3rd Project Meeting, 30/10-1/11/2012
Chania, Crete, Creece

ΓΔ Εκπαίδευση και πολιτισμός
Πρόγραμμα δια βίου μάθησης GRUNDTVIG

SUSTAINABLE WATER MANAGEMENT IN AGRICULTURE

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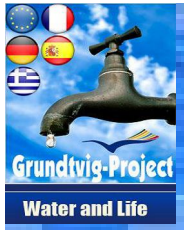

Role of IOTSP in 'Water and Life'

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- The Institute of Olive Tree and Subtropical Plants in cooperation with Local Water Boards in rural areas organize courses and lectures in order to increase farmers awareness for water saving.
- More specifically the role of the NAGREF-Institute for Olive Tree and Subtropical Plants in this project is:
- to suggest several methods and practices for water saving in agricultural sector
- to teach the farmers to use the innovative, water saving irrigation systems
- to produce informative material (leaflets, etc) for rational use of water
- report on water availability, crop needs and irrigation

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Water management in Greece

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- Greece is considered as a rich country in water resources, with mean annual rainfall of 700 mm, which corresponds to 115 billion m^3.
- 50% are lost due to evapotranspiration process, 30% (35 billion m^3) due to surface runoff (reaching the sea) and only 20% goes for aquifer recharge.

- The uneven distribution of rainfall (900 mm in Epirus and N. Greece and 400 in Athens and Naxos),
- The extreme weather events
- The man-induced interventions

result in water shortage phenomena occurred in specific areas of the country. However, the ratio between the total water consumption and available water resources is estimated around of 12%, which is slightly higher than the average of OECD countries.

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Water resources in Crete

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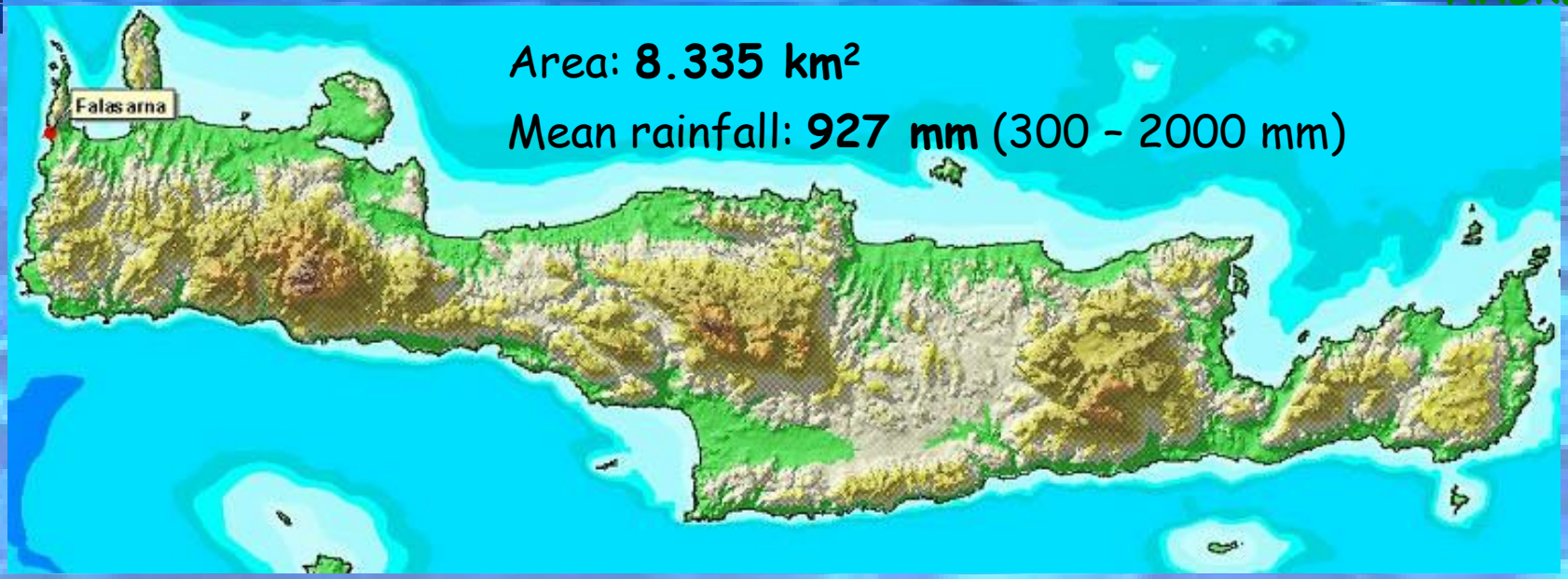

Annual water balance of Crete (Mm^3)

Hydrological conditions	Rainfall	Evapotranspiration	Surface runoff	Deep percolation
Normal	7,69	4,83 (62,8%)	0,74 (9,6%)	2,12 (27,6%)
Wet	10,33	6,48 (62,7%)	0,99 (9,6%)	2,85 (27,6%)
Dry	5,07	3,18 (62,7%)	0,49 (9,7%)	1,40 (27,6%)

Water resources in Crete

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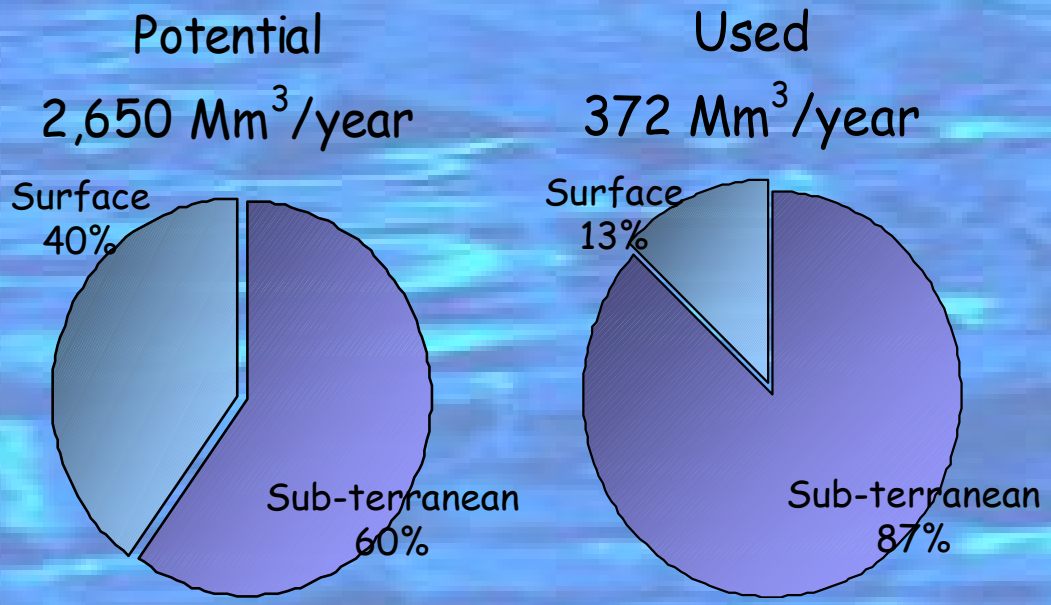
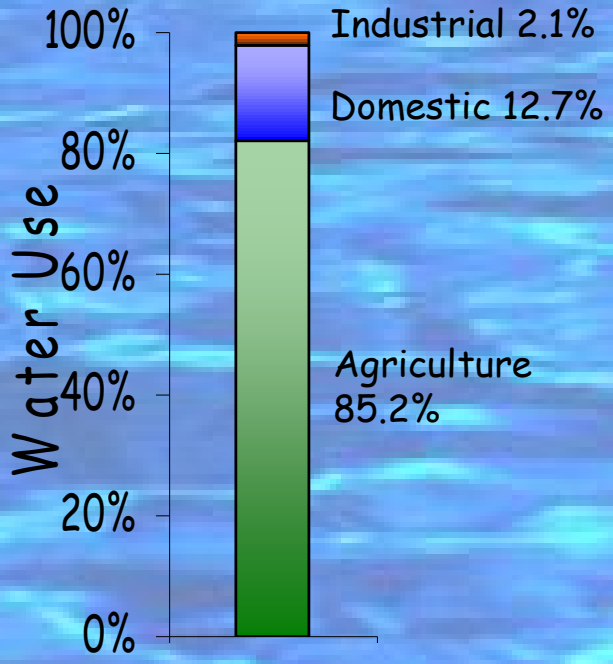


Source: Region of Crete, 2002

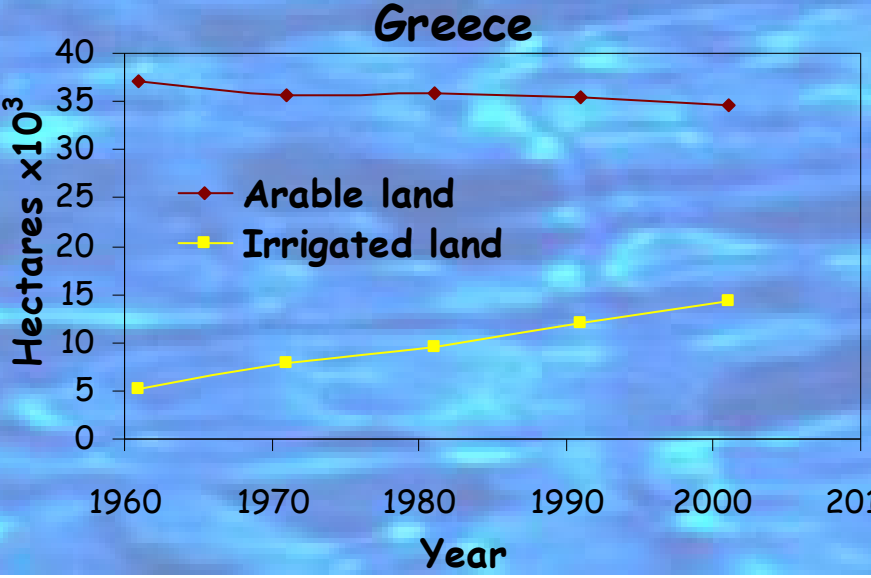


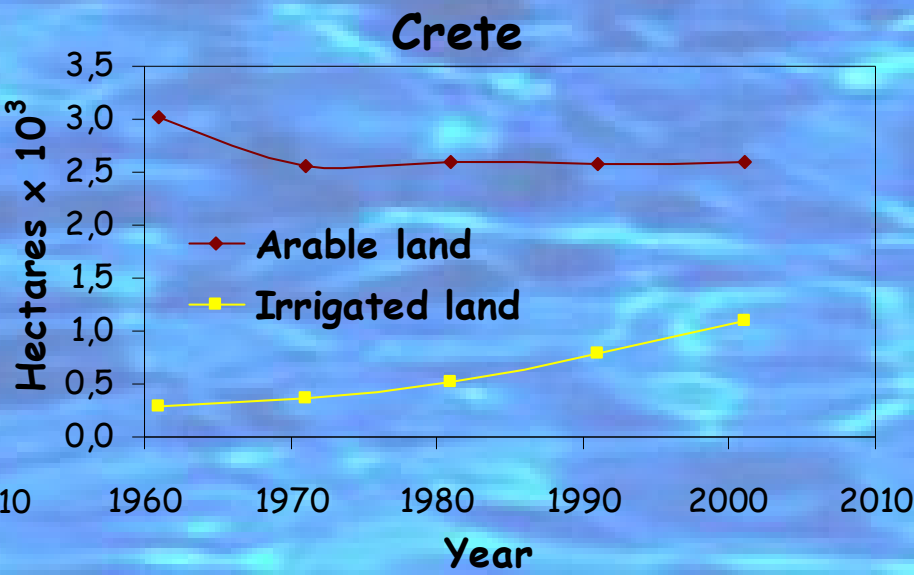
Water demand and deficit in Crete (RGC, 2002).

Water use	Consumption (Mm3)	Deficit	Cover percentage
Irrigation	302,06	156,31	65,9%
Domestic & other uses	69,75	7,59	90,2%
Total	371,81	163,90	72,2%

Irrigated areas

- The last 40 years the irrigated areas in Greece increased by 275% while in Crete the increase was 376%. At the same time the total agricultural land decreased by 6,7% and 13,7% respectively. The percentage of irrigated land in Crete is 42,3% (Region of Crete, 2002) while the respective % for Greece is 41,1% (NSSG, 2001).
- Main crops: olives, citrus, grapevines, field and greenhouse vegetables and avocado
- Methods of irrigation: drip (vegetables, grapevines, tree crops), sprinklers (forage crops, vegetables) and furrows (vegetables)
- Irrigation scheduling: mainly empirical





Evolution of irrigated crops

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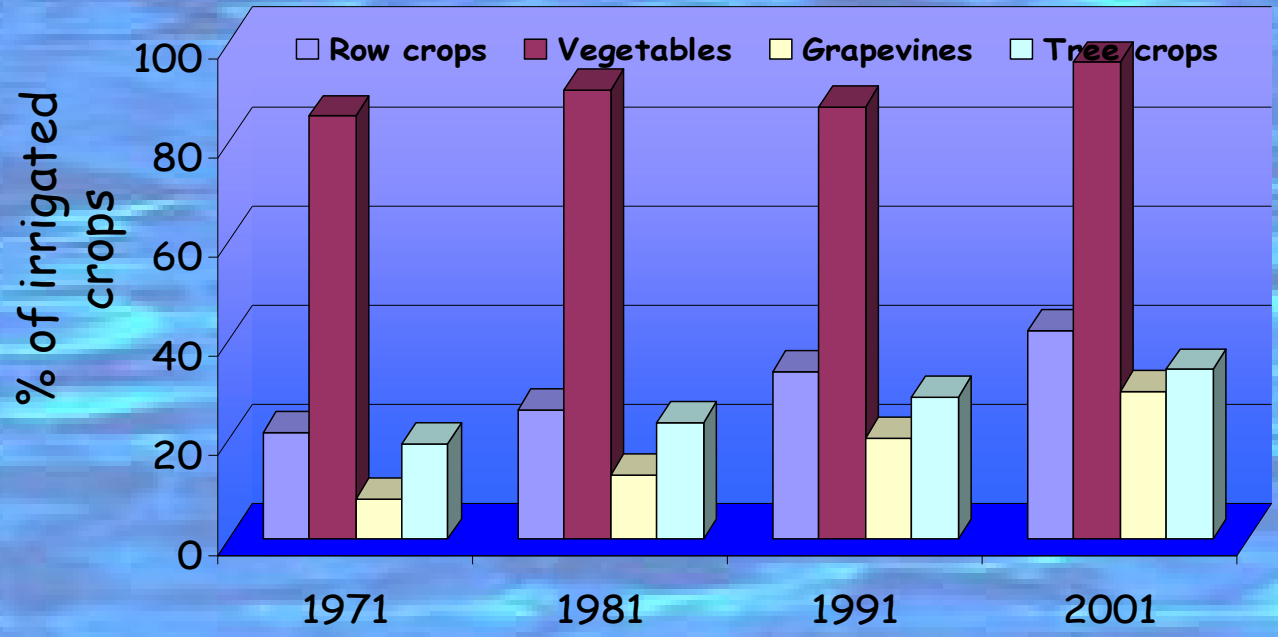
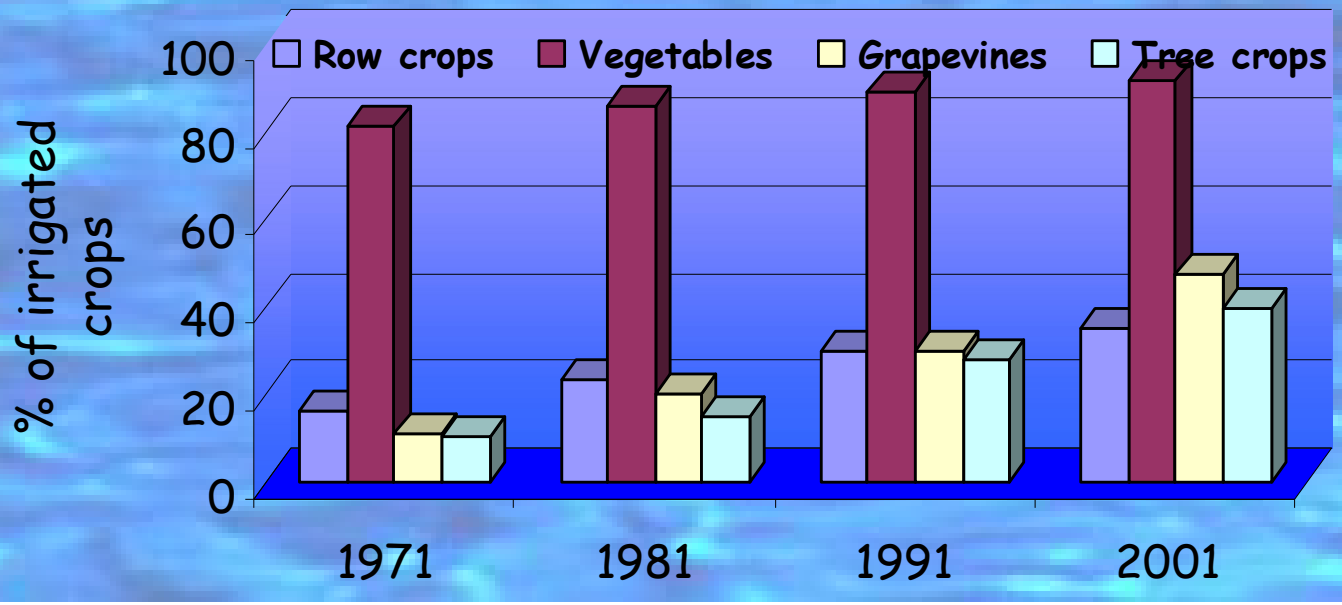
Evolution of main irrigated crops in the country





Evolution of main irrigated crops in Crete

Sustainable water management in agriculture

- Sustainable water management in agriculture aims to match water availability and water needs in quantity and quality, in space and time, at reasonable cost and with acceptable environmental impact.

- Its adoption involves:

  - technological problems
  - social behavior of rural communities
  - economic constrains
  - legal and institutional framework
  - agricultural practices

Sustainable water management in agriculture can be achieved by:

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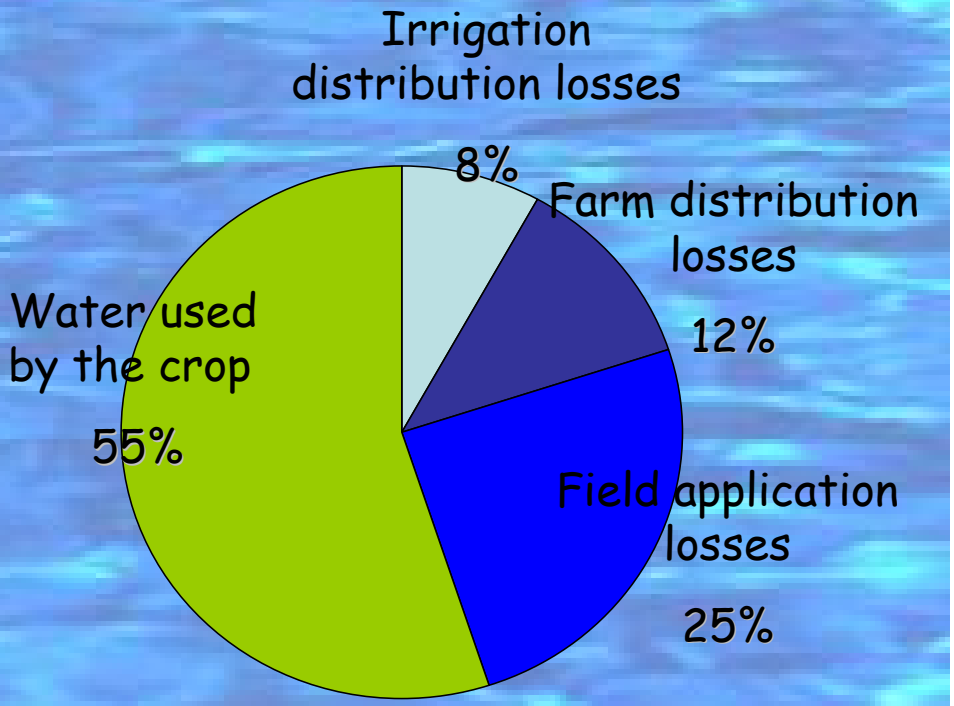
Application of best irrigation practices

- Reduction of water losses

- Detect and eliminate any water leakage in the networks using up-today methods (GIS, remote sensing, etc).
- Repair and maintain the networks



- Improve the efficiency or irrigation systems used

- surface irrigation systems: land leveling and use of short length furrows and basins
- sprinkler irrigation systems: use pressure regulators in sloping fields, monitor and adjust pressure, good system maintenance
- localized irrigation systems: use a single drip line for a double row crop, control of pressure, adjust the amount and the duration of irrigation according to soil characteristics

Sustainable water management in agriculture

- Increase water use efficiency

- obligatory use of localized irrigation systems (with or without subsides)
- apply proper irrigation scheduling based on soil and climatic conditions and the crop
- proper irrigation techniques to avoid soil salinisation
- adopt innovative irrigation techniques, which require reduced amount of water like regulated deficit irrigation (RDI), partial root drying (PRD) and subsurface irrigation in water scarce regions
- apply fertigation (application of fertilizers though the irrigation system)
- application of agrochemicals (herbicides, fungicides, etc)
- establish a local advisory system for advising the farmers for irrigation

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Advisory system BEWARE

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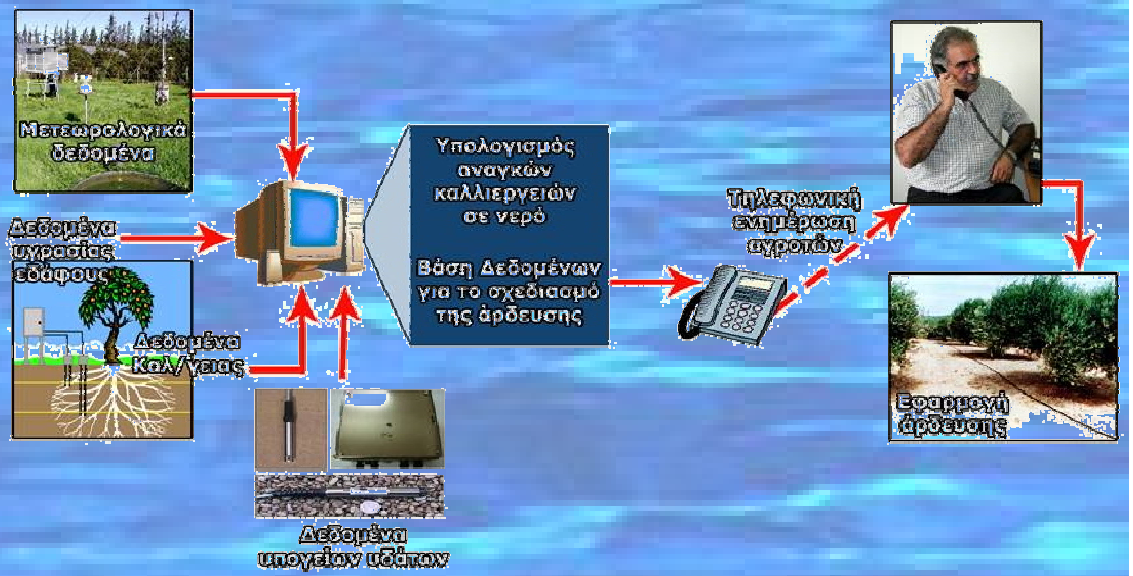
An advisory system to assist farmers for irrigation scheduling have been developed in Crete, Greece in the frame of CRINNO. The irrigation information is based in real-time data (climatic, soil, crop) and is given to the farmers through internet or phone call.



The purpose of the system is to improve irrigation efficiency at farm level.

Crop	Consultive irrigation (mm)	Empirical irrigation (mm)	Water saving (%)
Avocado	545	681	20,0
Orange	501	586	14,5
Olive	228	244	9,3
Grapevine	452	540	16,3

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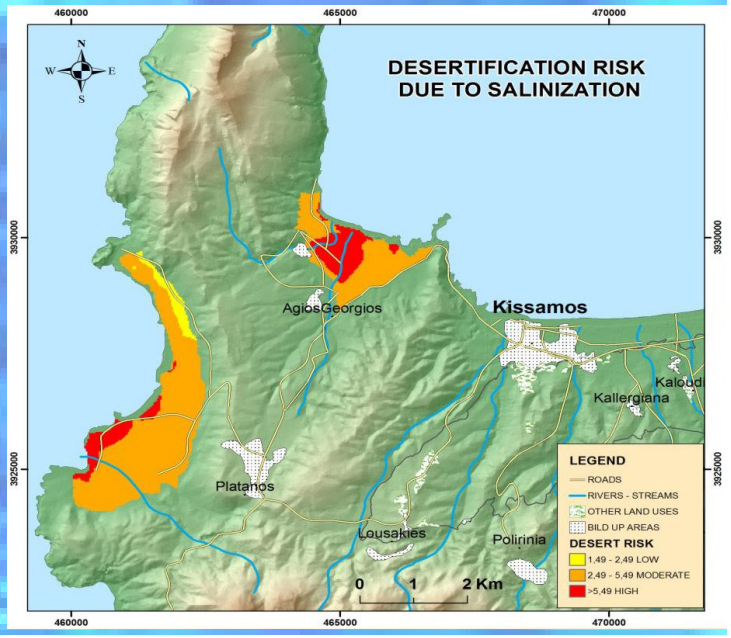
Water quality management:

It is important as much as the quantity management.

- Sources of water quality deterioration:
  - Use of agrochemicals (fertilizers, pesticides, etc)
  - Sea intrusion due to over-pumping (coastal aquifers)
  - Soil salinization (improper irrigation management)
- 35% of irrigated land is under high salinization risk while 49% is under moderate risk
- Protection measures:
  - Continous water quality monitoring
  - Rational use of agrochemicals (application of GAP)
  - Proper irrigation management
  - Artificial aquifer recharge (during the winter)



Sustainable water management in agriculture

Use of reclaimed waters for irrigation

The reuse of reclaimed water for irrigation of horticultural crops and recreational areas can ensure:

- ⇨avoiding the water quality deterioration of aquifers (minimize eutrophication)
- ⇨supply the soil with nutrients (mainly N, P and P) essential for plant growth minimizing the addition of fertilizers.
- ⇨an additional water source for water-deficient areas (in Crete will increase irrigated area by 5.3%)

- Development of guidelines for the reuse of reclaimed water for irrigation (in agreement with those of EU)
- The price of reclaimed water for irrigation must be lower than that of good quality
- For the use of marginal waters for irrigation it is necessary to follow an integrated management taking into account the crop (tolerance to salinity), the soil (proper tillage) and the irrigation method (drip, leaching, etc).

Water pricing

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- Water pricing in agriculture is still open to debate
- Water pricing can play a key role in giving incentive to make water use in agriculture more efficient, thereby reducing pressure on the environment.
- Water pricing policy must promote the future sustainability of the resource, discourage the waste and induce the adoption of water saving technologies.

➢ Barriers to the application of a pricing mechanism are:

- practical (water is often not metered)
- legal-historical (existing water rights)
- social (water is perceived as a public good).

➢ However appropriate pricing for wise water use has a central role to play in the transition to an era of scarcity.

Water pricing

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Irrigation water pricing in Crete

- 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. For example in Chania Prefecture the price of irrigation water is 0,07-0,12 €/m^3 in networks operated by TOEB, 0,10-0,17 €/m^3 operated by OADYK, 0,15 - 0,22 €/m^3 operated by Municipalities, whereas in some private projects it reaches 0.30-0.45 €/m^3.
- irrigation water tariffs must cover the O&M cost of water use and services
- volumetric water metering must be obligatory
- progressive, seasonal and over-consumption water tariffs (quotas) should be promoted
- an increasing block tariff charging system, for those exceeding crops' critical water requirements, must be established

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Strengthening capacity

- **Education and training** of professionals, technical staff and decision makers on subjects related to sustainable water management
- **Manpower build up.** Institutions to be staffed with qualified manpower (managers, engineers, technicians, social scientists)
- **Facilities and procedures.** Water authorities at all levels of management should be equipped with technologically advanced devices and programs e.g. computers, GIS, remote sensing etc.
- **Increase the farmers awareness. This implies:**

  Changes in education system

  Increased research

  Strong and effective Agricultural Extension Services

  Financial support by the State

  Wider and effective participation of farmers in water management


THANK YOU!