Intergovernmental mandates calling for & supporting Climate Change Assessment in the Arab Region

- First Arab Ministerial Declaration on Climate Change CAMRE 2007
- Arab Economic and Social Summit Resolution on Climate Change & Water Project 2009
- Arab Ministerial Council of for Meteorology & Climate 2018
- ACSAD Board of Directors Resolution 2013
- ESCWA 30th Ministerial Session Resolution setup Center for Arab Climate Change Policies 2018
Objective: To assess the impact of climate change on freshwater resources in the Arab Region through a consultative regional initiative that scientifically identifies the socio-economic and environmental vulnerability caused by climate change impacts on water resources based on regional specificities.

Purpose: To provide a common platform for assessing, addressing and informing response to climate change impacts on freshwater resources in the Arab region by serving as the basis for dialogue, priority setting and policy formulation on climate change at the regional level.
Integrated Assessment

GCM: Global Climate Modelling  
RCM: Regional Climate Modelling  
RHM: Regional Hydrological Modeling  
VA: Vulnerability Assessment  
IM: Integrated Mapping  
netcdf to ArcGIS
The Arab Domain

CORDEX-MENA/Arab Domain | 0.44° (50 km)

- Active Domain
- Full Domain (SMHI-RCA4)
Representative Concentration Pathways (RCPs)
As first represented in IPCC AR5 Projections

Graph adapted from: Meinshausen et al., 2010
Regional Climate Modeling & Hydrological Modeling

Different GCMs

General Circulation Model (GCM)

RCP
300 km x 300 km

Regional Climate Model (RCM)

50km x 50km

Ensembles used to reduce uncertainty at level of RCMs & RHMs

Ensembles aggregate findings of different RCMs & RHMs applied for same RCP & Domain

Regional Hydrological Model (RHM)

Calibration

25km x 25km

Same RCP

Extreme climate events
Temperature in the Arab region is increasing and is expected to continue to increase until the end of the century.
Precipitation trends are largely decreasing across the Arab region until the end of the century, though limited areas expected to exhibit an increase in the intensity and volume of precipitation.
## Extreme events indices

<table>
<thead>
<tr>
<th>Extreme temperature indices</th>
<th>Extreme precipitation indices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Index</strong></td>
<td><strong>Full name</strong></td>
</tr>
<tr>
<td>SU</td>
<td>Number of summer days</td>
</tr>
<tr>
<td>SU35</td>
<td>Number of hot days</td>
</tr>
<tr>
<td><strong>SU40</strong></td>
<td>Number of very hot days</td>
</tr>
<tr>
<td>TR</td>
<td>Number of tropical nights</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Climate impacts on Shared Water Resources

<table>
<thead>
<tr>
<th>Variable</th>
<th>RCP4.5</th>
<th>RCP8.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp.</td>
<td>2.3°C</td>
<td>4.8°C</td>
</tr>
<tr>
<td>Precip.</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Runoff</td>
<td>-2%</td>
<td>-12%</td>
</tr>
</tbody>
</table>
# Integrated Vulnerability Assessment: Sectors and Subsectors

<table>
<thead>
<tr>
<th>SECTORS</th>
<th>SUBSECTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>• Water availability</td>
</tr>
<tr>
<td>Biodiversity and Ecosystems</td>
<td>• Area covered by forests</td>
</tr>
<tr>
<td></td>
<td>• Area covered by wetlands</td>
</tr>
<tr>
<td>Agriculture</td>
<td>• Water available for crops</td>
</tr>
<tr>
<td></td>
<td>• Water available for livestock</td>
</tr>
<tr>
<td>Infrastructure and Human Settlements</td>
<td>• Inland flooding area</td>
</tr>
<tr>
<td>People</td>
<td>• Water available for drinking</td>
</tr>
<tr>
<td></td>
<td>• Health conditions due to heat stress</td>
</tr>
<tr>
<td></td>
<td>• Employment rate for the agricultural sector</td>
</tr>
</tbody>
</table>
Vulnerability Assessment Impact Chain
Water Availability

**EXPOSURE (0.50)**
- RCM
  - Change in temperature (0.17)
  - Change in precipitation (0.17)
- RHM
  - Change in runoff (0.17)
  - Change in evapotranspiration (0.17)

**EXTREME EVENTS INDICES**
- Change in maximum length of dry spell (0.16)
- Change in maximum length of wet spell (0.16)

**SENSITIVITY (0.50)**
- POPULATION (0.50)
  - Population density (0.14)
  - Total renewable water available per capita (0.50)
  - Water consumption per capita (0.13)
  - Share of water consumption in agriculture (0.13)
  - Refugee population (0.10)
- NATURAL (0.26)
  - Land use/land cover (0.27)
  - Soil storage capacity (0.25)
  - Degradation of vegetation cover (0.26)
  - Wetlands (0.22)
- MANMADE (0.24)
  - Urban extent (0.47)
  - Areas served by dams (0.53)

**ADAPTIVE CAPACITY (0.50)**
- KNOWLEDGE & AWARENESS (0.10)
  - E-Government development (0.33)
  - Tertiary enrollment (0.32)
  - Adult literacy rate (0.35)
- TECHNOLOGY (0.10)
  - Number of scientific and technical journal articles (0.46)
  - Information and communication technologies index (0.54)
- INFRASTRUCTURE (0.50)
  - WATER & SANITATION (0.50)
    - Areas served by dams (0.17)
    - Installed desalination capacity per capita (0.17)
    - Fossil groundwater (0.17)
    - Access to improved water (0.17)
    - Access to improved sanitation (0.16)
    - Area equipped for irrigation (0.16)
  - ECONOMIC RESOURCES (0.11)
    - GDP per capita (0.36)
    - ODA (0.30)
    - Food imports as % of merchandise exports (0.34)
- ENVIRONMENT (0.50)
  - Environment performance index (1.0)
- INSTITUTIONS (0.10)
  - Governance index (0.54)
  - Disaster risk reduction committees (0.46)

**POTENTIAL IMPACT (0.50)**

**VULNERABILITY ASSESSMENT**

6 Exposure indicators

10 Sensitivity indicators

20 Adaptive Capacity indicators
WATER AVAILABILITY VULNERABILITY

End-Century RCP 4.5

Legend

- Lakes
- Reservoirs
- Rivers
- Intermittent rivers
- Major cities
- Area not relevant to subsector

Low Vulnerability
High Vulnerability

RICCAR
Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region
Vulnerability Assessment Impact Chain
Agriculture: Crops

EXPOSURE (0.50)
- RCM
  - Change in temperature (0.17)
  - Change in precipitation (0.17)
- RHM
  - Change in runoff (0.17)
  - Change in evapotranspiration (0.17)

EXTREME EVENTS INDICES
- Change in number of hot days (0.16)
- Change in maximum length of dry spell (0.16)

SENSITIVITY (0.50)
- POPULATION (0.50)
  - Population density (0.12)
  - Share of agricultural labor force in total labor (0.12)
  - Total renewable water available per capita (0.13)
  - Share of water consumption in agriculture (0.50)
  - Share of agriculture in GDP (0.13)
- NATURAL (0.26)
  - Soil storage capacity (0.34)
  - Degradation of vegetation cover (0.32)
  - Rainfed areas (0.34)
- MANMADE (0.24)
  - Floodprone areas (0.46)
  - Irrigated areas (0.34)

ADAPTIVE CAPACITY (0.50)
- KNOWLEDGE & AWARENESS (0.11)
  - E-Government development (0.34)
  - Tertiary enrollment (0.33)
  - Adult literacy rate (0.33)
- TECHNOLOGY (0.11)
  - Number of scientific and technical journal articles (0.45)
  - Information and communication technologies index (0.55)
- INFRASTRUCTURE (0.50)
  - Areas served by dams (0.17)
  - Installed desalination capacity per capita (0.17)
  - Fossil groundwater (0.17)
  - Access to improved water (0.17)
  - Access to improved sanitation (0.15)
  - Area equipped for irrigation (0.16)
- ECONOMIC RESOURCES (0.10)
  - GDP per capita (0.35)
  - ODA (0.28)
  - Food imports as % of merchandise exports (0.37)
- EQUITY (0.08)
  - Female-to-male literacy ratio (0.52)
  - Migrants/refugees index (0.48)

6 Exposure indicators
10 Sensitivity indicators
20 Adaptive Capacity indicators

POTENTIAL IMPACT (0.50)
VULNERABILITY ASSESSMENT
WATER AVAILABLE FOR CROPS VULNERABILITY

End-Century RCP 8.5

Legend
- Lakes
- Reservoirs
- Rivers
- Intermittent rivers
- Major cities
- Area not relevant to subsector

RICCAR
Regional Initiative for the Assessment of Climate Change Impacts on Water Resources and Socio-Economic Vulnerability in the Arab Region

Agriculture: WATER AVAILABLE FOR CROPS
Vulnerability: RCP8.5 END-CENTURY (2081-2100)
RICCAR findings used to inform:


- **Lebanon – Ministry of Environment**: Lebanon’s Third National Communication to the UNFCCC submitted in 2016.

- **Lebanon / Tunisia / Sudan – Ministries of Agriculture**: Using RICCAR data and integrated vulnerability assessment tools for assessing climate change impacts on water resources and agricultural sector.


- **Basin-level analyses**: The Collaborative Programme on the Euphrates and Tigris builds on RICCAR’s regional climate modelling and hydrological modelling outputs to support more detailed analyses at the basin level.

- **Egypt (MWRI), Kuwait (KISR), Morocco (groundwater)**: Using RICCAR modelling outputs to inform national/sub-national studies.
Thank You

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www.riccar.org
www.unescwa.org
www.unescwa.org/our-work/climate-change