Transboundary Master Plan for the Lower Jordan River Basin

International Conference on Sustainable Development in the Jordan Valley

November 10-12, 2014

Kempenski Hotel, Dead Sea, Jordan

Gilad Safier
**Agenda**

- **Structure of WEAP model**
  - Sea of Galilee
  - Supply & Demand
  - Jordanian Water System

- **Annual Flow**
  - Current Flow
  - Assumptions for Full Cooperation Scenario
  - Flow in 2050

- **Design**
  - Water Withdrawal from the LJR
  - Brine
  - Water balance

- **Monthly flow**
  - Winter/Spring
  - Summer/Autumn
Structure of WEAP model

- Spans from the Sea of Galilee to the Dead Sea
  - Incorporates all the tributaries and their basins
  - Yarmouk only downstream El Wahdah dam

- Timeframe:
  - Hydrological year starts at October 1\textsuperscript{st}
  - Monthly Resolution
  - Base year: 2010
  - End year: 2050
  - Results for average years

- Calculates:
  - Water flows (m\textsuperscript{3}/month)
  - Chlorides (mg/L)
The Sea of Galilee

Net Evaporation in mm

Dr. Alon Rimmer
## Water Sources & Demand

<table>
<thead>
<tr>
<th>Crop</th>
<th>Area (dunams)</th>
<th>Annual water use rate (m³/dunam)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bananas</td>
<td>6500</td>
<td>1800</td>
</tr>
<tr>
<td>Subtropical Trees</td>
<td>4080 (5100*0.8)</td>
<td>735 (1050*0.7)</td>
</tr>
<tr>
<td>Dates</td>
<td>2200</td>
<td>945 (1050*0.9)</td>
</tr>
</tbody>
</table>

### Water Demand (not including loss, reuse and DSM)

<table>
<thead>
<tr>
<th>Month</th>
<th>Water Demand (Million Cubic Meter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct 2009</td>
<td>3.5</td>
</tr>
<tr>
<td>Nov 2009</td>
<td>3.4</td>
</tr>
<tr>
<td>Dec 2009</td>
<td>3.3</td>
</tr>
<tr>
<td>Jan 2010</td>
<td>3.2</td>
</tr>
<tr>
<td>Feb 2010</td>
<td>3.1</td>
</tr>
<tr>
<td>Mar 2010</td>
<td>3.0</td>
</tr>
<tr>
<td>Apr 2010</td>
<td>2.9</td>
</tr>
<tr>
<td>May 2010</td>
<td>2.8</td>
</tr>
<tr>
<td>Jun 2010</td>
<td>2.7</td>
</tr>
<tr>
<td>Jul 2010</td>
<td>2.6</td>
</tr>
<tr>
<td>Aug 2010</td>
<td>2.5</td>
</tr>
<tr>
<td>Sep 2010</td>
<td>2.4</td>
</tr>
</tbody>
</table>

### E. Hayarden Agri

### E. Hyarden

### Water Sources & Demand

Oct 2009 to Sep 2010 graph showing the trend of water demand.
Kingdom of Jordan

- KAC as the backbone of the Jordanian system
  - All surface water flows into the KAC
  - Most of the demand is taken from the KAC
- 4 demand zones along the KAC, with each zone:
  - 1 municipal consumer
  - 1 agricultural consumer with 4 branches:
    - Vegetables open field
    - Vegetables green houses
    - Fruit trees
    - Field crops
- Water from the KTD enters the system between demand zone 2 and 3
LJR starts at Alumot, at the discharge point of the SWC
(Today 9 MCM flows from the Sea of Galilee)

Flows are as follows:

- SWC inflow ~ 20 MCM, 2300 mg/l
- Upstream Harod ~ 55 MCM, 1250 mg/l
- Bezeq inflow ~ 80 MCM, 1450 mg/l
- Zarqa inflow ~ 90 MCM, 2050 mg/l
- Qaser El Yahood ~ 100 MCM, 2550 mg/l
- To Dead Sea ~ 110 MCM, 2900 mg/l
Full Cooperation Scenario

Assumptions & Projections

- Target year - 2050
- Water consumption will rely on:
  - natural resources from within the basin
  - Treated wastewater produced in the Jordan Valley
  - Treated wastewater produced in the basin, but outside the Jordan Valley
- Water from Syria or outside sources are not shown in the following calculations
- Climate change:
  - Natural sources decrease by 20%
  - Evaporation increases by 8%
- Demand increases as presented by Jeroen Kool
- All pollution from the LJR will be removed
- The LJR will become the major water conveyor from north to south
- 300MCM/Yr should flow to the Dead Sea
Full Cooperation Scenario

Annual Flow

- 237 MCM are discharged from the Sea of Galilee
- Additional 34 MCM from Yarmouk
  - LJR flow, 270 MCM, 270 mg/l
  - KAC is cancelled in the north
  - Jordan releases all tributaries (altogether 70 MCM/Yr)
- 1st major pumping St., upstream Harod
  - Maximal flow point in LJR, 283 MCM, 300 mg/l
  - KAC becomes a carrier of potable quality
  - 30 MCM is used as drinking water
- 2nd major pumping St., Upstream W. Fara
  - LJR flow, 205 MCM, 530 mg/l
  - Jordanian irrigation of 295 MCM/Yr:
    - 40 MCM, Locally produced WW
    - 60 MCM, WW from Amman
    - 120 MCM from LJ
    - 75 MCM from KTD (30 are released to the LJ)
- 3rd major pumping, downstream Q. El Yahood
  - LJR flow, 188 MCM, 1100 mg/l
  - 50 MCM for Palestinian date plantations

Salinity (mg/l Cl)
- 0-400
- 400-600
- 600-750
- 750-1500
- >1500

Tributaries

Annual flow (MCM)
- 1

Dates irrigation

50 MCM

Annual flow 2050 FCS

100 MCM potable

50 MCM fresh irrigation

50 MCM

Dates irrigation
Full Cooperation Scenario

Annual Flow

- Brine discharge point at confluence with W. Qelt,
  - 35 MCM from Western Brine Carrier, collecting water from the SWC and Fishponds effluents in Israel
  - 5 MCM of brine from Abu Zeighan

- 40 MCM of Palestinian drinking water will be supplied from the eastern Mt. Aquifer

- Palestinian irrigation supply of 80 MCM/Yr:
  - 32 MCM, locally produced WW.
  - 50 MCM, WW from upper towns in the west bank.
  - 7 MCM from eastern Mt. Aquifer
  - LJR as backup
  - Supported by a network of reservoirs, based on the Tirza reservoir system (9 MCM are lost in the system)

- 200 MCM/Yr flow into the Dead Sea
Full Cooperation Scenario

Annual Flow

- 35 MCM from Western Brine Carrier, collecting water from the SWC and Fishponds effluents in Israel
- 5 MCM of brine from Abu Zeighan
- 40 MCM of Palestinian drinking water will be supplied from the eastern Aquifer
- Palestinian irrigation supply of 72 MCM/Yr:
  - 32 MCM, locally produced WW.
  - 50 MCM, WW from upper towns in the west bank.
- Supported by a network of reservoirs, based on the Tirza reservoir system (10 MCM are lost in the system)

Annual Flow

Current Accounts

Salinity (mg/l Cl)

- 0-400
- 400-600
- 600-750
- 750-1500
- >1500

Tributaries

Annual flow (MCM)

- 1

2050 FCS

Tirza Res.

Salinity (mg/l Cl)

- 0-400
- 400-600
- 600-750
- 750-1500
- >1500

Tributaries

Annual flow (MCM)

- 1
Conclusions

 The proposed plan will greatly improve the ecological and hydrological condition of the Lower Jordan River, while providing a reliable water supply to consumers in the basin.

 Goal of 300 MCM/Yr flowing to the Dead Sea can be met with additional 100 MCM/Yr from an external source.

 The extra water will also facilitate:
   Adequate discharge and water quality in the summer/Autumn.
   Allow for smaller reservoirs to be built thus saving capital investments and water losses to evaporation.