

Ain Shams University
Faculty of Science



**"Geophysical contribution to the groundwater exploration in the
area of El Gallaba Plain, west of Kom Ombo, Egypt"**

A Thesis Submitted

By

Mostafa Sayed Geoshy Abd El-kader

Bachelor (B.Sc.) of Geophysics, Faculty of Science,
Al-azhar University, (2012)

For

Master of Science (M.Sc.) Degree in Geophysics

**Geophysics Department
Faculty of Science
Ain Shams University**

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Approval Sheet

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Mostafa Geoshy

ABSTRACT

Horizontal expansion in new lands in the Egyptian desert has long been a key strategic target pursued by successive governments. However, there are still many questions about the possibility of providing water for the reclamation of new land without resorting to the Nile water, at a time when Egypt suffers from severe shortage of surface water resources. Therefore, water experts in Egypt save no efforts to search for new solutions to provide other water resources.

One of the targeted promising new lands for reclamation is El Gallaba Plain (also known as El Kubbaniya basin) which is a desert area at the western fringes of the Nile Valley in Upper Egypt and lies to the Northwest of Aswan City and west of Kom Ombo town. Therefore, the area of El Gallaba Plain has been selected for investigation in the present work.

The investigated area is about 2574 km² and lies between Latitudes 24.4° and 25.0° N and Longitudes 32.4° and 32.9° E with an average E-W width of about 39 km and N-S length of about 66 km.

The present work depends on applying the Transient Electromagnetic (TEM) technique in the investigated area with the main objectives of delineating the subsurface geologic setting, the groundwater occurrence, the impact of the lithological and structural elements on the hydrogeological setting and delivering priorities of sites for groundwater exploitation. In order to reach consistent results with these objectives, several field and office activities have been conducted. The activities included review of the previous geological, hydrogeological and geophysical exploration work on the concerned area and its surroundings, collecting data of the existing wells, carrying out transient electromagnetic (TEM) measurements at 66 sites distributed along EW and NS lines forming a grid within the plain and critical analysis, qualitative and quantitative interpretation of the

acquired TEM data. The interpretation results have been presented in the form of maps and cross sections. Priority maps for groundwater exploitation in the study area have been also presented.

Geomorphologically, the area is characterized by two main geomorphic landforms. The first geomorphic unit includes Sin El Kaddab plateau and Gebel El Barqa. The second main unit is the collector lowlands which include the nubian and sandy silty plains, the drainage lines, the sand dunes and the alluvial fans.

Geologically, the stratigraphic sequence exposed in the study area ranges in age from Upper Cretaceous to Quaternary which represents the youngest deposits in the study area and consists mainly of alluvial sediments (mixture of gravels, sands, silts and mud). Based on satellite imagery and ground penetrating radar measurements (GPR), there are offsets in the subsurface strata resulted from two sets of buried faults (NW–SE and E–W). A set of prominent structures mainly striking in NW-SE and N-S direction have been also detected.

Hydrogeologically, the aquifer system in the investigated area is not homogeneous but consists of several horizontal layers that are affected by deep seated structures causing in some cases uplifting or subsidence of aquifer sections. Some of these structures are also responsible for seepage from Lake Nasser into the aquifer as well as across the aquifer layers.

A total of 66 transient electromagnetic (TEM) soundings were acquired in locations along successive profiles in E-W direction forming a survey grid covering the study area. The acquisition of the TEM soundings took place using the TEM-FAST 48.

The TEM sounding curves have been qualitatively analyzed before carrying out the detailed quantitative interpretation (inversion process). The analysis of the

curves trends and the generated 2D pseudo- sections revealed existence of two groups of layering successions.

The quantitative interpretation of the TEM sounding data was made by the computer software IX1D V.3.39. The initial model needed for TEM data inversion has been generated in view of the general geology of the area and from the lithological description and well logging records of 4 existing wells in the area.

The inversion of the TEM sounding data revealed that two groups of layering succession have been detected in the study area. The first group (I) consists of a sequence of six layers which dominates most of El- Gallaba Plain, whereas, the second group (II) consists of a sequence of four other layers detected in the north-eastern part of the study area. According to the correlation of the layers of group (I) with the geologic information, the upper four layers are related to the Quaternary deposits (Gravel, sand, clay, silty sand) whereas, the fifth layer corresponds to the Dakhla shale and the lower most detected layer corresponds to Keseiba Formation (fine grained sandstone). The fourth layer of this group (silty sand) is subdivided into two zones; the upper one is dry whereas, the lower one represents the Quaternary aquifer in the area. Similarly, based on the geological information, the second group of layers (II) is related, from top downwards, to Duwi Formation (sandstone), Qusseir Formation which forms the second and third layer and consists of silty sandstone and sandy siltstone, respectively. The lowermost layer consists of sandstone corresponding to Umm Barmil Formation which is saturated with groundwater.

A total of six geoelectrical cross- sections have been developed to illustrate the lateral and vertical extensions of the different layers in W - E direction and another geoelectrical cross section traversed the central part of El Gallaba plain in N – S direction. The cross-sections revealed the geological and the hydrogeological features in the area.

The Iso-resistivity contour map of the water bearing zone showed that the groundwater salinity in the northern and southern parts of the area is less than central part. The electrical resistivity is also affected by the lithological composition of the formation. The isopach map of the water bearing zone showed that the water bearing zone attains its maximum thickness at the southern and the central parts of the investigated plain. The water table map (generated from TEM data inversion results) indicated that there is a clear groundwater flow from the south (at Wadi El-Kubbanyia) toward the central part of the plain in the north.

The feasibility of the geophysical results for use by beneficiaries and decision makers is presented by a group of priority maps for groundwater exploitation in El Gallaba Plain. The generated maps delineated some localities in the south, middle and north of El Gallaba plain of first priority in terms of the electrical resistivity, aquifer thickness and depth to groundwater for drilling water wells.

Key words: Transient Electromagnetic, El Gallaba Plain, Wadi El- Kubbaniya, Groundwater, Quaternary aquifer.

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CHAPTER I**INTRODUCTION**

Egypt today is facing intersecting challenges at the nexus of population growth, inhabited land and food production. According to the Egyptian Central Agency for public Mobilization and Statistics (CAPMASTAT), the total population in Egypt is estimated at 99.56 million in 2019 with a population growth rate 1.9% and is projected to grow to around 122 million by 2030. The total land area of Egypt is 1 million km² of which nearly 96% is desert, while only 4% of the total land area is inhabited, mostly, along the Nile valley and within the Nile Delta. The dramatic population growth and the limited inhabited land area has caused critical socio-economic and environmental problems, including an increase of unemployment levels, reducing standard of living, and loss of productive agricultural land due to urban encroachment.

Horizontal expansion in new lands in the Egyptian desert has long been a key strategic target pursued by successive governments. However, there are still many questions about the possibility of providing water for the reclamation of new land without resorting to the Nile water, at a time when Egypt suffers from severe shortage of surface water resources. Therefore, water experts in Egypt save no efforts to search for new solutions to provide other water resources.

One of the targeted promising new lands for reclamation is El Gallaba Plain (also known as El Kubbaniya basin) which is a desert area at the western fringes of the Nile Valley in Upper Egypt and lies to the Northwest of Aswan City and west of Kom Ombo town. It is a vast plain with an area of about