Expected Impact of Climate Change on Population and Livelihood in Arid and Semi Arid Areas: Case Studies from Palestine

Palestinian Hydrology Group
Palestine
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Water Problem in Palestine

- Palestine is a semi-arid area with very limited water resources.

- Additional stress on water resources:
  - **Growth rate** is one of the highest worldwide; 3.06% in West Bank and 3.7% in Gaza while world average is 1.14%.
  - **Political conflict**; destruction or pollution of water resources in addition to limited accessibility.
  - Potential impact of **climate change** معرضين كباقي العالم للتاثر من التغير المناخي.
- **Period**: 65 years
- **Mean annual average rainfall**: 526 mm/yr
- **Mean annual average rainy days**: 60 days
- **Change in rainfall trend**: -22.4 mm (decrease)
- **Change in rainy days trend**: -10 days (decrease)

- **Period**: 41 years
- **Mean annual average temperature**: 24.3 °C
- **Change in temperature trend**: 2.3 °C (increase)
Period: 97 years
- Mean annual average rainfall = 522.7 mm/yr
- Mean annual average rainy days = 54 days
- Change in rainfall trend = 106 mm (increase)
- Change in rainy days trend = 30 days (increase)

Period: 34 years
- Mean annual average temperature = 21.4°C
- Change in temperature trend = 0.7°C (increase)
- Period: 75 years
- Mean annual average rainfall = 198.5 mm/yr
- Mean annual average rainy days = 35 days
- Change in rainfall trend = 28 mm (increase)
- Change in rainy days trend = 22 days (increase)

- Period: 30 years
- Mean annual average temperature = 25.6 °C
- Change in temperature trend = 0.2 °C (increase)
Temperature & Precipitation Trend Analysis تحليل التغير في درجات الحرارة وكميات تساقط الأمطار

Where:

- Refers to Temperature change in °C
- Refers to Precipitation change in mm
Vulnerability of Main Sectors to Climate Change

- Greater intensity and frequency of droughts will impact
- تكرار فصول الجفاف
- ترار اراضي المراحي
- rain-fed cropland زراعة بعلية

This can contribute to:
- water shortage نقص مياه
- land deterioration تدهور الاراضي
- biodiversity loss فقدان التنوع الحيوي
- desertification التصحر

<table>
<thead>
<tr>
<th>Sector</th>
<th>Vulnerability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>Very High</td>
</tr>
<tr>
<td>Water Resources</td>
<td>Moderate</td>
</tr>
<tr>
<td>Human Health</td>
<td></td>
</tr>
<tr>
<td>Land Degradation</td>
<td></td>
</tr>
<tr>
<td>Biodiversity</td>
<td></td>
</tr>
</tbody>
</table>

القطاعات الأكثر تعرضا للتأثير بالتغيير المناخي

- تكرار فصول الجفاف
- ترار اراضي المراحي
- water shortage نقص مياه
- land deterioration تدهور الاراضي
- biodiversity loss فقدان التنوع الحيوي
- desertification التصحر
### Water Supply & Demand in West Bank

<table>
<thead>
<tr>
<th>Year</th>
<th>Supply (MCM/year)</th>
<th>Demand (MCM/year)</th>
<th>Deficit (MCM/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Municipal</td>
<td>Industrial</td>
</tr>
<tr>
<td>2005</td>
<td>159</td>
<td>135</td>
<td>11</td>
</tr>
<tr>
<td>2010</td>
<td>159</td>
<td>156</td>
<td>25</td>
</tr>
<tr>
<td>2015</td>
<td>159</td>
<td>181</td>
<td>30</td>
</tr>
</tbody>
</table>

- Agriculture is the biggest consumer of water.
- Supply is assumed to be constant over the years.
- Water demand is estimated based on population growth.
Drought Phenomena ظاهرة الجفاف

- The frequency and duration of drought in the region is not fixed over time.

- The time between two occurrences of drought can be described as random variable.

![Graph showing frequency of occurrence of rain deficit years at Jerusalem Central Station.](image)
Case Study Areas

- Both areas are characterized by an arid and semi-arid nature.
- The area of case study 1 is mainly cultivated with irrigated agriculture (citrus, dates, and vegetables) and is a plain area that lies as low as 200 m below sea level.
- The area of case study 2 is hilly with steep slopes with elevations up to 800 m ASL. Most of the area in case study 2 is not cultivated and considered as range land used mainly for grazing while some parts are classified as nature reserves.
Jericho District Socio-economic profile

- 17% of HH income is used to purchase water
- 71% of population is less than 30 years
- 15% of population immigrate seasonally
- Unemployment lowest in WB at 9.1% (PCBS, 2008)
Impact on Crop Water Requirement based on temperature parameter

<table>
<thead>
<tr>
<th></th>
<th>T+1°C</th>
<th>T+2°C</th>
<th>T+3°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CWR change rate</td>
<td>2.7%</td>
<td>5.4%</td>
<td>8%</td>
</tr>
</tbody>
</table>
Impact on Crop Water Requirement based on precipitation parameter

<table>
<thead>
<tr>
<th>Change rate %</th>
<th>P-20%</th>
<th>P-10%</th>
<th>P</th>
<th>P+10%</th>
<th>P+ 20%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5.53</td>
<td>1.47</td>
<td>0.00</td>
<td>-1.44</td>
<td>-2.84.</td>
</tr>
</tbody>
</table>
Irrigation Water Demand Under Hypothetical Climate Change Scenarios

Deficits:

<table>
<thead>
<tr>
<th></th>
<th>T</th>
<th>T+1</th>
<th>T+2</th>
<th>T+3</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-20%</td>
<td>1.104</td>
<td>1.685</td>
<td>2.285</td>
<td>2.881</td>
</tr>
<tr>
<td>P-10%</td>
<td>0.294</td>
<td>0.877</td>
<td>1.469</td>
<td>2.065</td>
</tr>
<tr>
<td>P</td>
<td>0.00</td>
<td>0.581</td>
<td>1.172</td>
<td>1.763</td>
</tr>
<tr>
<td>P+10%</td>
<td>-0.286</td>
<td>0.291</td>
<td>0.880</td>
<td>1.470</td>
</tr>
<tr>
<td>P+20%</td>
<td>-0.566</td>
<td>0.010</td>
<td>0.596</td>
<td>1.181</td>
</tr>
</tbody>
</table>

As T & P decrease, IWR deficits increase

• Values are expressed in MCM/Year
Policy Recommendations: case study one

- Further efforts needed to **improve the predictions** of future irrigation water requirement for agriculture in Palestine; studies that consider the climate change impact on rain-fed and greenhouses agriculture and studies to cover the whole agricultural areas in Palestine. تحسين وتطوير ومراجعة طرق التنبؤ باحتياجات المياه للري والمروية

- Climate change should be addressed in **water resources management and planning**, for development of future water resources in Palestine, as one of the factors affecting water supply and demand. اخذ بعين الاعتبار التغير المناخي في إدارة مصادر المياه

- **Adaptation measure** should be considered to cope with climate change potential impacts on water demand and supply. وضع مؤشرات تكيف للتخفيف من الأثر على الحاجة والتزود بالمياه
Case Study 2: Socio-economic Profile

- Daily per capita income is <0.8$
- Poverty Rate is 22.5%
- Average family size is 8.6 and 76% is young
- Almost 74% of people rely on Livestock
- Population Growth is 3.3%
- Unemployment rate 24% (vs 15.6 in north)

- 40-50% of HH income goes for food
- 21% of HH income goes to purchase water
- Cultivated field crops are 66%, 25% and 9% barley, wheat and legumes respectively
- Unconnected to electrical, water or sanitation networks hence electrical generators, water tankers and cesspits and septic tanks.
Impact of the successive drought

- Deterioration and retrogression of rangeland productivity

[Graph showing the trend of range land sufficiency (month) from 1990-2000 with years 2009-2007 on the x-axis and range land sufficiency on the y-axis, indicating an increase in sufficiency over time.]
Range Land Deterioration
تدهور المراعي

- Lack of field crops seeds
- Extinction of some grass species
- Overgrazing
- More purchase of animal feed
Impact on livestock - main source of income

- Increased livestock mortality rate with 10% at least زيادة نسبة نفوق الماشية
- Decrease the quantities of the produced milk with 48% انخفاض انتاجية الحليب
- Delaying the breeding season for one month at least تأخر فترة الارضاع لشهر واحد على الاقل
- Increase the demand of the water consumption since there's the lack of the grasses and relying in the grains feedings زيادة استهلاك المياه للشرب بسبب اكل الاعلاف بدلاً العشب
- Reduction in the flock sizes – livestock sold to afford buying water tankers زيادة الاقبال على بيع الماشية لتغطية نفقات شراء المياه
Socio-economic impacts

- Outbreak of certain diseases- 32% live in concrete houses only, rest in tents or metal roof shelters. انتشار امراض ، 32 بالمئة يعيشون في بيوت من الباطون والباقي في خيام وبيوت صفيح
- Less water collected and Increased water costs أقل كمية مطر يتم جمعها و زيادة سعر المياه المشتراءه
- Internal Migration reaches 40% in some communities هجرة داخلية 40%
- Social instability عدم توفر استقرار اجتماعي ونفسي
- Reduction in percentage of population relying on raising livestock انخفاض نسبة المعتمدين على تربية الماشية
- Change in profession-shift from farming تغيير المهن
- Less expenditure on basics affecting household nutritional levels تغير انماط الصرف على المتطلبات الأساسية
Policy Recommendations

- It is important to re-assess the potential water resources (ground and surface) and consider the new change in the precipitation and temperature.

- Adopt more appropriate plans to eliminate internal migration from the vulnerable areas, invest in infrastructure, health and education services as well as WATSAN services.

- Develop an alternative plan for both irrigated agriculture as well as dry land farming. More drought resisting varieties, less water requiring crops, etc.

- Develop plans to regenerate the grazing areas and to maintain the current pattern of land use in those areas.

- Develop appropriate means to increase the water availability and accessibility to the vulnerable areas, mainly storage of surface water.
PWA in cooperation with NGOs and Civil society put effort on finding a strategy in order to mitigate impact of CC and they found matrixes include adaptation measures on different sectors, have been partially accomplished and still work need to be done particularly:

- Put a realistic plans
- Finding source of funds
- Fair and equitable agreement to control implementation of all proposed measures with out any political aggressive obstacles from the occupation side.
Thank you