The interaction between Water-Energy-Food in the Mediterranean region

Dr. Fadi Comair
General director of Hydraulic and Electric Resources
Honorary President of MENBO (Mediterranean Network of Basin Organization)

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The Mediterranean region strong of its 460 million inhabitants, is located at the crossroad of three continents

- Its basin shares a unique climate and natural and cultural heritage among the twenty-two riparian countries and territories where environmental and development issues are particularly acute.
- Considered as an “eco-region”, its economies remain mostly dependent on natural resources (especially on the southern rim).
Both water and energy are essential to every aspect of life: social equity, ecosystem integrity, economic sustainability and specially food production.

- Global energy and water demand are increasing in the Med. region
- Both are linked: Water is used to generate energy; energy is used to provide water
- It is predicted that by 2030 the world will need to produce 50% more for food and energy, together with 30% more available fresh water.
The Mediterranean region: specificities and multiple interactions

- Severe water scarcity in the southern countries, most eastern countries and few European countries (Cyprus, Spain, Malta)

- Scarcity is compounded by multiple nexuses
  - Water-Energy
  - Water-Food
  - Water-Health
  - Water-Environment
  - ...

- Many cross-cutting issues
  - Human rights, social, ical,
  - Political, economical
The Mediterranean region: specificities and multiple interactions

- Water-Energy and Food in southeastern Med region (more than any other region) are strongly inter-linked and highly inter-dependent
- W-E-F Interactions are numerous and substantial
- Importance of the nexus is not always recognized from planning and management perspective of the Mediterranean resources.
- There is an urgent need for an “Interaction Approach” that integrates planning, management and governance across the three sectors.
- Supports the transition to a Green Economy, which aims at resource use efficiency and greater policy coherence

(UNU, 2013)
The Mediterranean basin is under Threat

- Vulnerable area because of its: geographical position subjected to Global Changes
- Natural resources couldn’t be dissociated from its climatic characteristics that defines it.

- The PHEDER of Plato is the first document which describes the Mediterranean specificities it recalls the two elements of the Mediterranean culture:
  - Enchanted feelings of the Mediterranean natural sites
  - Taste of a mixture of civil and Urban animation
The Mediterranean basin is under Threat

- The threat is linked to the Med environmental stakes continuing growth in the pressures

**Causes**
- Demographic growth
- Refugee
- Urbanization
- Political, Religions, ethnic conflicts
- Intense irrigation
- Touristic activities
- Disposal of effluents
- Climate Change
- Unsettled and politicized shared water resources

**Consequences**
- Degradation of the biodiversity
- Increase of the water-energy and food demand
- Increase of the population: water, air, soil,…
- Threats to the quantitative and qualitative regenerative capacities of freshwater
- Degradation of the quality of freshwater and ecosystems
- Growing cost of water
- Conflicts on the Jordan, Tigris, Euphrates, Nile, Balkan basins.
The Mediterranean region: Climate change issue

- **Climate change** could increase still further the occurrence of droughts and in the southern and eastern Mediterranean, diminish average precipitation.

- Risk of greater contrasts between different seasons and regions and an increase in the occurrence of random droughts

- The future of the Mediterranean basin will shift to a general aridification climate of major coastal cities will shift to the South (Beirut → Alexandria)

  - Degradation with high economic and social negative impact.
  - The environmental stakes cover a double dimensions:
    - invite us to act rapidly in order to conserve the common heritage (depollution of the Mediterranean).
    - adaptation to a new environmental situation
  - the lack of means are very heavy even through the cooperation program has been set.
Climate change will affect availability and use of water, energy and food.

It acts as an amplifier of the already-intense competition over the three.

- Impacts of CG on both regional and global hydrological systems will increase, bringing higher levels of risk, with some regions more impacted than others.
- Each situation will require the appropriate and sustainable use of water and energy resources locally.
- Impact on food prices, increase on demand by around 40% between 2010 and 2030 by the growing population.
The Mediterranean region - Water issue: the challenge of scarcity

- The region suffers from water shortages: 180 million inhabitants benefit from less than 1,000 m³ per year per capita and **80 million are facing scarcity** (less than 500 m³/year/capita).
- Water demand **has doubled over the past 50 years**, with agriculture being the main consumer (64%).

![Renewable Fresh Water Resources per inhabitant in Mediterranean elementary river basins (between 1995-2005)](image)
The Mediterranean region-Water issue: the challenge of scarcity

The availability and use of water resources in the Middle Eastern Countries
The Mediterranean region - Water issue: climate change

- Mean global warming scenario 2°C MENA Region 2000-2050
Energy is Required in every stage of the water cycle:

For humans to take advantage of water resources, energy from some source is needed to extract, produce, lift, convey, distribute, process and treat the substance at every phase of its extraction, distribution and use.

Water cycle demands at least 15% of national electricity consumption, and is continuously increasing.

Water is Needed to Make Use of Energy:

Water is also used in the generation of most forms of traditional turbine-produced electricity. Sometimes water is a direct input to the energy generation process: cooling, hydropower, geothermal, exploration and refining. Much more often it plays a role at various intermediate phases of electricity generation (cooling, etc).
The Mediterranean basin nations need to draw a common energy vision.

They need to overcome their conflictual situation between oil and gas producer countries / vs the non-producers countries.

Producers countries are mainly 4: Algeria, Libya, Egypt and Syria. These 4 countries export 5% of their oil and 90% of the gas.

Two other countries will be potential producers: Israel, Lebanon.

Horizon 2030: EU countries consumption will need 75% fossil energy.

Southern countries consumption will reach 95% of fossil energy.

Demand management will increase to reach: - 235 M tep oil / 178 billion m³ gas.

- Increase in demography
- Increase in urbanization
- Increase of the social wealth
Over the period 1971-2006, the primary energy consumption of the Med. Basin grew two-fold and the electricity consumption grew four-fold.

The consumption of the countries of the Northern rim represents, around three times that of the SEMCs.

Med. region has a considerable potential of renewable energies (solar and wind), but still under exploited.

In 2010, 75% of the Med. greenhouse gas emissions were due to CO2 arising from energy use.
The Mediterranean region: Energy issue

- Europe dependency of producer countries and oil/gas transport pipes
  - 15% of med basin oil imports comes from Algeria, Libya and Egypt.
  - 35% from gas import

- European countries are linked to southern countries by several gas pipeline
  - Transmed (Algeria → Syria and Italy)
  - Galsi And Medgas

- 2030: Decrease of the EU gas production in the Netherland and Romania from 240 billion m³ To 114 billion m³ of gas
  - Algeria will be the 2nd gas exporter to EU after Russian

- Reinforce the Euro-Med transport line and interconnections
- EU do not have a unified energy strategy: nuclear / fossil / v.s renewable
- MENA countries faces: political stability problems
- Water, agriculture, desalination and food interaction
As water scarcity increases, more southwestern countries are forced into desalination except Turkey, Lebanon, and Syria and wastewater treatment/reuse, to augment their limited fresh water supplies.

In 2009: desalination cost in Arab region 4BUS$; 2.5 BUS$ energy.

Desalination is energy-intensive, and causes fast depletion of oil reserves (main source of income in many countries).

In some countries, CPDs consumes > 50% of total energy consumption.

Cost of energy = 87% of the running cost.

Accumulated current and near term total contracted capacity in Arab countries (GWI, 2010)
The Mediterranean region: Energy and Water desalination

Distribution of desalination water volume in the world, 2007

Desalination cost with respect to technological process (US$ par m³)

<table>
<thead>
<tr>
<th>Process</th>
<th>MSF</th>
<th>MED</th>
<th>SWRO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mediterranean Sea</td>
<td>—</td>
<td>1.35–1.59</td>
<td>1.08–1.32</td>
</tr>
<tr>
<td>Red Sea</td>
<td>—</td>
<td>1.28–1.43</td>
<td>1.06–1.23</td>
</tr>
<tr>
<td>Gulf water</td>
<td>0.84 (1.6)</td>
<td>1.21–1.34</td>
<td>1.23–1.36</td>
</tr>
</tbody>
</table>
The MENA Region: Energy and water desalination

Cost of solar energy with respect to thermal energy

- In Saudi Arabia (1st oil world producer) consumption is 1.5 million oil barrels for energy production used for water desalination.

- It is the case of the med countries (Spain, Algeria, Israel, Cyprus, Malta…. ) and also the gulf countries.

- If we don’t develop energy efficiency, the oil production for desalination will reach 8 Million barrels/day/country.

- The increase of water demand will increase the energy demand

- The MENA Region has already being trapped in the water-energy-food shortage
The MENA Region: Yearly desalination water cost, 2010

### Desalination Costs by Technology

- **MSF**
  - Operation and maintenance: 6%
  - Electrical energy: 23%
  - Capital repayment: 45%
  - Thermal energy: 26%

- **MED**
  - Operation and maintenance: 6%
  - Electrical energy: 19%
  - Capital repayment: 49%
  - Thermal energy: 26%

- **RO**
  - Operation and maintenance: 17%
  - Electrical energy: 33%
  - Capital repayment: 50%
  - Thermal energy: 17%

### Desalination Capacity and Energy Use

<table>
<thead>
<tr>
<th>Country</th>
<th>2003</th>
<th>2010</th>
<th>2003</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual desalination capacity (MCM/year)</td>
<td>Estimated primary energy used (mtoe)</td>
<td>National primary energy used (%)</td>
<td>Anticipated desalination capacity (MCM/year)</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>1,465</td>
<td>9</td>
<td>23.1</td>
<td>2,482</td>
</tr>
<tr>
<td>Kuwait</td>
<td>582</td>
<td>3</td>
<td>13.1</td>
<td>1,006</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>2,207</td>
<td>11</td>
<td>8.5</td>
<td>3,523</td>
</tr>
<tr>
<td>Qatar</td>
<td>206</td>
<td>1</td>
<td>6.6</td>
<td>282</td>
</tr>
<tr>
<td>Libya</td>
<td>272</td>
<td>1</td>
<td>5.5</td>
<td>532</td>
</tr>
<tr>
<td>Algeria</td>
<td>125</td>
<td>0</td>
<td>0.0</td>
<td>542</td>
</tr>
<tr>
<td>Total</td>
<td>4,837</td>
<td>26</td>
<td>10.0</td>
<td>8,227</td>
</tr>
</tbody>
</table>
The MENA Region: The Water-Energy-Food interaction

- The majority of water in the MENA Region is used in the agricultural sector (83%), a major cause of water resources over-exploitation and quality degradation in the region.

- The full food and supply chain consumes about 30% of total energy demand (global figures).

- In recent years, the quick increase in the price of oil lead to the increase in the price of food.

- Biofuels (energy) impact negatively on food production and water.
Presentation of Modeling Tools: planning and management of water and energy resources

WEAP- LEAP

- Integrated model for planning of water resources
- Integrated model for management energy: supply – demand and future prevision
Placing the Water-Energy-Food interaction as a priority for the region (Sustainable Development Initiative)

Bridging the knowledge gap in the W-E-F interaction in the MENA and EU Region by concentrated active research to

Identify inter-dependencies to influence policies, strategies, investments, and management (e.g., energy use in the water value chain, efficiency relationship in three resources)

Exploit synergies and identify and mitigate trade-offs among the development goals related to the security of the three

Identify opportunities in both demand side and supply side management (e.g., resources use efficiency, potential of energy capture from wastewater treatment plants, ...)

Appropriate and effective governance, institutional, and organizational frameworks for the nexus approach
Decision makers, in general do not have access to comprehensive tools that:

- Define and quantify interconnectivity between water, energy and food.
- Develop and interactive strategy for Holistic management and planning for the future of these resources in the Mediterranean region (3 sub-regions North – South and East).

This gap poses a Threat to the socio-economic sustainability of global resources.

- Integrative view of water energy and food: resources management must prevail at all levels including: governance, academic technology providers, civil society and private sector (promoting conservations and responsible investment and in R&D → further business opportunities
- Software and WEB based for water, energy and food Interaction tool for decision makers

What is next? Problem statement:
Thank you