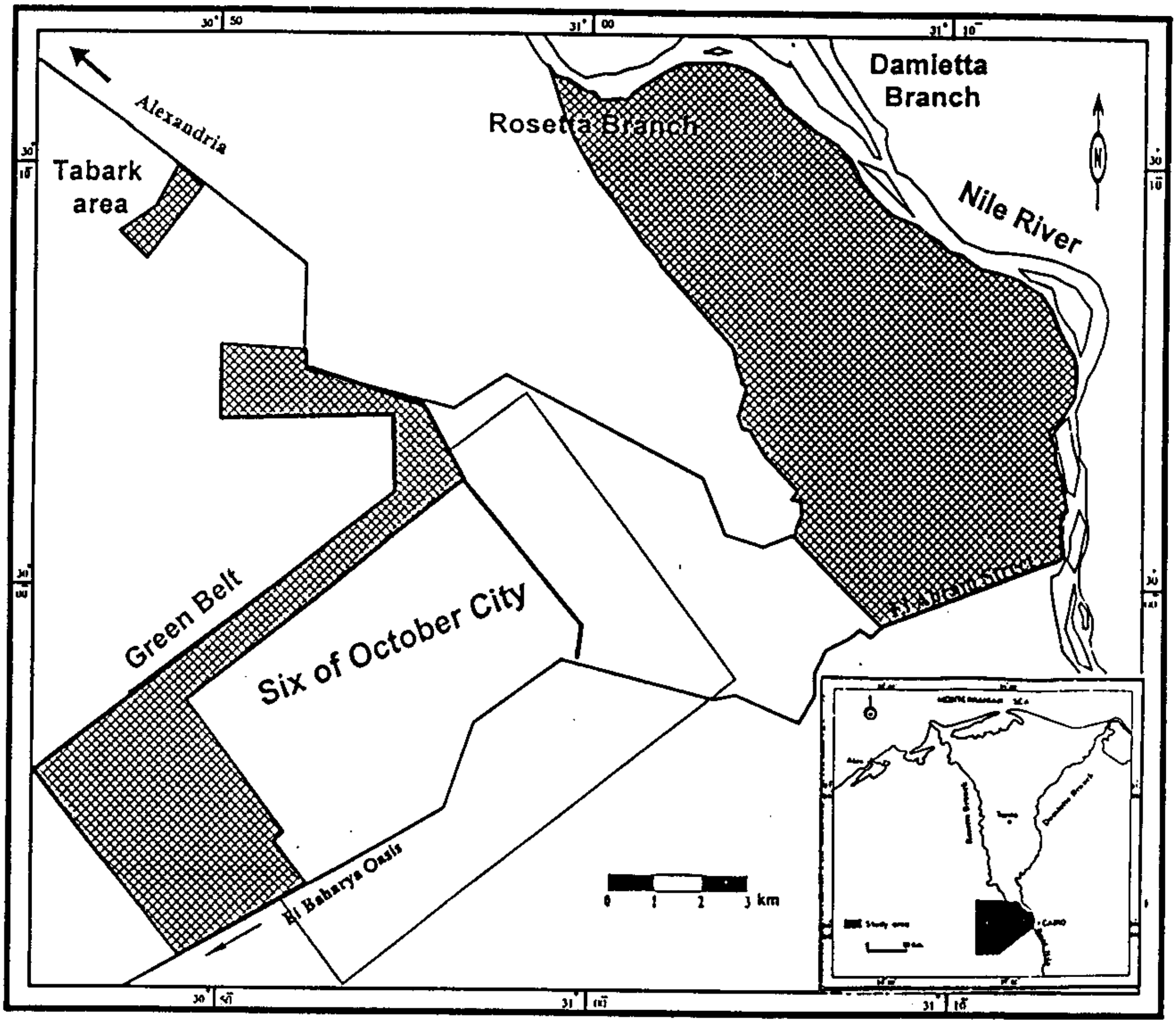

Fig. (1) Location map of the studied area

Table (1) The Meteorological data during the period from 1988 – 1994

Climatic Parameters	Months												Means
	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	
El Giza													
Rainfall (mm)	18.5	3.2	5.35	0.75	0.55	0.2	-	-	-	1.1	9.15	5.2	44
Max. T. (° C)	19.5	20.7	23.35	30.2	32.85	34.92	35.8	35.6	34.3	32.1	24.6	20.3	28.7
Mini. T. (° C)	8.9	8.5	11.05	15.1	18.3	20.95	22.8	22.8	22	19.6	13.6	9.2	16.06
Relative Humidity	69.2	60	61.4	50.9	49.4	53.4	58.4	61.9	63.2	62.3	17.4	69.05	60.5
South El Tahrir													
Rainfall (mm)	20.2	14.85	7.9	0.8	0.8	-	-	-	-	4.4	9.8	6.1	64.85
Max. T. (° C)	19.55	20.55	22.55	29.15	31.95	34.1	34.85	34.4	33.2	31.4	24.5	24.5	28.4
Mini. T. (° C)	7.8	6.85	8.5	12.05	14.85	18.45	20.65	20.5	19.3	16.9	12.2	11.1	14.1
Relative Humidity	72.95	64.55	69	59.45	58	58.8	64.5	69.3	69.8	68.5	70.9	69.1	66.2
Wadi El Natrun													
Rainfall (mm)	7.25	4.45	6.6	0.65	0.25	-	-	-	-	3.35	18.4	8.05	49
Max. T. (° C)	19.6	20.2	22.9	29.95	31.95	34.4	35.95	35.55	34.55	31.4	24.4	20.1	28.4
Mini. T. (° C)	9.1	8.3	10.45	14.15	16.5	19.4	21.4	22.8	20.6	19.3	16.3	10.3	15.7
Relative Humidity	59.75	54.45	54.4	44.75	45.65	52.5	51.95	60.6	56.5	55.55	58.2	46.1	53.3

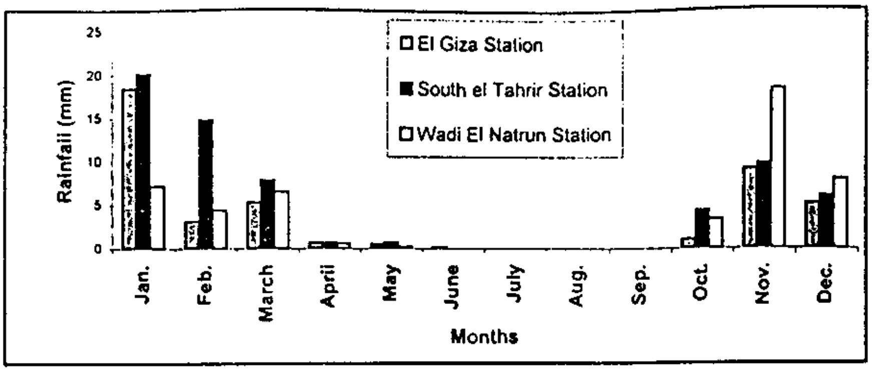

Fig. (2): Monthly mean values of rainfall at the different stations from years 1988 to1994.

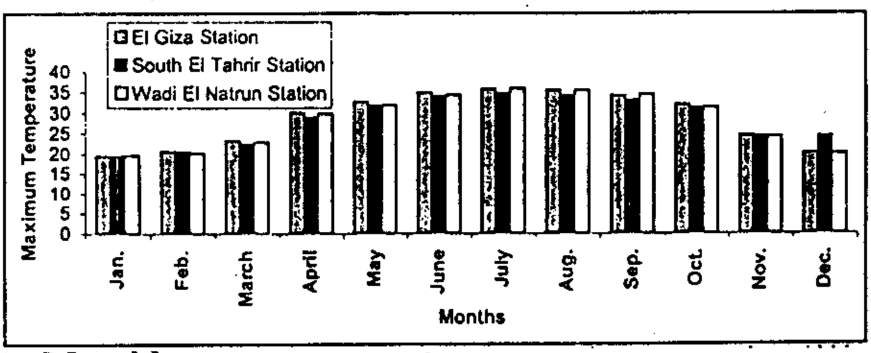

Fig. (3): Monthly mean values of maximum temperature at the different stations from years 1988 to 1994.

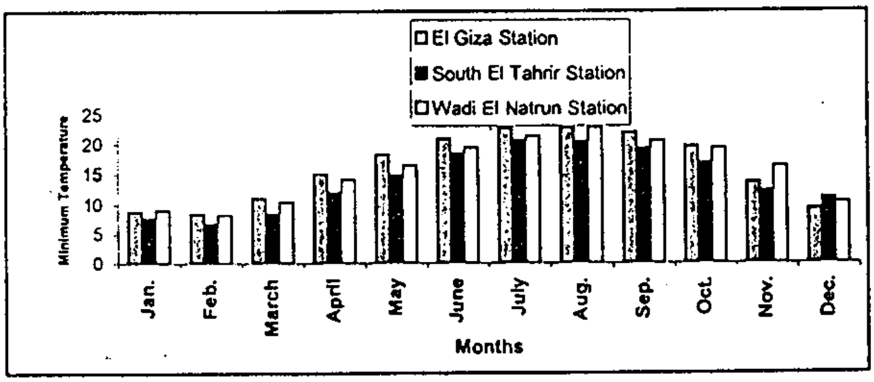

Fig. (4): Monthly mean values of minimum temperature at the different stations from years 1988 to 1994.

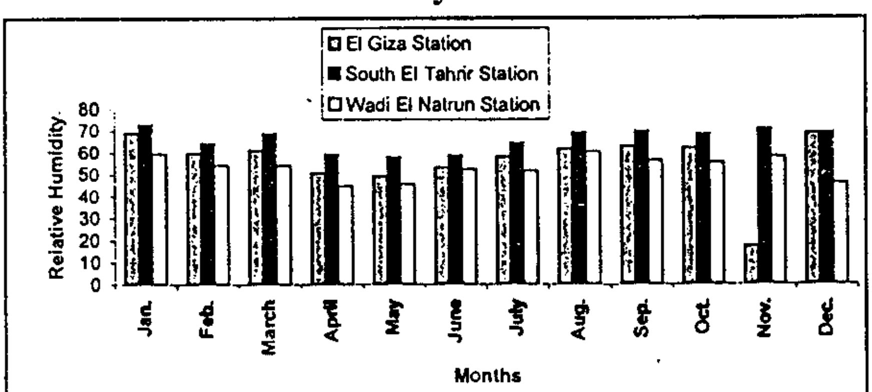

Fig. (5): Monthly mean values of relative humidity at the different stations from years1988 to 1994.

- The maximum and minimum values of air temperature are generally recorded in August and February, 35.95° C at Wadi El Natrun and 6.85°C at South El Tahrir station (Figs. 3 and 4), (Table 1).
- The relative humidity is generally higher in summer season than in winter, but, both the maximum and the minimum relative humidity values are recorded in January and April respectively, 72.95 at South El Tahrir area and 44.75 at Wadi El Natrun (Fig. 5) (Table 1).

4. Previous work:

The western of the Nile Delta was the subject of comprehensive studies for a long time. The previous studies concerning geomorphology, geology, hydrogeology, hydrochemistry and paleontology are the main subjects of interest in this study.

The previous geomorphological and geological studies are contained in the works of Andrews (1902), Blackenhorn (1901, 1902, and 1921), Hume (1925), Sandford and Arkel (1939), Ball (1939), Baily (1940), Merril and Owens (1947), Vischer (1947), Attia (1954), Yallouze and Knetsch (1954), Shata (1953, 1955, 1961 and 1962), Sigaev (1959), Said (1962), La Moreaux (1962), El Fayoumy (1964), Shata and el Fayoumy (1967), Abdellah (1970), Abu Al Izz (1971), Sanad (1973), Salouma (1974), Omara and Sanad (1975), Attia (1975), El Shazly et al. (1975), Abdel Daim (1976), El Ghazawi (1982), Shedid (1989) and RIGW (1992).

The previous hydrogeological and hydrogeochemical studies are found in the works of Shotton (1946), Paver and Pretorious (1954, Pavlov (1962), Abdel Baki (1983), Zaghloul et al. (1984), Fekry (1993), Moustafa (1993) and El Ghazawi and Atwa (1994), besides the studies, which were carried out by DRI (1966, 1971 and 1974), REGWA (1961 and 1968), RIGW (1990) and Gomaa (1995).

5. Scope of the present study: -

The present work deals with the following subjects:

1. Pollution of the groundwater resources of western Nile Delta area, and its impact on the development plans.
2. The impacts of human activities on groundwater quality and quantity as result of over-exploitation for the Lower Miocene aquifer.
3. Studying the hydrogeological conditions of Green Belt project around Six of October City.
4. Evaluation of groundwater extracted from different aquifers for different purposes.

To achieve this goal, the following has been discussed:

- Surface water in the Nile River, Rosetta branch, main canals and drains.
- Geology and hydrogeology of the different aquifers in the study area.
- Hydrochemical characters of the different aquifers in the study area.
- Groundwater pollution of the Quaternary (Pleistocene) aquifer.

6. Technique and methods of study:

6.1 Hydrogeological studies include: -

6.1.1 Collection of records on surface water levels from the Ministry of Irrigation.

6.1.2 Collection of well records from the Research Institute for groundwater.

6.1.3 Construction of water level maps and depth to water maps with the use of computer graphics.

6.1.4 Construction of surface water and groundwater hydrographs using computer programs.

6.1.5 Studying the relationship between surface water and groundwater.

6.1.6 Re-evaluating the pumping test data for the different aquifers using computer programs.

6.2 Hydrochemical studies include: -

6.2.1 Collection of water samples from canals, drains, groundwater wells of the Quaternary (Pleistocene) aquifer (both shallow and deep wells), and production wells of the Lower Miocene and Oligo-Miocene aquifers.

The water samples were analyzed for major cations (K^+, Na^+, Mg^{++} and Ca^{++}) and major anion (Cl^-, $SO4^{--}$ and $HCO3^-$) expressed in part per million (ppm) using the following methods:

1. Sodium and potassium were determined with the use of the flame photometeric technique described by Paech and Tracey, (1960).
2. Calcium and magnesium were determined with the use of the method described by Jackson (1958).
3. Chloride was determined using the method described by the American Public Health Association (1955).
4. Carbonate and bicarbonate were determined according to the methods presented by Jackson (1960).
5. Sulphate ions were determined according to the method described by Rossum and Villarrux (1961).

6.2.2 Studying the hydrochemical composition of water samples.

6.2.3 Construction of distribution maps of both salinity and major ions.

6.2.4 Studying the hydrochemical relation of water samples taken from shallow and deep wells through hydrochemical profiles.

6.3 Water pollution studies include:-

The collected water samples were analyzed for nitrate, ammonia and phosphate expressed in ppm using spectrophotometer according to the following methods:

1. Nitrate was determined according to the method described by Paech and Tracey (1956).
2. Ammonia was determined according to the method described by Booth and Lobering (1973).
3. Phosphate was determined according to the method described by Jackson (1958).
4. All water samples of shallow and deep wells of the Quaternary (Pleistocene) aquifer were analyzed for trace elements (Fe^{2+}, Mn^{2+}, Zn^{2+}, Cu^{2+}, and Pb^{2+}) using Atomic absorption device.
5. Determine of the Total Colony count/ml, the Coliform count/100 ml and the E.Coli count/100 ml.

7. Land Use:

On the land use of the study area can be divided into six major portions as following (Fig. 6):

7.1 Populated area:

It has 10.46% of the study area. It is comprised the main cities and villages which characterized by urban growth with uncontrolled rates. The use of septic tank, cess pools, drains, and leakage from sewage system in the study area contributes directly in the groundwater pollution. The increasing demand for potable water of groundwater is affecting the groundwater quantity and quality.

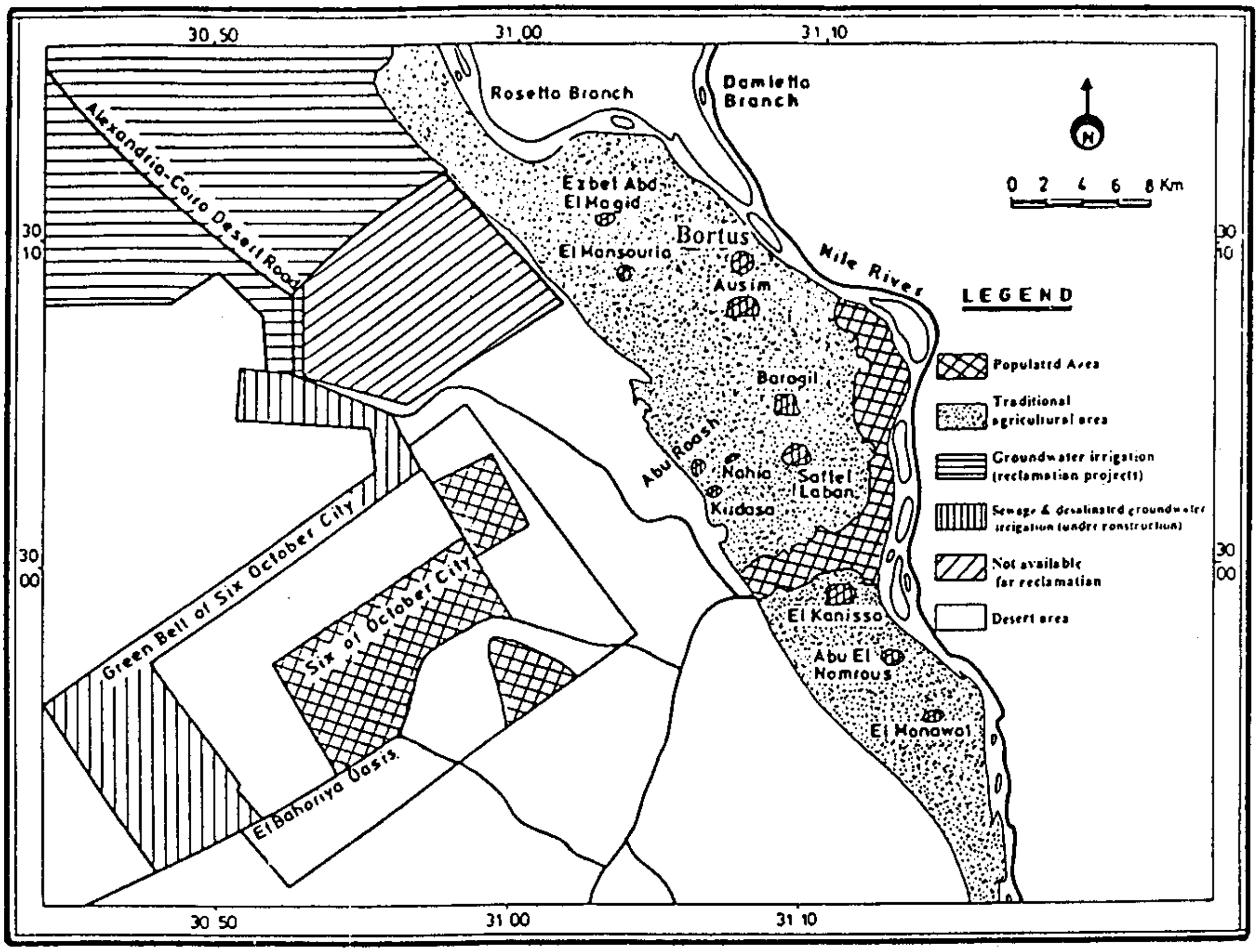

Fig. (6): Land use and groundwater development areas (Modified after Farid and Tunihof, 1991).

7.2 Traditional agricultural area.

It has 27.68% of the study area. Agricultural activities concern the application of chemical fertilizers and pesticides, and storage or disposal of livestock. Nitrogen (N), Phosphorous (P), and potassium (K) fertilizers are the main types applied in the form of Nitrate, ammonium, and phosphate pollution to the groundwater.

7.3 Groundwater irrigation (reclamation projects).

Reclamation projects depends on groundwater exist in the studied area shows a rapid increase in the last five years. It has 12.1 % of the investigated area and comprises Tabark area. These projects are generally carried out by the private sector and are mostly found along main roads (Cairo-Alexandria desert road). The increasing groundwater extraction is lowering water table levels resulting in depletion of the aquifer and pump costs increases.

7.4 Sewage and desalinated groundwater irrigation projects (under construction).

It is the Green Belt around Six of October City. It has 5.64% of the study area. This Belt is constructed to protect the city from dusty winds and reuse treated sewage water in the irrigation woody trees and desalinated water in cultivation vegetables and fruits.

7.5 Not available area for reclamation.

It has 5.45% of the study area.

7.6 Desert area.

It has 38.67% of the study area