The Use of Qattara's Depression to Reduce the Effect of Rising Water Levels as a Result of Global Warming

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Abstract– Global warming refers to natural duration changes in temperatures and weather phenomenon. Since two centuries ago, human activities have effect climate changes, due to the burning of fossil fuels such as coal, oil and gas which produces heat –trapping gases. Global warming is the long term warming of the planet's overall temperature; this warming is increased in the last hundred years due to the effect of climate changes and heat-trapping gases. Volume of fossil fuels is increased as the human population has increased. The burning of fossil fuels causes greenhouse gasses which prevent the heat from leaving the atmosphere. These gasses are carbon dioxide, chlorofluorocarbons, water vapor, methane and nitrous oxide. Moreover, Global warming causes a serious threat to human, animals and plants life on the earth in the forms of widespread flooding, changes in weather pattern and sea level rise, caused from melting ice sheets and glaciers in North and South poles.

Global warming effect strongly on the widening of the Ozone hole, this will cause a dramatically effect on sea rise all over world water's regions, then most of costal countries will be submerged by water and disappeared from the world maps.

The objective of this research is carried out to reduce the rate of sea level rise along Egyptian shore line by constructing channel between Mediterranean Sea and Qattara Depression.

The study area is located along the shoreline of the Egyptian Delta region. Most countries of this region is affected strongly from sea rise especially that located along the coastal border.

Maps of scale 1:500,000 for Cairo, Alexandria, and Bahariya Governorates, as well as Digital Terrain Models (DTM) for these districts were studied in order to determine the suitable route for the channel that connects the Mediterranean Sea with the Qattara Depression.

Keywords: Global Warming, Fossil Fuels, Green House, Rise of Sea Level, Qattara Depression.

1. INTRODUCTION

Climate change refers to natural and human activities which effect strongly on duration changes in temperatures and weather phenomenon. The burning of fossil fuels, includes coal, oil and natural gas, causes greenhouse gasses which prevent the heat from leaving the atmosphere. Then the greenhouse effect is a man-made process that plays a major part in changing the earth's climate. It produces the relatively warm and hospitable environment near the earth's surface where humans and other life-forms have been able to develop and prosper.

Global warming causes a disaster problem to the human being life on the earth in the forms of widespread flooding, flashfloods, changes in weather pattern and sea level rise, caused from melting ice sheets and glaciers in North and South poles.

The objective of this research is carried out to reduce the rate of sea level rise along Egyptian shore line by transferring water excess through the constructing channel between Mediterranean Sea and Qattara Depression.

The study area of Egyptian Delta Region as well as Qattara Depression was studied with the aid of remotely sensing techniques in order to obtain the suitable route for constructing channel between Mediterranean Sea and Qattara Depression.

2. STUDY AREA

A. Delta Region

The coastal zones of Egypt are perceived as vulnerable to the impacts of climate change because of the direct impact of sea level rise. In particular, the low-lying Nile Delta region, which constitutes the main agricultural land of Egypt and hosts over one-third of the Egyptian population is highly vulnerable to various impacts of climate change.

The Mediterranean coastal shoreline includes four large lakes along the Delta coast line which constitute about 25% of the total area of wetlands in the Mediterranean region. The Mediterranean coastal zone hosts a large number of economic and industrial centres as well as important beaches and tourist resorts. The precipitation along the coastal zone in winter varies between 130 and 170 mm/year and decreases gradually to the south. The tidal range is about 30-40 cm [1].

The Mediterranean coastal zone of Egypt suffers from a number of problems, including a high rate of population growth, unplanned urbanization, land subsidence, excessive erosion rates, salt water intrusion, soil salinization, land use interference, ecosystem pollution and degradation and lack of appropriate institutional management systems.

This zone hosts Alexandria city, which is the main harbor on the western side of the Delta located at a partly low elevation land. The city hosts about 40% of the country's industrial capacity, in addition to being an important summer resort. Other vulnerable large cities include the cities of Rosetta, Damietta, and Port Said.

The Nile Delta region as shown in Figure 1 is the most fertile land of the country and hosts most of the agricultural productivity and the largest part of the population of the country. Its shoreline has relatively low elevation areas. In addition, the Delta suffers from land subsidence that increases from west to east. Hence it is highly vulnerable to potential impacts of climate change.

The Nile Delta shoreline extends from Alexandria to the west to Port-Said to the east with total length of about 240 km and is typically a smooth wide coast. This zone consists of sandy and silty coasts of greatly varying lateral configurations, depending on where the various old branches of the Nile have had their outlets. The coastline has two promontories, Rosetta and Damietta. There are three brackish lakes connected to the sea: Idku, Burullus, and Manzala. In addition, there are several harbors located on the coast including: Alexandria, Edku fishing harbor, Burullus fishing harbor, Damietta commercial harbor, El Gamil fishing harbor and Port Said commercial harbor. Two main drainage canals, Kitchener and Gamasa, discharge their water directly to the sea within this zone.

The Nile Delta region is presently subject changes including shoreline changes, due to erosion and accretion, subsidence and sea level rise due to climate changes [1].

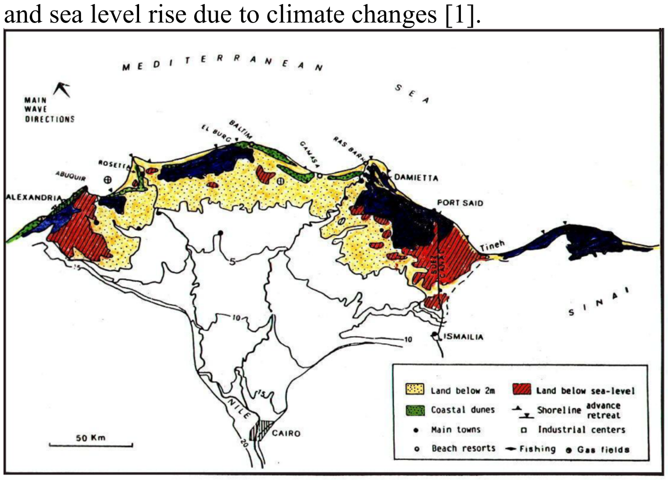

Figure 1 General Topography Of The Nile Delta Indicating Areas Below Mean Sea Level In Red And Areas Below 2m Contour Level In Yellow (El Raey, 2010).

Egyptian delta coasts are vulnerable to subsidence. Tide gauges' data from the Coastal Research Institute of Alexandria revealed a land subsidence of about 1.6 mm/year at Alexandria, 1.0 mm/year at Al-Burullus, and 2.3 mm/year at Port Said [5]. However, survey measurements carried out by Stanley and Warne [5] has revealed rates greater than 4mm/year at Port Said and about 2mm/year at Alexandria for the Holocene period [1].

B. Qattara Depression

The Qattara Depression was created by the interplay of salt weathering and wind erosion. Some 20 kilometres (10 mi) west of the depression lie the oases of Siwa in Egypt. Qattara Depression, arid Libyan Desert (Eastern Saharan) basin in North Western Egypt. The Qattara Depression has the shape of a teardrop, with its point facing east and the broad deep area facing southwest. The northern side of the depression is characterised by steep escarpments up to 280 m (920 ft) high, marking the edge of the adjacent El Diffa plateau. To the south the depression slopes gently up to the Great Sand Sea as shown in Figure 2. It covers about 7,000 square miles (18,100 square km) and contains salt lakes and marshes, and it descends to 435 feet (133 metres) below sea level. The depression extends between the latitudes of 28°35' and 30°25' North and the longitudes of 26°20' and 29°02' East as shown in Figure 3 [2].

The climate of the Qattara Depression is highly arid with annual precipitation between 25 and 50 mm (0.98 and 1.97 in) on the northern rim to less than 25 mm (0.98 in) in the south of the depression. The average daily temperature varies between 36.2 to 6.2 °C (97.2 to 43.2 °F) during summer and winter months. The prevailing wind forms a largely bimodal regime with most wind coming from north easterly and westerly directions. This causes the linear dune formations in the Western desert between the Qattara Depression and the Nile valley. Wind speeds peak in March at 11.5 m/s (26 mph) and minimal in December at 3.2 m/s (7.2 mph)[3]. The average wind speed is about 5 to 6 m/s (11 to 13 mph) [4]. Several days each year in the months March to May khamsin winds blow in from the south and bringing extremely high temperatures as well as sand and dust with them.

Figure 2 The Qattara Depression

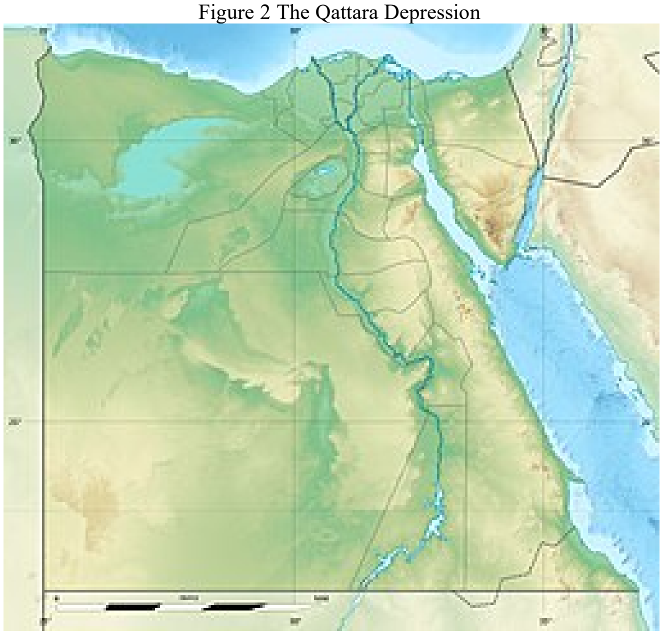

Figure 3 Qattara Depression in Egypt

3. Data Acquisition

Literature review was carried out for the Nile Delta Region as well as the Qattara Depression to study location, topography, climate changes, coastal erosion, greenhouse gasses and sea level rise.

Maps of scale 1:500,000 for Cairo, Alexandria, and Bahariya Governorates were obtained from Military Surveying administration to determine the border of each cities that have low-lying areas in Egyptian Delta Region.

Digital Elevation Model (DEM) can be defined as a digital model representation of the height for the Earth's surface with regarding to any reference datum. DEMs have essential applications either in the commercial market or in the science community. They can be used in engineering projects and infrastructure design.

United States of Geological Survey (USGS) supplies DEM all over the World with different resolutions. The USGS is a main penetration in the World digital mapping. In this research a 90 m DEM was provided by USGS to describe the land surface of the study area.

4. Methodology

A. Topographic Maps

Topographic Maps with scale 1:500000 were used to determine the borders of cities that have low-lying areas in the Egyptian Delta Region, Cairo, Alexandria, and Bahariya Governorates. Topography of ground surface for each city was studied as well as highway grid, natural lakes, drainage pattern, triangulation points and ground control points in order to obtain primary flooding areas that been expected for sea level rise.

B. Geographic Information System (GIS)

DEM for each city's boundary was used with the aid of Geographic Information System (GIS), lunched by Environmental System Research Institute(ESRI), named ARC-GIS version 10.3 to determine the missing parameters needed for simulation as shown in Figures 4,5 and6. ArcMap, spatial analysis tools, are used through the procedures of watershed delineation to establish watershed and its sub-watersheds. Watersheds for each city will be clarified with its drainage pattern and its outlet station to recognize the surface runoff through the main channel of each watershed.

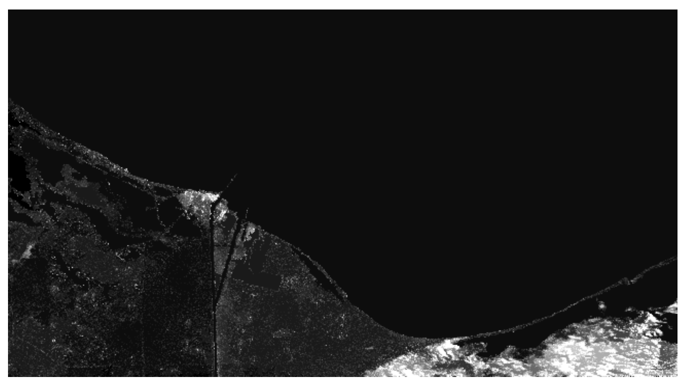

Figure 4 DEM for Port Said city

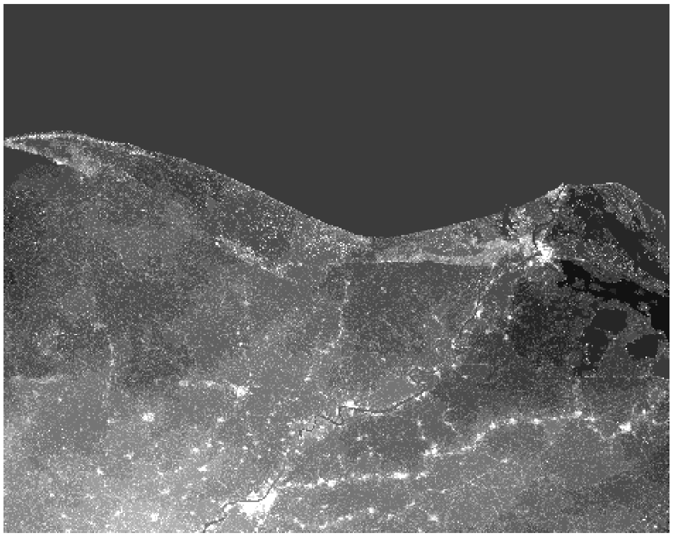

Figure 5 DEM for Gamasa city

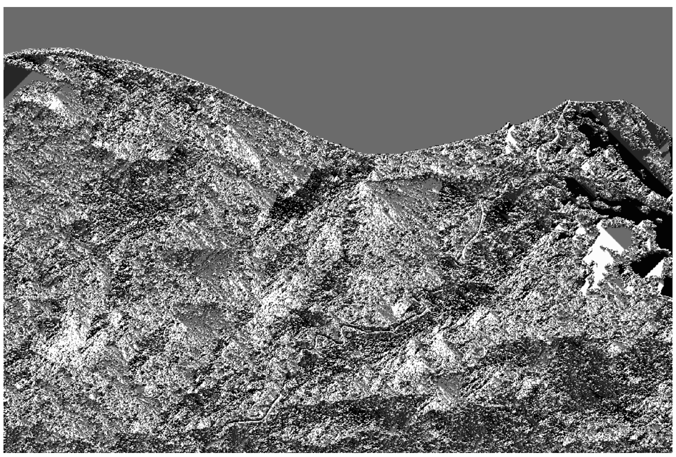

Figure 6 DEM for West Domita city

5. Conclusion And Recommendation

It is concluded that the water volume that will fill Qattara Depression = 1213 km^3. The shortest route to connect the Mediterranean coastal shoreline with the Qattara Depression is the dashed red colour as shown in Figure 7.

It is recommended to use DTM with high resolution in order to provide accurate watershed delineation for watersheds and their sub-watersheds.

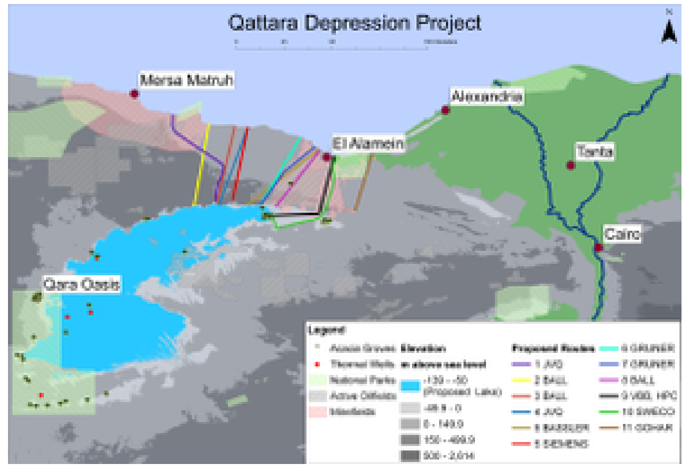

Figure 7 Road connected Mediterranean Sea and Qattara depression

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