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Global Warming & Climate Change in Egypt (Environmental Effects & Suggestions)

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ABSTRACT:

This document mainly aims to achieve the higher protection of environment in Egypt from global climate change and decreasing carbon emissions around River Nile, Delta and coasts by producing some suggestions of scientific solutions with providing new imaginary mapping of the region with some civil society, law and government efforts for facing this great crisis.

Keywords

Climate Change – Global Warming – Carbon Emissions – Greenhouse Gas Emissions – Temperature Increase

1. Introduction

Climate change is a serious environmental challenge that could undermine the drive for sustainable development. The global mean surface temperature has increased by an average of 0.6 to 0.9 degrees Celsius (1.1 to 1.6° F) between 1906 and 2005.(1)

Climate change is mainly caused by the *rate* increase acceleration of temperature that has nearly doubled in the last 50 years. These rising temperatures will have significant impacts at a global scale and at local and regional levels. (1)

While it remains important to reduce greenhouse gas emissions and the accumulation of greenhouse gases in the atmosphere. Reverse climate change in the long run, many of the impacts of climate change are already in evidence.(2)

As a result, governments, communities, and other sectors of civil society are increasingly concerned with anticipating the future effects of climate change .While searching for strategies to mitigate and adapt to its current and future effects. (1)

Limitation of carbon emissions using new legislations, building new material coast borders, enhancement of scientific research and development sustainability of the whole problem in Egypt are the main factors of this study that is discussing the controlling of Climate change results.

2. Country Conditions Background

Egypt is located between 22o to 32o North and 24o to 37o East. It is bordered on the west by Libya, on the north by the Mediterranean Sea, on the south by Sudan, and on the east by the Gaza Strip, Israel and the Red Sea (Figure 1). Its coastline extends for more than 3,500 km along the Mediterranean Sea and the Red Sea coasts. The Nile delta coast, which constitutes about 300 km, hosts a number of highly populated cities such as Alexandria, Port-Said, Rosetta, and Damietta. (3)

Figure 1. Map of Egypt

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Fig.1. Map of Egypt(3)

Egypt's climate is semi-desert, characterized by hot dry summers, moderate winters, and very little rainfall. The country has areas with strong wind, especially along the Red Sea and Mediterranean coasts. Sites with an annual average wind speed of 8.0-10.0 m/sec have been identified along the Red Sea coast and about 6.0-6.5 m/sec along the Mediterranean coast. Average precipitation in the Ethiopian highlands (where much of the water in the Nile originates) is highest in July, August, and September, at 5.4 mm/day, and almost negligible between January and March. (4)

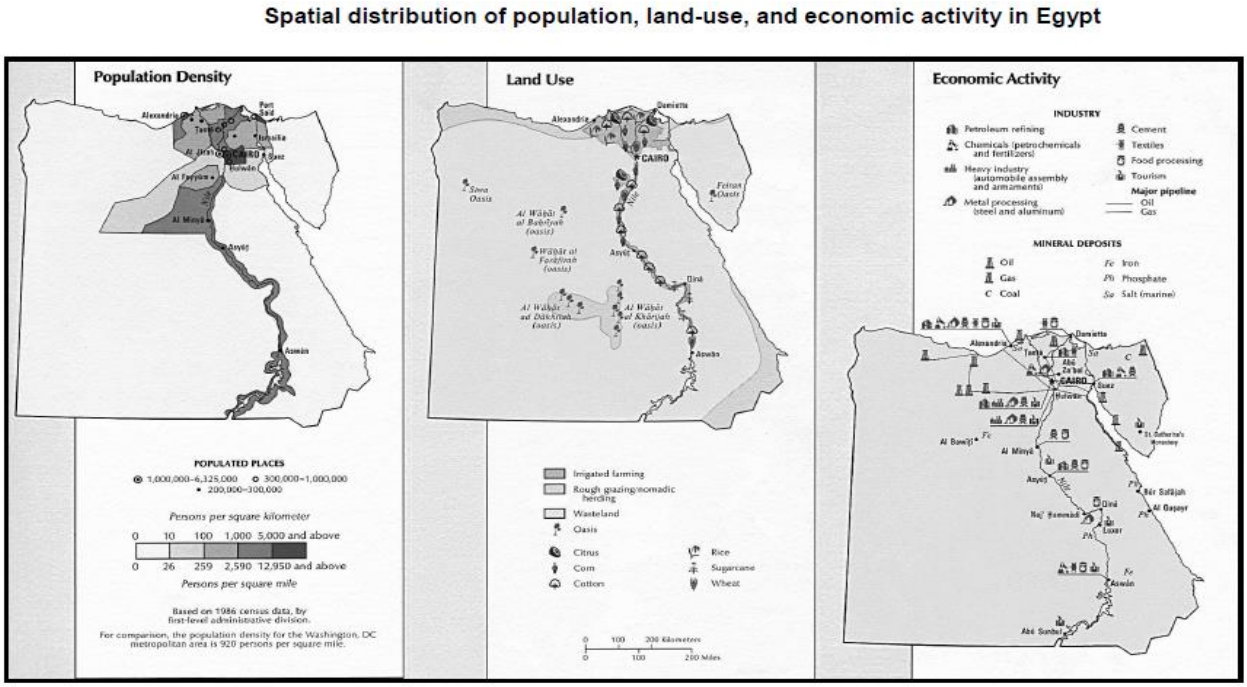


Figure.2 (3)

3. Climate Change in Egypt

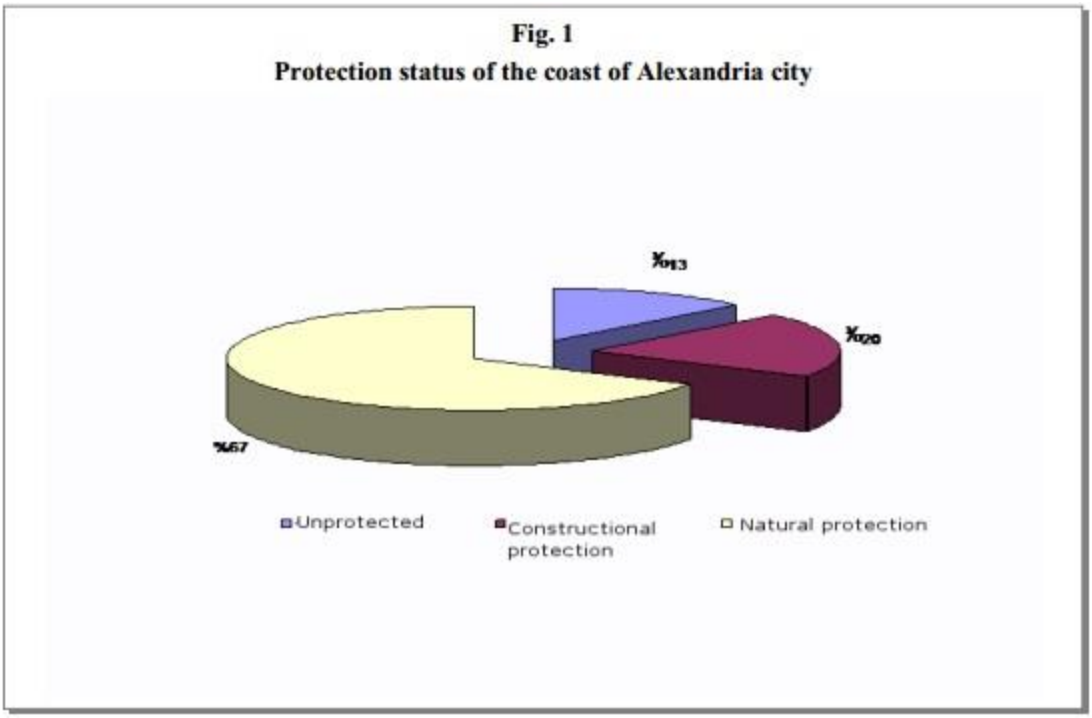
Egypt is potentially one of the countries most at risk from the effects of climate change. It is located in an arid - to semi-arid zone. The inhabited area of the country constitutes only 4% of the total area of the country (1 million km2), and the rest is desert. Its only source of water, the River Nile, provides more than 95% of all water available to the country. The source of this water lies far to the south, from rainfall on Ethiopian hills (86%) and equatorial lakes (14%). Most of the population of Egypt (over 60 million people in total) are associated with the agricultural sector which constitutes 20% of gross national products and consumes about 80% of the water budget.(4)

The coastal zone of Egypt extends for more than 3,500 km and is the home of more than 40% of the population. Most of these people live in and around a number of very important and highly populated industrial and commercial cities: Alexandria, Port Said, Damietta, Rosetta and Suez.(4)

Alexandria city is one of the oldest cities on the Mediterranean coast, and is an important tourist, industrial and economic centre. The city has a waterfront that extends for 60 km, from Abu-Qir Bay in the east to Sidi Krier in the west and includes a number of beaches and harbours. Alexandria's beaches are the main summer resort of the country, and its harbours are the most important import/export link between Egypt and Europe. About 40% of all Egyptian industry is located within the governorate of Alexandria. As a result of its high population density and industrial pollution, environmental problems have affected a large sector of the community in the area. (4)

Fig. 1

Protection status of the coast of Alexandria city



Source: Information and Decision Support Centre – Advisory Committee for Crisis/ Disaster Management and Disaster Risk Reduction. (4)

4. Population and Water Security:

The first impact of climate change in Egypt is likely to be felt in water domain. Water is already a limited resource, with per capita share at the edge of poverty line, below 1000m3 per year. Nile River provides more than 95% of all water to Egypt. The annual rainfall varies from a maximum of 180mm/year on the North coast, to an average of 20 mm on the middle of Egypt to 2 mm/year on the Upper Egypt. Both water supply and demand are expected to be exaggerated by climate change. It is expected by 2050 that climate change will raise water demand by an average of 5% . Most of the future projections indicate to declines in water availability, reach in some cases to 70%. (4) Agriculture sector will be the most effected economic sector from the shortage of water, it consume 80% of water budget, absorb 40% of Egyptian labor, and constitutes 20% of gross national Product.(4)

Table (1): Potential loss of areas, population and land use due to Sea Level Rise (SLR) over Alexandria Governorate (by percentage)

Elevation	SLR 0.5 m	SLR 1.0 m	SLR 2.0 m
Area	51	62	76
Population	50	64	79
Agriculture	93	95	100
Industry	65	70	90
Residential	45	50	75
Municipal Services	30	50	70
Commercial Areas	20	25	35
Community Facility	15	20	30
Archeological Sites	48	55	70

Table 1. (4)

- **Then** we can say that climate change also threatens to upend the precarious balance of water allocation between Egypt and the other states bordering the Nile. Egypt and Sudan currently claim the vast majority of the Nile's water despite their location down river from the source regions. These claims are made under the Nile Basin Treaty of 1959. The treaty denied the riparian states, which were still under colonial rule, all but the most minimal allocation of water. Today, states like Ethiopia that already face severe water stress are demanding more water than the treaty allows for. While the variability in models prevent a conclusive determination of whether climate change will mean more or less rain at the Nile's source waters, it is clear that the increased evaporation due to rising temperatures will result in greater water stress. Increased scarcity will threaten Egypt's development plans. As the Nile's waters dwindle, the survival of communities in Ethiopia and other states currently disputing water rights with Egypt will also be placed in jeopardy. Finally, climate change could exacerbate the food security issues that Egypt already faces. Egypt's report to the UNFCCC states that "climate change may bring about substantial reductions in the national grain production." Grain is only one of Egypt's food sources endangered by

unmitigated climate change. Even without climate change, by 2020 Egypt is projected to import 300-360 thousand metric tons of fish, which is a third of its projected domestic production. However, climate change could drastically increase Egypt's trade imbalance in fish products while simultaneously tightening the global fish market. As the sea level rises, salt water will infiltrate the North Egyptian lakes where 60% of Egypt's fisheries are located. As the lake water becomes saltier, the aquatic plants that protect the marine life by filtering the contaminated wastewater from Egypt's industry will die off. The shallow nature of Egypt's lakes will provide little protection from temperature increases that could disrupt the marine ecosystems. As Egypt's domestic fisheries face increased risks, Egypt will be forced to import more fish from other nations whose own fisheries will be facing decline. Disruptions in Egypt's food supply could impose starvation and economic stress, likely leading to unrest (5).

- Climate change will affect the population's economic activities. Just a 0.25m rise in sea level would devastate the populous cities that drive Egypt's economy. Forty percent of Egyptian industry is located in Alexandria alone; a 0.25m rise in sea level would put 60% of Alexandria's population of 4 million below sea level, as well as 56.1% of Alexandria's industrial sector. A rise of 0.5m would be even more disastrous, placing 67% of the population, 65.9% of the industrial sector, and 75.9% of the service sector below sea level. Thirty percent of the city's area would be destroyed, 1.5 million people would have to be evacuated, and over 195,000 jobs would be lost. Alexandria is not the only Egyptian city that would be devastated by even a 0.5m rise in sea level. A 0.5m rise would cost over 2 billion dollars and eliminate over one third of the jobs located in Rosetta, another city in the Delta. The Egyptian Report to the United Nations Framework Convention on Climate Change (UNFCCC) in 1999 estimated that sea level rise would force the migration of 2 million people currently living in the Nile Delta. Other cities threatened by a rising sea level in the delta include Port Said, Matruh City, and Arish City.(4)

Table (2): Population expected to be displaced and loss of employment due to Seas Level Rise (SLR) in Alexandria Governorate

Year	2000 (SLR=5cm)	2010 (SLR=18cm)	2030 (SLR=30cm)	2050 (SLR=50cm)
-Area at risk (km2)	32	144	190	317
-Population to be displaced (Thousands)	57	252	545	1,512
-Loss of Employment:				
a- agriculture	0,336	1,370	3,205	8,812
b- tourism	1,359	5,737	12,323	33,919
c- industry	5,754	25,400	54,936	151,200
-Total loss of employment	7,449	32,509	70,465	195,443

Table 2.(4)

5. Effects of Climate Change in Egypt

- The future predictions of average temperature in Egypt, as a result of global warming to an increase by 4 OC in Cairo and by 3.1 to 4.7 OC in the rest of Egypt by 2060.(5)
- The International Plant Protection Convention (IPPC) projected a further 2-11 degree Fahrenheit (1.4 to 5.8 OC) rise in average global surface temperature during the 21st century.(5)
- The annual precipitation may drop by 10 to 40% over most of Egypt by 2100.

- Raising the Mediterranean Sea level by 0.5m by 2050. This will lead to flooding the coastal areas along the Nile Delta.(5)

6. Suggestions for adaptation of Climate Change in Egypt

(Roles/Responsibilities)

Roles of Government:

- Government should start in building new cities and development of the wide deserts in Egypt; also we have to mention the Upper Egypt in such topic that is very rich having a big natural wealth and human power.
- Legislation of new laws concern carbon emissions percentage coming from factories especially in free zones and Petroleum Sectors.
- Fuel using (e.g. cars and trucks) reduction opportunities for decreasing carbon emissions and climate change effects and exchanging by biofuel (e.g. Biodiesel) and clean energy resources which are an **environment friendly**
- Solar energy could help in heavy use in homes and businesses especially Egypt has a very sunny weather all the year.

6.1. Responsibilities in big cities like Cairo and Alexandria:

- Law Associations and Human Rights Organizations has very important role in determining and discussing about new laws especially in housing in coastal cities like Alexandria where will be the most harmful effect of the crisis, belong building about certain distance far from beaches to decrease the results of any possible disappearing of parts of the city.

- Scientists should find new idea of building bumpers & barriers of modified materials of good mechanical and physical properties that resist the absorption of salts in front of beaches instead of concrete big blocks that can be eroded easily because of brackish water salts. Also,

enhancement of technical and scientific capacities is necessary to develop and apply methodologies ensuring assessment of weaknesses and vulnerabilities to climate change, including upgrading of monitoring and assessment capabilities.

- Scientific Research should start taking the climate change as new point of PHD and Master researches studies to find out new ways of protection the Egyptian coasts from these dangerous carbon emissions' effects.
- Comprehensive assessment of expected costs of adaptation to climate change including: damages, losses and cost benefit analysis.
- Periodic mapping and updating of vulnerable areas in light of the success of adaptation measures.
- Protecting and enhancing vital ecosystem services, such as water flows and water quality.
- Maintaining costal barriers and natural flood control and pollution reduction mechanisms.
- Reducing land and water degradation through actively preventing, and controlling, spread of invasive alien species.
- Enhancing the role of the media in motivating the community to adopt a culture addressing climate change associated crises and disasters and in taking part in awareness raising **campaigns** and consultations.
- The most important role now is depending on the Egyptians themselves, by starting leaving away from beaches and living in new cities. Even any one needs to live near to sea; he should choose a place far from the beach by a certain distance which scientists and government should give advice about it to people.

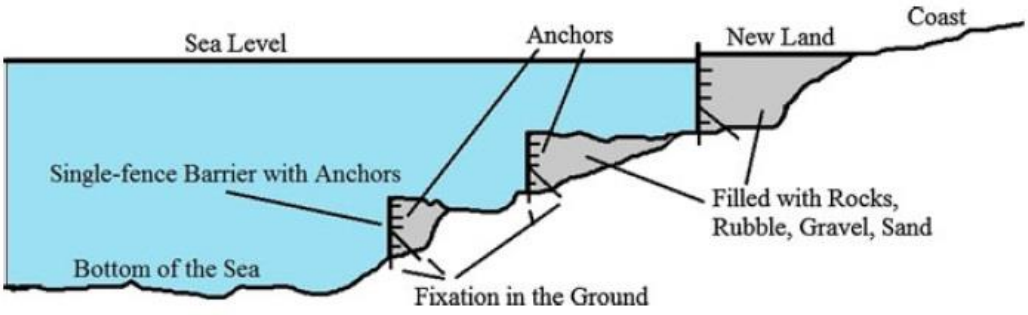
- **Human Rights Associations** in Egypt has an important role in changing the culture of Egyptians by pressing using **campaigns** and making forums, seminars, **facebook** events and pages, workshops and efficient discussion with full **scientific** and **legitimate** team.

7. Ideas of Building New Barriers for Protecting the Coasts from Tsunami Acting:

7.1. Solution A:

Tsunami impact on a coast can be reduced by applying a submerged vertical barrier to reflect tsunami before the catastrophic waves are built up near the coast.

However, construction of such long walls by conventional submarine technology is difficult.(7)
The construction of extended submarine walls at a depth of between 50 and 500 m below sea level by a relatively simple and efficient technology is described. The submarine walls can consist either of high-strength steel fences with anchors or two parallel steel fences with distance holders, lowered into the sea and fixed with rocks inserted from top. Alternatively, the barriers could be built from gabions (prefabricated steel net baskets filled with rocks) and lowered into the sea. The space between these tsunami barriers and the coast can be filled with solid material, thus allowing reclamation of new land, or this gap can be used for fish farming. These barriers can contribute to preservation of beaches and natural ecosystems at the coast.
The realization of such tsunami barriers requires the development of special ships and pontoons for inserting the steel fences, steel baskets and the rocks, the arrangement of harbor's for their stationing, the production of corrosion-resistant steel wires and factories for steel fence and basket production.(7)
This early communication is meant to inform governments of countries prone to tsunami risk as well as insurance companies about the possibility of protecting threatened cities, airports, nuclear power stations, harbor's and popular beaches from the next large tsunami and from tidal waves. Such national projects would stimulate industries and provide occupation for many people.(7)
For the new application to the tsunami barriers, special saltwater-corrosion-resistant steels have to be used, for example chromium- and molybdenum-containing low-carbon steel. All alloy parts should have the same composition in order to prevent electrolytic corrosion at the contacting points. For galvanized normal steel, the life of 60 years in the sea has been reported. Thus, an extended life can be expected when using special stainless steel, especially if it is coated by an elastic polymer or covered by a layer of concrete. With sufficient stabilization by horizontal fences or concrete, the rock structure itself would remain intact even if the steel fence would corrode after hundreds of years. Also, it would be possible to add a new fence and fix it to the horizontal anchors.(7)
The top concrete walls with hanging inclined structures will be beneficial against the impact of tsunami and highest storm waves when wall height is at least comparable to the
height of the arriving waves. The structure allows later heightening with rising sea level and replacement of the hanging protecting structures. (7)



Schematic cross section of terrace with three *vertical* tsunami barriers

(7)

7.2.Solution B: Polymers

Also polymers can be used as barriers especially it can't be eroded or rusted from salinized sea water like blocks.

Barrier from wall of gabions are coated or filled in by a salt-water resistant elastic polymer like a natural or a synthetic rubber, PVC, polyamide, poly-urethane.(9)

These barriers are against shock waves such as Tsunami and/or against high sea waves comprising a wall of gabions extending preferably 50 m to 500 m, maximum 4 km below sea level, a wall of which the lowest end is adapted to be fixed on the sea floor or in the ground, said wall being furthermore designed to be stabilized in a substantially vertical position and to be protected against erosion above sea level by hanging and replaceable surge stoppers or wave deflectors.(9)

Synthetic polymers like polyethylene are used nowadays, environmental engineers feel to use geosynthetics structures in abundance as a long remedial measurement replacing indigenous methods and concrete structures to mitigate natural hazards like coastal erosion, coastal depression, flooding, coastal landslides.(9)

Advantages of Polymers in as barriers :

- *Resistance to acidic & alkaline environments. Immune to rot, mildew,*
- *Flexile and can easily take the contours of the ground.*
- *No rusting hence long lasting in marine or river saline environment*

- *No effect of water; non-biodegradable, does not affect the marine environment and organisms*
- *High tensile strength, high abrasion resistance, high thermal stability.*
- *Resistance to U.V. degradation.*
- *Very convenient for handling and placing.*
- *Can be filled in situ or filled and placed in position using cranes. Suitable for underwater construction.(9)*

Solution C: PMM (Polymeric Marine Mattress)

Benefits:

- Durability and long-term tensile capacity
- Monolithic high mass and porosity
- Flexibility and hydraulic characteristics
- Sensitivity to wave run-up or reflection(9)

Polymeric Marine Mattress (9)

The PMM (Polymeric Marine Mattress) is an integrally formed grid structure manufactured of a stress resistant copolymer polypropylene material that is then filler with stone. PMM were developed for erosion control and submerged foundation applications, including the following:

- Foundations for breakwater, jetties, groins and dikes
- Pipeline protection
- Riverbank protection, channel linings and bridge scour abatement
- Scour Protection
- Shoreline revetments, retaining walls, and embankment stabilization(9)

Conclusions

1. Global warming is mainly caused from temperature increase.
2. Controlling carbon emissions is a way of environment protection.
3. Water Shortage is a reason of Global warming
4. New modified material & polymers should be used as in coast barrier techniques.
5. Society and government role in new legislation.

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