The Next Nexus: Climate, Food & Agriculture, Water, Jobs, Migration; Challenges and Opportunities

CMI World Water Day; March 25, 2019; Marrakesh

Dorte Verner
Climate has shaped the cultures of countries

• Despite the harsh environment, the MENA region is the cradle of civilization:
  • Origin of many of the world’s food crops
  • Agriculture
  • Urbanization (rural -> urban = migration?)
  • …..

• Climate variability (CV) is not new, prolonged drought =>
  • Water shortage for crops and people; People left their homes to look for pasture (migrated).

  => Climate-Water-Food/Ag-Jobs-Migration nexus goes back far ~ 4000 years.

• With CC, **coping strategies** that people have exploited throughout history may no longer be adequate, therefore climate adaptation is needed.
-A 2 degree warmer world does not mean 2 degrees everywhere.

-Lower precipitation and higher temperatures will make most areas much drier.
In a Changing Climate, the Challenge is to Increase Climate Resilience

• CC, Enso, etc. are threats to poverty reduction & economic growth
  • May reverse the development gains made in recent decades.

• Current and projected CVC call for both mitigation and adaptation in order to reduce the negative impacts of CC and build climate resilience.
Climate change impacts are costly to economies

Cumulative GDP Losses Due to Climate Change, 2012-

Tunisia, Syria, Yemen
Climate change impact are costly to economies

Cumulative GDP Losses Due to Climate Change, 2012-

Tunisia  | Syria  | Yemen
---|---|---
\[0\] | \[0\] | \[-20\]

2020  | 2030
---|---
Climate change impact are costly to economies

Cumulative GDP Losses Due to Climate Change, 2012-

- Tunisia
- Syria
- Yemen

Cumulative GDP Loss

2020
2030
2050
CC impacts are also costly to Households & People

Source: Authors’ calculations based on a modeling suite, including downscaling of global climate models, crop modeling, global economic modeling, and subnational-level economic modeling.
Rural People are Migrating to Urban Areas and beyond, but Rural Poverty will remain substantial over the coming decades

- ~900 million global rural poor (78% of total poor)
- ~750 million global poor work in agriculture (63% of total poor)
- ~200 million rural poor could migrate to urban areas by 2030 (based on projected urbanization)
- ~700 million poor people remaining in rural areas to be lifted out of poverty by 2030.
CC reduces the availability of already overexploited Water Sources

• Supply: in 2050, the MENA region will likely face a 10% reduction in water run-off due to CC;
• Demand for water is likely to increase more than 60% by 2050
• Today: 16% renewable-water-supply gap; 2050: likely a 50% gap

=> This impacts food and agriculture.
CC challenges agriculture, rural livelihoods, and food security

• Climate models project that some areas suited for agriculture could be unable to produce by 2100
  - This will affect people and livelihoods
  - Contribute to migration.

• Stress on local food production systems requires increased imports
  • E.g. the Gulf countries are particular concerned about the production in Jordan, Lebanon, etc.
+ there is a need for Improving Nutritional Outcomes
CC affects Productivity - Feeding 9 Billion People in 2050

Food Production by Region
1972-2050
(Constant 2004-06 US$)

Food Demand By Commodities in 2050 relative to 2005-07
(Billion kg per year)

CEA 2013 based on FAO 2012
Land is also scarce and will become scarcer in 2050

Arable Land per person, 2010 & 2050

<table>
<thead>
<tr>
<th>Country</th>
<th>2010 ha/person</th>
<th>2050 ha/person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tunisia</td>
<td>0.50</td>
<td>0.30</td>
</tr>
<tr>
<td>Sudan</td>
<td>0.40</td>
<td>0.30</td>
</tr>
<tr>
<td>Turkey</td>
<td>0.50</td>
<td>0.30</td>
</tr>
<tr>
<td>Morocco</td>
<td>0.40</td>
<td>0.30</td>
</tr>
<tr>
<td>Libya</td>
<td>0.30</td>
<td>0.20</td>
</tr>
<tr>
<td>Iran</td>
<td>0.30</td>
<td>0.20</td>
</tr>
<tr>
<td>Algeria</td>
<td>0.40</td>
<td>0.30</td>
</tr>
<tr>
<td>Syria</td>
<td>0.20</td>
<td>0.10</td>
</tr>
<tr>
<td>Afghanistan</td>
<td>0.10</td>
<td>0.05</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Iraq</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Lebanon</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>UAE</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Egypt</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Oman</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Jordan</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Yemen</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Qatar</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Bahrain</td>
<td>0.05</td>
<td>0.05</td>
</tr>
<tr>
<td>Kuwait</td>
<td>0.05</td>
<td>0.05</td>
</tr>
</tbody>
</table>

2050 ha/person
2010 ha/person

Source: The World Bank
CC + other => migration => changes gender roles, e.g. in rural areas

-Male migration => stayers face increased work load (home-farm-community); empowerment of women?

-Women are stakeholders in adaptation & important agents of change.
High climate impacts where food demand is high

Most studies now project adverse impacts on crop yields due to climate change (3°C warmer world)

Percentage change in yields between present and 2050

-50% Change

Source: World Resources Institute

No data
Some Solutions/Opportunities
Food – incl. ag. - as the next growth engine in a changing climate

• Link with value chains, processing, agribusiness and food enterprises
  • The service sector is becoming a bigger contributor to growth
  • The global consumer food-service business – everything from cafes and fast-food chains to restaurants: $1.85 trillion business (source Euromonitor).

• Rural rain-fed areas can be part of this.
What and where are the Opportunities to Deliver?

**NORTH AMERICA & EUROPE**
- Biodigesters
- Fertilizer Mgmt
- Supply Chain Mgmt

**LATIN AMERICA**
- Livestock Efficiency
- Agroforestry
- Rice (AWD+)
- Pasture Mgmt
- Fertilizer Mgmt
- Zero Till

**AFRICA**
- Agroforestry
- Pasture Management
- Fertilizer Application

**ASIA**
- Rice (AWD+)
- Livestock Efficiency
- Biodigesters
- Fertilizer Mgmt
- Degraded Land Restoration

**Legend**
- **P** - Productivity
- **R** - Resilience
- **E** - Emissions
Allowing scarce land and water to be used to produce more jobs in the agricultural supply chain
Frontier Agriculture may be a solution to improve food security and livelihoods for ALL — including refugees

- **Frontier agriculture**: climate-smart and water-saving agriculture technologies
  - It requires no arable land and little water
  - “Climate in a box”
  - Some are portable systems.

- Create business-people and jobs.
Ponic systems for fast production of fruits, vegetables, animal feed, ....

• Hydroponics and aquaponics require much less water, no soil, and minimal use of land, including none-arable land.

• Alternative to produce nutritious food while increasing livelihoods in water/land constrained areas.

Source: ARIJ (2016).
Many Crops can be produced using hydroponics:

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Fruit</th>
<th>Herbs</th>
<th>Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leafy greens, radishes, celery, cucumbers, potatoes, yams, peppers, wheatgrass, onions, leeks, carrots, parsnips, squash, zucchini, corn, bok choy, kale, swiss chard, arugula, watercress, chives, broccoli, beans, squash, peas, cauliflower, cabbage, carrots, onions, radishes, beets, microgreens</td>
<td>Tomatoes, watermelon, cantaloupe, strawberries, blackberries, raspberries, blueberries, grapes, dwarf citrus trees (lemons, limes, oranges), dwarf pomegranate tree, bananas</td>
<td>Chives, oregano, mint, basil, sage, Rosemary</td>
<td>Rice, barley</td>
</tr>
</tbody>
</table>
### Types of *Ponic* Systems

<table>
<thead>
<tr>
<th>Simple &amp; Less Water Saving</th>
<th>Hydroponic Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wick Systems</strong></td>
<td>![Wick System Diagram]</td>
</tr>
<tr>
<td><strong>Deep Water Culture</strong></td>
<td>![Deep Water Culture Diagram]</td>
</tr>
<tr>
<td><strong>Ebb &amp; Flow</strong></td>
<td>![Ebb &amp; Flow Diagram]</td>
</tr>
<tr>
<td><strong>Drip Method</strong></td>
<td>![Drip Method Diagram]</td>
</tr>
<tr>
<td><strong>Nutrient Film Technique</strong></td>
<td>![Nutrient Film Technique Diagram]</td>
</tr>
</tbody>
</table>

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**Aquaponics**  
Advanced & More Water Saving

**Aeroponics**  
Advanced & More Water Saving
Examples of vertical farming approaches

Source: Authors’ compilation (left four images) and AeroFarms (right image).
Water usage & production, hydroponics vs. traditional soil-farming methods, m³/year

- Traditional Soil Method
  - Water Usage m²/year: 700
  - No. of Growing Seasons: 2
  - Production (kg/m²): 12

- Wicking Bed Technique
  - Water Usage m²/year: 118
  - No. of Growing Seasons: 4
  - Production (kg/m²): 37

- Nutrient Film Technique
  - Water Usage m²/year: 87
  - No. of Growing Seasons: 4
  - Production (kg/m²): 45

Source: ARIJ (2016).
# Decision Matrix for FA Water-Saving Technologies

<table>
<thead>
<tr>
<th>TECHNOLOGY</th>
<th>FOOD</th>
<th>WATER USE*</th>
<th>ENERGY USE</th>
<th>TECHNOLOGICAL COMPLEXITY</th>
<th>MAINTENANCE</th>
<th>START-UP COSTS</th>
<th>FINANCIALLY SELF-SUSTAINING</th>
<th>MOBILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>WICK SYSTEMS</td>
<td>CROPS</td>
<td>LOW</td>
<td>NONE</td>
<td>SIMPLE</td>
<td>HIGH</td>
<td>LOW</td>
<td>HIGH</td>
<td>LOW-HIGH</td>
</tr>
<tr>
<td>DEEP WATER CULTURE</td>
<td>CROPS</td>
<td>LOW</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>LOW</td>
<td>MED-HIGH</td>
<td>MEDIUM</td>
<td>LOW</td>
</tr>
<tr>
<td>EBB &amp; FLOW</td>
<td>CROPS</td>
<td>LOW</td>
<td>LOW-HIGH</td>
<td>COMPLEX</td>
<td>HIGH</td>
<td>MED-HIGH</td>
<td>LOW</td>
<td>LOW</td>
</tr>
<tr>
<td>DRIP METHOD</td>
<td>CROPS</td>
<td>LOW</td>
<td>HIGH</td>
<td>COMPLEX</td>
<td>LOW</td>
<td>MED-HIGH</td>
<td>LOW</td>
<td>LOW</td>
</tr>
<tr>
<td>NUTRIENT FILM TECHNIQUE</td>
<td>CROPS</td>
<td>LOW</td>
<td>HIGH</td>
<td>COMPLEX</td>
<td>MED-HIGH</td>
<td>HIGH</td>
<td>MEDIUM</td>
<td>LOW</td>
</tr>
<tr>
<td>AQUAPONICS</td>
<td>CROPS, FISH</td>
<td>LOW</td>
<td>LOW-HIGH**</td>
<td>COMPLEX</td>
<td>HIGH</td>
<td>MED-HIGH</td>
<td>LOW</td>
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Hydroponics and Refugees’ Livelihoods

Hydroponics & vertical farming

- Inputs & training
- Refugees' background & skills
- Host community capabilities

Nutritious food
- Jobs, Income & livelihoods
- Entrepreneurship
- Skills & knowledge
- Social Capital & Cohesion
Enabling Environment for Hydroponics?

• Basic inputs to hydroponics are available.
• Hydroponics, compared to traditional farming systems, provide high-cost savings on water, land, fossil fuels, and chemicals.
• Startup and operating costs depend on the type of system.
  • The more advanced and complex the system, the higher the startup and operating costs.
• Less waste and overall better resource management with hydroponics.
• System allows for more crop cycles in a year than traditional farming and more high-value crops in some areas.
• Example of Djibouti.
Thank You  Merci  شكرا
EMISSIONS

Agriculture: Today

LAND USE CHANGE
~11% OF TOTAL

TOTAL EMISSIONS

AGRICULTURE
~13% OF TOTAL

FOREST LAND
63%

CROPLAND
25%

BURNING BIOMASS
11%

SUSTAINABLE LAND USE
~11% OF TOTAL

LIVESTOCK
62%

FERTILIZATION
16%

RICE - 10%

OTHER - 12%

IPCC 2014
By 2050, Agriculture and Land Use Change could represent 70% of Global Emissions - if global emissions are reduced in accordance with a 2C goal, while Agriculture were to remain in business as usual.

By 2050, Agriculture will therefore have to reduce its emission intensity by 60%, if it is to maintain its footprint in parallel with overall emissions reductions. This already assumes emissions from Land Use Change will have fallen to zero.