Egypt

Ministry of Environment

Climate Change Vulnerability & Adaptation in Egypt and the role of Research & Science in informing Adaptation to CC in food production and Water Resources

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Introduction

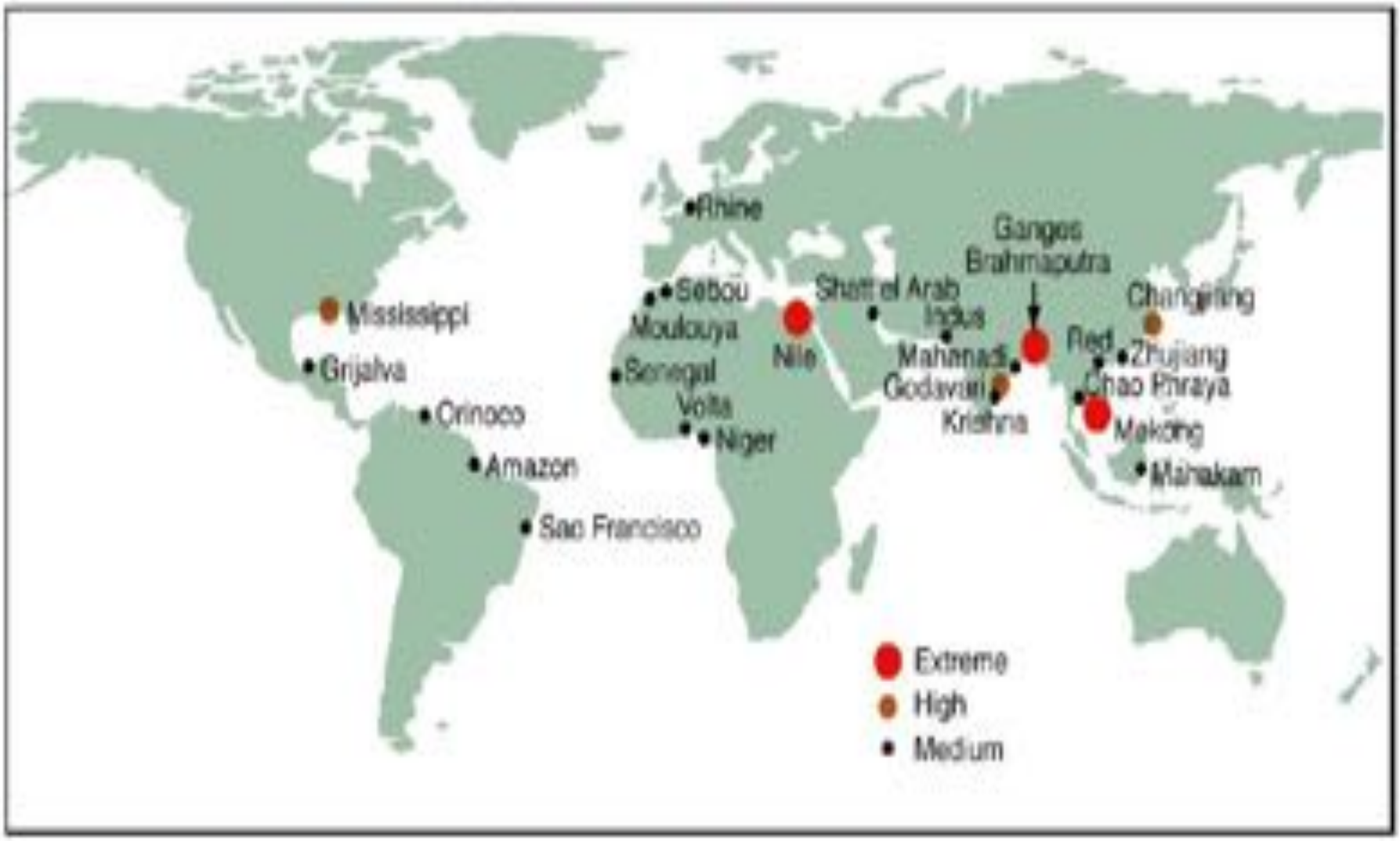
Egypt's large and dense packed population makes the country extremely vulnerable to climate change.

Egypt does not produce enough food to feed its current population. Its water resources also are rather limited.

Moreover, The studies have indicated that the following areas are the most vulnerable in order of severity and certainty of results:

Agriculture, coastal zones, aqua-culture and fisheries, water resources, human habitat & settlements, and human health.

The most vulnerable areas in the world (IPCC)

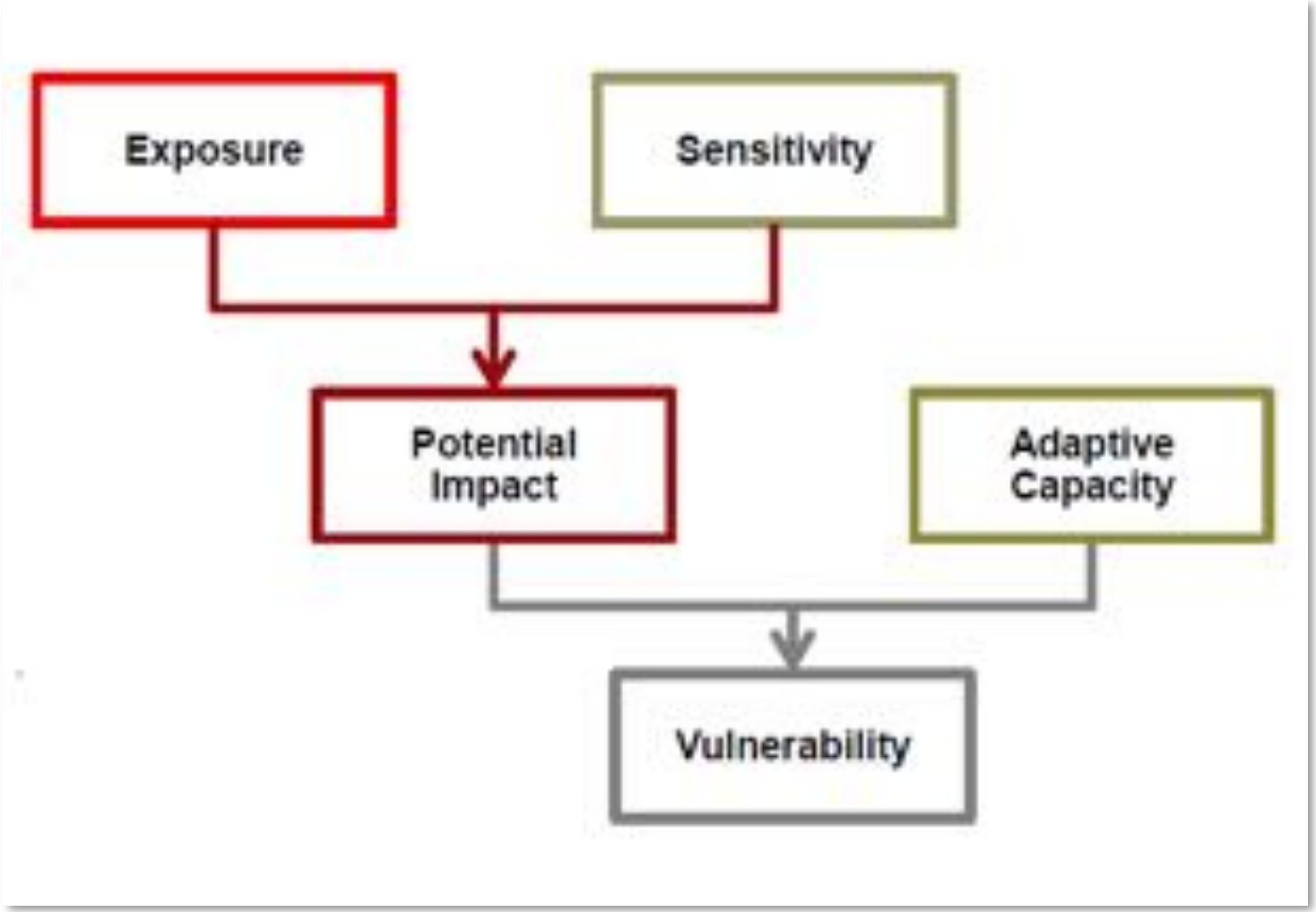


Vulnerability

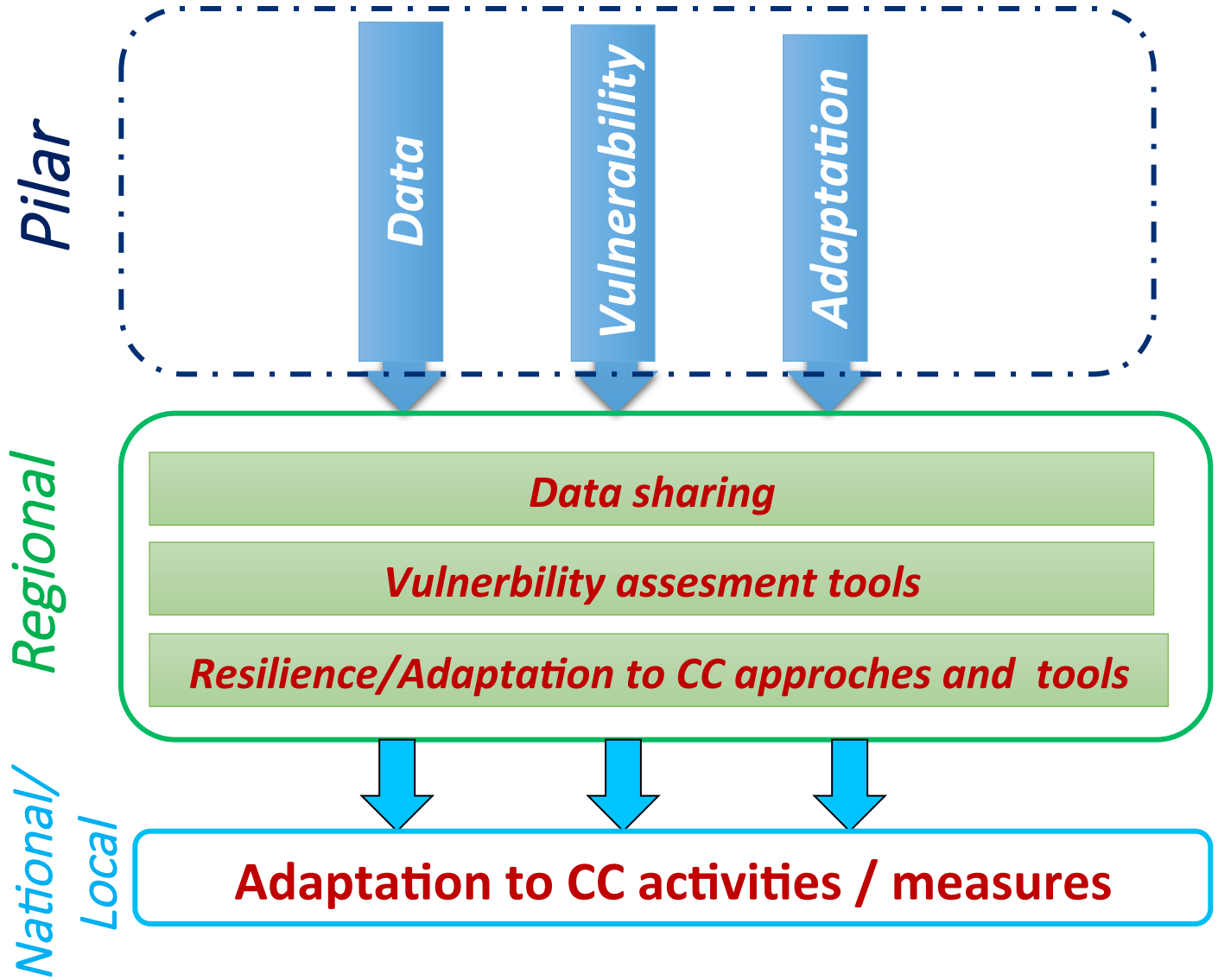
- **Exposure** to Climate Change Risks

  and

- **(Natural) Adaptive Capacity** to Cope with Risks



Core ideas to build the Resilience / adaptation to CC



Vulnerability of Egypt to climate change

What we expect ... As a result of climate change??!!

Although it is difficult to predict the effects of high temperature and sea level rise in the specific area, but there are many expectations:

- **Flooding large areas of the coastal plains, which is considered one of the best agricultural land in the world.**
- **Vulnerable the coastal installations (Coastal Constructions) such as bridges, water barriers and Utilities also will increase the erosion of beaches.**
- **Saltwater intrusion (Saline Water Intrusion) to aquifers (Aquifers) and scarcity of water resources.**
- **The difficulty of agriculture in arid regions and increase the high temperatures of the demands on irrigation.**

What we expect also?

- Reduction in agricultural crop and thus shrinking food stocks.
- You'll also find some species they are in an environment where the environment not having enough time to adjust.
- Declining soil fertility and worsening as the erosion change citizen of plants and increased drought and changing rainfall patterns will lead to desertification.
- A lot of disorder ecosystems (Ecosystems) and Biodiversity.
- Spread of pests (Pests) and disease-carrying insects (Mosquitoes) that transmit malaria.
- The accelerating frequency of climatic disasters such as high droughts, floods, storms and other than harms to communities and their economies.

Delta Region

- **Risks through sea level rise on the costal zone, which is already subsiding at approximately 1-3mm/year around the Nile delta.**

- **Low lying Nile delta region, which constitutes the main agricultural land of Egypt and hosts most of the population, industrial activities and commercial centers, is highly vulnerable to various impacts of climate change.**

Delta Region (Cont.)

- Rising sea level would destroy weak parts of the sand belt, which is essential for the protection of lagoons and the low-lying reclaimed lands in the Nile delta of Egypt (Mediterranean Sea).

- One third of Egypt's fish catches are made in the lagoons. Sea level rise would change the water quality and affect most fresh water fish. Valuable agricultural land would be inundated.

Agriculture sector: vulnerability

- **CC may lead to reduction in crop productivity**

Crop	Change %		Reference
	2050s	2100s	
Wheat	-15*	-36**	(Abou- Hadid ,2006)
Rice	-11		(Eid and El-Marsafawy,2002)
Maize	-19		(Eid, El-Marsafawy, Ainer, El-Mowelhi, El-Kholi, 1997)
	-14	-20	(Hassanein and Medany, 2007)
Soybeans	-28		(Eid and EL-Marsafawy, 2002)
Barley	-20		(Eid, El-Marsafawy, Ainer, El-Mowelhi, El-Kholi, 1997)
Cotton	+17*	+31**	(Eid, El-Marsafawy, Ainer, El-Mowelhi, El-Kholi, 1997)
Potato	-0.9 to -2.3	+0.2 to +2.3	(Medany and Hassanein, 2006)

Coastal areas: vulnerability

- Sea level rise
- Impact on human settlements
- Impact on touristic villages in Northern coast (e.g Marina), thus impacting economy
- Impact on agricultural areas (saltwater intrusion)

Coastal areas: vulnerability

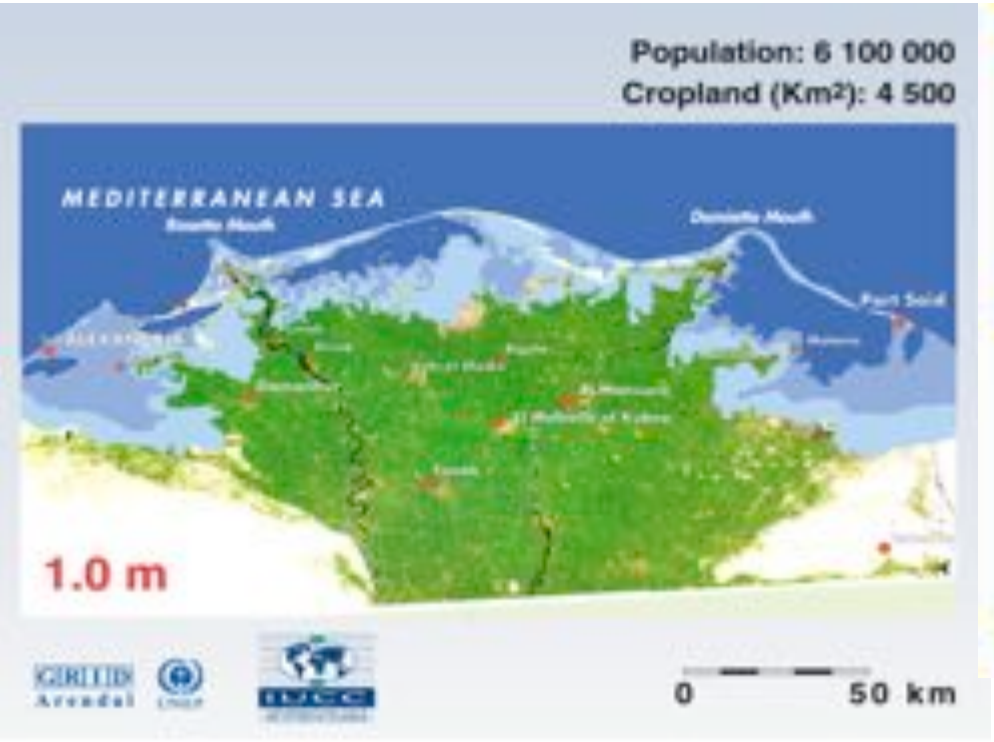
- Coral communities in the Red Sea would be exposed to bleaching due to increasing temperatures.
- Loss of habitats and loss of biodiversity.
- Fish stocks will be moving northward to deeper waters.
- System dynamics of the Northern lakes of Egypt will change.

Coastal areas: vulnerability

- **Biological marine systems**
- **Coastal dynamics**
- **Inundation**
- **Saltwater intrusion**

Coastal areas: vulnerability

- **Some coastal low lying land could be inundated in the Nile Delta.**



Climate Change & Sea Level Rise

Nile Delta – Current Situation

Nile Delta – 1 Meter Sea Level Rise

Nile Delta – 2 Meter Sea Level Rise

Total affected area and its percentage to the Nile Delta area According to CoRI measurements till 2100

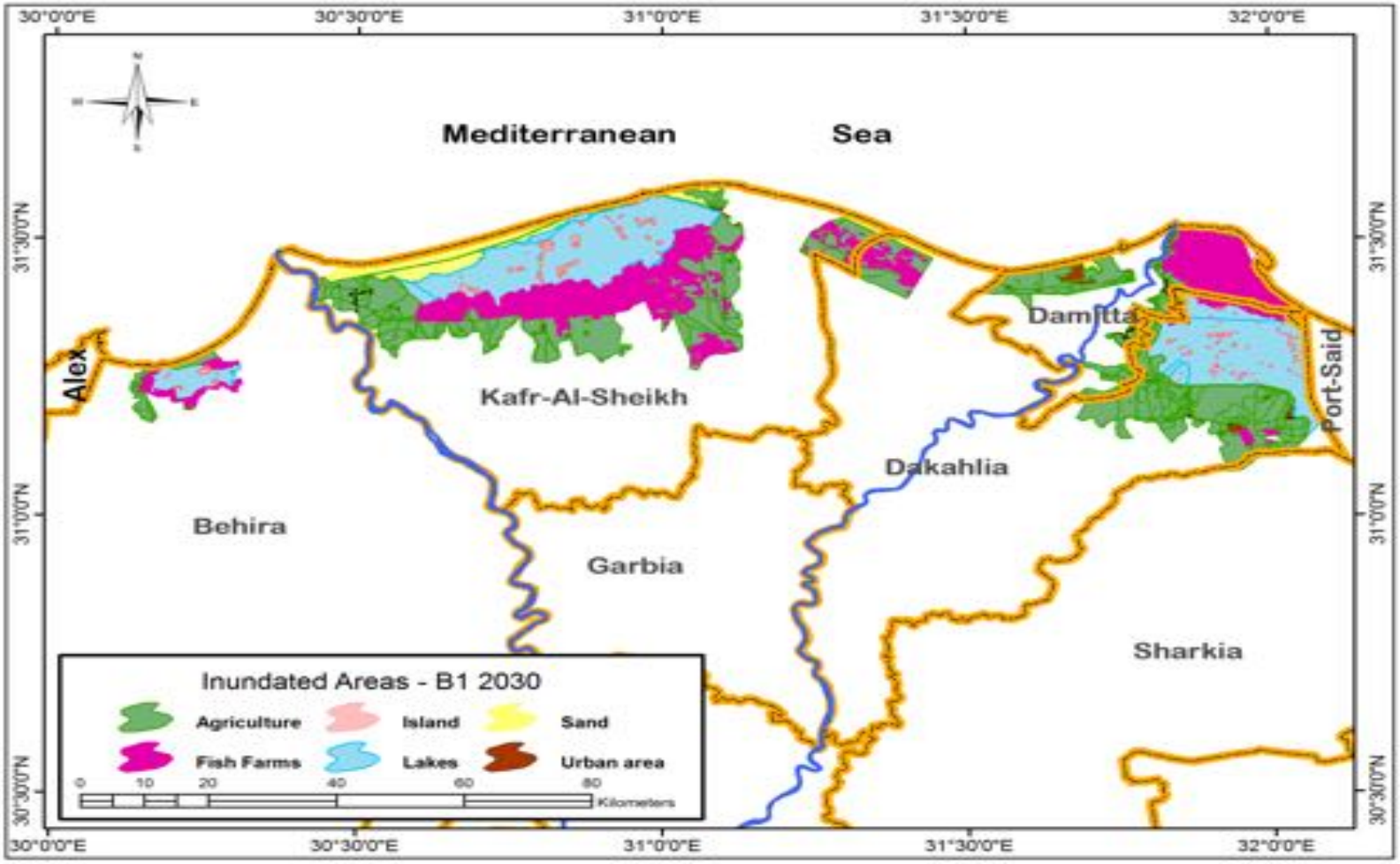
(Without Mohammed Ali wall and zero level for lakes borders)

Year	2025	2050	2075	2100
Total Area Affected (km2)	633.8	691.8	748.4	832.7
Total % of the Nile Delta Area	2.53	2.57	3.0	3.33

Vulnerability of Costal Zones

Nile Delta Inundation through Different Scenarios

1. Scenario B1 2030 *(SLR) = 7 - 18 cm*



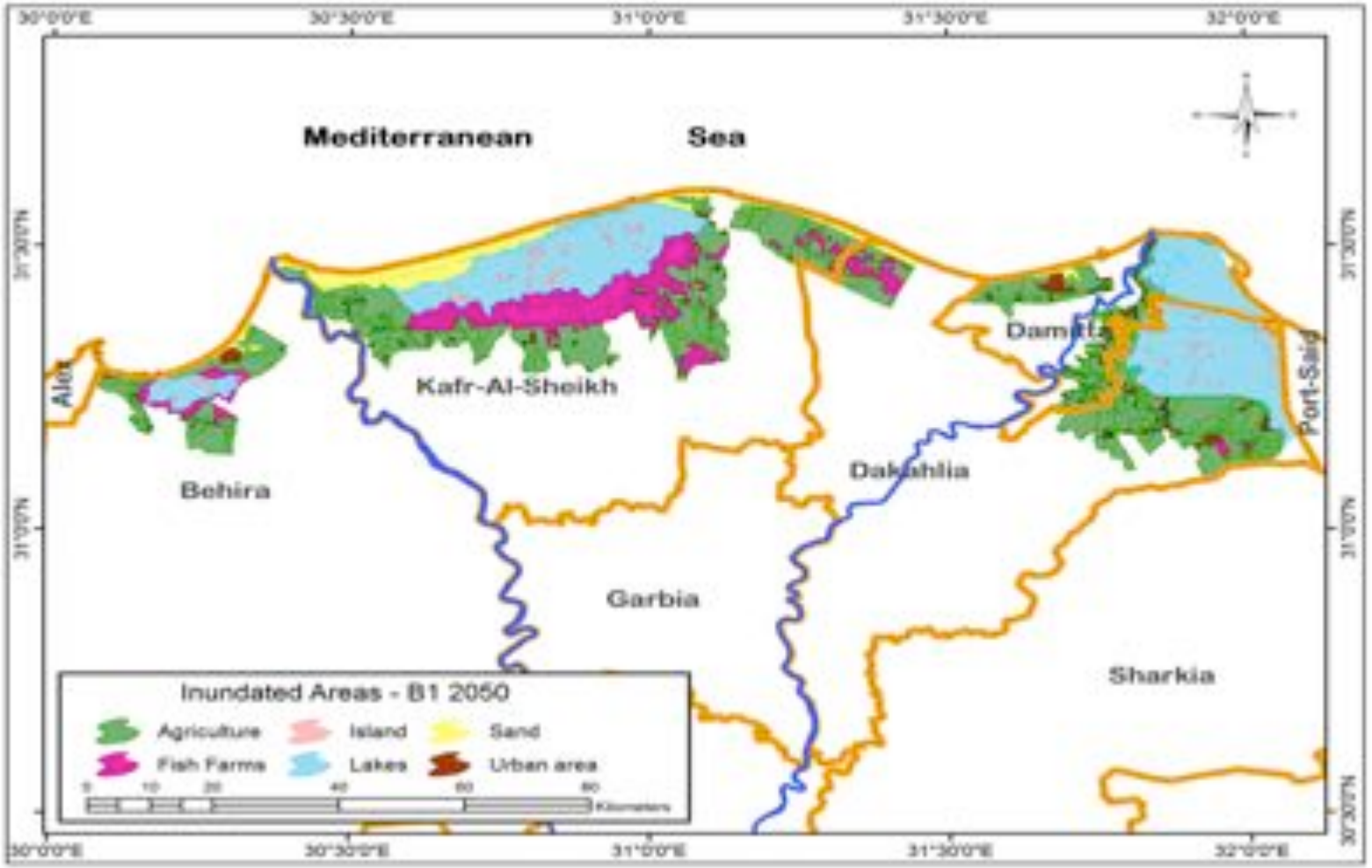
Vulnerability of Costal Zones

Governorate	Inundated areas of agricultural land (km^2)	Inundated areas of urban land (km^2)
Kafr Al-Sheikh	494.897	13.843
Al-Behira	35.103	1.079
Damietta	168.889	28.391
Dakahlia	479.86	20.582
Total	**1179**	**52**

Governorate	Losses in agricultural sector (Billion L.E.)	Losses in urban sector (Billion L.E.)
Kafr Al-Sheikh	17.675	7.389
Al-Behira	1.859	1.139
Damietta	7.454	29.042
Dakahlia	19.329	13.48
Total	**46**	**43**

Vulnerability of Costal Zones

3. Scenario B1 2060 *(SLR) = 16 - 40 cm*



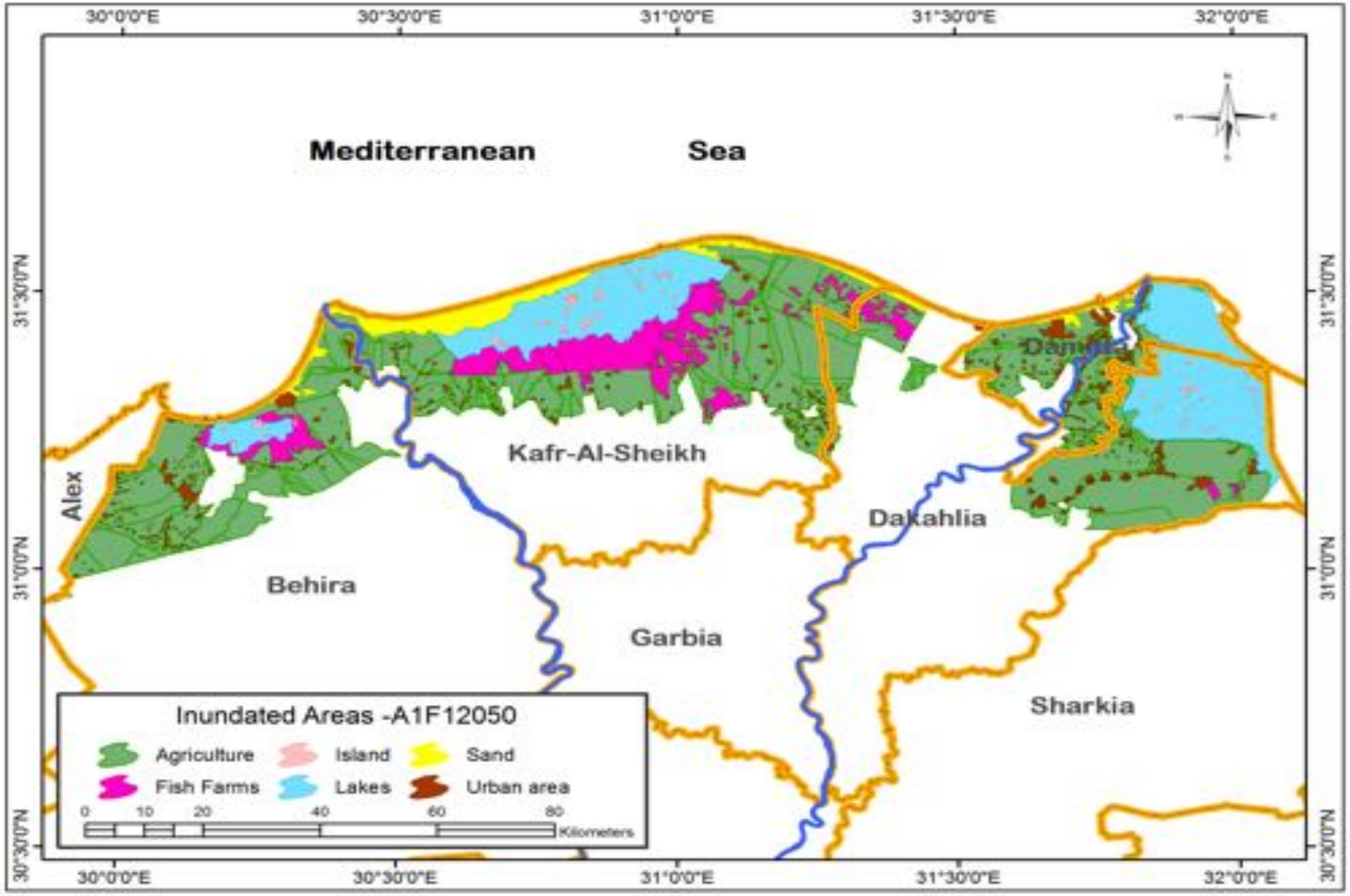
Vulnerability of Costal Zones

Governorate	Inundated areas of agricultural land (km^2)	Inundated areas of urban land (km^2)
Kafr Al-Sheikh	585.017	72.015
Al-Behira	155.539	9.882
Damietta	207.596	31.5
Dakahlia	517.077	22.15
Total	**1465**	**136**

Governorate	Losses in agricultural sector (Billion L.E.)	Losses in urban sector (Billion L.E.)
Kafr Al-Sheikh	20.893	30.521
Al-Behira	8.675	9.002
Damietta	9.433	32.191
Dakahlia	20.932	14.272
Total	**60**	**86**

Vulnerability of Costal Zones

4. Scenario A1F1 2060 *(SLR) = 34 - 69 cm*



Vulnerability of Costal Zones

Governorate	Inundated areas of agricultural land (km^2)	Inundated areas of urban land (km^2)
Kafr Al-Sheikh	1079.016	22.348
Al-Behira	844.076	41.09892
Damietta	388.846	56.34026
Dakahlia	862.69	34.16628
Total	**3175**	**154**

Governorate	Losses in agricultural sector (Billion L.E.)	Losses in urban sector (Billion L.E.)
Kafr Al-Sheikh	38.536	12.018
Al-Behira	44.603	34.214
Damietta	16.919	51.564
Dakahlia	33.873	19.831
Total	**134**	**118**

Vulnerability of Costal Zones

	With protection	Without protection
Area (km^2) 2030	152.9	1150
% of Nile Delta	0.6	3.9
Area (km^2) 2060	450.0	3100
% of Nile Delta	1.9	12.0

Threatened Areas due to SLR in the Nile Delta

Potential inundation of Nile Delta from high SLR in 2060

Vulnerable Cities in North Coastal zone

Alexandria City:

A scenario involving a Sea Level Rise (SLR) of between 0.5m and 1.0 m is assumed. If no action is taken, an area of about 30% of the city will be lost due to inundation, almost 2 million people will have to abandon their homes, 195,000 jobs will be lost and an economic loss of over $ 35.0 billions. The most severely impacted sectors are agriculture, industry and tourism, respectively.

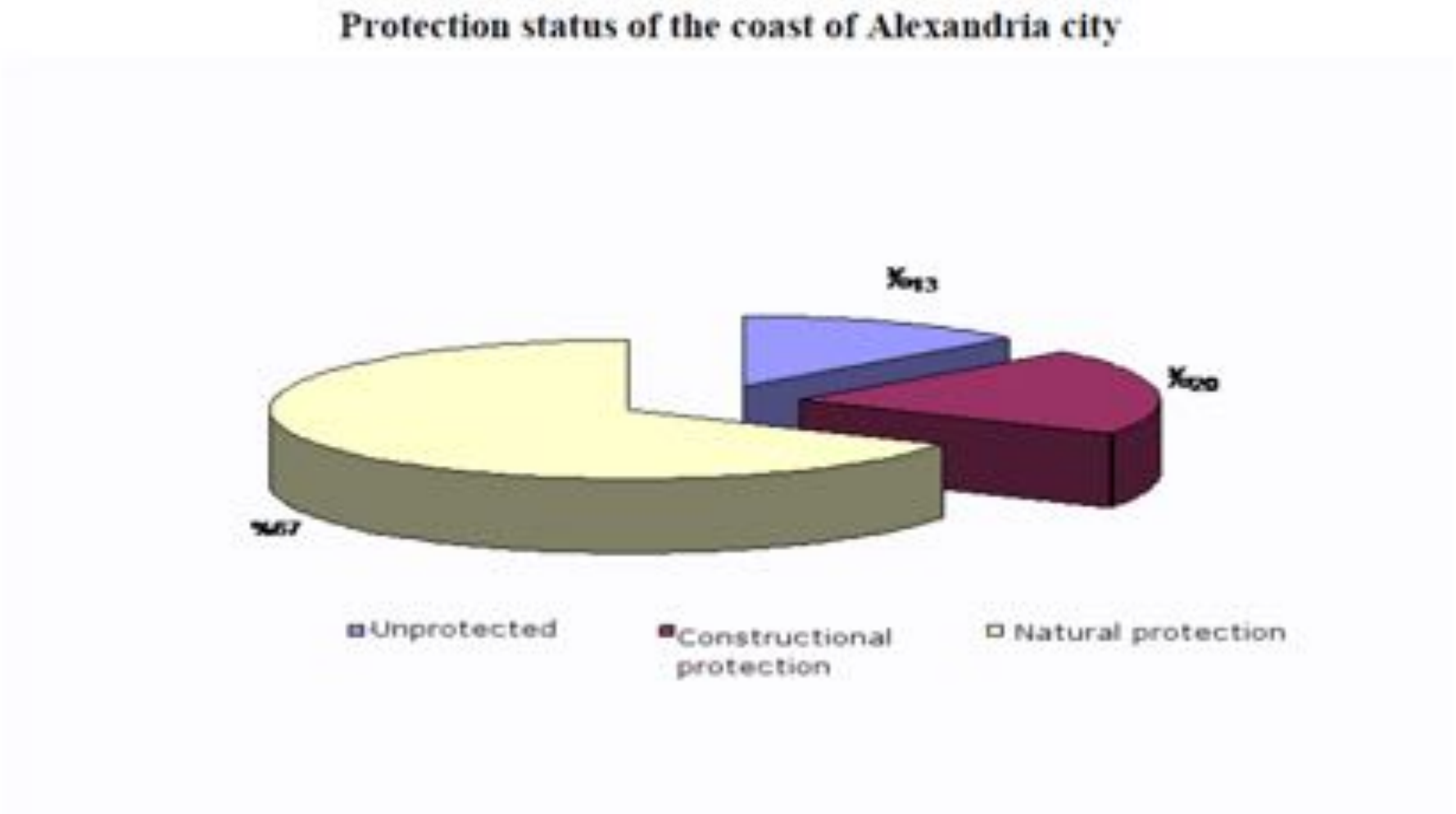
Rosetta City:

The expected economic losses in land cover of Rosetta for a sea level rise of 0.5 m were estimated Studies showed that about 1/3 of the employment in the city will be affected and a loss of about $ 2.9 billion is expected.

Port-Said City:

Several studies point out the high vulnerability of the city to sea level rise. The most affected sectors are expected to be the industrial, transportation and urban sectors. A loss of employment of 6,759 jobs is expected due to a SLR.

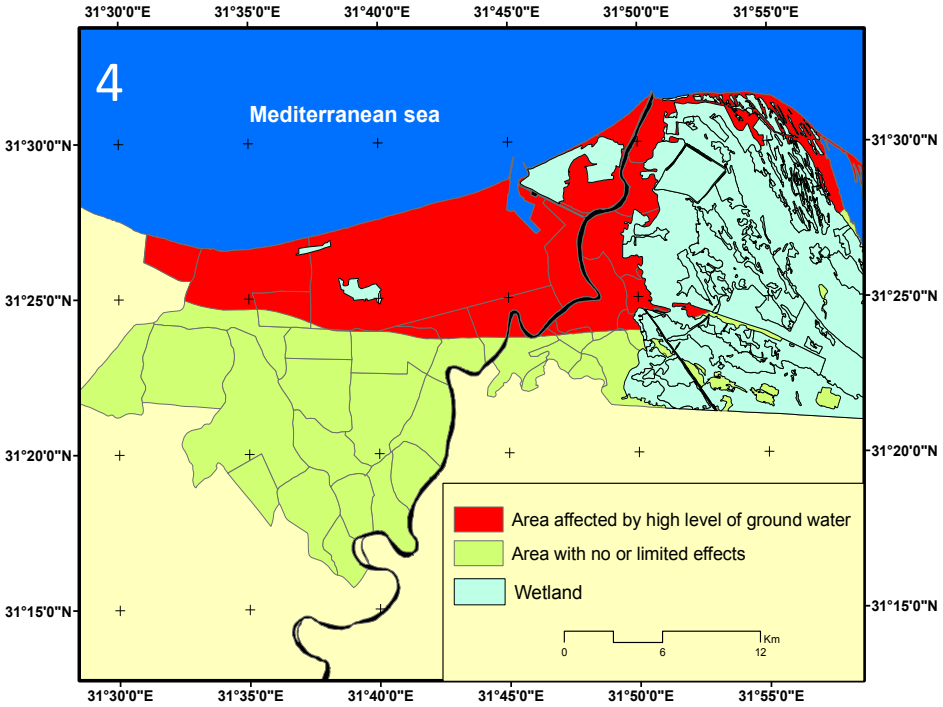
The Coastal Zone in Alexandria City



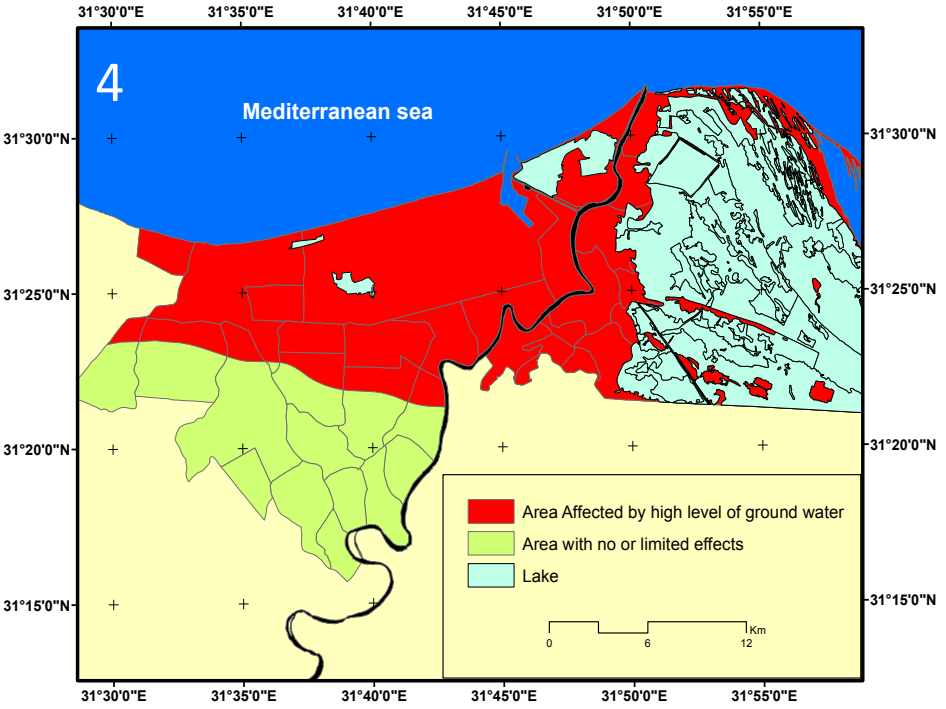
Higher levels of groundwater table and its impacts

Area Affected by HGW

2050



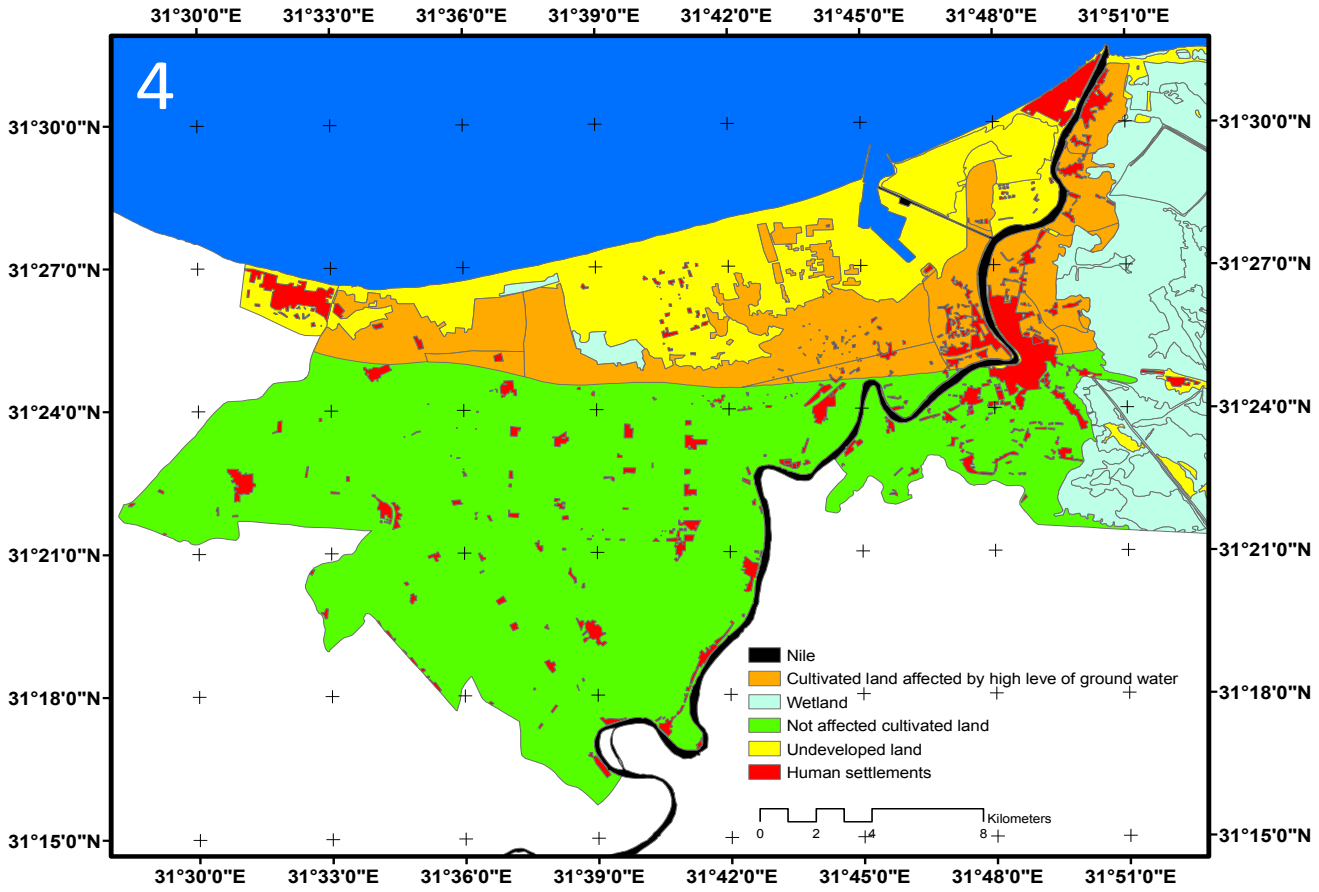
2100



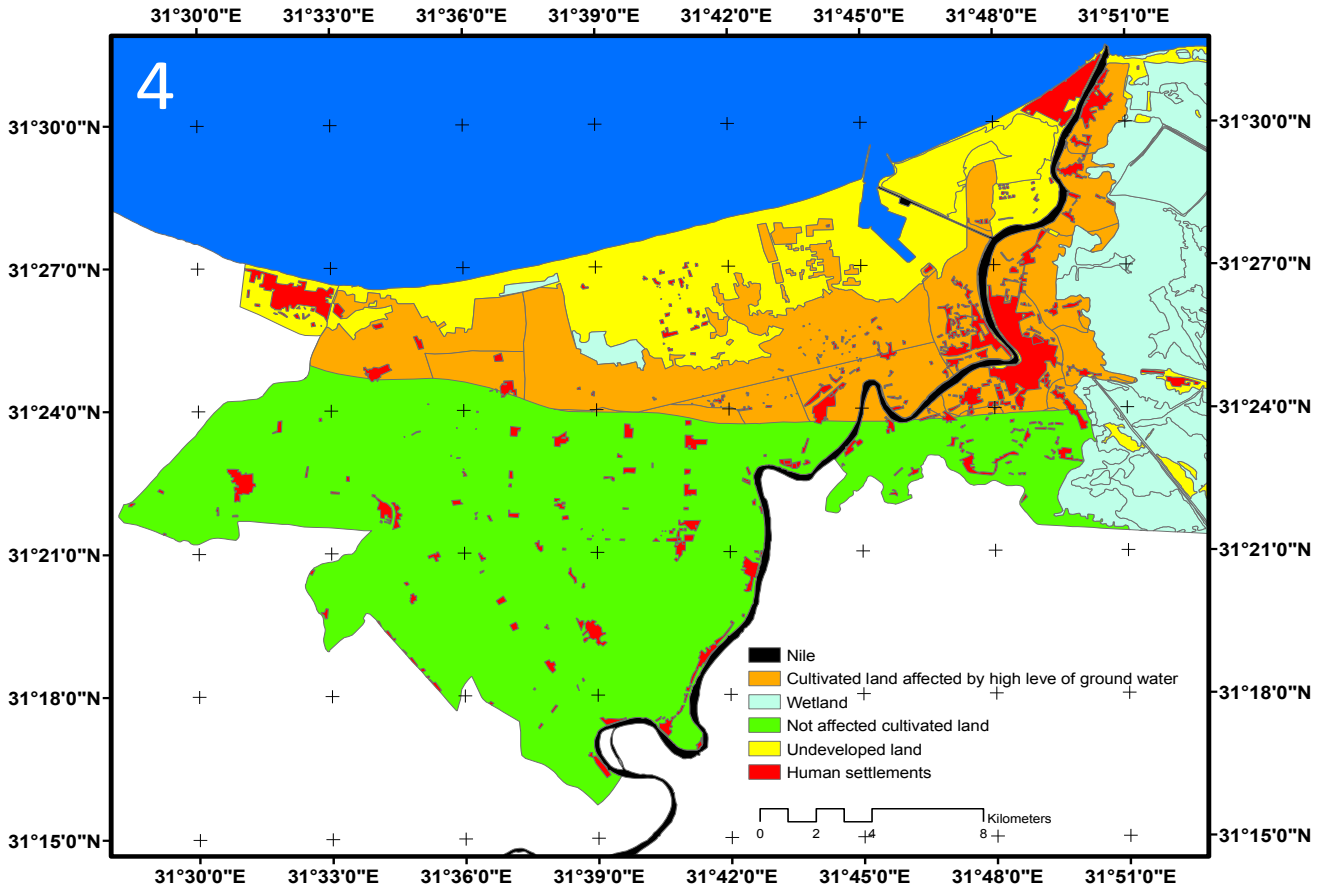
Area affected by HGW

Locality	Affected area (km^2)	Locality	Affected area (km^2)
Ras Al - Bar	3.13	Kafr Solayman Al – Bahri	3.59
As - Senaneyah	8.48	Kafr Abu Saad	0.00
Dumyat Al - Gadida	89.70	Kafr Al – Manazlah	0.00
Domyat	21.84	Mit Abu Ghaleb	0.00
Ar - Rakabeyah	34.01	Kofour Shehata	0.00
Shat Gheit An - Nasara	3.24	As – Sawalem	0.00
Kafr Al - Batikh	11.66	Izbet Al - Borg	73.93
Shat Moheb Wa As - Sayela	2.17	Arriyad	10.54
Al - Bostan	7.90	Azahraa	0.00
Shat Ash - Shoara	2.39	Om Erezk	0.00
Kafr Al – Morabein Ash–Sharqeyah	2.17	Shat Ash - Sheikh Dorgham	12.34
Kofour Al – Ghab	7.18	Shat Al - Kheyatah	8.80
Al – Mohamadeyah	5.76	Al - Ananeyah	8.91
Kafr Al – Wostani	3.75	Al Basateen	13.35
Kafr Saad	7.28	Om El Reda	6.90
Izab An – Nahdah	4.02	Al Abassia	7.13
Izab Al – Basartah	2.30	Gamasa	6.36

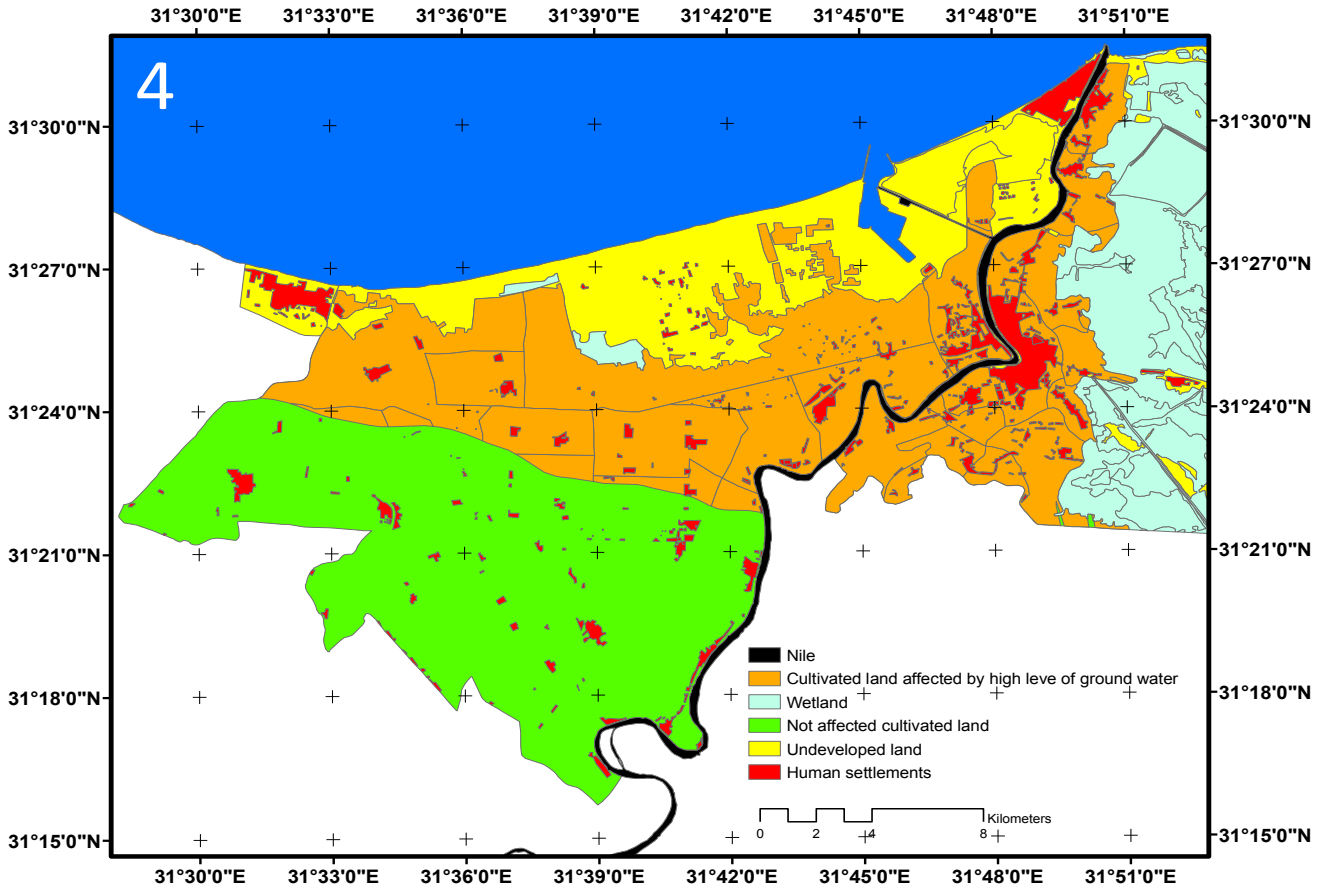
Cultivated land vulnerable to high levels of groundwater table 2025



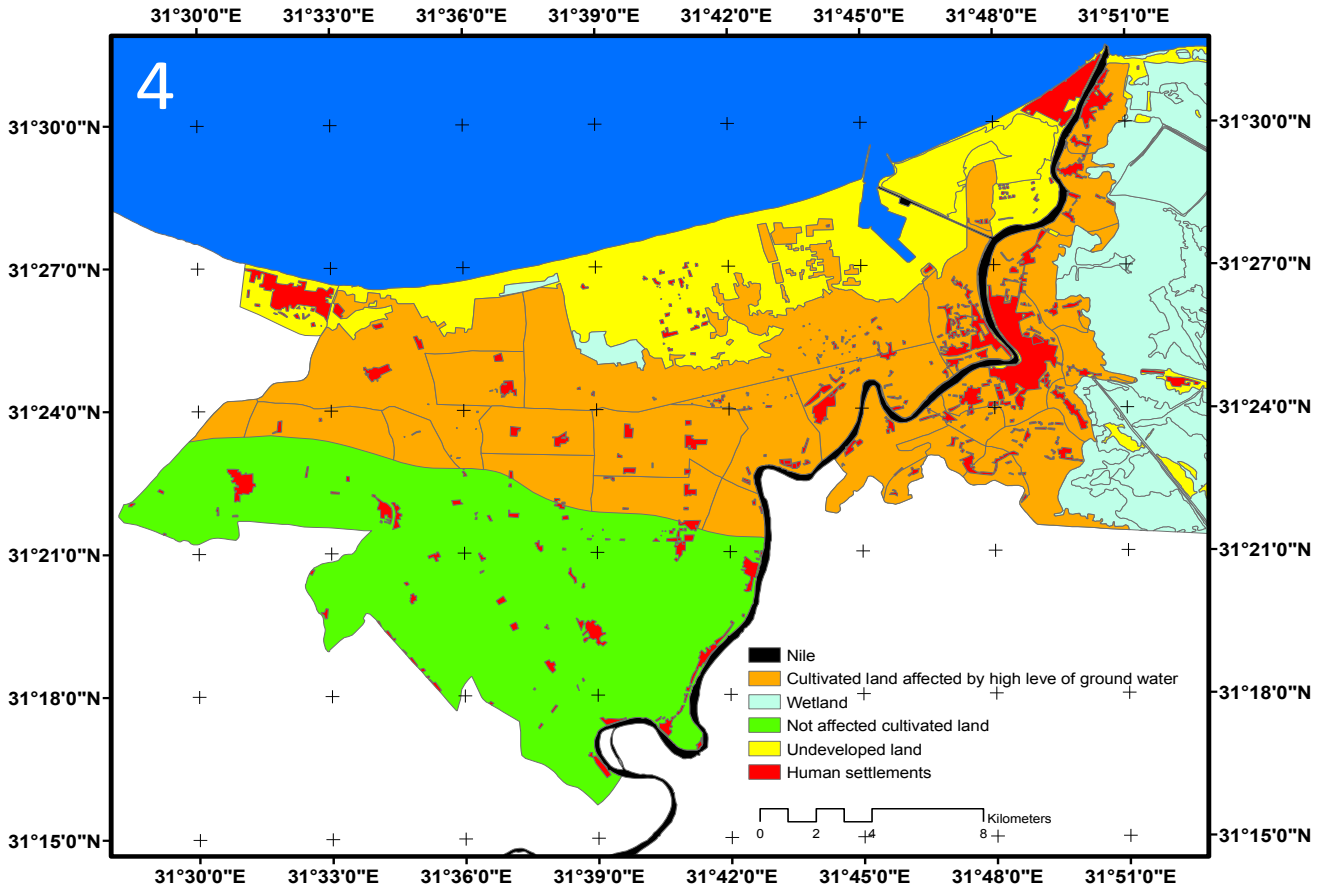
Cultivated land vulnerable to high levels of groundwater table 2050



Cultivated land vulnerable to high levels of groundwater table 2075



Cultivated land vulnerable to high levels of groundwater table 2100



Cultivated land affected by HGW

Locality	Affected Cultivated land 2025	Affected Cultivated land 2050	Affected Cultivated land 2075	Affected Cultivated land 2100
As - Senaneyah	99.89	99.89	99.89	99.89
Dumyat Al - Gadida	83.67	99.56	99.98	99.98
Domyat	65.87	0.00	0.00	0.00
Ar - Rakabeyah	48.05	56.82	91.31	98.71
Shat Gheit An - Nasara	43.98	99.64	99.64	99.64
Kafr Al - Batikh	37.72	87.64	99.96	99.96
Shat Moheb Wa As - Sayela	0.00	53.33	99.69	99.69
Al - Bostan	0.00	13.23	99.80	99.80
Shat Ash - Shoara	0.00	30.43	99.84	99.84
Kafr Al - Morabein Ash - Sharqeyah	0.00	0.00	0.00	15.38
Kofour Al - Ghab	0.00	0.00	5.86	0.00
Al - Mohamadeyah	0.00	0.00	13.06	38.78
Kafr Al - Wostani	0.00	0.00	2.57	10.68
Kafr Saad	0.00	0.00	14.62	39.41
Izab An - Nahdah	0.00	0.00	99.74	99.74
Izab Al - Basartah	0.00	0.00	99.73	99.73
Kafr Solayman Al - Bahri	0.00	0.00	14.81	35.21
Mit Abu Ghaleb	0.00	0.00	0.00	85.54
Izbet Al - Borg	97.07	99.66	0.00	0.00
Arriyad	2.54	43.40	99.94	99.94
Shat Ash - Sheikh Dorgham	99.49	99.49	99.49	99.49
Shat Al - Kheyatah	99.65	99.65	99.65	99.65
Al - Ananeyah	0.00	0.45	97.75	99.74
Al Basateen	0.00	13.41	100.00	100.00
Om El Reda	30.11	64.49	100.00	100.00
Al Abassia	0.00	0.99	95.27	100.00

Economic value of the impacts of higher levels of groundwater on agricultural productivity

Value of HGW impacts on agriculture (1)

- **Value of current agricultural production =**
  - **L.E. 608 million.**
- **Value of agricultural production 2100 =**
  - **1st scenario:**
    - **Cultivated land = 48634 km^2.**
    - **L.E. 237 million (- 55%).**
  - **2nd Scenario:**
    - **Cultivated land = 41305 km^2.**
    - **L.E. 231 million (- 62%).**
- **Accumulative loss in agricultural value =**
  - **1st scenario = L.E. 7.1 billion**
  - **2nd scenario = L.E. 8.9 billion**

Value of HGW impacts on agriculture (2)

- **Value of accumulative crop yield (under current levels of GW) = L.E. 23.5 billion.**
- **Value of accumulative crop yield (under higher levels of GW) = L.E. 17 billion.**
- **Accumulative loss in agricultural value =**
  - **L.E. 6.5 billion.**

- **Adaptation are increasing with each passing day as the mitigation efforts are still not enough to stop the increasing concentrations of greenhouse gases in the atmosphere**
- **Wide areas of the Nile Delta are vulnerable to high levels of groundwater table.**
- **The need to consider the role of existing man-made features in assessing physical vulnerability.**
- **The need to develop socioeconomic profile.**

Some estimates of expected loss

Value billion LE.

No.	Sector	Expected losses in 2030	Expected losses in 2060
1	Agriculture	25	112
2	Tourism	19	85
3	Coastal properties	1	7
4	Heat Stress	3	14
5	Air Pollution	6	14
	Total	49	232

Source : CCRM Project

Adaptation

How to Adapt with climate change ?

Mitigation

Preventive Approach

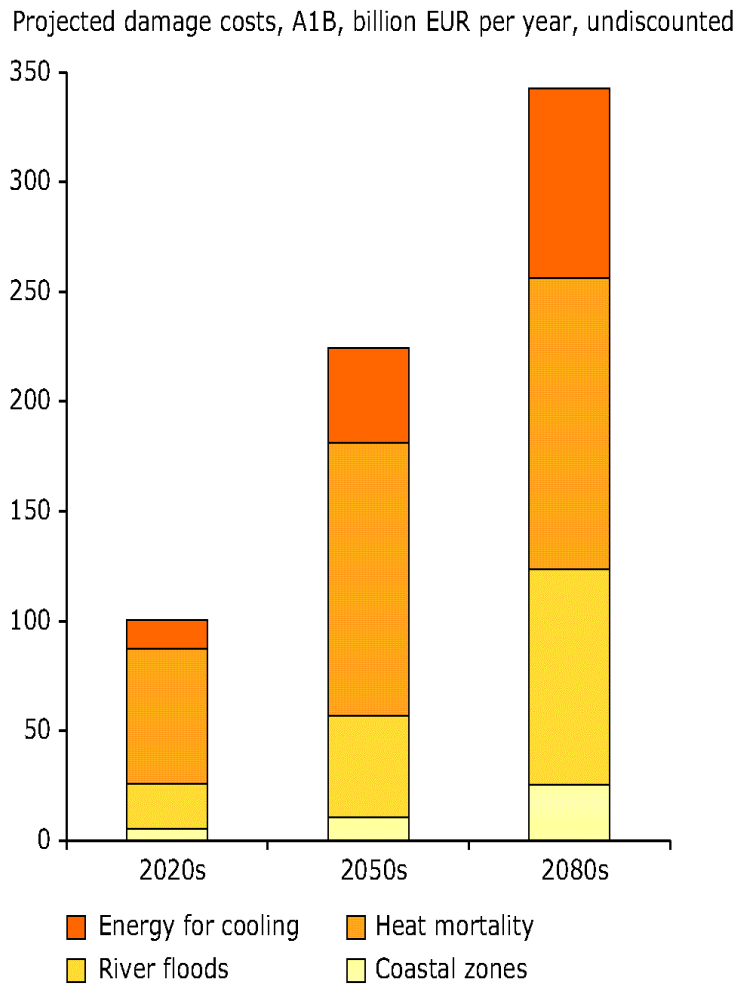
Adaptation

Corrective Approach

To adapt or to mitigate: Is that the question?

Mitigation and adaptation are both necessary and complementary.

- **We need to increase mitigation efforts**. If the 2°C target is missed, adaptation increasingly costly.
- **We need to adapt**. Adaptation is inevitable (delayed impact of emissions). Adaptation is cheaper
  - 1€ invested in flood protection saves 6 € damage costs.
- **We need to act now**. Postponed adaptation and maladaptation will lead to higher damage costs.



Proposals for combating climate change

- **Logical solution optimized to address climate change is to stop emissions significantly**
- **Increase the forestry and changing agricultural practices.**
- **Reduce dependence on fossil fuels as the primary source of energy and seek forward to providing clean energy sources (renewable energy production from wind, water and sun).**
- **Recycling & walking and the use of mass transportation and reduce consumption (Turning Down) and lights-out time of departure (Switching Off) and change behaviors.**

Preventive measures

To reduce the risk of flooding requires speed to take the necessary measures to control high groundwater levels are as follows:

- immediately stop of domestic exchange in groundwater in all the villages in Delta and the work covered drainage systems to reduce groundwater levels in all coastal cities.
- Reduce leaching rates of irrigation water to groundwater through the use of modern irrigation methods.
- Water re-use and recycling to reduce wastewater and reduce its negative effects.

Preventive measures

- The expansion in the construction of waves walls along our coasts especially in North low of them and in front of the watercourses.
- The Nile Delta will not be with the effectiveness meaningful protection from flooding coastal areas unless it is to control the continuing rise in groundwater levels to those areas.
- The problem may increase to include flooding the coastline groundwater.

Adaptation Process

- **Sand Dunes systems should be treated as the first defensive line for the Nile Delta.**

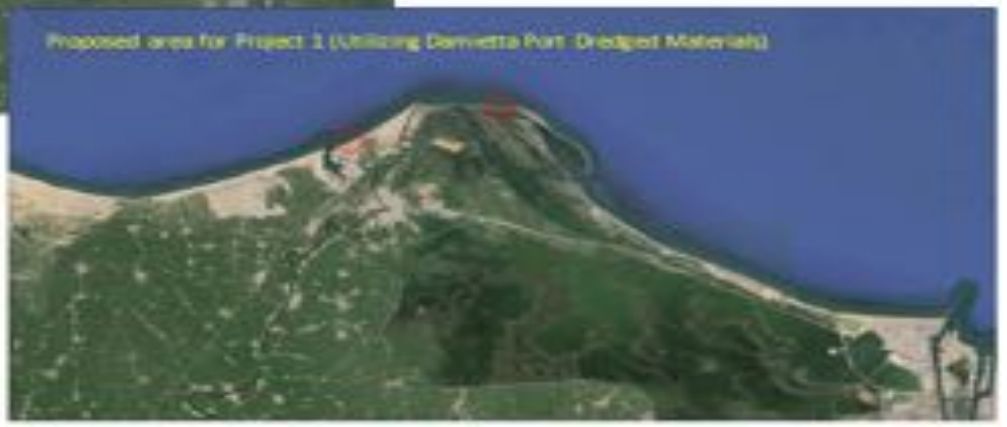
- **Coastal Lakes are appropriate adaptive measure against sea level rise.**

- **International Coastal Road may be considered as the second protection measure and studies to support it are urgently required.**

- **Coastal Protection work needs regular maintenance and should be considered in any coastal zone management plans.**

- **The Northwest Coast extended from Alexandria to the Egyptian-Libyan borders is not vulnerable as it has elevation more than 10 m above average sea water level.**

1- Utilizing Dredged Bed Material from Damietta Port Approaching Channel in Beach Nourishment



Proposed nourished areas

2- Coastal Sand Dunes Stabilizing

International coastal road

3- Coastal Lakes as an Appropriate Adaptive Measure against Sea Level Rise

Manzala Lake management

Sampling locations

According to DO

4- Managed Alignment

Shore Protection in different regions

Shore Protection in different regions cont.

Suggestions To Adapt To Climate Change

Top Policy Priorities

- **More efficient use of water resources**
  - **Water Demand Management**
  - **Planning for less future water supply**
- **Development of new supplies of water.**
  - **Reuse of treated wastewater**
  - **Desalination of Sea Water**
- **Protection of Coastal Zone**
- **Foster Cooperation on climate change within Nile Basin countries**

Top Agriculture Policy

- Certified seed / Stress tolerant varieties
- Crop pattern under climate change circumstances
- Focus on Crops that consume little water
- Consider Focus on Cotton
- Protect old and new Agriculture land

Examples of the agriculture adaptation

Stresses tolerant varieties (heat & salinity)

Specify deficit irrigation (di) management levels and recommendations that could be applied under different agricultural systems in targeted areas.

Wheat

Faba beans

Maize

Rice

Hydroponics in severe salinity lands

strawberry

Cantaloupe

Tomato

Snap beans

Lettuce

Adaptation Needs

Estimated overall costs for adaptation measures for agriculture and coastal zone at 2020 and 2050 in Egypt

Program	Financed Needed (million US$)	
	2020	2050
Observation and control of climate change	90	210
Land and agriculture production	311	948
Irrigation	2055	2150
Socio-economic studies	16	28
Capacity building, enlightenment and training	17	51
Coastal zones and shore regions	330	620
Total	2719	4007

(Source: Egypt National Environmental Economic and development Study (NEEDS) for Climate Change, April 2010. Prepared in cooperation with UNFCCC

CC Aadaptation Strategy

Main objectives of Egypt's National Strategy for Adaptation to Climate Change and Disaster Risk Reduction

Increase the flexibility of the Egyptian community

when dealing with the risks and disasters that might be caused by climate change and

its impact on different sectors and activities

Strengthening national capacities

to absorb and reduce the risks and disasters

to be caused by such changes

The strategy included

- Goals
- Determinants
- Risks caused by Climate Change
- Assessment of Current Situation
- Adaptation & Risk Reduction
- Integration of Adaptation plans in Programs and Sus. Dev. Plans
- Role of Civil Society
- Regional & International cooperation
- Proposed Operational Framework
- Anticipated Cost estimates for Adaptation
- Monitoring, Assessment and Follow-up procedures

CC Adaptation strategy Programmes

for Nile water resource

No	Programs
1	Prepare a periodic report on the hydrological situation of the Nile River to re-evaluate the performance of climate models with time
2	Develop operation policies to High Aswan Dam depending on the expected climate changes to achieve the maximum flexibility of coping with climate change and the maximum safety limits against droughts' and floods' periods
3	Monitor rains and floods for adaptation strategies trends
4	Design a mathematical model to simulate regional climatic changes for the Nile River Basin to predict the future status of the provision of water resources
5	Raise awareness of climate change issues linked to rationalize the consumption in anticipation of the future

CC Adaptation strategy Programmes

for Nile water resource

No	Programs
6	Develop new varieties bear high temperature, salinity, and drought in keeping with the expected climate changes
7	Alternative crops perform the same intended and have little water consumption and less grow season, such as beet sugar instead of cane sugar
8	Develop new varieties have a short growing season to minimize the water needs
9	Reduce crop area in wasteful consumption of water and do not allow an increase spaces and crops, especially rice and sugar cane
10	Reduce wastage of irrigation water through irrigation compliance in timely and appropriate quantities

CC Adaptation strategy Programmes

for Coastal zone

No	Programs
1	Identifying inundation risk areas to study and implement appropriate protection works
2	Preservation of the natural protection systems such as sand dunes and studying installed mechanisms
3	Use the international coastal road as a protect wall against the sea level rise
4	Review legislation to prevent development on coastal strips exposed to inundation risk
5	Integrated management of coastal areas, capacity building, and knowledge technologies used
6	Create new development themes in Egyptian deserts and its coastline taking into account potential environmental pressures caused by climate change
7	Assess socio-economic impacts caused by inundation of coastal lands by North

CC Adaptation strategy Programmes

for Coastal zone

No	Programs
8	Study the change in the hydraulic behavior of the coastal aquifers and the disturbed of the natural balance between the fresh groundwater in those aquifers and seawater
9	Study the expected deteriorate to agricultural drainage systems and determine the need of using pumps to raise the water to the sea
10	Determine the shortage volume of usable fresh groundwater and assess the expected economic loss
11	Monitor and apply RCMs for the northern coastal region to predict the expected SLR
12	Develop the prioritized regions most vulnerable to SLR
13	Participate in the development of the national strategy to address the impact of climate change on water resources and coastal areas

CC Adaptation strategy Programmes

for Flash Flood Harvesting

No	Programs
1	Adjust the safety factor of the dams built in desert regions
2	Maximize the harvesting of rainwater and floods
3	establish dams with enough storage for Bedouin communities requirements
4	Evaluate the economic returns of the collected water
5	Review and amend legislation relating to non-construction in the floodplain areas

Conclusions

- Egypt adaptation strategies to CC impacts in water resources sector is closely linked with development choices and pathways for the country and the region.
- Egypt already faces major water management challenges.
- It is obvious that reduction in Nile supply due to CC may increase the problem. Thus, it is crucial for Egypt to increase its understanding of the potential risks from CC and to reduce its vulnerability to these effects.

Conclusions

- **Climate change is widely considered to be one of the greatest challenges to modern human civilization that has profound socio- economic and environmental impacts.**

- It is essential to develop a portfolio of strategies that includes Adaptation, mitigation, technological development and research (climate science, impacts, adaptation and Mitigation(to combat climate change

Conclusions (contd.)

- It is imperative on countries to take a proactive role in planning national and regional programmes cope with climate variability and climate change.

- Integration of strategies and frameworks to cope with climate change into sustainable development planning is an urgent need, especially in the developing countries.

Recommendations

1. Political will at all levels.
2. Human resource management, financial and technical.
3. Development of legal and institutional frameworks.
4. Establish systems for evaluation, monitoring and follow-up and performance indicators.
5. Develop a national model for the analysis and prediction of socio-economic impacts .

Anchorage with the new agreement (Paris 2015)

- Vulnerability Assessment
- Loss and damage Assessment & Evaluation.

- Adaptation to CC:
  - Capacity Building to formulate a National Adaptation Planning (NAPs)
  - Initiating the implementation of adaptation to CC

- Financing: Support / help partners to benefit from funding through various funds (GCF, AF, GEF, EU, bilaterals…).

For more information :

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Thank You