Vulnerability to climate change in the key sectors Arab region

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The integrated Assessment model
Components of vulnerability

- Exposition (0.50)
- Sensitivity (0.50)
  - Potential Impacts (0.50)
  - Adaptive Capacity (0.50)
- Vulnerability
<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>
Impact chain

EXPOSURE (0.50)
- RCM
  - Change in temperature (0.17)
  - Change in precipitation (0.17)
- RHIM
  - Change in runoff (0.17)
  - Change in evapotranspiration (0.17)
- EXTREME CLIMATE INDICES
  - Change in number of days > 35 °C (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)
  - Flood prone areas (0.46)
  - Irrigated areas (0.54)

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 (0.56)
- INSTITUTIONS (0.10)
  - Governance index (0.53)
  - Disaster risk reduction committees (0.47)
- 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)
  - Environment performance index (1.0)
  - Energy consumption (0.50)
  - Density of road network (1.0)
- ECONOMIC RESOURCES (0.16)
  - 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)
Vulnerability of Water Availability to climate change
The water availability study area represents 49% of the Arab Region and is defined by selected indicators and water users, as reflected by the areas drawing upon fresh water resources:

- Populated areas (greater than 2 inhabitants per sq km)
- Irrigated cropland areas
- Rainfed cropland areas
- Livestock areas (greater than 10 heads per sq km)
- Forested areas
- Wetland areas
Impact chain of water sector

CHANGE IN THE WATER AVAILABLE FOR CROPS – IMPACT CHAIN

EXPOSURE (0.50)

6 Exposure indicators

- RCM
  - Change in temperature (0.17)
  - Change in precipitation (0.17)
- RIM
  - Change in runoff (0.17)
  - Change in evapotranspiration (0.17)
- EXTREME CLIMATE INDICES
  - Change in number of days > 35°C (0.16)
  - Change in maximum length of dry spell (0.16)

SENSITIVITY (0.50)

10 Sensitivity indicators

- 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 (0.10)
  - 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)
  - Flood prone areas (0.46)
  - Irrigated areas (0.54)

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)
- INSTITUTIONS (0.10)
  - Governance index (0.53)
  - Disaster risk reduction committees (0.47)
- 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 (0.16)
  - Area equipped for irrigation (0.16)
- ENVIRONMENT (0.17)
  - Environment performance index (1.0)
- ENERGY (0.17)
  - Access to electricity (0.50)
  - Energy consumption (0.50)
- TRANSPORT (0.16)
  - Density of road network (1.0)

20 Adaptive Capacity indicators

- EQUITY (0.08)
  - Female-to-male literacy ratio (0.52)
  - Migrants/refugees index (0.48)

POTENTIAL IMPACT (0.50)

VULNERABILITY ASSESSMENT
Exposure indicators

8 indicators

**RCM**
- Change in temperature (0.17)
- Change in precipitation (0.17)

**RHM**
- Change in runoff (0.17)
- Change in evapotranspiration (0.17)

**EXTREME CLIMATE INDICES**
- Change in number of days > 35 °C (0.16)
- Change in maximum length of dry spell (0.16)
# Sensitivity Indicators

**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 (0.54)
# Adaptive capacity indicators

<table>
<thead>
<tr>
<th>Category</th>
<th>Weight</th>
<th>Indicators</th>
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<tbody>
<tr>
<td>Adaptive capacity (0.50)</td>
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<td></td>
</tr>
<tr>
<td>Knowledge &amp; Awareness   (0.11)</td>
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<td>E-Government development (0.34)</td>
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<td></td>
<td></td>
<td>Tertiary enrollment (0.33)</td>
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<tr>
<td></td>
<td></td>
<td>Adult literacy rate (0.33)</td>
</tr>
<tr>
<td>Technology              (0.11)</td>
<td></td>
<td>Number of scientific and technical journal articles (0.45)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Information and communication technologies index (0.55)</td>
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<tr>
<td>Institutions            (0.10)</td>
<td></td>
<td>Governance index (0.53)</td>
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<td></td>
<td></td>
<td>Disaster risk reduction committees (0.47)</td>
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<tr>
<td>Infrastructure (0.50)</td>
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<td></td>
</tr>
<tr>
<td>Water &amp; Sanitation (0.50)</td>
<td></td>
<td>Areas served by dams (0.17)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installed desalination capacity per capita (0.17)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fossil groundwater (0.17)</td>
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<td>Access to improved water (0.17)</td>
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<td></td>
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<td>Access to improved sanitation (0.16)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Area equipped for irrigation (0.16)</td>
</tr>
<tr>
<td>Environment (0.17)</td>
<td></td>
<td>Environment performance index (1.0)</td>
</tr>
<tr>
<td>Economic resources (0.10)</td>
<td></td>
<td>GDP per capita (0.35)</td>
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<td>ODA (0.28)</td>
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<td>Equity (0.08)</td>
<td></td>
<td>Female-to-male literacy ratio (0.52)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Migrants/refugees index (0.48)</td>
</tr>
<tr>
<td>Transport (0.16)</td>
<td></td>
<td>Density of road network (1.0)</td>
</tr>
</tbody>
</table>
### Exposure

**WATER: WATER AVAILABILITY**

**EXPOSURE: RCP 8.5 END-CENTURY (2081-2100)**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Low EX</th>
<th>Moderate EX</th>
<th>High EX</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCP 4.5 Mid-century</td>
<td>5%</td>
<td>88%</td>
<td>7%</td>
</tr>
<tr>
<td>RCP 8.5 Mid-century</td>
<td>2%</td>
<td>64%</td>
<td>33%</td>
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<tr>
<td>RCP 4.5 End-century</td>
<td>5%</td>
<td>68%</td>
<td>27%</td>
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<tr>
<td>RCP 8.5 End-century</td>
<td>3%</td>
<td>39%</td>
<td>58%</td>
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</table>
**Scenario**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Percentage of study area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low SE</td>
<td>43%</td>
</tr>
<tr>
<td>Moderate SE</td>
<td>52%</td>
</tr>
<tr>
<td>High SE</td>
<td>4%</td>
</tr>
</tbody>
</table>

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

**Sensitivity**
- Water availability
  - Sensitivity
  - Population (0.16)
  - Natural (0.26)
  - Manmade (0.24)

**Population (0.16)**
- Population density (0.12)
- Share of agricultural labor force in total labor (0.05)
- Total renewable water available per capita (0.13)
- Share of water consumption in agriculture (0.30)
- Share of agriculture in GDP (0.19)

**Natural (0.26)**
- Soil storage capacity (0.34)
- Degradation of vegetation cover (0.32)
- Flooded areas (0.34)

**Manmade (0.24)**
- Flood prone areas (0.46)
- Irrigated areas (0.44)
### Scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Percentage of study area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low PI</td>
</tr>
<tr>
<td>RCP 4.5 Mid-century</td>
<td>12%</td>
</tr>
<tr>
<td>RCP 8.5 Mid-century</td>
<td>6%</td>
</tr>
<tr>
<td>RCP 4.5 End-century</td>
<td>10%</td>
</tr>
<tr>
<td>RCP 8.5 End-century</td>
<td>7%</td>
</tr>
</tbody>
</table>

Areas with highest potential impact:
- the Asir Mountains,
- the Green Mountains, and
- the eastern Jafara Plain Basin.

Areas with lowest potential impact:
- the southern Horn of Africa, the central Tigris-Euphrates Basin.
Scenario | Percentage of study area
--- | --- | --- | ---
Low AC | Moderate AC | High AC
All climate scenarios | 43% | 52% | 4%
Components of vulnerability

EXPOSURE (0.50)

SENSITIVITY (0.50)

POTENTIAL IMPACTS (0.50)

ADAPTIVE CAPACITY (0.50)

VULNERABILITY
## Vulnerability

### Areas with highest vulnerability:
- the upper Nile Valley,
- the southwestern Arabian Peninsula, and
- the northern Horn of Africa

### Areas with lowest vulnerability:
- the Tigris-Euphrates Basin and
- the lower Nile Valley, including the Nile Delta

### Percentage of study area

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Low Vul</th>
<th>Moderate Vul</th>
<th>High Vul</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCP 4.5 Mid-century</td>
<td>0%</td>
<td>57%</td>
<td>43%</td>
</tr>
<tr>
<td>RCP 8.5 Mid-century</td>
<td>0%</td>
<td>48%</td>
<td>52%</td>
</tr>
<tr>
<td>RCP 4.5 End-century</td>
<td>0%</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>RCP 8.5 End-century</td>
<td>0%</td>
<td>43%</td>
<td>57%</td>
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</table>
Thank you