Climate Change: Fallout on Energy, Water & Food Security

Adnan Badran
Sustainable Energy & Water Resource Management for Food Security in the Arab Region

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Nexus of:
ENERGY
WATER
Food security
Main Message

• The Arab region is the most water-scarce region in the world, with a high level of dependence on resources flowing from outside the region.

• As semi arid region, the Arab region has developed a higher share of its water resources than any other region of the world.

• Current challenges stem from the fact that there is little scope for further supply development, yet demand is rising fast due to population pressure and the demand for more water for all uses.

• Fast growing cities and rising living standards create:
  - Pressure for more water for municipal and industrial uses.
  - Demand for water for agriculture as food demand rises and farmers expect a better living.

• The demand for environmental services has become pressing, whilst throughout the region the resource is increasingly threatened by climate change.
Challenges set a tough agenda for the sector for the coming years

1. Water resources management that promotes efficiency throughout the sector, including the whole food chain.

2. Increases in crop water productivity that can produce more output and provide more income for less water in agriculture.

3. Institutional arrangements and systems of land, water and people management policies and practices that intensify sustainable and productive water use.

4. Heeding the voice of the environment.
Climate Change:
UN backed – IPCC science report on climate change (Nov. 2014)

• By 2050, all World’s electricity must be produced from zero or low carbon sources. Otherwise, our planet faces irreversible damage.

• Any delay; remedy would cost much more!

• Report says renewables have to grow from current 30% share to 80% share, of the power sector by 2050.

• By 2100, all fossil fuel generation without carbon capture and storage (CCS), shall be phased out.

• Canadian company in Calgary, Alberta/Canada has developed a one of a kind cleansing technology, that captures and removes CO2 from air.
Science has spoken:

• Warming is unequivocal & human influence on climate is clear.
• Between 1983 – 2012 it was warmest 30 yrs over a period of 1400 yrs.

• Warming impacts:
  - acidification of oceans
  - melting the arctic ice cap.
  - unpredictable floods & storms.
  - less rain & poor crop yield.
  - shortage of waters in aquifers
Science has Spoken:

- UN Secretary General Ban Ki-Moon described the IPCC report:
  “Science has spoken, there is no ambiguity in the IPCC message. Leaders must act, time is not on our side, there is a myth that climate action will cost heavily, but inaction will cost much more”

U.S. John Kerey described the report:
“those who choose to ignore or dispute, science which is so clearly laid out in the report, do so at great risk for all of us and for our kids and grandkids”
U.S. Secretary of State Ed Davey on Energy & Climate Change described the report:
“most comprehensive, thorough and robust assessment of climate change ever produced”.

“It sends a clear message across the world—we must act to save the planet by striking a new climate deal in Paris next year”.

“If we cannot develop carbon capture and continue dumping CO2 into atmosphere, then we have to stop using fossil fuel in the production of our electricity” IPCC
Science has Spoken:

• U.S. President Barack Obama and Chinese President Xi Jinping announced last month that both countries will curb their greenhouse gas emissions over the next two decades.

• Under the agreement, the United States would cut its 2005 level of carbon emissions by 26-28% before the year 2025. China would peak its carbon emissions by 2030 and will also aim to get 20% of its energy from zero-carbon emission sources by the same year.

• China's next steps: China has agreed to provide another 800-1,000 gigawatts of nuclear, wind, solar and other zero emission generation capacity by 2030. That amount of zero-emission output exceeds all the coal-fired power plants that exist in China today and is close to total current electricity generation capacity in the United States.
For the first time, solar power provides over half of total energy in Germany.
### Renewables in Electricity Production of Jordan as compared to other countries (2014)

<table>
<thead>
<tr>
<th>Country</th>
<th>Share (2012*)</th>
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<tbody>
<tr>
<td>Brazil</td>
<td>85%</td>
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<tr>
<td>Canada</td>
<td>53%</td>
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<tr>
<td>China</td>
<td>21%</td>
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<tr>
<td>Ecuador</td>
<td>55%</td>
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<tr>
<td>India</td>
<td>14%</td>
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<tr>
<td>Iceland</td>
<td>100%</td>
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<td>Iran</td>
<td>5%</td>
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<table>
<thead>
<tr>
<th>Country</th>
<th>Share (2012*)</th>
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<tbody>
<tr>
<td>Japan</td>
<td>13%</td>
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<tr>
<td><strong>Jordan</strong></td>
<td>0.4%</td>
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<tr>
<td>Morocco</td>
<td>8.9%</td>
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<tr>
<td>South Korea</td>
<td>3.7%</td>
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<tr>
<td>Switzerland</td>
<td>60%</td>
</tr>
<tr>
<td>Taiwan</td>
<td>5.3%</td>
</tr>
<tr>
<td>United States</td>
<td>13%</td>
</tr>
</tbody>
</table>

Source: Renewables 2014 Global Status Report.

2013:
- SOLAR PV INVESTMENT -22%
- SOLAR PV ADDITIONS +32%

Source: Renewables 2014 Global Status Report
Wind Power Total World Capacity, 2000–2013

Gigawatts

World Total

318 Gigawatts

Source: Renewables 2014 Global Status Report
Jobs in Renewable Energy

Source: Renewables 2014 Global Status Report.
Food Security in the Arab Region
Water & Food Security

Arab Region of semi-arid zone will be affected highly by climate change.

- 25% less rainfall.
- 3°C rise in temperature.
- May become completely an arid-zone, lower agricultural outputs, broken food chain.
- Fresh-water may become brackish as rising sea waters seeps-into aquifers.
- Nile Delta, the food basket of Egypt, may disappear under the rise of sea level (> 1 m) threatening life of 46 million people inhabitants.
Distribution of Arab Water

1. Deserts cover 87% of Arab land.
2. Arab region consist of 14 countries out of 22, most water-scarce worldwide.
3. Share of arab per capita water yearly 1000 m³, one-eighth of an average per-capita of 8000 m³ world wide.

4. Total arab water resources is 371.8 billion m³ distributed as follows:
   - 41% Mashreq Arab States.
   - 23.4% Maghreb Arab States.
   - 31% Nile Arab States.
   - 4.6% Arab Peninsula(Gulf States).
**Poverty of Water Resources in the Arab Region**

Arab region houses 5% of world population and occupies 10% of earth space, with 1% only of world water resources.

- Annual renewable water is less than 1%.
- Average annual rainfall is 2.1%.
Agriculture consumes 87% of available water resources, (the highest) as compared to 70% of world average.

- Industrial sector consumes 7%.
- Domestic use 6%
Water crisis in Arab region

1. Shortage of water-resources and less R&D in finding new resources.
2. Increase population and migrations.
3. Absence of governance & management of water resources efficiently.
4. Inefficiency of agricultural technology practices.

So we need:

- Efficient irrigation system i.e. sprinkler, drip irrigation etc.
- New cultivars using less water (modified).
- Genomes grown in saline and brackish waters.
- High yield crops on same amounts of water.
- Protective horticulture crops, plastic-culture to reduce evaporation and conserve moisture, produce vertical hi-yield.
- Polymers in soils to conserve water.
- Improved practices of pests & weed control, harvest, handling, packing, storage, shipping and distribution to consumers, to reduce loss (estimated as 30%).
- Conserving virtual waters in importing hi-water consuming agricultural crops and produce.
The Triangle  
**Sustainable, integrated approach**

- R&D and innovations toward sustainability, efficiency, governance and management of the *Triangle*.
- **Wind Energy** i.e. wind tunnel of Egypt along Suez canal to produce renewable energy.
- **Solar Energy**: The Arab sunbelt (PVS & CSP, etc...)

- From **sustainable renewable energy**:  
  1. water is extracted from desalination.  
  2. water-reuse from recycling, efficiently.  
  3. lowering 87% of water use on agriculture to world average of 70% by utilizing efficient irrigation technology.  
  4. hi-agriculture-productivity with less water.
**Desalination:** with R&D, innovation, cost of desalination is going down.

Arab region occupies advanced position in desalination:

- 50% of desalinated water produced world wide is in the Arab region.
- It is expected to grow from 1.8% to 18.5% by 2025.
- Recycling of grey water currently is 4.7 billion m³.
- To sustain the delivery of above, shift to renewables.
- RO through innovative nano-membranes is competing with thermal desalination
Trans-boundary water resources

- 60% of renewable water resources in Arab countries originate from outside the region.

- The Renewable resources estimated at 350 billion m$^3$:

  The Nile provides 84 billion m$^3$ of which:
  - 55 billion m$^3$ for Egypt.
  - 29 billion m$^3$ for Sudan.

- Euphrates –Digla basin shared by Turkey, Syria, Iraq. (70% billion m$^3$)

- Jordan river delivery of renewable water is 1.3 billion m$^3$.

- Johnston project on dividing Jordan River between Jordan, Syria and Israel in 1950’s failed.
Trans-boundary water resources: Problematic

- Israel occupied Jordan river springs originated in Syria & Lebanon and diverted it to Tibris- the national water reservoir of Israel.

- Yarmouk river springs and water harvest on the Syrian heights diverted by Syria to Dams (40%), Israel diverted the other part to Tibris. Jordan suffered 20% annual deficit in its water resources.

- Trans-boundary shared underground water need to be managed by the stakeholders of the underground basin jointly, in particular the grand aquifers of:
  1. **Nubian stand stone aquifer** shared by Egypt, Libya, Chad, Sudan.
  2. **Western Sahara aquifer** shared by Algeria, Libya, Tunis.
  3. **Basalt aquifers** shared by Saudi Arabia, Jordan.
Trans-boundary waters: Based on rights & Justice

- Agreement of joint management of shared basins, on principles of UN-convention on the law of non-navigational uses of int’l watercourses.

- Arab countries should become parties and ratify the convention.

- High level economic and social boards should be created by riparian countries of shared basins to develop partnership of shared interest to unite them around the shared water and not disperse them.

- Although agreements on the Nile signed by Egypt with Sudan and last month with South Sudan, but still there are more countries (11 riparian countries in total), should be part of joint agreement and party to the convention.
Water & Food Security in the Arab Region

- Food and water is inextricably linked.
- Annual renewable water per capita is 850 m$^3$, compared to world average 8000 m$^3$.
- 87% of Arab water resources used for agriculture.
- Therefore, food security for self-sufficiency could be achieved through right policies and improved agricultural and irrigation technologies.
- Integrated approach, nexus of water – food security.
- For sustainable future of water resources generated outside the Arab world (60%), water board of riparian countries should be established to preserve and conserve the flow of water from its sources, and maintain the quality against pollution, and also an economic and social development plan of those countries should be placed into effect, to overcome poverty and bring water sanitation to MDGs.
- In the Nile basin, 11 sharing countries suffer from poverty, epidemic diseases and lack of sanitation. Collective sharing by riparians and ODA from developed countries should be in place to develop those nations to become self-reliant, and meet UN-MDG’s by 2015, and SDGs for 2030.
- Jordan and Syria built 220 million m³: "Unity Dam" for electricity & storing water for domestic use and irrigation, but the dam has failed to collect water due to diverting its sources.

- Renewable waters in arab region from rainfall amounts to 250-400 mm annually, and rainfall on coastal zones of Syria and heights of Yemen, South-Sudan amounts to 1000 mm annually. The average annual rainfall on the Arab region amounts to 2000-2300 billion m³ annually.
Extraction of water from Arab aquifers has reached a threatening levels:

- Egypt: 94% of renewable water aquifers.
- Libya: 609% of renewable water aquifers.
- Saudi Arabia: 936% of renewable water aquifers.
- Kuwait: 2,075 of renewable water aquifers.
- Jordan: 160% of renewable water aquifers.
- Over-exploitation of water aquifers... In Jordan is about 160% of annual renewable recharge.
- In Yemen groundwater is pumped at a rate four times of its annual recharge.
- Over 6 extraction of ground water beyond safe yield levels, resulted in decline in water table and pollution of ground water. Examples: “Gaza strip and Libya”. Where sea water diffused to over-extracted aquifers yielding brackish water.
لذا فإن إمكانات الموارد المائية تستطيع أن توقف التدهور في إنتاج الغذاء العربي باستخدام الكفاءة والإدارة الحكيمة لمصادر الماء. واستخدام التقنيات الحديثة لمواجهة تحديات الأمن المائي والغذائي، فالعرب ينتجون حاليًا نصف ما يأكلون، ولا بد من ردم الفجوة الغذائية.

إن تحديات الطاقة والمياه والغذاء تشكل مفاصل رئيسية، أن الأوان أن يتوضد العرب في محاجحتها بشكل متكامل، كما توجد الأوروبيون حول فصل الفحم والجديد، وعليها أن تتحرك لتدارك الخطر القادم حول الأمن المائي والغذائي وطاقوي مع تحديات تغير المناخ ضمن إستراتيجية وخطط عمل زمنية واضحة، ولدينا من العقول والمهارات والمهارات ما يجعلنا أهلاً لمواجهة هذه التحديات وتجاوزها نحو عالم أفضل.
The first great civilization arose on banks of great rivers, Nile of Egypt, Tigris and Euphrates of Mesopotamia, Indus of Pakistan, and Hwang Ho of China. All great civilizations developed by building large irrigations and making land productive, they collapsed when water resources were mismanaged.
Water sustains life, it sustains the environment, and it sustains development. Global water crises is linked to global environmental crises and degradation of life-support ecosystem. It is a crisis of management, fragmented institutions, inadequate policies, deficient legal system, insufficient funding for water supply, pollution control and shortage of political will.
- Rapid population growth, contribute to environmental degradation. Water supply is stretched to its limits, many parts of the world are facing water scarcity. It is the rural areas suffer the most, 1.2 billion without basic sanitation.

- If “water is life” then adequate clean water is “fundamental human right”... then why water crisis so slow to deal with.

- The political economy of low water-tarrifs and high fuel and water subsidy in Arab countries has contributed to overuse of scarce resources and deprived needed revenues to maintain the physical and health condition of water supply networks. The price estimate of water average is only 35% of the cost of supply in the arab region
Quick fixes and short-term solutions are not adequate to address water and sustainable development:

- policy-makers need to change course and adopt policy reforms that address key strategic studies. Shift from development of water supply to efficiently managing the available water supply, to efficiently managing the available water resources.

- water demand management yield sustainable development cost effective, managing demand provide policy makers to adjust water allocation more equitably, rationally and sustainably.

- water need of municipal, industrial and agricultural sectors are legitimate, but we should maintain water flows to wetlands, aquifers, river basins, and other ecosystem, with rationale (biodiversity and balanced ecosystem)

- reliable accounting of the social, economic, environmental effects of new policy, provides guidelines for navigating a transition to a sustainable water future.
- Waste water treatment and reuse, should become sustained policy.

- Water crises cannot be addressed in isolation of land degradation, deforestation and ecosystem loss. Integrated approach that links between water, land and people and investing in those three areas will yield a sustainable water management and a sustainable development.

- the task in water management is how to coordinate services, industry, agriculture science, environment, waste management and population.

- how to forge international action, when upstream countries (users) see little benefits in stopping pollution which affect downstream users.

- And how to forge an action to protect the recharge zones of fresh water to feed aquifers?
IN SUMMARY:

- Water reforms need to be addressed to:
  a. introduce policy and legal reforms to enable a shift from culture to secure more supplies through expensive water development to one which manages demand, by improving efficiency, cutting losses, protecting water from over use and pollution. Bring it with public awareness campaign.
  b. gov’t urged to introduce water tariffs that rationalize water use, achieve cost recovery and promote equity through targeted subsidies.
  c. reorient the role of state-water authority from water provider to that of effective regulator and planner to enable public-private partnership to provide clean water, safe sanitation.
  d. Encourage solar energy linked to desalination.
  e. Tap the potential of waste water reclamation, as well as grey water recycling for reuse.
Let’s Reuse Water!

Did you know we have less than 1% of fresh water we can use?

Thank you