International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-3 Issue-3, February 2014

Impact Assessment of Global Warming on Egypt

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Abstract*— *Extreme* weather events due to global warming become more frequent and intense in Egypt. *Recently, some interior parts of Egypt saw torrential heavy rainfall and even snow for the first time in nearly half a century. Global warming consequences threaten Egypt's densely populated coastal strip and Nile Delta, and could have grave consequences for the country's economy, agriculture and industry. A rise of only 30cm to the sea level over the next 15 years would flood 200 square kilometres and displace 500,000 people, effectively ending 70,000 agricultural jobs. Planners and Decision makers are required to think about new scenarios and strategies which are raised as challenge in front of the recent climate changes in Egypt and related impacts. This paper describes recent climate changes impact in Egypt, its future impacts and tries to define defensive actions against the expected global warming crisis on Egypt.

Index Terms*— *Climate change, Egypt, Global warming, Nile delta, Sea Level Rise (SLR)

I. INTRODUCTION

By dramatically increasing of sea levels due to global warming, several threats will affect Egypt's densely populated coastal strip and Nile Delta, which could have grave consequences for economy, agriculture and industry. Combined with growing demographic pressures, rise in sea levels could turn millions of Egyptians into environmental refugees by the end of the century, as Nile Delta will turn to wasteland by rise of only 30 cm to sea level over the next 15 years and will cause displace of about 500,000 people, effectively ending 70,000 agricultural jobs. Challenges raised now are to prepare for expected global warming crisis and related impacts.

II. EGYPT

A. Egypt Location

Officially the Arab Republic of Egypt is a country mainly in North Africa, with the Sinai Peninsula forming a land bridge in Southwest Asia. Egypt is thus a transcontinental country, and a major power in Africa, the Mediterranean Basin, the Middle East and the Muslim world. It possesses a land bridge (the Isthmus of Suez) between Africa and Asia, traversed by a navigable waterway (the Suez Canal) that connects the Mediterranean Sea with the Indian Ocean by way of the Red Sea. Covering an area of about 1,010,450 square kilometres, Egypt is bordered by the Mediterranean Sea to the north, Palestine to the northeast, the Red Sea to the east, Sudan to the south and Libya to the west.

Manuscript published on 28 February 2014.
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The great majority of Egyptian people live near the Nile River Basin, in an area of about 40,000 square kilometres, where the only arable land is found, meaning that about 99% of the population uses only about 5.5% of the total land area. The large areas of the Sahara Desert are sparsely inhabited. About half of Egypt's residents live in urban areas, with most spread across the densely populated centres of greater Cairo, Alexandria and other major cities in the Nile Delta. Egypt lies between latitudes 22° and 32°N, and longitudes 24° and 36°E.

B. Population density

Egypt is the most populated country in the Middle East and the third most populous on the African continent, at about 80 million inhabitants in 2009. The population is concentrated along the Nile (notably Cairo and Alexandria), in the Delta and near the Suez Canal. About half of Egypt's 80 million people live in the Nile Delta region. Outside of major cities, population density in the delta averages 1,000 persons/km² or more. Alexandria is the largest city in the delta with an estimated population of more than 4 million. Prior to the construction of the Aswan Dam, the Nile flooded annually replenishing Egypt's soil. This gave the country consistent harvest throughout the years. Now, The Nile Delta (Coordinates: 30°54′N 31°7′E) is eroding at a rate of 50 km2 per year, and it has been predicted that this Delta will have vanished by the year 2550 CE. Figure 1 shows the Egyptian population development and figure 2 shows the population density in Egypt [7], [17].

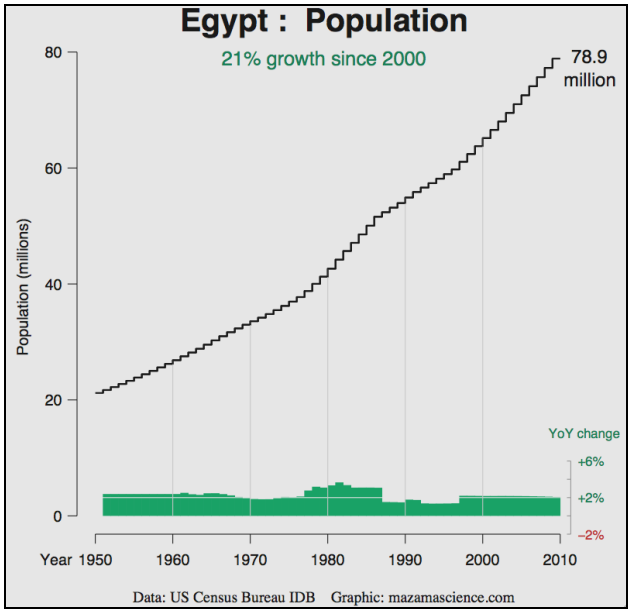

Fig 1: The Egyptian population has surged to nearly 85 million, a 20% rise in the past decade alone [17]

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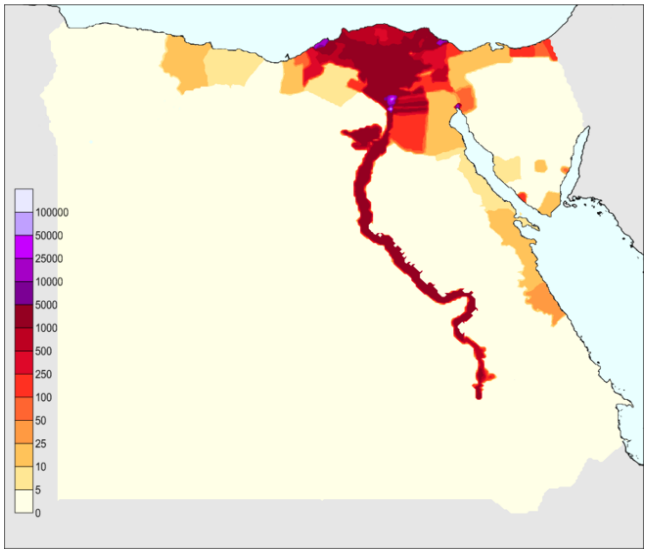

Fig 2: Egypt 2010 population density- people per km^2 [7]

III. CLIMATE

A. Usual Climatic

The climate in Egypt varies from Mediterranean climate on coastal areas to hot dry clime in southern and desert regions. The maximum temperature ranges from 32º C in Alexandria to 34º C in Cairo and increases up to 40º C in Aswan.

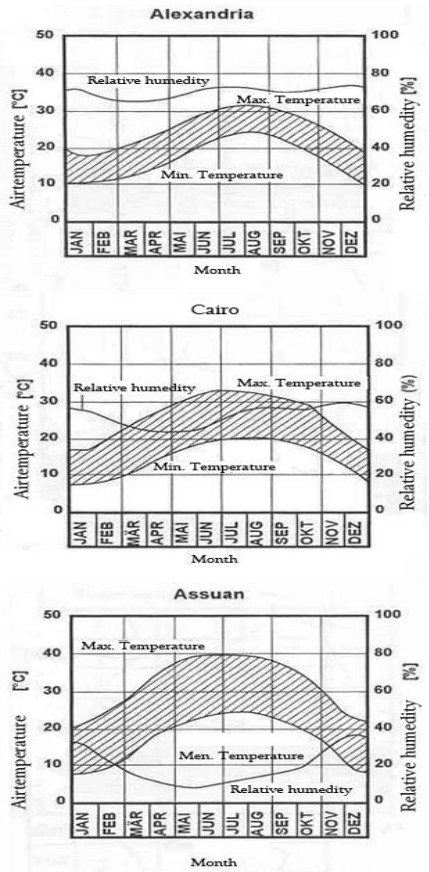

Figure 3: Air Temperature and relative humidity in Alexandria (north Egypt) and Aswan (south Egypt) and in Cairo [24]

The winter temperature average minimum temperature is 15º C in the three cities. The temperature amplitude is 12 in Alexandria, 17 in Cairo and reaches 20 in Aswan. The relative humidity has a wide range from 75% year over in Alexandria and fluctuates with average 55% in Cairo and 20% in Aswan (see figure 3).A steady wind from the northwest helps lower temperatures near the Mediterranean coast. The Khamaseen is a wind that blows from the south in spring, bringing sand and dust, and sometimes raises the temperature in the desert. Figure 4, and Figure 5 shows wind speed and rainfall in Cairo.

Most of Egypt's rain falls in winter months. South of Cairo, rainfall averages only around 2 to 5 mm per year and at intervals of many years. On a very thin strip of the northern coast the rainfall can be as high as 410 mm, mostly between October and March. Snow falls on Sinai's mountains and some of the north coastal cities such as Damietta, Baltim, Sidi Barrany, etc. and rarely in Alexandria. Frost is also known in mid-Sinai and mid-Egypt [23]

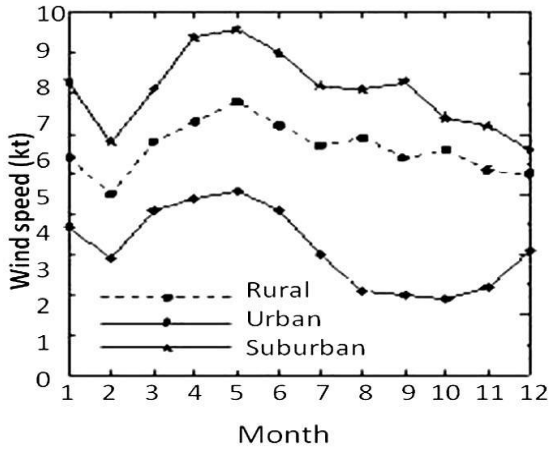

Figure 4: Mean monthly values (1995-2000) of wind speed at the urban, suburban and rural areas in Cairo [23]

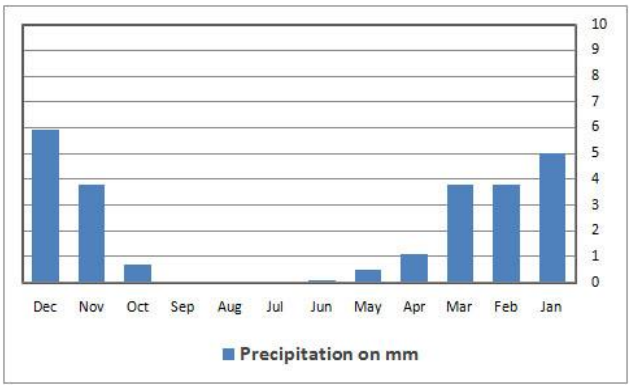

Figure 5: Average monthly precipitation in Cairo

Fig 4: Cairo climate, [23]

B. Climatic recent problems

Jim Andrews said "I cannot recall seeing so much rain forecast by a numerical forecast model for Egypt and northwest Arabia. I am talking about highest rainfall of 10-15 cm in an area from south of Cairo east to Sinai, also the Nile Delta" [16]

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Extreme weather events due to global warming become and will be more frequent and intense. Recently, some interior parts of Egypt saw torrential heavy rainfall and even snow for the first time in nearly half a century. In January 2010, there were colder weather conditions than usual during the day and very cold at night all over the country coupled with low-and middle clouds and thunderstorm and wind mostly north-westerly moderate to brisk exciting of sand and dust and consists of frost on the plants in the Sinai and Upper Egypt. Some snowy storm blew upon some unusual spots even in southern Egypt leaving tops above 1,500 meters whitened with snow [16]. Rain-induced flooding swept away a great number of homes, knocked out power lines, cut roads, endanger the lives of citizens and motorists at risk, claimed the lives people, left many injured and missing persons and hundreds displaced in different parts of Egypt, in the Sinai Peninsula, the Red Sea port of Hurghada, Luxor ,and Aswan [6]. Figure 5 shows total precipitation in Egypt in 2010 and The map in Figure 6 shows the negatively affected areas by rain on 2010-2011.

In Sinai; a Pool caused 5.3 million cubic meters of flood water behind the bridge cranes, the largest dams North Sinai Governorate, in the threat of dam collapse and exposed him to danger, especially after the rise of water above it and expanded it to several kilometres and continuity of flow until the city of El Arish. In El-Arish, the central-Arish hospital was flooded by a flood and caused power outages, which stopped all the medical devices, which led to losses estimated at millions of pounds. In the North Sinai Governorate there were affected areas in the centre. Flooding killed Bedouin and bulldozed hundreds of acres. There were dozens missing persons and more than 1000 stuck in North, Central and South Sinai as floods cut off roads, power lines and water and washed away hundreds of huts, dozens of chalets and thousands of nomadic herds of camels, sheep and goats [10].

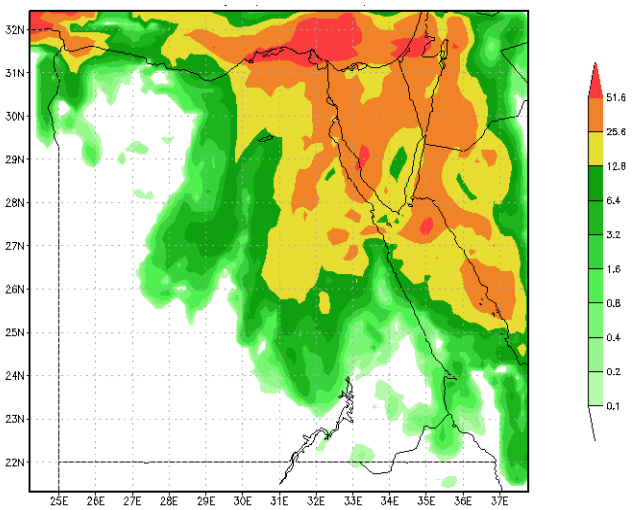

Figure 6: Total precipitation in Egypt on 17-18 Jan.,2010, [9]

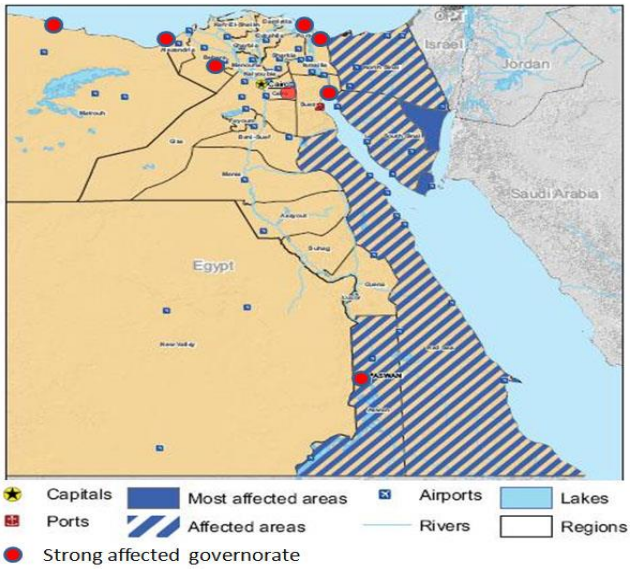

Figure 7: Badly affected areas by rain on 2010-2011 [after DREF]

In Aswan; snow balls have been seen. Heavy rain accompanied with Blared winds and lightning covered the area, outbreak of fires in homes, close the international airports in Aswan and Abu Simbel. High winds caused a blackout for the entire province and flooded several streets in the water. Rain behind the Red Sea Mountains caused flooding in a sweep of a number from the villages, leaving behind hundreds of houses collapsed (around 1150 houses), and the sinking of agricultural land and crops. The floods also destroyed some 57 high-rise, high pressure, west and east of the Nile which led to the power outages and interruption of electricity to the province of Aswan. The hurricane led to take off and drape, electrical towers, high pressure from the places they are installed, and to the uprooting of trees not under the age of 200 in the root. Accompanied by the hurricane, a huge ice balls were falling on residential areas directly and in places other than the usual exposure to Seoul, and far from storm water drains. All this led to Aswan complete paralysis. The storm lasted less than half an hour, leaving behind huge disasters [6].

In Suez; the Port Authority closed the port of oil and the port of Suez and the port of literary due to bad weather conditions and increasing wind speed and wave heights and the lack of vision. Ports have been closed in order to avoid incidents between vessels or a collision with the port berths, where the waves reached a height to 4 meters and wind speeds reaching 30 km / hour [1].

IN Alexandria; the port is closed due to the severity of the swells. Dozens of buildings were damaged in Alexandria as a severe cold front moved into the area, dropping the temperature twenty degrees while bringing high winds, dropping snow in some areas. The region saw severe thunderstorms and 6 to 9 metre waves, with reports of 4 metre waves crashing a shore at Alexandria [4]. Figure 7 shows records of wind speed at Alexandria at December 2010.

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Figure 8 : Wind speeds from December 05 to December 12, 2010 in Alexandria [4]

Roads; heavy rains caused many of the cracks in the way of Egypt, Aswan, Kom Ombo and the road to victory Nubia, Edfu and in Ramadi. High winds caused plunge many of the streets. Heavy rain affected the movement of citizens, especially vehicular traffic, and the problem appeared clear of places that accumulated rain water back by the lack of disposal due to obstruction of the vast majority of storm water drains deployed on the streets and cars based on the withdrawal of excess water areas, and there were many road bumps along key streets, which left many injured and some dead people

This heavy rain caused an obstruction of traffic on the road to Cairo - Hurghada and the Floods have cut off roads in central Sinai, caused closure of the road from Km 109 in South Sinai to the eyes of Moses, blocked the road leading to the Ahmed Hamdi tunnel, and blackout in the city of Sharm el-Sheikh. Confusions due to bad weather at the airports of Cairo and Sharm el-Sheikh occurred [1]. The rains and floods cut off the desert road, "Qeft - short," the north of Luxor, which led to obstruct the passage of tourist buses coming to the province of Luxor causing traffic jams in those buses.
The magnitude of the disaster was very large and there were a lot of bereaved families and thousands of people are in the open

IV. CLIMATE CHANGE IMPACTS ON EGYPT

Reductions in water availability due to global warming would hit southern Mediterranean countries the hardest. In Egypt, water pollution is already a major health hazard - would become still worse as pollutants become more concentrated with reductions in river flow. Agricultural production may cease altogether over an area extending 20 km inland. Some water supplies could become unusable due to the penetration of salt water into rivers and coastal aquifers as sea level rises. In coastal areas, large areas of productive land may be lost through flooding, saline intrusion and water logging. The combination of higher prices and crop losses would lead to deterioration in levels of food security. Salt is infiltrating soils and eroding the foundations of ancient buildings, as well as untold thousands of buried artifacts and undiscovered antiquities. Homes, are eroding from underneath. A tendency for a northwards shift of the desert line could be found [15], [18]. Flooding had already begun with the Mediterranean rising an average of 2 centimetres annually over the past decade. It has already flooded parts of Egypt's shoreline, predicting an increase in sandstorms and longer periods of drought followed by flooding. Researchers predict the Mediterranean will rise by 30-100 cm by the end of the century. A one-metre sea-level rise would submerge Alexandria [13]

There are a lot of other problems that Egypt might face consequentially. For example, a rise in sea levels of 50 cm could lead to the loss of about 194,000 jobs and the displacement of about 1.5 million people in Alexandria. With a sea level rise of 2 m it is expected that 76% of Alexandria land will sink, the agriculture land will be completely under the sea water, 70% of archaeological sites will be covered by sea water also and 97% of its population will be affected [19].

A. *Water availability*

Climate change and pollution are bound to have some effect on the availability of fresh water in the Nile basin, which could cause water shortages (in case of decreased rainfall) or flooding (in case of periodic increased rainfall). Both the quantity and quality of fresh water resources are in danger. Water shortages are already hitting Egypt (table 1). Reduced Nile water flows coupled with Egypt's growing population have already put a strain on agricultural output. Egypt had already entered the cycle of water poverty. Egypt would need 86.2 billion cubic metres of water in 2017, while resources would only reach 71.4 billion cu. m. In 2006 Egypt's water resources were 64 billion cu. m, of which the Nile provided 55.5 billion cu. m, or 87 percent. But by 2017 the Nile is expected to supply only 80.5 percent of Egypt's resources [13].

Table 1 : Water availability in Egypt [11]

Country	Per capita water availability 1990 (cubic meters)	Per capita water availability 2025 (cubic meters)	Water poverty line
Egypt	1,123	630	1000

B. *Egypt -Delta Region*

The low-lying coastal and delta regions host one third of Egypt's population, and include the arable land for the majority of the country's crops [18]. Delta region is currently home to 60% of Egypt's 80 million people. By 2017, Egypt's water needs may surpass its resources as rising sea levels inundate much of the country's most fertile. About 15% of Delta land is currently under threat from the rising sea level and the seepage (of salt water) into ground water [13].

A 1 metre rise of the sea water level would put more than 12% of the country's best agricultural land at risk in the Nile Delta, and rises dramatically to 25% (SLR of 3m) and even almost 35% (extreme SLR of 5m). A huge number of people will be affected, for example, 8 million people will be affected by 1.5 m of SLR [13]. In the extreme case of 5 m SLR, more than half (~58%) of the Nile Delta will be facing destructive impacts, which would threaten at least 10 major cities (among them Alexandria, Damanhur, Kafr-El-Sheikh, Damietta, Mansura and Port-Said), flooding productive agricultural lands, forcing about 14% of the country's population (~11.5 million people) into more concentrated areas to the southern region of the Nile Delta, and thus would contribute to worsening their living standards. people will find themselves wedged between flooding and rising sea levels [20], figure 8.

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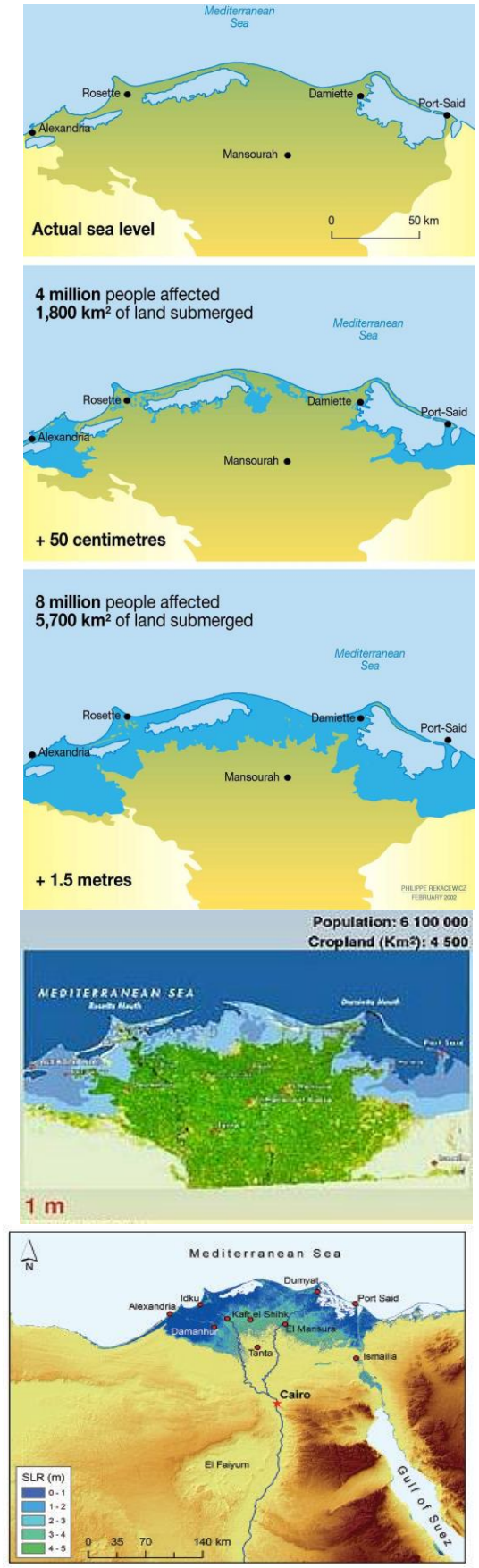

Figure 9: SLR scenarios of 1-5 meters in the Nile Delta region [13], [20], [14]

C. Human health

Human health would be adversely affected by higher temperatures, mainly due to changes in geographical ranges of disease vectors like mosquitoes, waterborne pathogens, water quality, air quality and food availability and quality. Incidence of infectious diseases like malaria and schistosomiasis will increase. Higher CO2 concentrations and fiercer and more frequent sand storms in desert areas will increase allergic reactions and pulmonary diseases all over the region [20]

D. GDP

As for SLR's (sea level rise) effect on GDP, Egypt's economy is by far the most vulnerable: for SLR of 1 metre, more than 6% of its GDP is at risk, which rises to more than 12% for an SLR of 3 metres [20]. It is expected that by 2050 Egypt will experience a decrease in national production of many of its major crops (–11% for rice to –28% for soybeans) compared with their production under 2006 climate conditions [5]. Other agricultural activities could also be affected by climate change and variability, including changes in the onset of rain days and the variability of dry spells [12]. Sea level rise and coastal flooding may impact food security and lead to malnutrition and hunger. For this case even farmers need agricultural planning and consultation to confront these changes successfully.

The shoreline of Egypt extends for about 3000 km. An increase of between 1-4°C in average temperature will cause a drastic decline in the index of tourism comfort. Areas classified between "good" and "excellent" are likely to become marginal to "unfavourable" by the year 2080, mainly because of hotter summers, extreme weather events, water scarcity and ecosystems degradation. Beach erosion and sea level rise will affect coastal tourist destinations especially in locations where sandy beach stretches are narrow and buildings are close to the shoreline [20], [19].

E. Infrastructure

Climate change is expected to significantly affect infrastructure. Transportation infrastructure is generally vulnerable to projected increases in the intensity and frequency of hot days, storm activities, and sea level rise. Infrastructure in the coastal zones is particularly vulnerable to SLR and possible storm surges. Energy distribution and transmission systems will be more prone to failure as extreme weather events become more frequent [20].

V. ACTION AGAINST CLIMATE CHANGES IMPACTS IN EGYPT

Egypt has been actively involved within United Nations forums in the deliberations leading to the Framework Convention on Climate Change, which it signed in Rio in 1992 [19]. Cairo has allocated US$300 million to build concrete walls to protect Alexandria's beaches as part of a "national strategy study" to combat the coming floods, but the cost of preventative measures was too high for Egypt alone [13]. Following are some solution ideas to help reducing global warming impact on Egypt.

The short-term oriented policy is to prepare for moving the population at risk in the Nile Delta region, where their recent area will be affected by Sea level rise 1-2 scenarios at least.

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By the expected SLR scenarios, those people will be displaced away from their lands, The Nile Delta, which is about 24,900 km2 in area, by the SLR scenarios, 0.5, 1.0 and 1.5m the land loss and affected people will be as shown in Figure 9 and Figure 10.

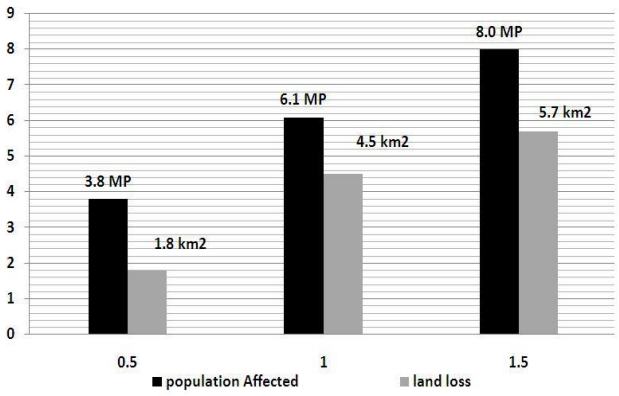

Figure 10: Land loss by SLR in Nile Delta and affected population by flood

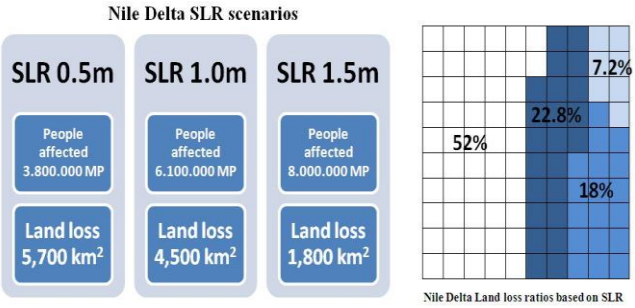

Figure 11: Sea level rise (SLR) scenarios of 0.5, 1.0, 1.5 meters in the Nile Delta region

A. Seawall Alternative

It is important to protect the Nile Delta' lowlands from the sea's incursion. As a precaution project is building seawalls. It is to build concrete wall along the Delta's entire coastline and skirting it with a plastic diaphragm to prevent saltwater seepage along the 240-kilometre coast to hold back the Mediterranean, Figure 12[3].

B. Renewable energy Alternative

As a help in reducing the greenhouse gas emissions, is enhancing renewable energy projects, like Zafarana Wind Farm and Elkorimat solar energy station. The Zafarana wind farm, which is located about 120 km south of the Suez city on the red sea coast, is the largest plant of its kind in Africa. The Red Sea coast is one of the best sites for wind energy production. The size of the project is up to 700 power plants. It is to generate energy from the wind in Zafarana as a production of electricity in 1400 GW / h per year. It will reduce emissions of carbon dioxide of about 800 thousand tons per year. The estimated potential available in Egypt for the production of energy from wind is about 20,000 MW, which is equivalent to the capacity of 16 stations for the production of nuclear energy, Figure 13 [2].

Figure 12: Seawall to protect coastal area of Delta region in Egypt

Figure 13: Zafarana Wind Farm in Egypt

C. Migration of affected people

As a solution for the affected people, implementing mitigation and adaptation policies should be taken for the people at risk in Nile Delta, There are three alternatives for moving people to safe places near or far to their owns. the first is to direct the migration of affected people or those whom at critical risk to the new Development Corridor project suggested by Farouk El-Baz to the west side of Nile Basin region and its delta which will be suitable for sustainable development of the old and new region around Nile River and Delta. The second alternative is to direct the affected people migration from northern areas of Nile Delta, due to the SLR, to the nearby northern area of Sinai, which is counted as rich region with its natural resources and wide areas of land suitable for receiving moved people and cultivation jobs. The third one is to urbanize new discovered area to be developed in the Egyptian western desert.

C.1 Development Corridor Alternative

It is a proposed superhighway west of the Nile from the Mediterranean Sea coastline to Lake Nasser. The proposal would provide numerous opportunities for the development of new communities, agriculture, industry, trade and tourism around a 2,000 km strip of the Western Desert. The Government of Egypt was unable or unwilling to pursue the project, when it is first proposed since 20 years ago, for whatever reasons. Because the country is presently facing insurmountable problems, the proposal is resubmitted for consideration by the private sector- local, Arab and international investors [8], Figure 13, Figure 14 and Figure15.

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C.2 Sinai Alternative

Sinai is the bridge between Asia and Africa. The research program on remote sensing aids to groundwater exploration in Egypt's deserts resulted in a number of definable accomplishments that are directly related to finding ground water at specific sites, with direct application for agricultural use. Ten sites were recommended for more detailed analysis and eventual drilling in the northern Sinai, and nine sites in southern Sinai. The southern part of the Eastern Desert showed strong structural control on drainage development, and therefore offers high potential for large ground water reserves in fracture reservoirs. Parts of the Western Desert should be developed utilizing recently discovered groundwater in large buried stream channels, and by initiating an irrigation project west of Lake Nasser, see figure 17.

C.3 Urbanize western desert Alternative

In 28 June 2011 an Egyptian Exploratory team, started an expedition in the previously unexplored regions of the Great Egyptian Sand Sea in the Western part of the Western Desert. The expedition found that, the Great Sand Sea is not consisting of Pleistocene-Recent sand dunes as previously described and mapped in the geologic map of Egypt. It is essentially made up of a series of parallel longitudinal sandstone ridges extending North Northwest- South Southeast and belonging to the well known Nubian Sandstone rock unit. A big area of about 3.5 million Feddan is able to be developed [21], [22]. Water is available under the Egyptian desert with great amounts, that the depth of water storage reaches 3500 m underground. Solar radiation is intense (6.6-6.7 kwh/m2/day) and wind velocity reaches 7m/s. Lime stone and shale clay soil are available for local building materials in the new discovered Oases and plateaus. A touristic site "White desert national park" lies near new Oasis. Considering the threat of fresh water scarcity in Egypt, the expected effects of global warming on it especially on coastal and delta regions, in addition to national needs to create new urban communities outside the scope of the Nile Valley, a primary master plan and a general plan of a city "Gardens' city" has been planned to be developed in new Farafah Oasis in the new discovered areas. The city will depend on renewable energy like wind and solar power. In case of being developed, Gardens' city will be the first product of big development opportunities in Egypt, see figure 18-19 [25].

The other hand long-term oriented and proactive policies of sustainable development in our case active policies of climate change defence actions for sustainable environment and environmental protection, emission reduction, and active reproductive health programs, also functional cooperation to increase water management and pollution control techniques, to offer employment in rural areas and sustainable agricultural policies – may become the most effective policy of conflict prevention that will enhance both human and societal security in the affected regions of Egypt in the early 21st century [19].

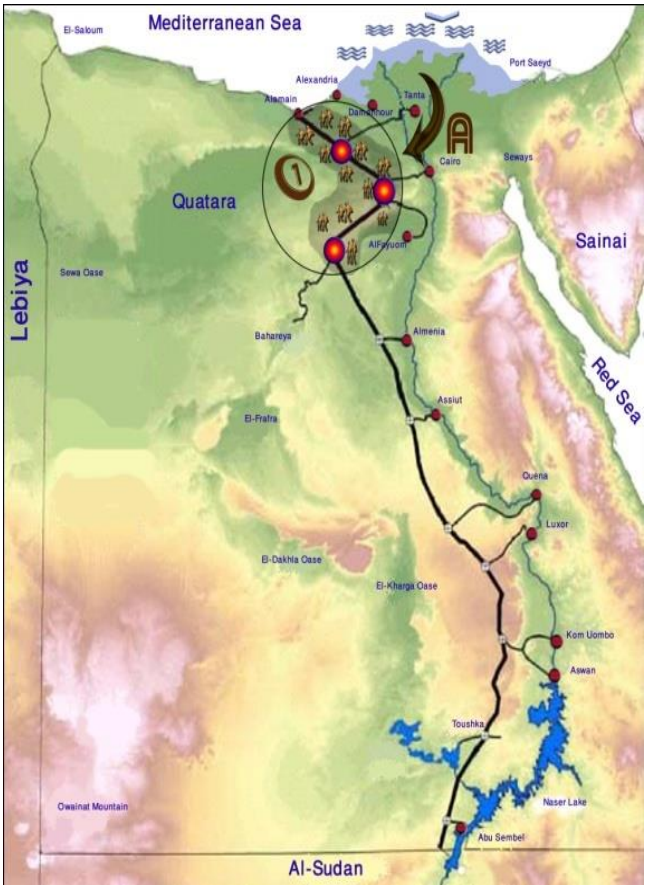

Figure 14: 1st Population migration from Nile Delta due to SLR 0.5 m

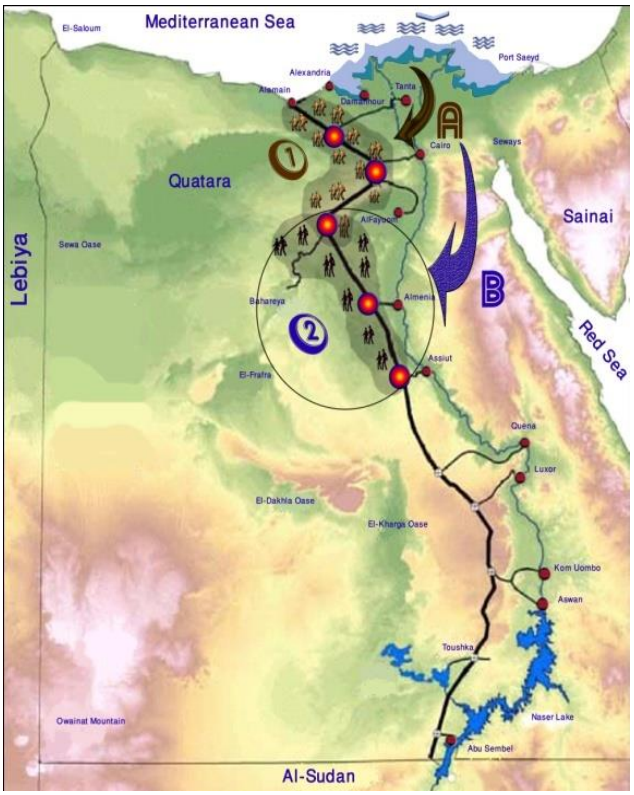

Figure 15: 2nd Population migration from Nile Delta due to SLR 1.0 m

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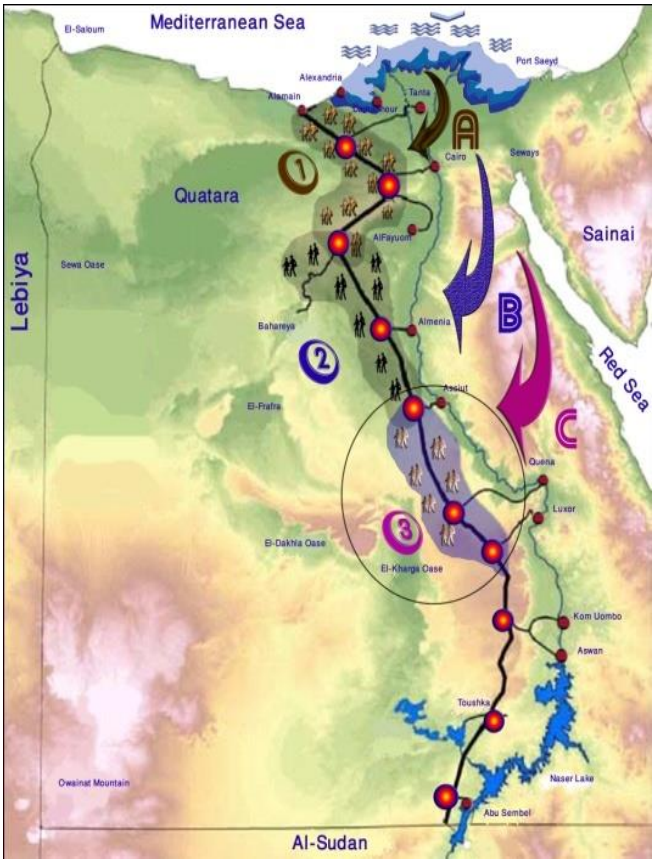

Figure 16: 3rd Population migration from Nile Delta due to SLR 1.5 m

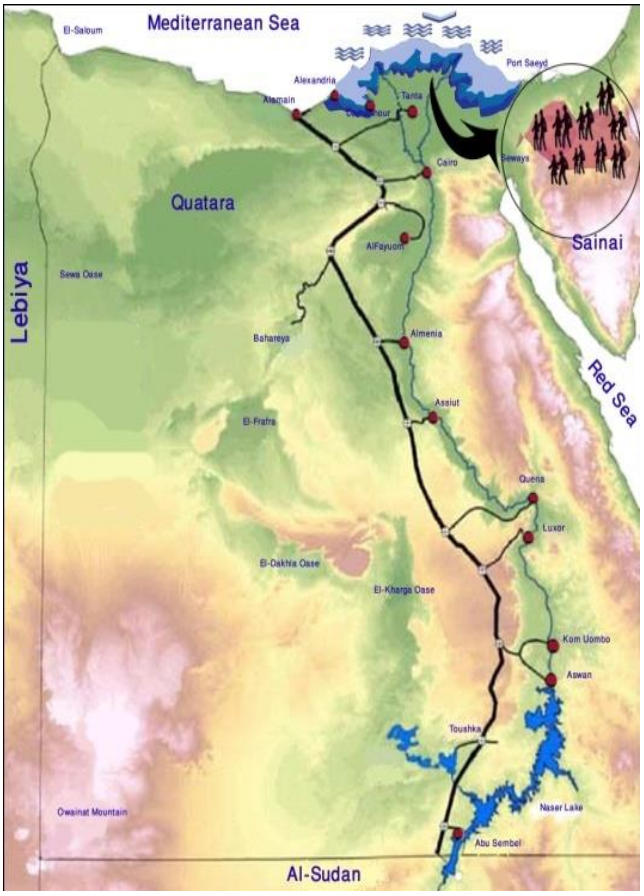

Figure 17: Sinai as an alternative for receiving population migration from Nile Delta

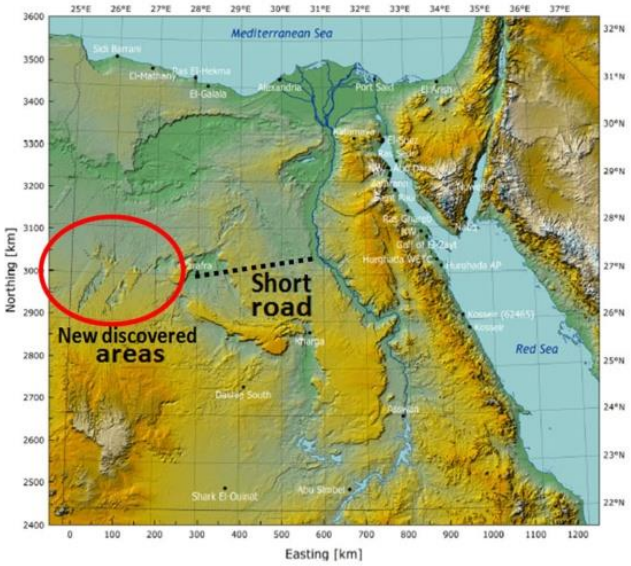

Figure 18: Newly discovered areas and to be initiated road to Nile valley (180 km) [25]

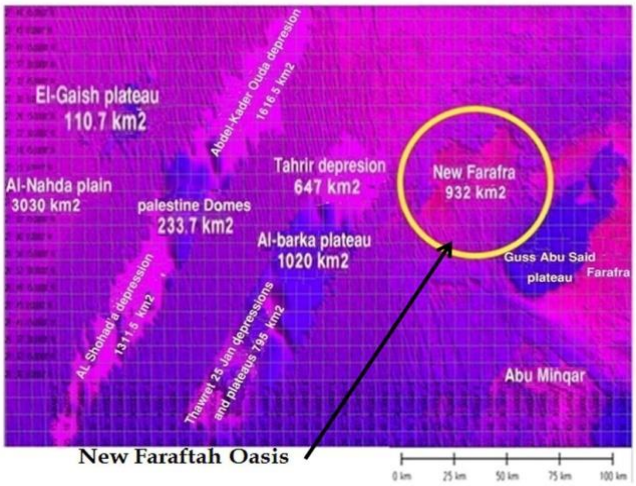

Figure 19: Newly discovered areas in Egyptian western desert [22]

VI. CONCLUSION AND RECOMMENDATION

This paper has shown that the coastal areas in Egypt are highly vulnerable to the potential impacts of climate change. Rising seawaters are raising havoc in Egypt, turning the Nile Delta into a salty marsh and forcing farmers off their lands and near and far future of Egypt. There are some suggested projects for Egypt to reduce global warming impact on it. Proactive action needs to be taken, both in terms of expanding knowledge, cooperation, implementing mitigation and adaptation policies. The main conclusions and recommendations are listed below:

- The Egyptian coastal areas are highly vulnerable to the potential impacts of sea level rise and the expected increased severity and frequency of extreme events.
- A change in policies to develop consumption patterns everywhere and a system for water use that suits everybody in Egypt is much needed.

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- Infrastructure should be enhanced to withstand climate change both in design criteria and operations.
- A coherent climate strategy for the nation as a whole is needed.
- Concrete regional action to deal with climate change is needed with a strategic assessment and risk reduction to joint efforts through the League of Arab countries and the Nile basin countries.
- An early warning system of SLR for the Mediterranean coastal areas in Egypt must be established through satellite systems.
- Proactive planning and protection policies and measures should be initiated for vulnerable sectors with particular emphasis on the coastal zone.

REFERENCES

[1] Ahram Online (2011)"Wind, rains and sandstorm lash Egypt, close ports," 2010 Ahram Online, Saturday, Cairo 35-22 , 25 June 2011. http://english.ahram.org.eg/NewsContent/1/0/1723/Egypt/Wind,-rains-and-sandstorm-lash-Egypt,-close-ports.aspx

[2] Anod Elkabandy: Green energy in in the heart of the Egyptian desert- 700 station wind power Zafarana. Journal of our environment - the Environment Public Authority - No. 141, 2013. http://www.beatona.net/CMS/index.php?option=com_content&view=article&id=1474&lang=en&Itemid=84

[3] Cam McGrath: Nile Delta disappearing beneath the sea. Jan 29 2014 (IPS). http://www.ipsnews.net/2014/01/nile-delta-disappearing-beneath-sea/

[4] cruisebruise.com (2010), Brilliance Of The Seas- Severe Listing In Rough Seas, December 12, 2010. http://www.cruisebruise.com/Collisions_Damage_At_Sea/Brilliance_Of_The_Seas_Severe_Listing_December_12_2010.html

[5] Deborah Phelan (2011) " Egypt's Next Crisis: Climate Change & Justice -- "We are Egypt!", Climate Change: The Next Generation, January 30, 2011. http://climatechangepsychology.blogspot.com/2011_01_01_archive.html

[6] DREF, 2010 "The International Federation's Disaster Relief Emergency Fund" (DREF), DREF operation n° MDREG009 GLIDE n° FL-2010-000012-EGY, 21 January 2010

[7] Egypt. http://en.wikipedia.org/wiki/Egypt - 15 June 2011

[8] Farouk El-Baz, Ted A. Maxwell, Ibrahim Hassan Himida & Samy Soliman Mohammed, (Egypt: Groundwater Exploration in the Sahara Desert", center of remote sensing. http://www.bu.edu/remotesensing/research/completed/sahara-groundwater/)

[9] flaflom.org (2010) "Total precipitation in grid format" on 17-18 Jan.,2010, Flash Flood over Sinai, 17&18 Jan 2010. http://flaflom.org/Expectedresults.htm

[10] FluTrackers.com (2010) "Extreme, Unusual Rain Aimed for Egypt",FluTrackers.com, January 17th, 2010. http://www.flutrackers.com/forum/showthread.php?p=336678

[11] Hans Cathcart (2007), "Future Demands on Nile River Water and Egyptian National Security", ICE Case Studies, Number 203, May, 2007. http://www1.american.edu/ted/ice/nile-2020.htm

[12] IPCC (2007) "Climate Change 2007: Working Group II: Impacts, Adaption and Vulnerability", IPCC Fourth Assessment Report: Climate Change 2007, IPCC Intergovernmental panel for climate change. http://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch9s9-4-4.html

[13] IRIN (2011) " EGYPT Disaster looms for Delta region", the humanitarian news and analysis service of the UN Office for the Coordination of Humanitarian Affairs, CAIRO, 7 October 2009 (IRIN), 18 June 2011. http://www.irinnews.org/Report.aspx?ReportId=86472

[14] Issandr El Amrani (2010) "Is Egypt's Delta going to drown, or not?" http://www.arabist.net/blog/tag/environment

[15] Jacqueline Karas " climate change and the Mediterranean region". http://www.greenpeace.org/raw/content/international/press/reports/climate-change-and-the-mediter.pdf

[16] Jim Andrews (2010) " Extreme, Unusual Rain Aimed for Egypt", AccuWeather.com, Jan 16, 2010. http://www.accuweather.com/blogs/andrews/story/23777/extreme_unusual_rain_aimed_for_egypt.asp

[17] Kenneth D. Worth (2011) "Egyptian Turmoil Bullish for Oil Stocks, But Not for Reasons Some Might Think" , Seeking Alpha (SA), February 2, 2011. http://seekingalpha.com/article/250392-egyptian-turmoil-bullish-for-oil-stocks-but-not-for-reasons-some-might-think

[18] Michael Cote (2011), Egypt Is Extremely Vulnerable to Climate Changes: Could a New Government Help the Country Adapt?, Environment, February 3, 2011. http://www.good.is/post/egypt-is-extremely-vulnerable-to-climate-impacts-how-could-a-new-government-help-the-country-adapt/

[19] Mohamed El-Raey; Dia H.El-Quosy; Mahmoud El-Shaer; Osama A.El Kholy; Ayat Soliman (1995) " Egypt: Inventory and Mitigation Options,and Vulnerability and Adaptation Assessment", CSP interim report on climate change country studies, March 1995

[20] Mostafa K. Tolba; Najib W. Saab, (2009), Arab environment climate change- Impact of climate change on Arab countries, 2009 report of the Arab forum for environment and development

[21] Ouda K. (presented conf.): Fostering sustainable water management and agriculture in Egypt's 'New Valley' WaDImena Egypt - June 2009

[22] Ouda, K. et al.: New Findings in Geology, Geomorphology, and Groundwater Potentiality of the Great Sand Sea, Western Desert, Egypt: An advantage which would lead to establishment of new societies in order to meet growing demands in Egypt. Geology of the Nile Basin Countries Conference (GNBCC-2012): Geology and development challenges, March 20th and March 22nd 2012, Alexandria (Egypt)

[23] S. M. Robaa (2003) "URBAN-SUBURBAN/RURAL DIFFERENCES OVER GREATER CAIRO, EGYPT", Atmosfera, Universidad Nacional Autónoma de México, ISSN (Versión impresa): 0187-6236, MÉXICO, pp. 157-171

[24] Somaya Abouelfadl (1999) "Hybrid and passive cooling of houses in hot dry areas- Upper Egypt as an example" (in German language). ISB N 3-932602-51-X

[25] Somaya T. Abouelfadl, Khaled A. Ouda, Assmaa A. Atia, Nada Al-Amir: A primary master plan Of Gardens' City- A new city in Egyptian Western Desert (EGCWD). International Conference on Future Environment and Energy– ICFEE 2013, Rome, Italy. 24-25 February 2013

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)