Impacts of Climate Change on Water Resources, Agriculture and Food Security in the Arab region

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Food Security, Agriculture, & Climate Change…

Projection & Monitoring Tools for Policy Formulation
Climate Change Impact on Agriculture in the Arab Region

- Increased Water Scarcity
- Rise in land Degradation, Soil Erosion and Salinity
- Negative Impact on Socio-Economic & Political Stability
- Negative Effect on Food Security
- Increased Investment Needs & Insufficient Climate Financing
<table>
<thead>
<tr>
<th>Climate Change Impact on Agriculture in the Arab Region</th>
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<tbody>
<tr>
<td>• Most Arab countries dependent on <strong>rainfed Agriculture</strong>: Mashreq 57%, Maghreb &gt; 80%</td>
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<tr>
<td>• Agriculture consumes up to 80% of fresh water</td>
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<td>• Low water productivity &amp; inefficiency in irrigation causing 60% of water losses</td>
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<td>• <strong>By 2030, CC effects will reduce renewable water resources by 20%</strong></td>
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<td>• <strong>By 2080, CC will decrease agriculture output by over 20%</strong></td>
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<td>• Agriculture’s share of GDP 7% (23% in Arab LDCs)</td>
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<td>• 38% of population’s main source of employment/livelihood</td>
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<td>• Highest food importing region: spending $110 billion/year, importing 25% of the global wheat markets</td>
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<td>• <strong>By 2050, 70% of population will live in cities: decrease food production while demand &amp; consumption will rise</strong></td>
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<td>• Regional priority is <strong>adaptation</strong>, but bilateral flows for mitigation 5X the adaptation in 2016 &amp; only 5/22 Arab States accessed the GCF</td>
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<td>• In 2016, the region received $4.6 billion bilateral flows: $3.7 billion mitigation, $0.7 billion adaptation, $0.3 billion cross-cutting actions</td>
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Land degradation affect 92% of hyper arid land & 73% of arable land, costing $9 billion/year (2-7% of countries’ GDP), most affected region by sand & dust storms.
A Tool for Monitoring Food Security…Climate Change, Water & Agriculture as Key Indicators

Key results

- Underperformance in three core indicators: undernourishment, food insecurity experience & obesity
- Hotspot areas in all 4 food security dimensions: yield gap, limited arable land, excessive water use in agri sector, high import dependency, poverty & unemployment levels, affected child and women nutrition as well political stability.
- Need for data collection at national & local levels
Tool for Projecting Agricultural Productivity within Climate Change..... AquaCrop Model and RICCAR Data

- Historical Yield Data
- Crop Data
- Soil Data
- RICCAR Climate Change Scenarios*
- AquaCrop Simulations

- Seasonal precipitation, temperature changes and evapotranspiration
- Changes in crop yield, crop water productivity, length of growth cycle
- Irrigation scheduling and deficit irrigation

*EC-Earth, CNRM-CM5, and GFDL-ESM2M
### AquaCrop Tool for projecting Agricultural Productivity

**Key Results**
- 20 Workshops, 9 Case Study Reports in 9 Countries,
- advisory service

<table>
<thead>
<tr>
<th>Crop Type</th>
<th>Location</th>
<th>Yield Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfed wheat</td>
<td>Morocco</td>
<td>Decrease between 9 &amp; 26%</td>
</tr>
<tr>
<td>Irrigated tomato</td>
<td>Iraq</td>
<td>Decrease 7%</td>
</tr>
<tr>
<td>Rainfed Sorghum</td>
<td>Sudan</td>
<td>Decrease 7 - 11%</td>
</tr>
<tr>
<td>Irrigated wheat</td>
<td>Yemen</td>
<td>Decrease between 4 - 7%</td>
</tr>
<tr>
<td>Rainfed Sorghum</td>
<td></td>
<td>Decrease 8 - 16%</td>
</tr>
<tr>
<td>Irrigated potato</td>
<td>Palestine</td>
<td>Decrease 3%</td>
</tr>
<tr>
<td>Supplementary irrigated wheat</td>
<td>Lebanon</td>
<td>Increase 4 - 17%</td>
</tr>
<tr>
<td>Rainfed wheat</td>
<td>Jordan</td>
<td>Increase by 34 - 48% due to CC shift in rainfall mid-wheat growing season</td>
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<tr>
<td>Rainfed wheat in Tunisia</td>
<td></td>
<td>Decrease by 7.0% while irrigated wheat yield will not vary</td>
</tr>
<tr>
<td>In Egypt</td>
<td></td>
<td>Important amounts of water saved (up to 40%) through deficit irrigation for wheat and Maize</td>
</tr>
</tbody>
</table>
2 localities selected (Zemamra & Marchouch)
Crop types identified (rainfed soft wheat, irrigated sugarbeet and soft wheat)
2 scenarios: RCP 4.5 & 8.5 consider the periods 2020-2030, 2040-2050

Crop growth cycle will decrease
Crop yields will decline, food production affected significantly
Shortage of growing-season length have a negative impacts on grain yield (quantities and quality)
Rainfed crops will be more sensitive to climate change than irrigated crop
A rise in the need for water of irrigated crops by 7-12%
AquaCrop: a Tool for projecting Agricultural Productivity ..... Data Input to Projections, Results to Policy Options

**Institutional & Financial Arrangements**
- Adopt and scale up conservation-agriculture practices in rainfed agriculture
- Promote investments to modernize irrigation systems
- Water accounting systems to monitor water availability and water allocations
- Promote research and assessments on use of crop varieties suited to new climate conditions

**Technical Arrangements**
- Adjusting sowing dates according to temperature and rainfall patterns
- Modify irrigation depth & application time
- Applying conservation agriculture such as (minimum tillage, applying crop rotation)
- Promote rainwater harvesting, application of supplementary irrigation

**Evidence Generation**
- Research to compare yields, soil properties development and plant growth phases
- Produce interactive map using geographic information systems to see impacts of climate change on agriculture areas
- Unified & reliable database between institutions (Agriculture – Water-Meteo – Statistics authority)
AquaCrop: Added Module on Irrigation Water Management….An Adaptation Measure

Application of deficit-supplementary irrigation

- An adaptation measure to optimize crop productivity & water yield
- Used for both Irrigated or Rainfed
- optimum irrigation timing & water quantities
- Allows maximizing water use efficiency for higher yields per unit of irrigation water applied
- Crop is exposed to certain level of water stress either during a particular growth period or throughout the whole growing season without reduction in yield

Impact of deficit irrigation on crop productivity: Egypt

<table>
<thead>
<tr>
<th>Yield</th>
<th>Adaptation measures</th>
<th>Yield change [%]</th>
<th>Yield productivity /water unit [%]</th>
<th>Irrigation water savings [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>60% DI</td>
<td>0.2</td>
<td>67</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>80% DI</td>
<td>0.2</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Maize</td>
<td>60% DI</td>
<td>-1.6</td>
<td>64</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>80% DI</td>
<td>-0.1</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>Tomato</td>
<td>60% DI</td>
<td>-43</td>
<td>-6</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>80% DI</td>
<td>-22</td>
<td>-20</td>
<td>20</td>
</tr>
</tbody>
</table>

- Minor yield changes for wheat & maize
- Major reduction in yield for tomatoes
## Towards a Resilient Agriculture Sector… Recommendations for Agriculture Strategies & Policies

- Cross sectoral coordination (ministerial & technical levels), ensuring stakeholders engagement, & building solid partnerships
- Formulation of adaptation measures with identified priority areas within the impact of Covid-19 pandemic (short and long terms ones)
- Use of innovative and improved agricultural technologies: affordable, adaptable to the region & improve crop & water productivity
- Investing in nature-based solutions: use of drought-resistant varieties, efficient water storage methods & practice crop rotation
- Adoption of innovative digital solutions
- Mobilizing resources for investment in agriculture value chains
- Improving data collection, reporting, and sharing
- Performing periodic risk assessments to evaluate short, medium & long-term decision-making
Thank you