
# Water resources management in the island of Crete: present situation, problems and perspectives

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# Introduction

- The area of Crete: 8335 $km^2$
- Total population: about 600,000 people
- Climate: sub-humid Mediterranean, with humid and relatively cold winters and dry and warm summers
- Average annual precipitation: about 927 mm
- Total water used 410 $Mm^3/yr$
- The major water use (85.2%) is for irrigation in agriculture, 12.7% for domestic use (including tourism industry) and 2.1% for industrial use
- The main issue in water resources management on the island is focused on the uneven geographical and seasonal distribution of water resources in relation to the water demand hotspots.

# Hydrological balance

- Water resources management: key issue in the island of Crete mainly due to – the spatial and temporal variation of the rainfall events
  – the intense water uses (tourism, farming)
- Cultivated land has not increased significantly during the past 50 years but the irrigated land during that period has been doubled ⇒ the water requirements for agriculture have been doubled

Table 1: Estimated Hydrological balance of Crete (in $Mm^3$)

| Hydrologic conditions | Precipitation | Actual Evapotr/tion | Runoff | Groundwater recharge |
|---|---|---|---|---|
| Normal year | 7690 | 4830 (62.8%) | 740 (9.6%) | 2120 (27.6%) |
| Wet year | 10330 | 6480 (62.8%) | 990 (9.6%) | 2850 (27.6%) |
| Dry year | 5070 | 3180 (62.8%) | 490 (9.6%) | 1400 (27.6%) |

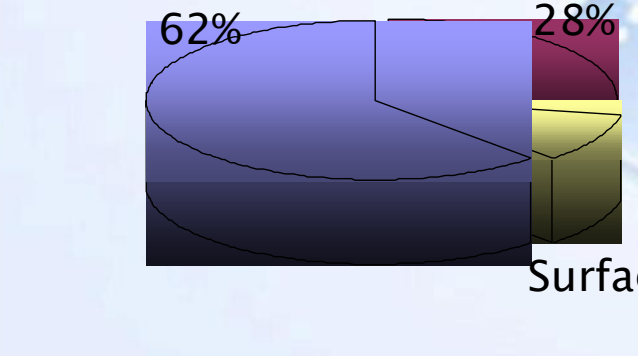
# Water resources in Crete

- Total available water resources in Crete: 2860 $Mm^3$

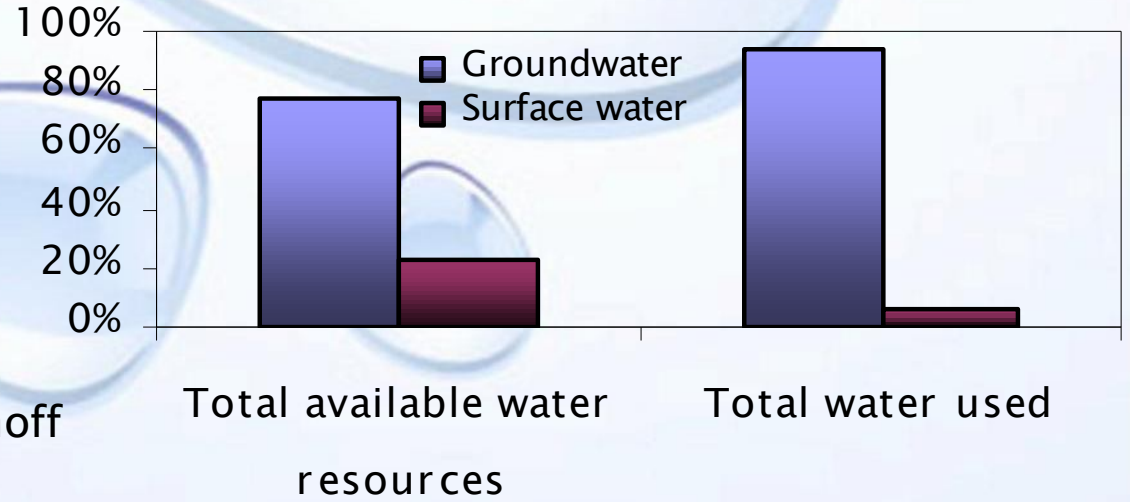
2232 $Mm^3$ (78 %) come from groundwater resources

628 $Mm^3$ (22 %) come from surface water

- Total exploitable water resources: 857 $Mm^3$,
- The water supply (410 $Mm^3$) does not fully cover the demand (536 $Mm^3$)




Hydrological balance of Crete




Available and used water resources

# Water in agriculture

- **Agriculture:**
  - important sector of the local economy
  - contributes 13% to the GDP
  - occupies around 6.7% of the active island employees
- **Main crops**: olives (85 % of the total tree crops), citrus, grapevines, vegetables and avocados
- **Irrigation networks**: modern type made of pressurized distribution systems with delivery of water to the farm outlets. Are constructed by:
  - the government ⇨ large irrigation schemes
  - the local authorities ⇨ medium scale local network
  - private individuals ⇨ small scale local networks
- **Irrigation methods used:**
  - drip irrigation (vegetables, vine-yards, tree crops),
  - sprinkler (forage crops and vegetables)

# Irrigated crops

❖ **Irrigation scheduling:**

For vegetables: empirically or using tensiometers (greenhouses)
For tree crops: Empirically or based on meteorological parameters (mainly Class A pan) or on advisory systems

❖ **Irrigated area in Crete:**

- ◈ 42.3% of the available agricultural land
- ◈ increased more than 55% in the last 15 years

Water demand and deficit in Crete (RGC,2002).

| Water use | Estimated demands ($Mm^3$) | Consumption ($Mm^3$) | Deficit ($Mm^3$) | Cover percentage |
|---|---|---|---|---|
| Irrigation | 458.37 * | 302.06 | 156.31 | 65.9% |
| Domestic & other uses | 77.34 | 69.75 | 7.59 | 90.2% |
| Total | 535.71 | 371.81 | 163.90 | 72.2% |


# Agricultural water management

Bodies involved in agricultural water management:

- The Local Farmers Irrigation Organizations (TOEBs) and individual farmers that own small water supplies (springs, wells, etc). They manage irrigation water only.
- Municipalities provide and manage water for a variety of uses (drinking water, tourism, agriculture).
- Other semi-governmental entities, like OADYK in western Crete, which is responsible for the supply of water to a variety of organizations for numerous water uses.
- The Prefectures that play an advisory/supervisory role and are also involved in decision making
- The Region of Crete, which is involved in decision making and suggestion of solutions or better management from a large scale perspective

# Water pricing

## Agricultural use:

- The price of irrigation water varies greatly among areas in the island or even among catchments due to different pricing structure, policies and managing organization.

  In Chania Prefecture the price of irrigation water is 0,07–0,12 €/$m^3$ in networks operated by TOEB, 0,10–0,17 €/m3 operated by OADYK, 0,15 – 0,22 €/$m^3$ operated by Municipalities, whereas in some private projects it reaches 0.30–0.35 €/$m^3$.
- Irrigation water tariffs must cover the O&M cost of water use and services
- volumetric water metering is obligatory
- an increasing block tariff charging system, for those exceeding crops' critical water requirements, must be established

## Municipalities

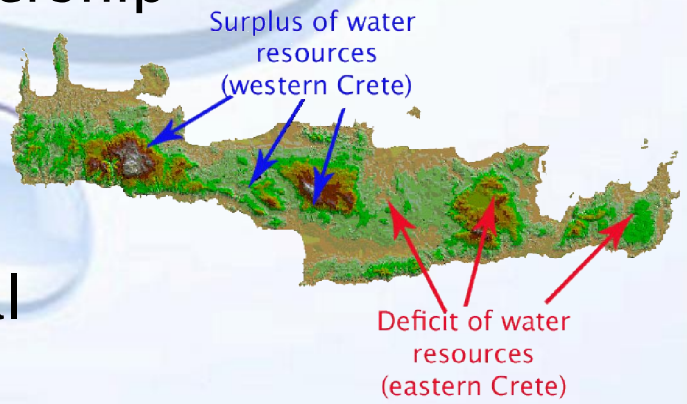
- Price is variable according to use (drinking supply, tourism, agriculture) and the area (0.15 – 1.5 €/$m^3$)
- Prices scaling up relatively to consumption

# Pressures in water management

Water availability in average terms is not the limiting factor. Much more important are the significant regional and seasonal variations in water availability and demand (Fig 4).

## Pressures in water management:

- Water use conflicts (when different uses served, mainly in coastal areas where tourist industry is prevailing)
- Water distribution from one region to another due to misconception on water resources ownership
- Human impact on water resources
  - ⇒ Quantity: overexploitation of groundwater resources
  - ⇒ Quality: sea water intrusion in coastal aquifers and pollution events (fertilizers, pesticides, effluents)



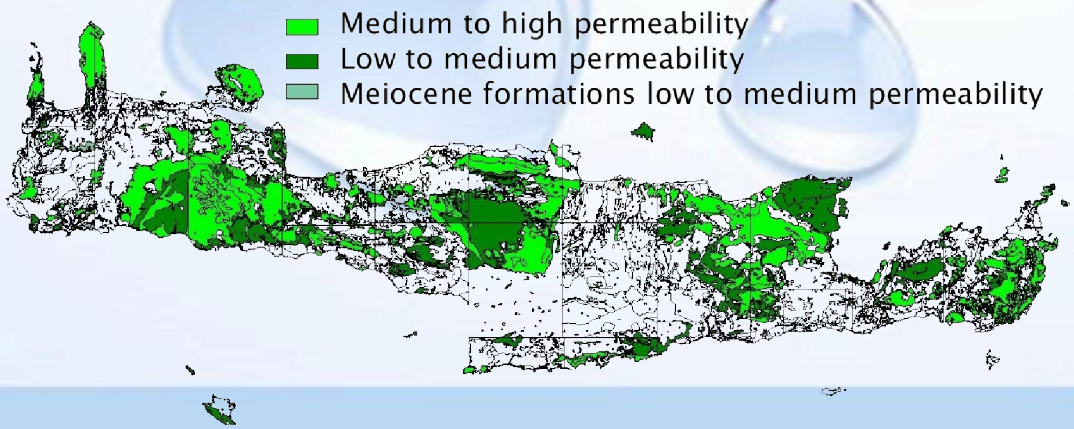

Pressure in water management


# Problems in water management

- Institutional and administrative problems:
  - too many organizations involved in water resources management at a prefecture and river basin level
  - coordinative and competence problems are generated over the management of the same water resources
  - different stakeholders manage different uses and the priorities in use are not maintained
- Infrastructure problems:
  - need for funds from EU and government for projects of unexploited resources
- Legal problems:
  - the implementation of the Groundwater Framework Directive 2000/60 was voted in the Greek Parliament in December 2003 (N. 3199/2003). However, there is a delay in the implementation
  - full cost recovery is still an issue.

# Key actions for water management in Crete

- ✓ Exploitation of Un(der) Exploited Aquifers such as Karstic Aquifers
- ✓ Improved Freshwater Storage and Transport. GW Recharge promotion
- ✓ Pollution Control of surface and ground water. Water Quality Monitoring.
- ✓ Policy against overexploitation.
- ✓ Protection of Coastal Aquifers.
- ✓ Utilization of Untapped Surface Water Sources. Inter-basin Transfer.




Karstic aquifers of Crete.


# Key actions for water management in Crete

- ✓ Demand Reduction: Agricultural, Industrial and Domestic.
- ✓ Water Management Plan / System. Water Resources Inventory. Groundwater bodies definition (WFD).
- ✓ The evaluation of different development scenarios
- ✓ The determination of optimal measures / projects in conditions of extreme events (droughts of floods)
- ✓ The capability of dynamic water resources management in short time steps (e.g. 1 month) and the optimal use of water resources
- ✓ The optimal planning development and water projects
- ✓ Reuse of treated effluent water for irrigation


# THANK YOU