Technology transfer for water resources management

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SKIM Project
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THE MEDITERRANEAN BASIN
Population of the Mediterranean (North, South and East)

Source: data extracted from the United Nations, 2017
Demographic trends alone suggest that water recycling could become a critical component of water supply globally in the 21st century.
YEARNING AVERAGE RAINFALL

mm/year

- 0 - 50
- 51 - 150
- 151 - 300
- 301 - 450
- 451 - 600
- 601 - 750
- 751 - 900
- 901 - 1,200
- 1,201 - 1,500
- 1,501 - 1,820
DISTRIBUTION OF WATER RESOURCES IN THE MEDITERRANEAN REGION

- 66% in Europe
- 24% in North Africa
- 10% in the Middle East

Map showing distribution in countries like Italy, France, Spain, Turkey, Morocco, Algeria, Libya, and Egypt.
Variation of annual average precipitation in the next sixty years (A2 scenario)
THE CHALLENGE

DEMAND

SUPPLY

Nicola Lamaddalena, Deputy Director – CIHEAM Bari
Freshwater resources: current (2015) and predicted (2050) water withdrawal (km³)

- **Latin America and the Caribbean**: 13,570 km³
  - Renewable water resources: 13,200 km³
  - Water withdrawal, 2015: 265 km³
  - Water withdrawal, 2050: 371 km³

- **East and Southeast Asia**: 9,083 km³
  - Renewable water resources: 9,052 km³
  - Water withdrawal, 2015: 1,052 km³
  - Water withdrawal, 2050: 1,301 km³

- **Sub-Saharan Africa**: 3,884 km³
  - Renewable water resources: 3,723 km³
  - Water withdrawal, 2015: 121 km³
  - Water withdrawal, 2050: 161 km³

- **South Asia**: 1,947 km³
  - Renewable water resources: 1,947 km³
  - Water withdrawal, 2015: 1,034 km³
  - Water withdrawal, 2050: 1,397 km³

- **Middle East and North Africa**: 403 km³
  - Renewable water resources: 403 km³
  - Water withdrawal, 2015: 298 km³
  - Water withdrawal, 2050: 263 km³
Water Withdrawals by sector

Source: data extracted from Aquastat database. FAO, 2016
In the past years the policy choices privileged the big hydraulic infrastructures in irrigation giving priorities to the quantitative aspect rather than the qualitative (Supply Management).
ATATÜRK DAM – Completed in 1990
## CALIBRATED NOZZLE FOR EGYPT

<table>
<thead>
<tr>
<th>Pressure (Bars)</th>
<th>Discharge (L/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15</td>
<td>0.75</td>
</tr>
<tr>
<td>0.2</td>
<td>0.8</td>
</tr>
<tr>
<td>0.4</td>
<td>0.84</td>
</tr>
<tr>
<td>0.5</td>
<td>0.89</td>
</tr>
</tbody>
</table>
HIGHER DISTRIBUTION UNIFORMITY WITH LESS WATER VOLUME
MOROCCO
Configuration Analysis

Discharges (l/s) vs. Piezometric Elevation (m a.s.l.). The graph shows the relationship between discharges and elevation, with specific points marked at 90%, 93%, and 10%. The SET POINT is indicated on the graph.
The current policy choices highlighted the importance of Operation, Maintenance and Management activities (DEMAND MANAGEMENT)

- **TECHNICAL APPROACHES** (improving WUE at the whole chain of the system, use of unconventional waters, use of new technologies, ....)

- **INSTITUTIONAL APPROACHES** (PIM, Capacity Development,....)
TECHNICAL APPROACHES
WATER LOSSES IN IRRIGATION IN THE MEDITERRANEAN BASIN (%)

- Losses in the Distribution and Conveyance System: 15%
- Losses in the On-Farm System: 25%
- Application Losses at Farm Level: 15%
- Water Used by the Crops: 45%

Source: FAO, 1994
Storage Efficiency

\[
\frac{W_{\text{reservoir out}}}{W_{\text{reservoir in}}} \times \frac{W_{\text{farm gate}}}{W_{\text{reservoir out}}} \times \frac{W_{\text{field}}}{W_{\text{farm gate}}} \times \frac{W_{\text{root zone}}}{W_{\text{field}}} = \frac{W_{\text{root zone}}}{W_{\text{reservoir in}}}
\]
TO PREFER THE ON DEMAND DELIVERY SCHEDULE RATHER THAN THE ROTATION
SOIL-WATER BALANCE

Diagram showing the balance between field capacity (FC), the upper limit of the soil's water retention, and the lower limit, which is often referred to as the permanent wilting point (WP). The diagram illustrates how water levels fluctuate within the soil profile, indicating the importance of managing water availability for optimal plant growth.
Simulated soil-water balance for TABLE GRAPES according to the rotational delivery schedule conducted by the Water Users Association.
Simulated soil-water balance for Table grapes according to the on-demand delivery schedule

369 mm
IRRIGATION EFFICIENCY
TECHNIQUES
Reservoir

Distribution Network

On-Farm Network

Crops

Soil

ETc

R

W_{out}/W_{in}

RO

DP
Pressure Deficit:

Q = 1200 l/s
Pressure Deficit:

\[ Q = 700 \text{ l/s} \]
H = 23 m  
CU = 63%  
DU = 67%  
DE$_{90}$ = 62%  
dn$_{90}$ = 3mm/h

H = 48 m  
CU = 74%  
DU = 80%  
DE$_{90}$ = 80%  
dn$_{90}$ = 4.5mm/h
CAS 1:

\[ E_{G,1} = 0.95 \times 0.60 = 0.57 \]

CAS 2:

\[ E_{G,2} = 0.95 \times 0.80 = 0.76 \]

\[ \Delta E = (0.76 - 0.57)/0.57 = 0.33 = 33\% \]
ISTITUZIONAL APPROACH
PARTICIPATORY IRRIGATION MANAGEMENT (PIM)

• Involvement of irrigation users in all aspects and at all levels of irrigation management.

• Transfer of irrigation systems from public organizations (Gov’ts) to WUAs.
CONSORZIO DI BONIFICA OF CAPITANATA (Italy)

FARMERS ASSOCIATIONS

UNIONE AGRICOLTORI
(large farms)
(Farmers)

COLTIVATORI DIRETTI
(small farms)
(farmers who cultivate their own land)

CONFEDER. AGRICOLTORI
(small farms)
(farmers who cultivate their own land)

ELECTION OF THE GOVERNING BOARD
(79 600 land owners)
BOARD OF DELEGATES

90 PEOPLE (Direct election)

18 PEOPLE (Representative of Communes and Region)

SELECTION

1 PRESIDENT
2 Vice-PRESIDENT
COMMISSIONS (1 President)
ADMINISTRATIVE DEPUTATION

BUDGET  IRRIGATION  MAINTENANCE  PERSONNEL  ..........
GENERAL DIRECTOR

DIRECTOR OF AGRICULTURAL SERVICE
- WATERSHED MANAGEMENT
- EXTENSION SERVICE
- IRRIGATION

DIRECTOR OF ENGINEERING SERVICE
- BIG WORKS
  - Design
  - Supervision
  - Maintenance

DIRECTOR OF ADMINISTRATION
- LEGAL SESSION
- PERSONNEL
- ESPROPRIATIONS
- CONTRACTS

PERIFERICAL OFFICE (1 each 10 000 - 15 000 ha)
- 1 Head + 1 Assigned at the office job + 3 Workers (in charge for repairing)
- 2-3 Groups of 2 Workers (in charge for controlling and maintenance)
- 1 pick-up for each group of workers
- 1 Truck
- 1 Excavator
TARIFF RULES

BUDGET

COST OF MAINTENANCE (on the base of the previous Year Budget)

FIXED RATE (€/ha)

Cost of maintenance Irrigable Area = 15.5 €/ha

OTHER COSTS (on the base of the previous Year Budget)

VARIABLE RATE (€/m³)

Other Costs Available Water Volume = Contribution - P (€/m³)

Available water volume Irrigable Area = 2000 m³/ha

WATER AVAILABILITY

0.09 €/m³ 0 - 2000 m³/ha

0.18 €/m³ 2000 - 3000 "

0.24 €/m³ > 3000 "

VARIABLE RATE (€/m³)
IMPORTANCE OF THE TRAINING:
FROM THE CLASSROOM TO THE FIELD
WASTE OF FOOD
=
WASTE OF WATER.....
1. Population Growth

Basic Water Needs

\[(\text{Liters d}^{-1} \text{ p}^{-1})\]

- Drinking: 2-4
- Domestic: 40-400
- Food: 1000-5000

On average, 1 Kcal per liter
## 4. Diet

<table>
<thead>
<tr>
<th>Product</th>
<th>(liters per Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef meet</td>
<td>15000</td>
</tr>
<tr>
<td>Sheep meet</td>
<td>10000</td>
</tr>
<tr>
<td>Pork meet</td>
<td>6000</td>
</tr>
<tr>
<td>Chicken meet</td>
<td>2800</td>
</tr>
<tr>
<td>Eggs</td>
<td>4700</td>
</tr>
<tr>
<td>Cheese</td>
<td>5300</td>
</tr>
<tr>
<td>Milk</td>
<td>900</td>
</tr>
<tr>
<td>Cereals</td>
<td>1500</td>
</tr>
<tr>
<td>Fruit</td>
<td>1000</td>
</tr>
<tr>
<td>Legumes</td>
<td>1000</td>
</tr>
</tbody>
</table>
THE EXAMPLE OF THE APULIA REGION

Population : 4.000.000 ab
Surface : 20.000 Km2
Calories requirement: 2000 kcal/ab/d
Media: 1 kcal = 1 litro acqua (stima FAO, 2010)

In the world an average of 30% of food is wasted. Therefore, in terms of (virtual) water, in Puglia the waste is (on average):

2000 l/ab/d x 0.30 = 600 l/ab/d
600 x 4.000.000 : 1000 = 2.400.000 m3/d
2.400.000 x 365 = 876.000.000 m3/anno
EQUAL TO THE ENTIRE IRRIGATION REQUIREMENT OF CROPS IN APULIA !!
THANK YOU