

# Symposium Resolving the Water-Energy Nexus UNESCO, 26-27-28 Novembre 2008



## Water, Energy and Climate Change Nexus for Egypt

Objectives, approach and expected  
outcome of an ongoing study sponsored by Plan Bleu

**Adel Beshara, Ph.D.**

Sustainable Energy Development Consultant, Egypt

Email: [adelbeshara@gmail.com](mailto:adelbeshara@gmail.com)

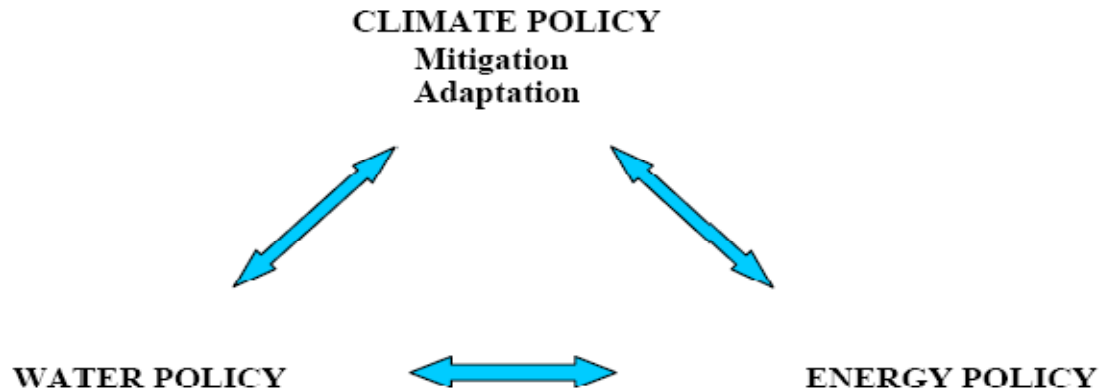
# Presentation Outline

- **Main study objectives.**
- **Why a water, energy and climate change nexus study for Egypt?**
- **Egypt high vulnerability to climate change.**
- **Water demand/supply matrix and expected climate change impacts.**
- **Energy demand/supply matrix and expected climate change impacts.**
- **Water and energy nexus: energy needs for water and water needs for energy.**
- **The way forward.**

# Main study objectives

## This study aims at:

- Evaluating Egypt's future energy needs for water production and mobilisation and water needs for energy production until 2050, while taking into consideration the "climate change" factor.
- Identifying the existing gaps in related data and information that is hindering the adequate evaluation of present and future water and energy needs.
- Estimate required investments to supply energy and water needs until 2050 (without and with taking the impacts of climate change into account).



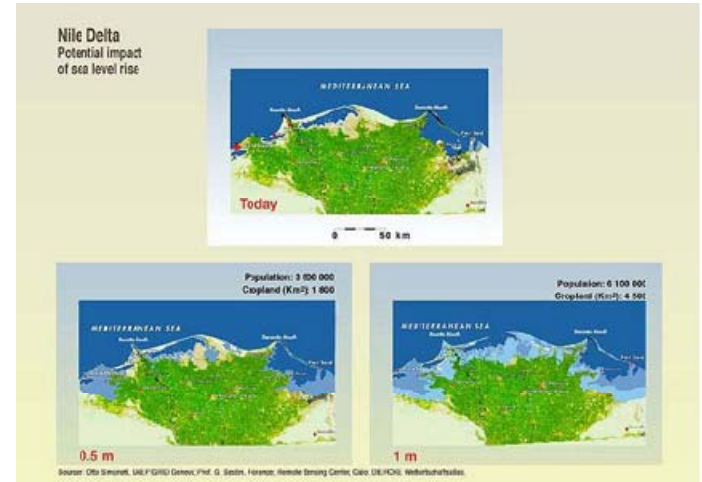
- Starting the establishment of a "knowledge platform" on this issue in the SEMCs to initiate information, experience and awareness sharing.
- Drawing the attention to and developing a roadmap for a futuristic integrated or at least coordinated policy making processes that should plan for the future use of water and energy in a close relation with the mitigation of and adaptation to climate change.

# Why a Water, Energy and Climate Change Nexus Study for Egypt?

- As the home of one of the oldest civilizations on the planet, Egypt has different concerns about global climate change and its consequences on the country's sustainable development plans.
- While not a major contributor to the world's total GHG emissions (0,5%), Egypt recognizes its own vulnerability to climate change in vital areas threatening the sustainability of its natural and socioeconomic systems.
- Predicted socioeconomic implications due to human migration, land loss, and soil salinity cause significant concerns.
- With 95 percent of Egypt's fresh water needs supplied from the Nile River, the country's vulnerability increases with any changes in rainfall patterns throughout the Nile Basin. Climatic changes will also impact agricultural productivity and fisheries, thus influencing the country's food supply.
- Water and energy are extremely interdependent and their demand/supply balance is already critical. This critical balance is estimated to be aggravated by the demographic expansion and the climate change impacts.
- The rights of the coming new generations are primarily tied to the sustainability of both water and energy resources.
- The topic of the nexus between the expected climate change impacts and the interdependence between water and energy issues in Egypt during the 21<sup>st</sup> century is extremely complicated and has not yet received its merited consideration.

# Egypt high vulnerability to climate change

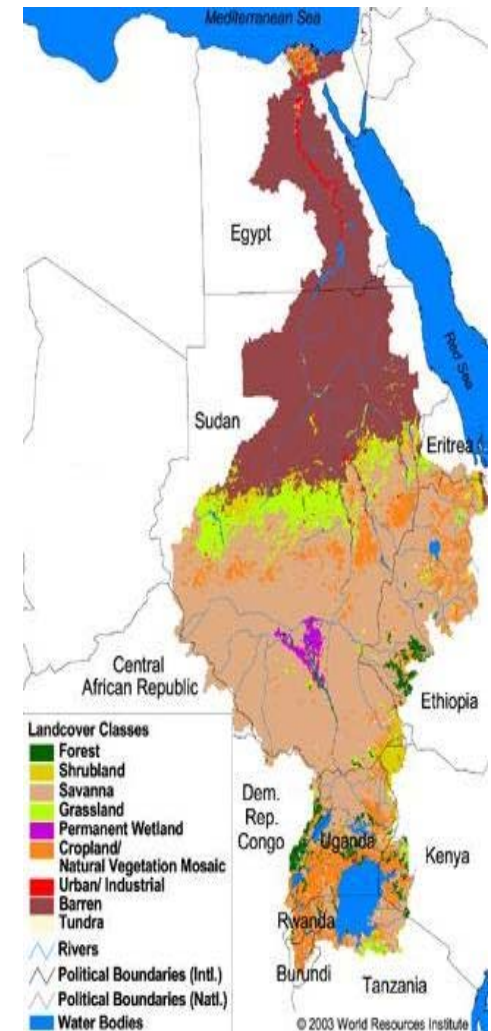
- Estimates show that 0.5 m Sea Level Rise (SLR) would lead to a permanent submersion of 1,800 km<sup>2</sup> of cropland in low lands in the Nile Delta, to increase soil salinity in the remaining land and to relocate more than 2 million people into the already overpopulated Nile Delta.



- Demographic expansion and climate change will drive Egypt to count deeply on both under groundwater exploitation and recycled water utilization. This will certainly affect both the quantity and the quality of freshwater discharges from the Nile to the coastal areas of the Mediterranean. Consequently, disturbance to the marine ecosystem will happen and has to be taken into consideration.
- Climate Change could also cause significant variation in Nile stream flow. Available hydrological models have predicted an increase of 30% or a decrease that can reach 70% in the annual Nile flow.

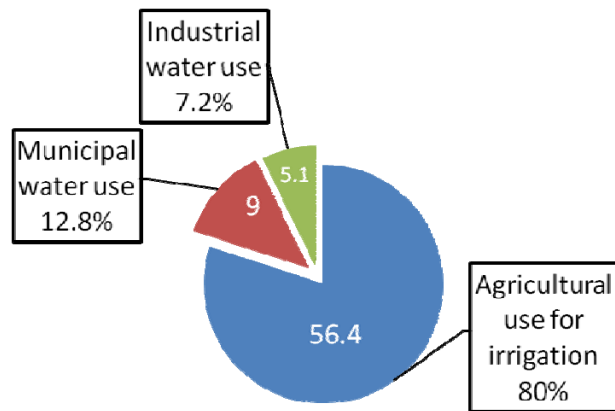
# Water demand/supply matrix and expected climate change impacts

- Egypt (without any significant rainfall) is almost entirely dependent on Nile water, a source shared by 9 other riparian nations.
- This trans-boundary waters extend Egypt's hydrological interdependence across its national frontiers, linking users in different countries within a shared water system.
- Managing that interdependence is one of the great human development challenges facing these nations as it can be a force for prosperous cooperation and peace or for conflict. Nevertheless, it is normally politics that would decide which course is chosen.
- While its demand for water is increasing, the country's annual share of 55.5 bcm of Nile water is almost constant. Different climate change scenarios expect an important decrease on the river's water yield originated in the Nile resources catchment areas.
- Egypt has currently an annual per-capita of 750 cm of renewable fresh water resources, lower than the regional average (1200 cm per-capita) and it is expected to further decline to 460 cm by 2050. Nile water is becoming scarcer than ever.

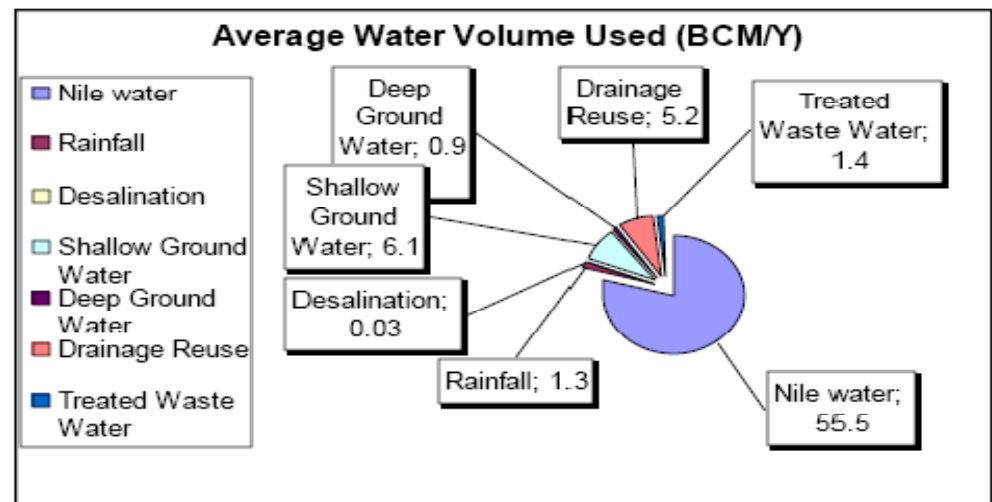


# Water demand/supply matrix and expected climate change impacts (contd.)

- Egypt current population is 75.9 millions (2006). The total annual water use is approximately 70.5 bcm compared to 55.5 bcm supplied from the Nile. This demand will increase due to population growth and economic development. It will be further intensified by global temperature rise.
- As the municipal and industrial demand for water increases, it is typically satisfied by diverting water from irrigation leading to a loss in the capacity of food production. This is typically offset by importing grains from abroad. Importing grains means importing virtual water, since 1 ton of grain represents 1,000 tons of water.



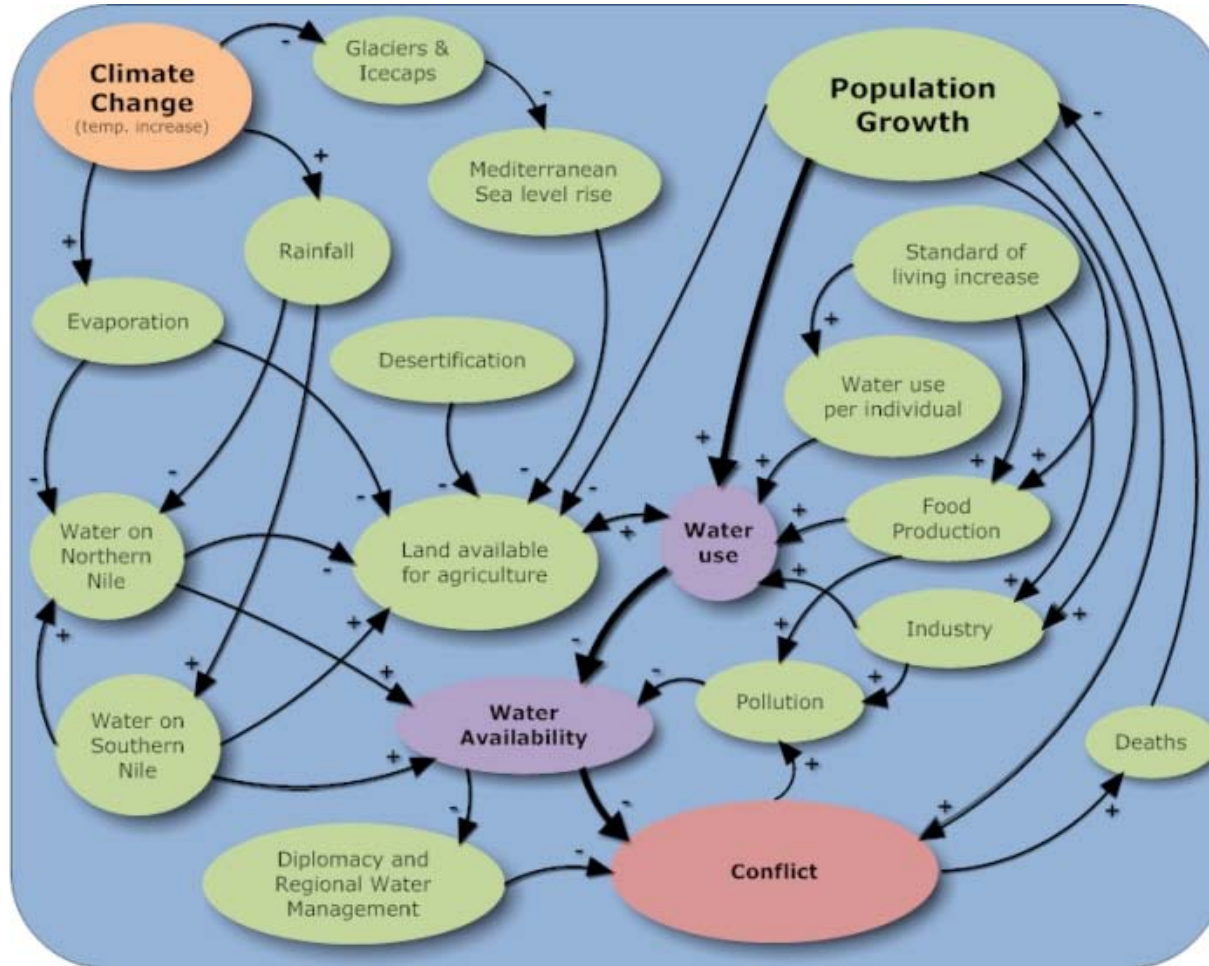
**Source:** Future challenges for water management in Egypt, Dia Al-Quesy, 2008.



**Source:** Plan Bleu, Zaragoza, Spain, March 2007



# Water demand/supply matrix and expected climate change impacts (contd.)



Source: ICE Case Study Number 203, May, 2007

**The links and the dynamics of the  
overlap of climate change, population growth and conflict**



# Energy demand/supply matrix and expected climate change impacts

## Electricity supply

Year	2006/2007	
	Quantity	% of total
Total Installed Capacity (MW)	21949	100
Thermal	18936	86.3
Hydro	2783	12.7
Wind	230	1
Peak Load (MW)	18500	
	Quantity	% of total
Total Generated Energy (GWh)	114268	100
Thermal	100708	88.1
Hydro	12925	11.3
Wind	635	0.6

## Electricity demand

Year	2006/2007	
	Quantity	% of total
Total Sold Energy (GWh)	98812	100
Industrial use	34569	35.0
Residential use	36596	37.1
Commercial buildings	7046	7.1
Public lighting	6653	6.7
Public utilities	4228	4.3
Governmental buildings	5562	5.6
Agriculture	3789	3.8
Exported through regional interconnections	369	0.4

# Energy demand/supply matrix and expected climate change impacts (contd.)

## Current hydropower status within the national power supply matrix

- Today most of Egypt's economic hydropower potential has been exploited.
- This can be easily noticed by the declining percentage contribution of generated hydro-electricity into the total electricity generated on the national level:
  - 70% of the generated electric energy in 1970
  - Decreased to reach 11.3% in 2006/2007
  - Estimated to be less than 3.5% by 2029/2030.
  - Expected to have a very modest contribution by 2100.
- The total installed capacity of existing hydro-power plants in the country is:
  - In 2006/07 is 2783 MW representing 12.7% of total power system
  - Expected to decrease to 4.1% by the year 2029/2030
  - Just a new installation of 64 MW is in its final phase of construction and will be operational during the first half of 2008
  - Only additional 68 MW of small hydro-power plants is planned to be installed by 2029/2030.

# Energy demand/supply matrix and expected climate change impacts (contd.)



**Panoramic overview on existing hydropower installations**



# Panoramic overview on existing hydropower installations

## Aswan I

No. of units: 7

Average Head: 20 (m)

Completed: 1960

Capacity: 280 MW

Discharge: 1340 m<sup>3</sup>/s



## Aswan High Dam

No. of units: 12

Average Head: 70 (m)

Completed: 1970

Capacity: 2100 MW

Discharge: 4152 m<sup>3</sup>/s



## Aswan II

No. of units: 4

Average Head: 20 (m)

Completed: 1985

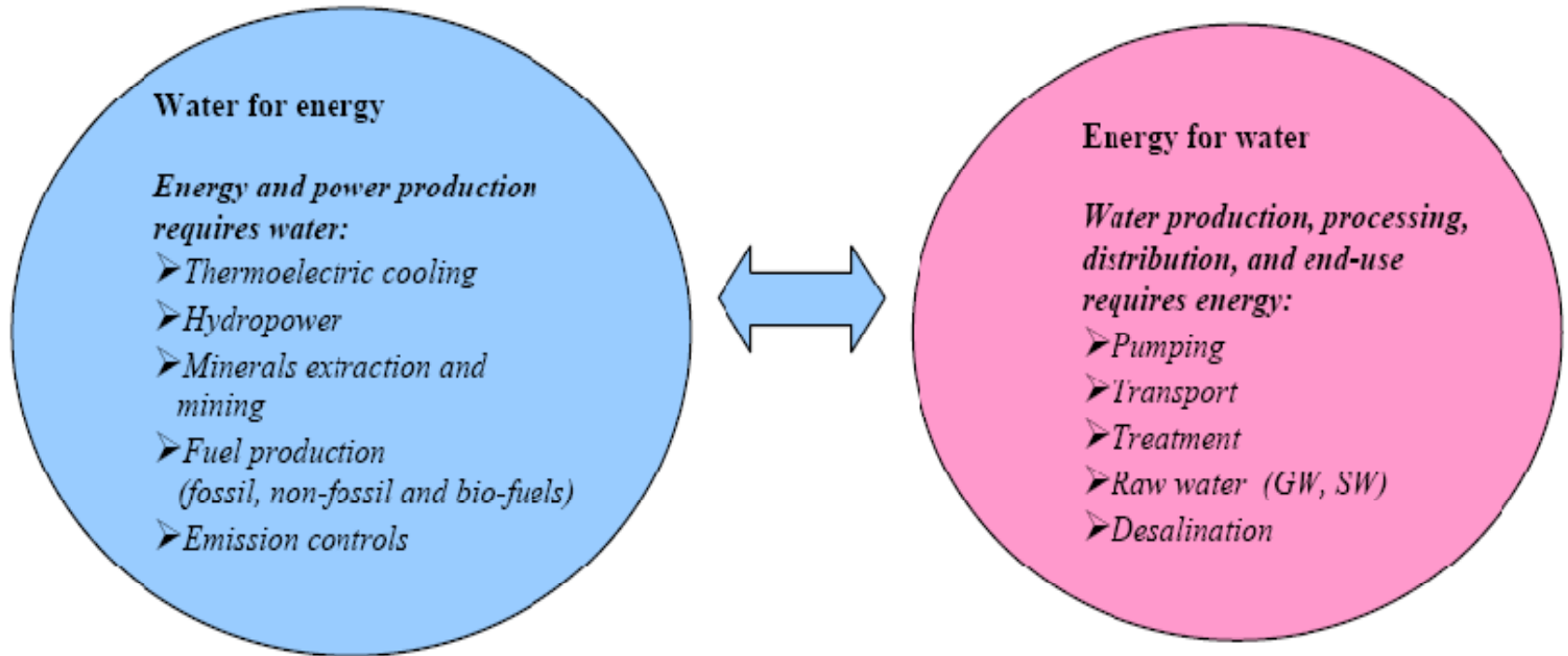
Capacity: 270 MW

Discharge: 1200 m<sup>3</sup>/s



# Water and energy nexus

(energy needs for water and water needs for energy)



**Source:** Draft concept paper on “Linking Water, Energy & Climate Change”,  
a proposed water and energy policy initiative for the UN Climate  
Change Conference, COP15, in Copenhagen 2009

# Water and energy nexus

## (Energy needs for water)

- The annual national electricity statistics does not provide an explicit figure for the current electricity needs for water production, treatment and mobilization in Egypt. This figure is estimated to be between 5 and 9% of the total electric energy consumption. The adequate evaluation of this figure and its standardized breakdown is strongly needed.
- Recently, many RO desalination units are being used to produce large amounts of fresh water particularly in Sinai as well as the Mediterranean and the Red Sea coasts.
- Water and energy consumers need to devote more efforts for using both resources in a more efficient and economic manner.
- **Energy needs for water will greatly increase due to:**
  - The increase in water demand due to population growth and economic development, that will be further exacerbated by global temperature rise.
  - The increasing need to pump deeper and deeper groundwater.
  - The need to develop non conventional water resources such as desalination and reuse to offset the deficit between water demand and available supply.



# Water and energy nexus

## (Water needs for energy)

- Egypt has already exploited its hydropower potential. The hydropower share is decreasing. Thus, the fear from the reduction of power generated due to climate change is not the major issue of climate change impacts on energy resources.
- Any temperature increase of the Nile's water may result in a significant decrease in power stations electricity production, as the discharge temperature downstream must not exceed a limit value. This would imply a long-term analysis of climate change impact on water flows and river temperatures.
- A governing issue is that Egypt started to have a problem to install thermal power plants alongside the Nile River and its main branches.
- Limitations on sites, cooling water availability and environmental constraints started to drive planners to install the power stations on the sea coasts. This trend, however, faces other constraints stemming from high value of lands and the concerns about the environment in such mostly touristic areas.
- Improving the efficiency of existing hydroelectric plants is under consideration. The development of micro-hydroelectric power plants and the linkage between pumped storage plants and wind farms as well as the potential of marine energy are other areas of investigation.

# The way forward

- The Egyptian authorities understand the pressing need of the upper riparian nations to electrify their countryside, develop manufacturing industries and improve the quality of life of their people.
- The intense competition for the limited water resources in the Nile Basin Countries is likely to increase over the next few decades. The climate change impacts would even worsen the situation.
- For Egypt in Particular, if the country cannot solve the population problem, the nation will inevitably face declining per-capita water availability and use, and eventually, declining quality of life and benefits. Policies to reduce population growth are necessary. Such policies will not be sufficient to prevent serious water-related problems from getting worse.
- We (experts, scientists, decision-makers and the public at large) need to develop a new way of thinking about water, its resources, its utilization and its economics. This has to be accompanied by an initiative of a broader societal debate on population-water-energy issues with the aim of developing a long-term policy for the sustainable use of water through a better management of available resources and to the improvement of its efficiency of use.

# The way forward (continued)

- Studying the water/energy nexus is rather a new topic in Egypt. This study faces different sorts of data gaps concerning the current and the future practices and plans.
- Preliminary results of this study indicates that the water supply and use matrix in Egypt will be more energy dependent in the years to come.
- Furthermore, the complex nexus between water, energy and climate change and its economic burdens needs also more efforts to be institutionalized and to be integrated into the decision making and development planning process in Egypt as well as in the whole region. This current study aims to represent a modest step in this way.
- Knowledge gained, lessons learned, barriers encountered and experiences practiced during the preparation of this study are normally made available through Plan Bleu to be exchanged among other Southern and eastern Mediterranean Countries (SEMCs) in the region.

*Thank You*  
*For*  
*Your Kind Attention*