Egypt’s efforts to modernize the management of irrigation system

Ministry of water resources and Irrigation Planning Sector

Emad Mahmoud
Irrigation and Drainage System In Egypt
• Egypt is classified as a hyper-arid country, suffers from physical water scarcity. The fresh water stress indicator reaches 104% in 2021 (which means fresh water resources is over exploited).

• A fixed 55.5 billion m³/year represents 97% of the country's total renewable water resources (Egypt’s share from the Nile water), the remaining 3% being minor quantities of renewable groundwater plus a few showers of rainfall.

• Egypt's total cultivated land is about 3.6 million ha. included old and newly reclaimed areas.
Egypt’s main challenge is to close the rapidly growing gap between the available water resources and the increasing demand.

- Impact of Upper Nile Developments in absence of cooperation.
- Impacts of climate change
- Water quality issues
Egypt has developed its strategy for water resources management until 2050 and the National Water Resources Plan until year 2037 titled “Water Security for All” to support socio-economic development in Egypt and to face the water scarcity.

- **Enhance Water Quality**
  - Treatment Plants
  - Sewage coverage
  - Industrial Waste

- **Rationalize Water Use**
  - Canal Rehabilitation
  - Modern Irrigation
  - Smart irrigation and digital farming

- **Develop Water Resources**
  - Desalination
  - Sustainable Use of GW
  - Rainfall harvesting

- **Create Enabling Environment**
  - Awareness
  - Capacity Building
  - Enhance cooperation
Egypt’s Available Water Resources

Water resources: 81.43 BCM

Conventional water resources: 58.9 BCM
- The Nile River: 55.5 BCM
- Precipitation: 1.3 BCM
- Deep Groundwater: 2.1 BCM

Non-Conventional water resources: 22.53 BCM
- Agr. drainage water + Shallow G.W: 15.78 BCM
- Treated wastewater: 6.4 BCM
- Desalination water: 0.35 BCM

* MWRI 2021
Water Usages
Mega project of Drainage water reuse

El-Dabaa treatment plant
With a capacity of 7 million m$^3$/day
With an area of 362 thousand Feddan

El-Hamam project (south of Dabaa)
With a quantity of 7.5 million m$^3$ / day
With an area of 362 thousand Feddan

New Delta & Mostaqlbal Maser & El-Moghra project
With a quantity of 10 million m$^3$ / day
An area of 1,358 million Feddan

Central and North Sinai Development Project
With a quantity of 7,000 million m$^3$ / day
With an area of 456 thousand Feddan

El Mahsama project
With a quantity of 1 million m$^3$/day
An area of 50 thousand Feddan

West Minya and west West Minya
With a total of 620 Feddan

Toshka project
7,000 m$^3$/Feddan/year
An area of 720 thousand Feddan

National projects
Rationalize the use of irrigated water

Increase the productivity

Decrease of fertilizers

Decrease the cost of production

Benefits from Farm Level Irrigation Modernization

• Stated increases in yields ranged from 20-30%
• Increases in income ranged from 10-20%
• Reductions in labour costs ranged from 30-40%
• Reductions in fertiliser costs ranged from 30-40%
• Reductions in energy costs ranged from 10-20%
Hydraulic Modeling for post rehabilitated canals

Post-rehabilitation Conditions
Design Flow = 9.6 m³/s

Post-rehabilitation Conditions
Moderate Flow = 4.3 m³/s

Can we use wedge storage?

- Storage upstream of ElMedwashar Regulator = 70,000 m³
- Time to fill storage ~ 2 hr at supply Q=9.6 m³/s and no withdrawal ... (actual filling time is longer)
Risk Map

HIGH RISK  MEDIUM RISK  LOW RISK
Shore protection Works
Water Accounting

• The MWRI decided to establish and implement a Water Accounting Unit (WAU) within the Planning Sector to create an independent, and scientifically sound water accounting system that serves Egypt’s need, which helps improve water management, allocates water between sectors and users, boost agricultural yields and water productivity in all sectors.

• Water accounting is a systematic quantitative assessment of the trends and status in water supply, demand, allocation and uses, for certain domain producing information. Accurate water accounting is vital for understanding hydrological process, managing water flows, and future planning.
Nile Delta - Crop maps 2020-2021

- Summer Crops: 1,921,143 ha
- Winter Corps: 1,964,525 ha
- Orchards: 445,781 ha
## Water Consumed per crop

<table>
<thead>
<tr>
<th>Crop</th>
<th>Area (ha)</th>
<th>Water consumed (mm/ season)</th>
<th>Water consumed (Mm³/ season)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>269,846</td>
<td>667</td>
<td>1,800</td>
</tr>
<tr>
<td>Rice</td>
<td>568,816</td>
<td>1200</td>
<td>4,271</td>
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<tr>
<td>Summer vegetables</td>
<td>366,944</td>
<td>513</td>
<td>1,885</td>
</tr>
<tr>
<td>Cotton</td>
<td>79,771</td>
<td>656</td>
<td>523</td>
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<tr>
<td>Summer Other Crops</td>
<td>635,765</td>
<td>562</td>
<td>3,575</td>
</tr>
<tr>
<td>Total summer</td>
<td>1,921,142</td>
<td></td>
<td>12,054</td>
</tr>
<tr>
<td>Wheat</td>
<td>831,232</td>
<td>598</td>
<td>4,964</td>
</tr>
<tr>
<td>Clover</td>
<td>427,943</td>
<td>588</td>
<td>2,516</td>
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<tr>
<td>Winter vegetables</td>
<td>500,962</td>
<td>370</td>
<td>1,856</td>
</tr>
<tr>
<td>Winter Other Crops</td>
<td>205,387</td>
<td>554</td>
<td>1,138</td>
</tr>
<tr>
<td>Total winter</td>
<td>1,965,524</td>
<td></td>
<td>10,474</td>
</tr>
<tr>
<td>Orchards</td>
<td>445,781</td>
<td>896</td>
<td>3,996</td>
</tr>
</tbody>
</table>
Water allocation
Actual Evapotranspiration

Delta
Asuit
Naga Hamadi
Asana
Aswan
Performance indicators for the consumptive use sheet provide key information on the magnitude of beneficial use of water depletion in a basin. Water used by key water users in a basin is expressed in terms of fractions. Transpiration fraction is the part of ET that is transpired by plants and it reflects an impact on bio-physical process in water scarce basins. 

\[ \text{Transpiration fraction} = \frac{T}{ET} \]
Monitor

Monitor all soil and climate parameters using sensors to measure:

- Climate humidity and temperature.
- Soil (Moisture, Temperature, EC, PH, TDS, NPK).

Control

Connecting FARM ACTUATORS like:
- PUMP
- Control Valves

We can take immediate action by just one click.

Analysis

The system stores sensors data on the local storage and make profile for soil parameters change over time which give the farmer:

- better understanding and clear view for crop behavior in short and long term.
- can precisely calculate his running cost (power, water and fertilizers consumption).
System Components

- Sensors Node & Valves control
- Soil Sensor
- System Gateway & pump control

Images showing various components of the system.
Effective Efficiency: A Water Use Efficiency Concept for Allocating Freshwater Resources

Andrew A. Keller and Jack Keller

Egypt’s Nile Valley irrigation system (NVIS) is an excellent example of a multiple use-cycle system with a high global efficiency but low local efficiencies. Egypt is interested in expanding the area irrigated by Nile River waters without reducing the high productivity of the present irrigated areas. To accomplish this will require an aggressive conservation program. However, directing conservation efforts toward areas where multiple use-cycles are possible, and thus $E_e$ is already quite high, will result in little real water savings.

Our estimate for the classical irrigation efficiency for the NVIS is $E_i = 41.2\%$. Thus there might appear to be considerable opportunity for conserving water by reducing water losses in the NVIS. Actually, however, the potential water savings are small because the effective irrigation efficiency for the NVIS (based on the cropland $U_{ci}$ and effective use, $U_e$, values) is $E_e = 91.3\%$. 
Thank you