WaterStrategyMan
EVK1-CT-2001-00098

PROCEEDINGS

OF THE

WORKSHOP ON THE RANGE OF EXISTING CIRCUMSTANCES

held at

Hermoupolis, Syros, Greece

8th July, 2002

Prepared by
Ruhr-University Bochum

July 2002

The *workshop on existing circumstances* was held in the Auditorium of the University of the Aegean in Hermoupolis on the island of Syros, Greece on July 8th, 2002. It was attended by the partners of the *WaterStrategyMan* project as well as by a number of visitors.

All presentations held at the workshop and the reports on the water deficient regions are available for download (for project partners) on the
ARID Cluster website http://arid.chemeng.ntua.gr/
and the WaterStrategyMan website (http://environ.chemeng.ntua.gr/wsm/)

Contents

1. Introduction

1.1. The Project

The project "Developing Strategies for Regulating and Managing Water Resources and Demand in Water Deficient Regions" (EVK-1-2001-0081), in short WaterStrategyMan or WSM, is supported by the European Union under the Fifth Framework Programme and contributes to the key action "Sustainable Management and Quality of Water".

It is primarily aimed at developing and evaluating water strategies for water deficient regions in Southern Europe. There are four specific goals of the project:

- A review of existing approaches in terms of Integrated Water Resources Management (IWRM), demand management, sustainability indicators and development strategies
- The study of the differences between water quantity and water quality with regard to water management
- Highlighting the importance of the regional and cultural context
- The development of alternative IWRM options and long-term scenarios for water deficient regions.

The project has a duration of 3.5 years and consists of four phases: The first phase (diagnostic phase) will identify a set of representative regions in Southern Europe and will then define representative paradigms for water deficient regions which, in turn, will form the theoretical framework for developing, analysing and evaluating water management options.

At the end of phase one, six water deficient regions will be selected and conceptualised as paradigms.

In phase two (analysis phase), a consistent methodology for analysing and evaluating different water allocation scenarios and water management options will be developed and will encompass the entire range of the selected paradigms.

The strategy formulation phase is aimed at comparing and identifying appropriate plans, actions and policies that apply to the paradigms.

The main objective of phase four, the synthesis and dissemination phase, is the synthesis of the results from the previous project phases. Based on the six identified paradigms, widely acceptable guidelines and protocols will be formulated with a view to implement the European Water Framework Directive (WFD) timely and efficiently. The WFD essentially aims to improve the quality of aquatic ecosystems and at basing the utilisation of water resources on the principle of sustainability.

Each of the four project phases is organised in several work packages. Their structure in interdependence in the project in depicted in the following figure.

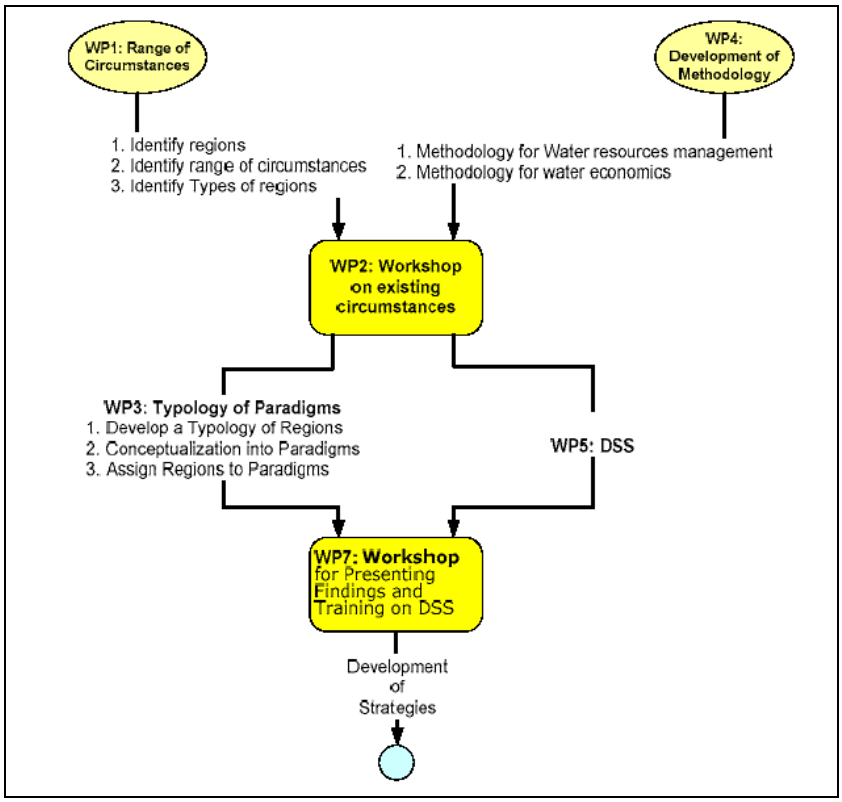

Figure 1: Structure of the work packages and their interaction

1.2. The workshop

Given the structure of the project described above, the workshop plays a major role for the definition of the subsequent work packages. The workshop brings together the efforts in WP 1 (Determining the range of existing circumstances) and WP 4 (Development of a methodology) and facilitates the passage into the subsequent work packages (WP 3, WP 5 and WP 7) of the project.

The workshop on the range of existing circumstances mainly serves the following purposes:

- Presentation on and discussion of the range of existing circumstances
- Constructing a typology for water deficient regions
- Highlighting the range of policy alternatives in general
- Outlining water management strategies for the regions presented

As a result, the workshop was organised in four sessions. In session one, the range of existing circumstances in the candidate regions of the six countries was presented. A typology of common circumstances in the water deficient regions was constructed in session two. The entire range of policy alternatives in IWRM was presented in session three. Finally, an exercise was thought up in order to outline water management strategies for water deficient regions (session four).

Agenda

9.30-9.40 Opening Session

Welcoming Partners and Workshop objectives *(D. Assimacopoulos)*

9.40-12.00 Session 1 - The Range of Existing Circumstances in Water Deficient Regions

- Greece *(I. Katsiardi)*
- Italy *(A. Peruffo)*
- Israel *(E. Feinerman)*
- Spain *(C. Marin)*

11.00-11.20 Coffee Break

- Cyprus *(I. Glekas, I. Iacovides)*
- Portugal *(R. Maia)*
-

12.00-13.00 Session 2 - Exercise 1: Constructing a Typology of Water Deficient Regions

(All participants. Moderator: D. Assimacopoulos)

13.00-15.20 Lunch Break

15.20-17.00 Session 3 – Towards Integrated Water Resources Management: The Range of Policy Alternatives *(Moderator: E. Todini)*

- Demand Reduction and Supply Augmentation Options *(E. Todini)*
- Competing water uses and economic instruments *(B. Barraqué)*
- Environmental economic instruments *(E. Interwies)*
- Social Capacity Building and Institutional Options *(E. Vlachos)*

17.00-17.30 Coffee Break

17.30-19.0 Exercise 2: Outlining Water Management Strategies for Water Deficient Regions *(Moderator: C. Karavitis)*

19.00 End of Workshop

Executive summary

Session 1: The range of existing circumstances in water deficient regions

The presentations of the case studies by the partners in session one were organised in three parts: The first part of the presentation describes the key issues of water management in the country. Part two introduces the identified water deficient regions while part three discusses the range of circumstances in the identified regions in more detail; water related problems, instruments and responses were described thoroughly. This part of the presentation is aimed at describing the full range of existing circumstances and thereby first supporting the discussion of functionality of the tool and secondly at initiating the discussion for WP 8 (Generation of coherent water management scenarios).

In total, thirteen water deficient regions in six countries (Greece, Italy, Israel, Spain, Portugal and Cyprus) have been presented. The key issues in water management, represented by matrices for each region, are summarised on the next page.

It has been agreed that Israel, although initially considered as one region should be studied on the basis of two regions within the country. The reason for this is that the range of existing circumstances in the country is too wide to be used for the purpose of the case studies.

Details of the water deficient regions are provided in the presentations held during the workshop (appendix) as well as in the report on the range of existing circumstances (Deliverable No. 1).

Session 2: Exercise 1: Constructing a typology of water deficient regions

Based on the individual partner presentations in the previous session, an attempt was made to characterise common issues in the regions. A consistent typology of the thirteen regions has been constructed using the Indicators Matrix given below. The objectives of this exercise were to find common characteristics and gaps in the identified regions and to develop a coherent typology for the regions.

Although the thirteen water deficient regions vary with regard to size, topography, water quality problems and water management, several shared features have been identified.

The most obvious feature in the regions is the aridity index (i.e. the ratio of precipitation to potential evapotranspiration) which is lower than 0.7 in all regions (sub-humid) and around 0.3 on average (arid to semi-arid).

The discussion yielded, however, that this index cannot be seen as a pressure on water resources *per se* because aridity itself does not describe a demand for water. There might be situations where the aridity index is very low but the water demand and hence the pressure on the water resource does not exist.

With the Attica region being the only exception, the water demand is stable or increasing in all regions and dominated by conflicting consumers such as tourism and agriculture. Furthermore, the demand pattern is characterised by high seasonal fluctuations. Agriculture is the dominant water user in the specified regions (with the exception of the Cyclades).

Cost recovery is poor in most of the regions where adequate data is available. Price elasticity appears to be very small for all users.

The priorities for development in eleven of the thirteen regions are given to agriculture and tourism respectively.

The need to use more indicators to describe the typologies for the regions was discussed. A paradigm should involve demand management, developmental, environmental, economical as well as institutional and social components as stipulated by the EU Water Framework Directive.

Session 3: Towards Integrated Water Resources Management (IWRM): The range of policy alternatives

The objective of session 3 was to present the entire range of possible water management interventions in arid or semi-arid regions. These include demand reduction and supply augmentation measures as well as economic instruments to control the use of water for different users and institutional and social capacity building options.

Supply augmentation and demand reduction options can be classified into measures to increase the efficiency of existing use of water and the use of non-used resources (rain water harvesting, waste water reuse etc).

The highest potential for demand reduction is the efficiency increase for existing structures; losses in the distribution system (related to the water supplied) may amount to 40 per cent in some regions (e.g. Ribeira do Algarve in Portugal) so that a lot of water could be saved by introducing efficient leakage detection and control measures.

The efficiency of agricultural water use (being defined as the ratio that actually reaches the plant) is generally about 60 per cent in and can sharply be increased by a change to pressure systems instead of gravity systems and by simple measures such as lining of canals etc.

Economic instruments towards a sustainable use of water include economic incentives and cost recovery (taking into account economic, social and environmental impacts).

Horizontal and vertical integration, in particular for transboundary water management, was emphasised.

Session 4: Exercise 2: Outlining Water management strategies for water deficient regions

The objective of this session was to predefine the strategies applicable to the regions for the emerging paradigms. The emerging strategies will be used in the development of the decision support tool (WP 5) as well as in the formulation of general strategies, guidelines and protocols of WP 8. In particular, the strategies are relevant to the review of existing water management plans in WP 8.1.

Based on the numerous water management options presented in the previous session (including demand reduction and supply enhancement, economical and environmental as well as institutional options), a strategy has been compiled for the Cyclades in Greece. Any set of actions in the matrix can be viewed as a strategy.

Table 1: Strategy options and actions matrix -Cyclades

	Demand management	**Supply Augmentation**	**Environmental options**	**Economic options**	**Socio-economic options**
Actions	Land use changes Compulsory private well metering	GW system improvement Rain harvesting GW recharge	.. …	… …	Confidence Regulations

Matrix of Existing Circumstances

		Attic c	Greece Thessal y	Cyclades	Akrotir i	Cypru s Germasogei a	Kokkinochori a	Israe l Israe l	Spai n Canary island s	Italy Emilia-Romagn a	Sado	Portugal Guadiana	Ribeiras do Algarve
Regional context	Climate type	Mediterranean	Mediterranean continental	Mediterranean temperate	Csa-Mediterranean	Csa-Mediterranean	Csa-Mediterranean	Dry subhumid to hyperarid	Oceanic	sub-continental	Cs: Mediterranean Temperate	Csa	Cs
	Aridity index [-]	0.31	0.2 to 0.65	0.3	0.33	0.356	0.268	0.05 to0.5	0.2 to 0.6	>1	0.54	0.46	0.68
	Population	3,761,810	753,848	112,615	156,000	10,000	30,000	6,200,000	1,781,366	3,924,456	292,960	182,580	324,100
Water availabilit y	Tot. water resources [mio m^3]	449	3094	212	30	20	30	2251	(GW)+ 78 surface v	1914	1768	7500	620
	Transboundary [mio m^3]	388	600	yes	-	-	-			no	no, but inter basin transfer	5500	no, inter basin transfer
Water quaiti y	Surface water	-	good	n/a	very good	very good	very good	good	good	n/a	poor	poor	poor
	Groundwater	poor	average	poor	fair-poor	very good	fair	average-poo	average	n/a	good	poor	poor
	coastal water	fair-poor	poor	good	good	good	good		poor	n/a	good	good	good
Water suppl y Percentage from	GW	17	15.7	22.5	33	15	30	57	87	34	16	55.5	71.5
	Surface water	-	68.3	77.5	62	50	-	29	5	66	84	56	19.7
	Desalination and recycling	-	-	?	5	35	13	14	8	yes	-	0.5	-
	Importing	83	16	?			57	-		no	-		8.8
Network coverag e percentage	Domestic	100	n/a	n/a	100	100	100	100	60	98	97	84	82
	Irrigation	-	n/a	n/a	85	70	85	100	85	84	72	76	77
	Sewerage	90	66	58	75	80	70	80	60	71	87	83	73
Water us e percentage	Domestic	71	3.3	23	30	0.6 mio m^3	6%	31	27	42	24.3	14	21.8
	Touris m	-	-	-	10	0.9 mio m^3	10%	4	7	-	0.6	1.37	10.9
	Irrigation	25	95.8	77	60	6.5 mio m^3	84%	59	58	32	441	400	305
	Industr y	4	0.9					6	3	26	730.1	3.3	2.41
	Population to resources index	4494	204	531	192	1200	1000	n/a	438	494	6035	42720	1912
Water demand	Water demand trends	decreasing	stable	increasing	increasing	increasing	increasing	increasing	increasing	stable	increasing	increasing	increasing
	Consumption index [%]	69	38	50	100	67	100%	stable urban per capita consumptio	53	100	68	5.4	55
	Exploitation index [%]	49	31	15	100	67	300%	100	58	-	70	12	57
Pricing system	avg household budget for dom. water	117	149	231	99.2	99.2	99.2	$90	356	11%	0.75%	0.89%	0.90%
	avg household budget for agr. water [€	n/a		n/a	0.11/m^3	0.11/m^3	0.11/m^3		variable	n/a	0.06 Eur/m^3	0.06 Eur/m^3	0.07Eur/m^3
	Avg household income [€]	20639	10582	13710	24207 urban/18488 rural	24207 urban/18488 rural	24207 urban/18488 rural	$36000	16800	n/a	13562	13562	13573
	Cost recovery	good	poor	poor	dom 0.58 full financial Irr 0.11 O&M	dom 0.58 full financial Irr 0.11 O&M	dom 0.58 full financial Irr 0.11 O&M	Agricultural demand is elastic; urban and industrial elasticities are small	average	n/a	37%	23%	40%
	Price elasticit y	fair	poor	poor	very small	very small	very small		average	n/a	very small	very small	very small
Social capacity building	Public participation	poor	poor	poor	fair	fair	fair	very high	poor	average	poor	poor	poor
	Public education in water conservation	fair	average	average	fair	fair	fair	fair	poor	average	poor	poor	poor
Water Resources Management	Water ownershi p	state	state	state	state(partly private)	state (partly private)	state (partly private)	state	GW: mostly private; surface water: public and private	public	public (partly private)	public (partly private)	public (partly private)
Decision making level	Water supply for each sector	National	regional	Municipal	national	national	national	national	region-local	regional-municipal	National/municipal	national/municipal	national/municipal
	Water resources allocation	National	national	national	national	national	national	national	regional-island	regional-municipal	national	national	national
	Local economy basis	tertiary sector	primary sector	tertiary sector	agri/tertiary	agri/tertiary	agri/tertiary	national	tourism	agriculture/tertiary sector	agriculture/industry	agriculture/tertiary sector	tourism
Water policy	Development priorities	urban growth	agriculture	touris m	agri/tourism	agri/tourism	agri/tourism	Recycling and desalisation	touris m	demand management and water water reuse	industr y	agri-culture	tourism and agri-culture

Aridity index : Precipitation/Potential Evapotranspiration
Resources to population index: Total water resources/population
Consumption index Water consumed/total water resources

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Appendix: Individual presentations

Welcoming Session

1 Welcoming Partners and Workshop objectives *(D. Assimacopoulos)*

Session 1 - The range of existing circumstances in water deficient regions

2 Greece *(I. Katsiardi)*

3 Italy *(A. Peruffo)*

4 Israel *(E. Feinerman)*

5 Spain *(C. Marin)*

6 Cyprus *(I. Glekas, I. Iacovides)*

7 Portugal *(R. Maia)*

Session 2 - Exercise 1

8 Constructing a Typology of Water Deficient Regions *(All participants. Moderator: D. Assimacopoulos)*

Session 3: Towards Integrated Water Resources Management: The Range of Policy Alternatives

9 Demand Reduction and Supply Augmentation Options *(E. Todini)*

10 Competing water uses and economic instruments *(B. Barraqué)*

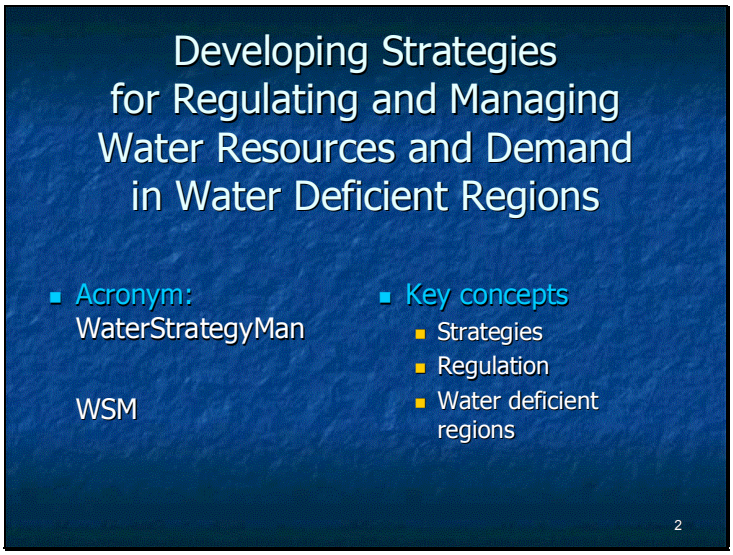
11 Environmental economic instruments *(E. Interwies)*

12 Social Capacity Building and Institutional Options *(E. Vlachos)*

Session 4: Exercise 2

13 *Exercise 2:* Outlining Water Management Strategies for Water Deficient Regions *(all participants (Moderator: C. Karavitis)*


Welcome to the workshop
WaterStrategyMan Project
D. Assimacopoulos
NTUA, July 2002

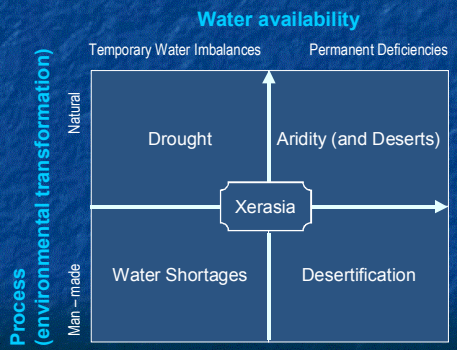

Developing Strategies for Regulating and Managing Water Resources and Demand in Water Deficient Regions
Acronym: WaterStrategyMan
WSM
Key concepts
Strategies
Regulation
Water deficient regions
2

WSM Objectives

- To explore alternatives for:
  - Regulating and managing water resources in water deficient regions
- Select representative water deficient regions and provide concrete examples of implementation /evaluation steps
- Develop and evaluate strategies for an IWRM
- Develop methodology, tools, guidelines and protocols of implementation for decision makers

3

Interfaces of water deficit



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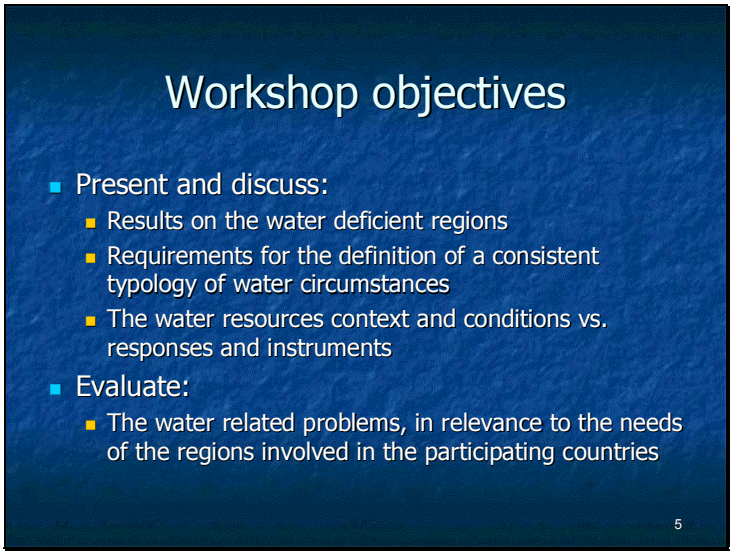
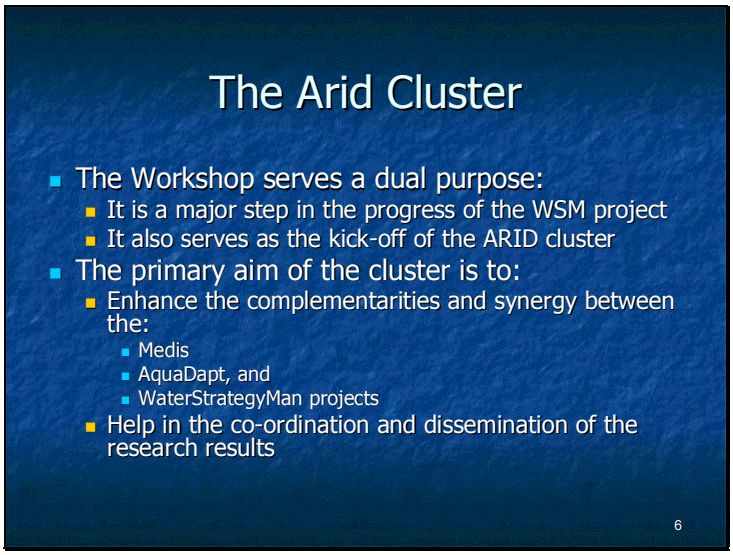

Workshop objectives
Present and discuss:
Results on the water deficient regions
Requirements for the definition of a consistent typology of water circumstances
The water resources context and conditions vs. responses and instruments
Evaluate:
The water related problems, in relevance to the needs of the regions involved in the participating countries
5


The Arid Cluster
The Workshop serves a dual purpose:
It is a major step in the progress of the WSM project
It also serves as the kick-off of the ARID cluster
The primary aim of the cluster is to:
Enhance the complementarities and synergy between the:
Medis
AquaDapt, and
WaterStrategyMan projects
Help in the co-ordination and dissemination of the research results
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Programme
Opening Session: Welcome and Workshop objectives
SESSION 1: The range of existing circumstances in water deficient regions
9.40-10.00 Greece
10.00-10.20 Italy
10.20-10.40 Israel
10.40-11.00 Spain
11.00-11.20 Coffee Break
11.20-11.40 Cyprus
11.40-12.00 Portugal
SESSION 2: Exercise 1: Constructing a Typology of water deficient regions
Lunch Break
SESSION 3: Towards Integrated Water Resources Management: The range of Policy Alternatives
15.20-15.40 Demand Reduction and Supply Augmentation Options
15.40-16.00 Competing water uses and economic instruments
16.00-16.20 Environmental economic instruments
16.20-16.40 Social Capacity Building and Institutional Options
16.40-17.00 Discussion
17.00-17.30 Coffee Break
SESSION 4: Exercise 2: Outlining Water management strategies for water deficient regions
17.30-18.00 All participants
18.00-19.00 Discussion
19.00 End of Workshop
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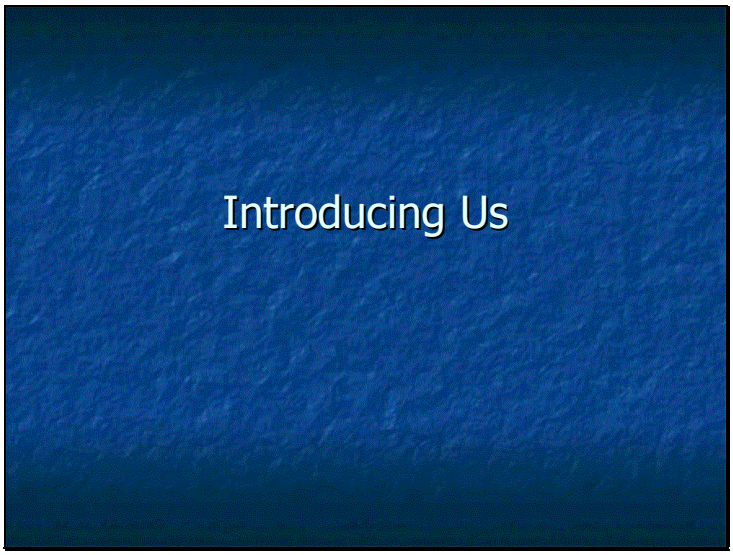
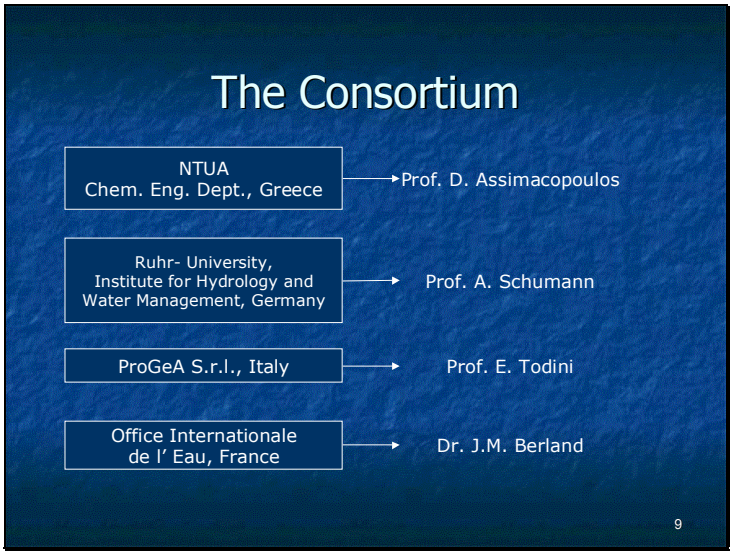

Introducing Us


The Consortium
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Dr. J.M. Berland
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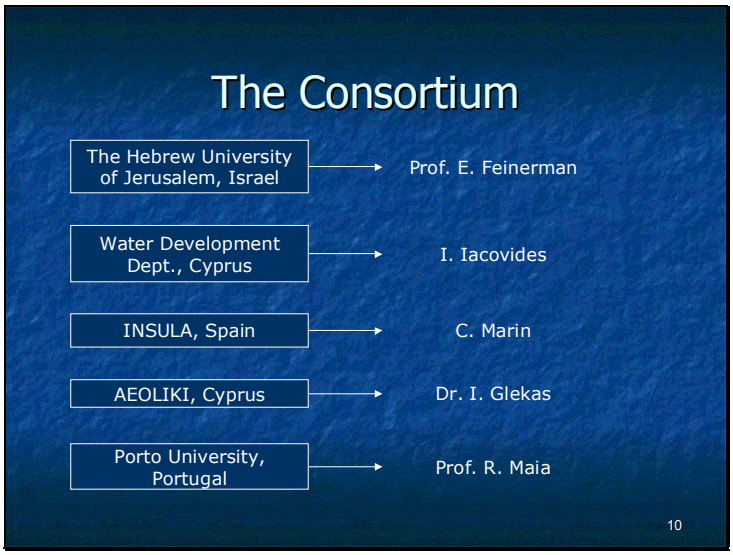
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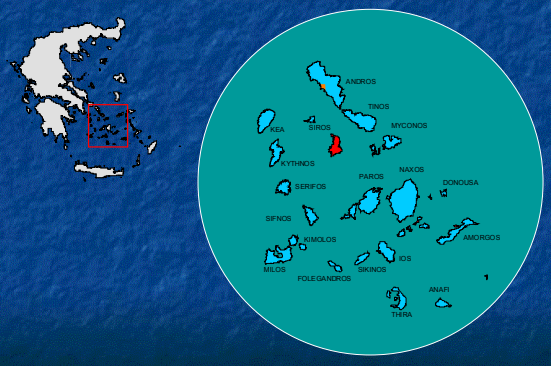
Introducing Syros

Cyclades



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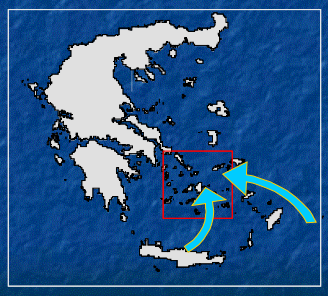
Prehistory



- The name "Keros - Syros" appears around 2700 BC to 2300 BC
  - Phoenicians
  - Cretans
  - Ionians

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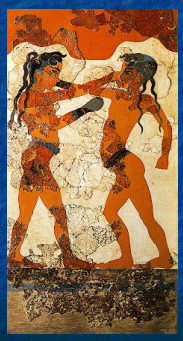
The different cultures: 2500 BC

14

The different cultures: 1500 BC



15

The different cultures: 400 BC

16

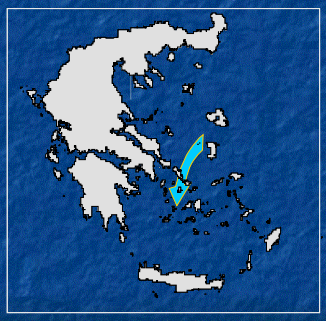
The new era

- The 4th Crusade
  - From 1204 until 1566 the island Syros, like all the Cyclades, was taken by the Venetians, who spread Roman Catholicism
  - The medieval city of Ano (Upper) Syros was built in the 13th century
- The Ottoman years
  - The island was taken by the Turks in 1537
  - It continues flourishing because it retained numerous privileges thanks to the influence of its Catholic inhabitants and also because the "Capitulation" agreed between Francoise and the Sultan

17

The 19th century

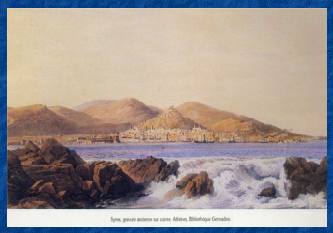
- Crossroad: Athens, Istanbul, Alexandria and the other ports of the Levant
- In 1821, thousands of Greeks, who were driven out of Chios and other Aegean islands by the Turks, found refuge on the then uninhabited shores of Syra Bay



18

The 19th century

- The city in 1820 it numbered 5.000 inhabitants
- The new city placed under the patronage of Hermes, the god of commerce, it was called Hermoupolis
- 1828: it numbered 15.000 inhabitants
- 1830: Third city in Greece
- At one time there was even a possibility of it becoming the capital of the newly established Greek kingdom



19

The 19th century

- 1844: The National Bank of Greece opens its own first branch in Hermoupolis
- 1840: Sail-ship is outdated by steam-ships
- 1855: The "Greek Steam-ship Company" is created by the National Bank of Greece and 200 shareholders in Syros
- A shipyard starts operating

20

The late 19th century

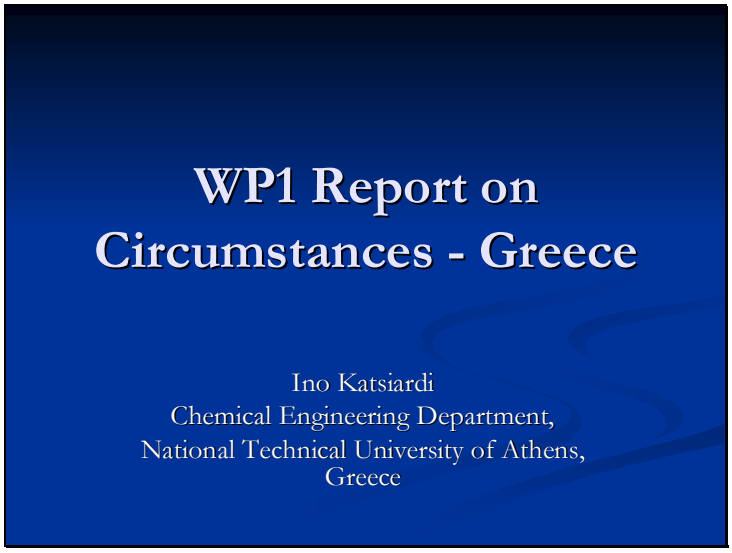
21

The 20th century

- After the war: Local population does not immigrate
- New standards of living create new water demands
- 1965: The first desalination unit (evaporation process) is built in the shipyard

22

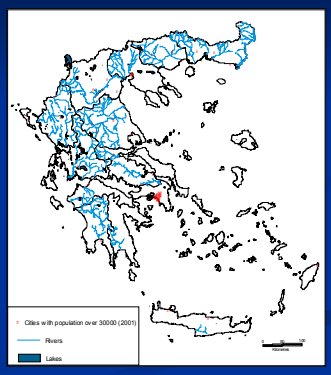

Have a pleasant time in Syros
Azolimnos
Megas Gialos-Strand
23


WP1 Report on
Circumstances - Greece
Ino Katsiardi
Chemical Engineering Department,
National Technical University of Athens,
Greece


Overview of the
country

Overview of Greece

- Total Area of Greece: 132.160 km^2
- Total population of Greece (2001): 10,939,605
- Recorded tourist arrivals (1998): 11,363,822
- Greece has one of the greatest water resources potential per capita in the Mediterranean area
- However, water shortage problems are frequent in parts of the country



Physical Characteristics

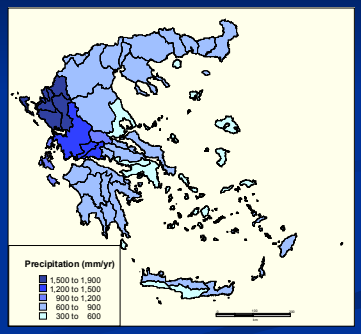
- Climate
  - Mediterranean
  - Precipitation varies from 200mm to 2150mm
- Geomorphology
  - Mostly mountainous
  - Extended coastline
- Geology
  - Mainly limestone and sedimentary rocks
- Ground Water
  - Many aquifers
  - Estimated amount 10,300 hm^3/year.
- Surface Water
  - 765 recorded streams, of which 45 perennial
  - Four transboundary rivers
  - 60 lakes, 3 transboundary
- Surface Water storage features
  - Dams, reservoirs

Issues in Water Management

- Seasonality of demand
  - Tourism, peaks in the summer
  - Agriculture, peak demand in the dry season
- Main user: agriculture, highly dependent on irrigation
- Uneven distribution of resources
- Uneven distribution of population
- Overexploitation and salinisation of underground aquifers
- Dependence on transboundary waters flowing from non EU regions - About 14 km^3/y (30% of total average annual water resources) originates outside the country
- Increasing frequency of droughts and torrential rains in recent years

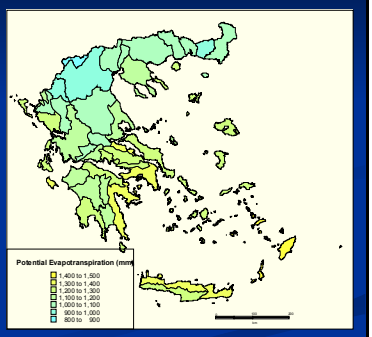
Precipitation

- Precipitation is high in the northwestern part of the country, and low in the islands and eastern part of the country



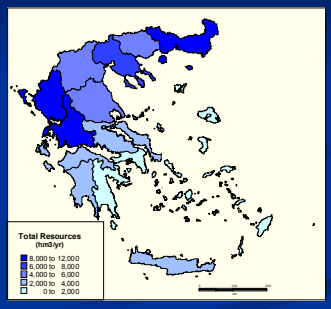
Potential evapotranspiration

- Potential evapotranspiration is very high, particularly in regions with low precipitation



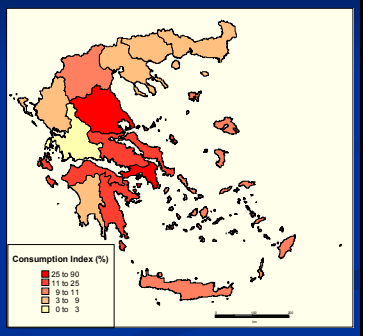
Uneven distribution: Total Resources

- The richest departments:
  - West Sterea Ellada
  - Epiros
  - West and Central Macedonia
  - Thrace
- The most deficient regions:
  - Southern Aegean Islands
  - Attica
  - East Peloponnesus



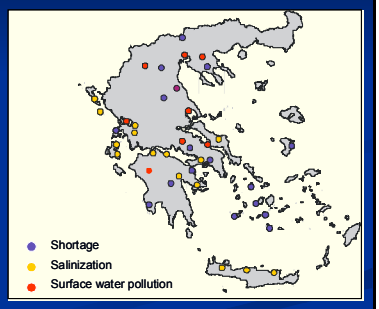
The Human Factor

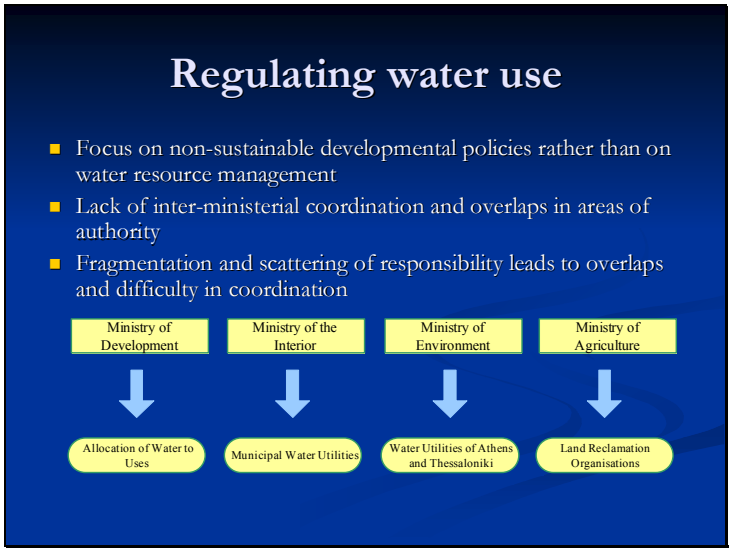
- Consumption index: Water consumed / Total Water Resources
- Attica has the higher consumption index due to the large domestic needs
- Aegean Islands face seasonal water shortage problems



Water quality and Pollution

- Influx of pollutants through transboundary rivers
- Domestic effluents and agrochemicals are major sources of surface and groundwater pollution
- Coastal waters are of good quality, except where effluents from the larger cities are discharged
- Runoff during flooding
- No effluent charging systems

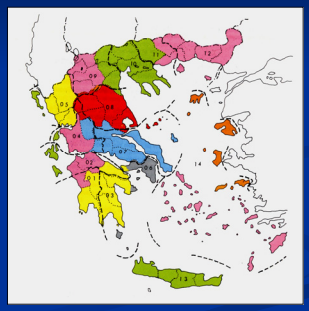



Regulating water use
Focus on non-sustainable developmental policies rather than on water resource management
Lack of inter-ministerial coordination and overlaps in areas of authority
Fragmentation and scattering of responsibility leads to overlaps and difficulty in coordination
Ministry of Development
Ministry of the Interior
Ministry of Environment
Ministry of Agriculture
Allocation of Water to Uses
Municipal Water Utilities
Water Utilities of Athens and Thessaloniki
Land Reclamation Organisations


Water Management and Administration
Ministry of Development
Allocates water to uses, and is responsible for the use of water in industry and energy production
Ministry of Agriculture
Responsible for agricultural use
Ministry of the Interior
Responsible for domestic use, except in the cases of the cities of Athens and Thessaloniki
Ministry of the Environment
Responsible for the protection and conservation of water resources, as well as domestic use of water in Athens and Thessaloniki
Foreign Ministry
International water issues
Ministry of Welfare
Ministry of Transportation
Use of water in navigation
Ministry of Culture
Use of water in sports
National Tourist Organisation
Use of water in tourism and recreation
Regional Authorities
Approval for Water Utilities and issues
Prefecture authorities
Water use license issuing
Local Authorities
Provision of water services and creation of Water utilities

Regional level of administration

- Mostly overlapping with the hydrological departments

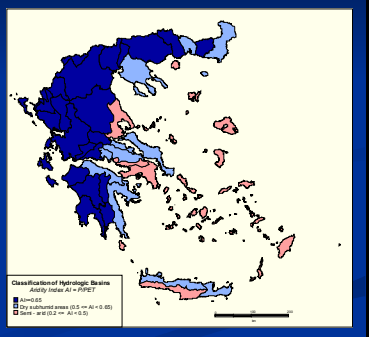


Selection of Candidate Regions

Aridity Index by Region

The most arid Regions:

- Attica
- Thessaly
- The Aegean islands and the southern part of Crete



Selected Candidate Regions

- Attica
- Thessaly
- The Cyclades Islands

Reasons for the Selection

- Attica
  - water deficit is permanent, caused by increased domestic demand
- Thessaly
  - water deficit is seasonal, caused by demand for irrigation
- Cyclades islands
  - water deficit is seasonal, caused by an influx of tourist population
  - severe conflicts with use for irrigation

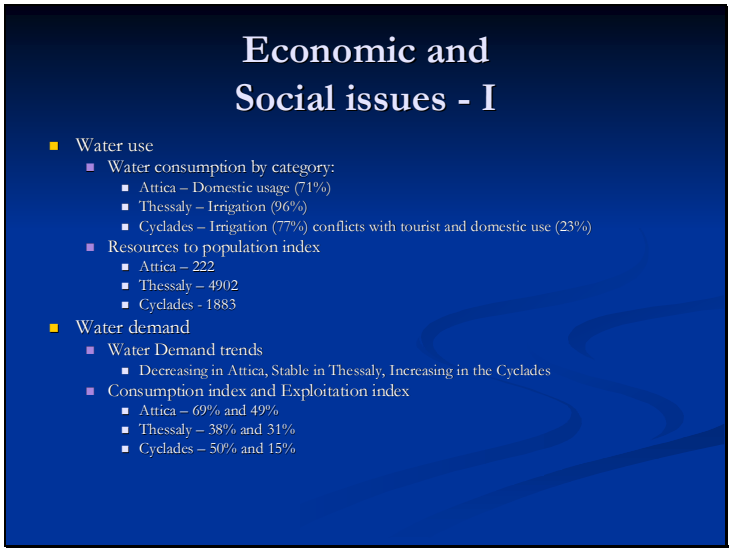
Range of Circumstances - Region Characteristics

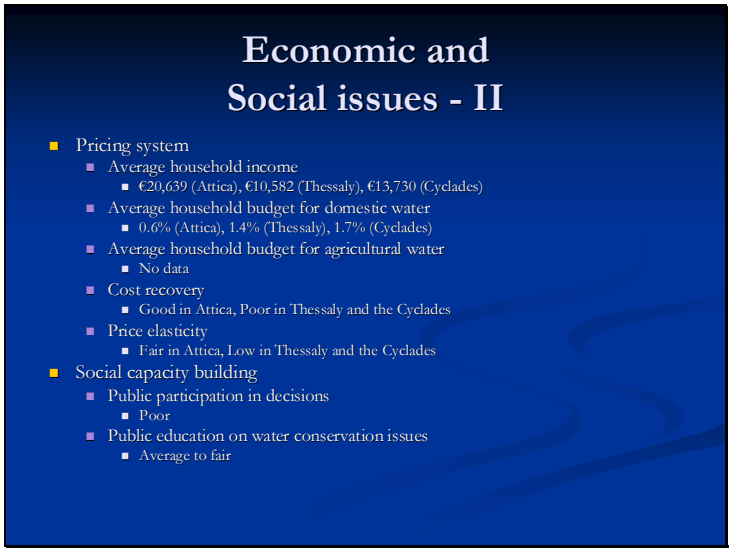
Natural conditions and infrastructure I

- Regional Context
  - Climate type
    - Attica – Mediterranean
    - Thessaly – Mediterranean continental
    - Cyclades – Mediterranean temperate
  - Aridity Index
    - Attica and Cyclades – about 0.3, semiarid
    - Thessaly
      - Semiarid
      - Subhumid
  - Permanent population
    - 3,761,810 Attica
    - 753,848 Thessaly
    - 112,615 Cyclades
- Water availability
  - Total Water Resources / Availability (hm^3)
    - 449 Attica
    - 3,094 Thessaly
    - 212 Cyclades
  - Trans-boundary water (hm^3)
    - Attica 388
    - Thessaly – will be 600
    - Cyclades -Variable
- Water quality
  - Surface water
    - None in Attica and Cyclades
    - Good in Thessaly
  - Ground water
    - Average to poor
  - Coastal water
    - Poor to Good

Natural conditions and infrastructure II

- Water Supply
  - Supply coming from:
    - Attica – mainly imported (83%)
    - Thessaly – mainly surface water (68%)
    - Cyclades – Variable; overall, mainly surface resources (77%)
  - Network coverage
    - Attica – 100% water supply, no data on irrigation and sewerage
    - Thessaly – No data
    - Cyclades – No data


Economic and
Social issues - I
Water use
Water consumption by category:
Attica – Domestic usage (71%)
Thessaly – Irrigation (96%)
Cyclades – Irrigation (77%) conflicts with tourist and domestic use (23%)
Resources to population index
Attica – 222
Thessaly – 4902
Cyclades - 1883
Water demand
Water Demand trends
Decreasing in Attica, Stable in Thessaly, Increasing in the Cyclades
Consumption index and Exploitation index
Attica – 69% and 49%
Thessaly – 38% and 31%
Cyclades – 50% and 15%


Economic and
Social issues - II
Pricing system
Average household income
€20,639 (Attica), €10,582 (Thessaly), €13,730 (Cyclades)
Average household budget for domestic water
0.6% (Attica), 1.4% (Thessaly), 1.7% (Cyclades)
Average household budget for agricultural water
No data
Cost recovery
Good in Attica, Poor in Thessaly and the Cyclades
Price elasticity
Fair in Attica, Low in Thessaly and the Cyclades
Social capacity building
Public participation in decisions
Poor
Public education on water conservation issues
Average to fair

Decision Making Process

- Water Resources Management
  - Water ownership
    - State ownership
  - Decision making level (municipal, regional, national) regarding:
    - Water supply for each sector:
      - National in Attica, Regional in Thessaly and Municipal in the Cyclades
    - Water resources allocation for each sector is National
- Water Policy
  - Local economy basis
    - Primary Sector in Thessaly, Tertiary sector in Attica and the Cyclades
  - Development priorities
    - Infrastructure (Attica), Agriculture (Thessaly), Tourism (Cyclades)

Attica

- Greek capital district
- Area: 3,207 km^2 (3,761,810 inhabitants)
- The region produces 36% of the GNP, mostly on tertiary sector activities
  - Economic activities are commerce, industry, agriculture and tourism
- Per capita product is €12,560
- Mean declared income per inhabitant €6930 in 2000
- 10.4% unemployment rate

Attica

- Attica WRM is under the direct control of the Ministry of the Environment
- Two main rivers, Illissos and Kifissos, but with little flow, highly polluted
- Total water availability 449 hm^3 vs. total annual water demand of 408 hm^3
  - Significant water quantities imported from Sterea Ellas Regions
- Drought periods in the 1990's introduced the need for
  - Pricing control of demand
  - Public awareness campaigns
- Only part of Greece where demand management through pricing control has been effective – EYDAP S.A.

Thessaly

- Area: 13,377 km^2 (753,848 inhabitants)
- The region produces 6.3% of the GNP
- Mean declared income per inhabitant €3550 in 2000
- Per capita product is €10,950
- 12.2% unemployment rate
- One main river, Pinios , and two major lakes, Lake Plastira and Lake Karla
- Total water availability 3,094 hm^3 vs. total annual water consumption of 1,171 hm^3
- Planned transfer of 600 hm^3 yearly from the Acheloos watershed
- Water shortage problems occur during the irrigation period, while in the winter floods occur in large areas

Thessaly

- Mostly Agricultural area
- Includes Larissa and Volos – Large urban centres with significant Industrial units
- Regional authorities encourage tourism development
- Water supply is not regulated by a single authority
  - The larger cities each have their own services providers
  - There is a number of independent local services, mostly through the municipalities
    - Pricing of water is a subject of political pressures
    - Cost recovery is on average poor
- Public discontent about current management framework

Cyclades

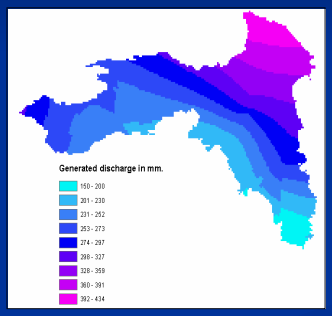
- Area: 2,553 km^2
- 24 inhabited islands (112,615 inhabitants)
- The region produces 1% of the GNP
- Per capita product €12,330
- 12% unemployment rate
- Mean declared income per inhabitant €4600 in 2000
- No major (permanent) surface water resources
- Total water availability 212 hm^3 vs. total annual water demand 30.95 hm^3
- Water shortage problems occur during the summer period – in some islands at peak season, the tourist population can be 30x the local population

Cyclades

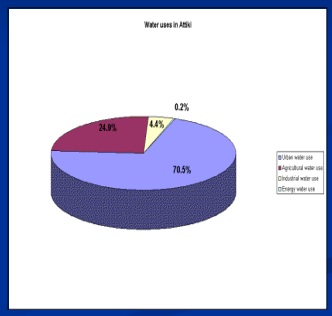
- In some islands overexploitation of the underground aquifers has led to salinisation
- Major water consumer is agriculture, while the major economic activity is tourism - conflict
- Desalination plants are used to cover water demand in some islands and in others water is imported with tankers
- Several small (local) water services suppliers, mostly municipalities or municipal water authorities
- Pricing of water is subject to political pressures

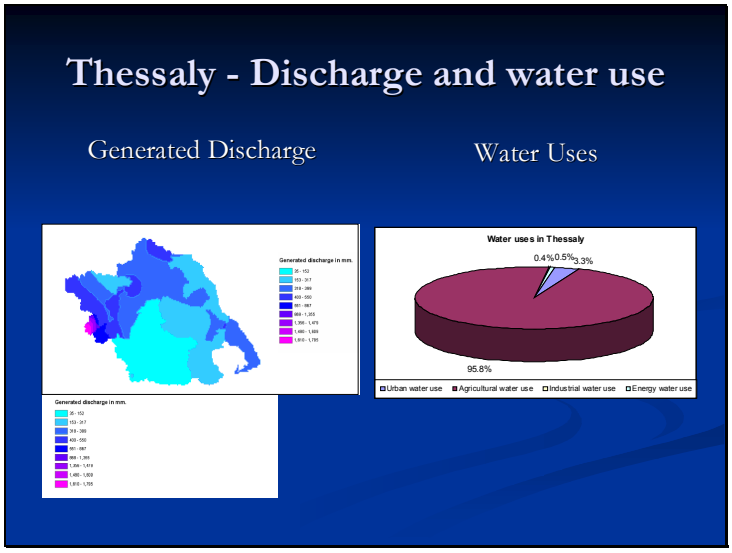
Attica - Discharge and water use

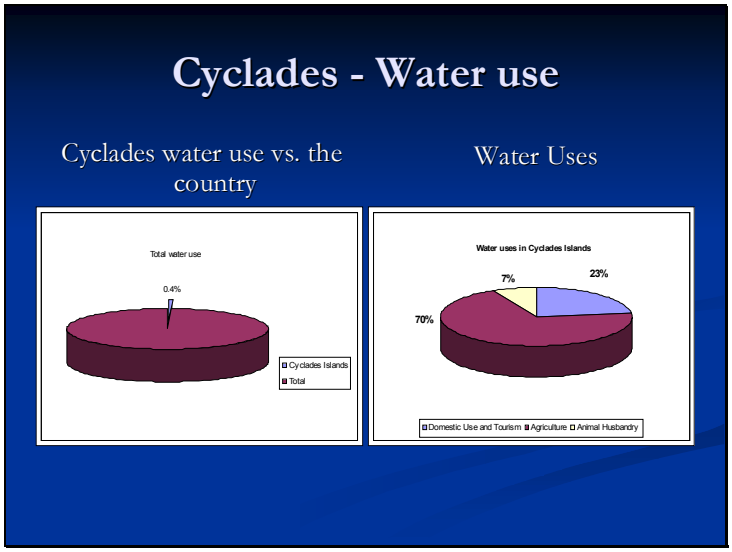
Generated Discharge



Water Uses




Thessaly - Discharge and water use
Generated Discharge
Water Uses
Water uses in Thessaly
0.4%
0.5%
3.3%
95.8%
Urban water use
Agricultural water use
Industrial water use
Energy water use


Cyclades - Water use
Cyclades water use vs. the country
Water Uses
Total water use
0.4%
Cyclades Islands
Total
Water uses in Cyclades Islands
7%
23%
70%
Domestic Use and Tourism
Agriculture
Animal Husbandry

WaterStrategyMan

EVK1-CT-2001-00098

Report on Italy:

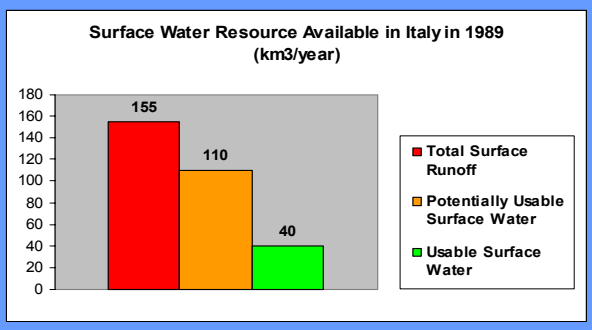
Range of Existing Circumstances and Region Analysis

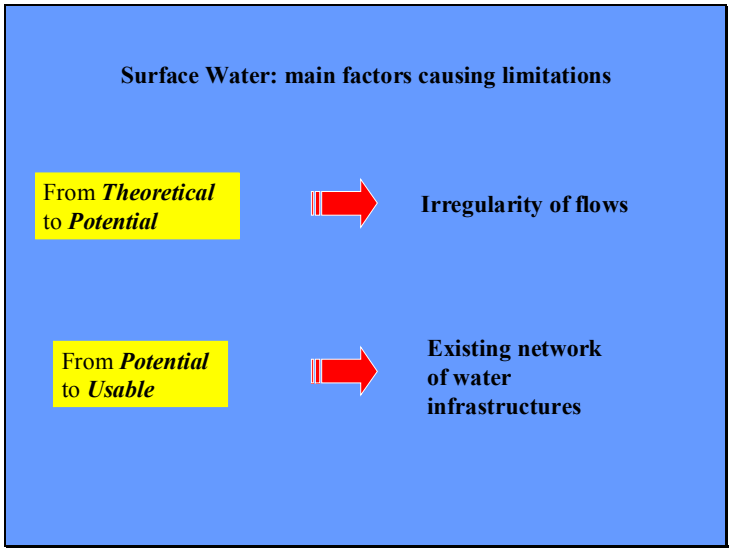
Report on Italy - Part 1

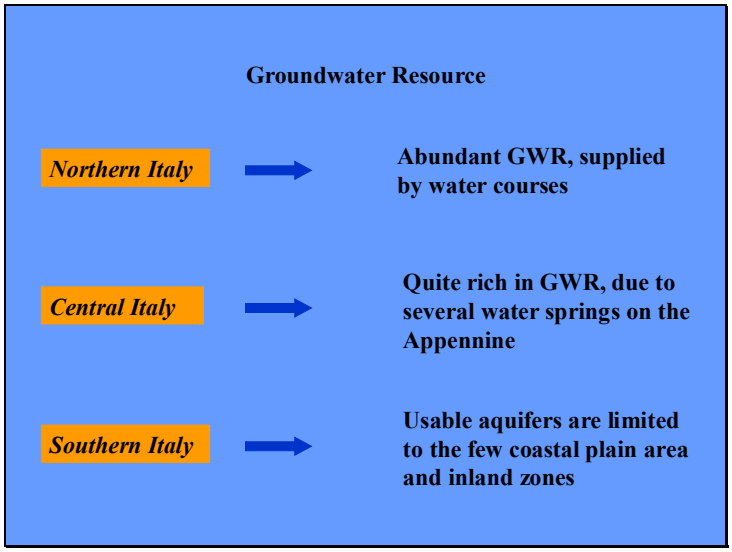
Country Overview

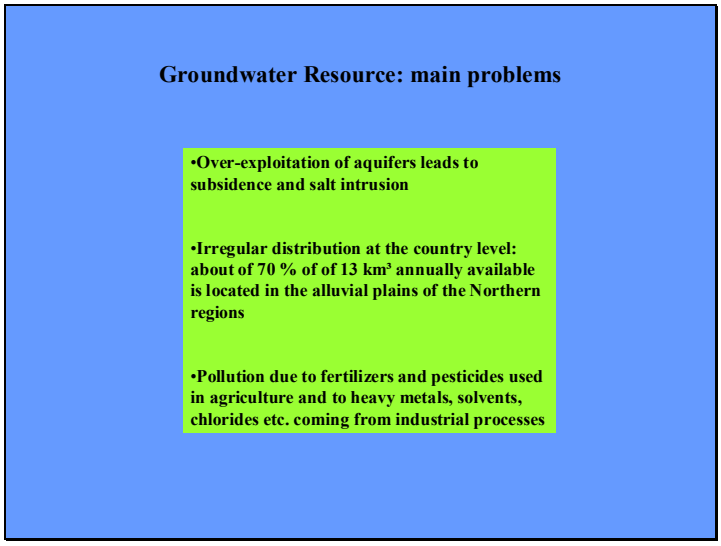
WATER DEMAND
AND
SUPPLY STATUS

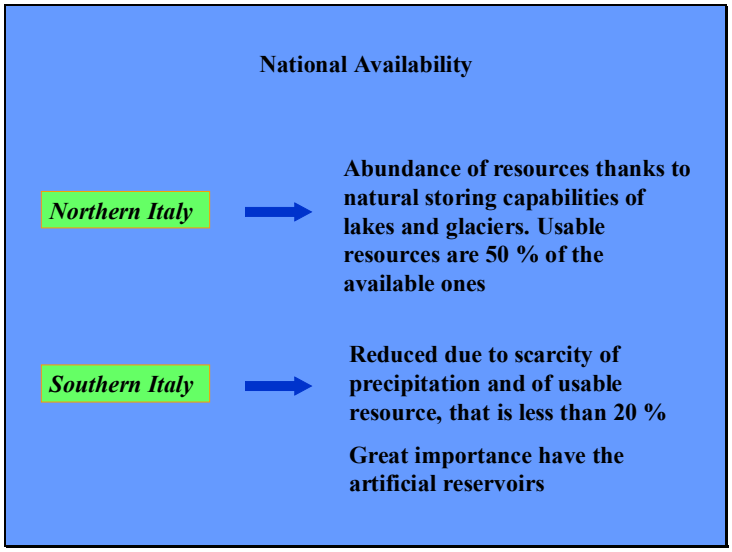
Surface Water: Theoretical vs Potential vs Usable

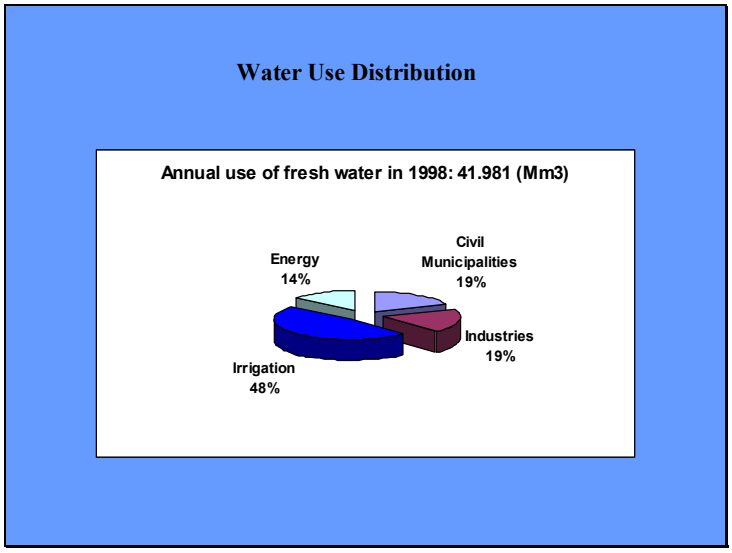


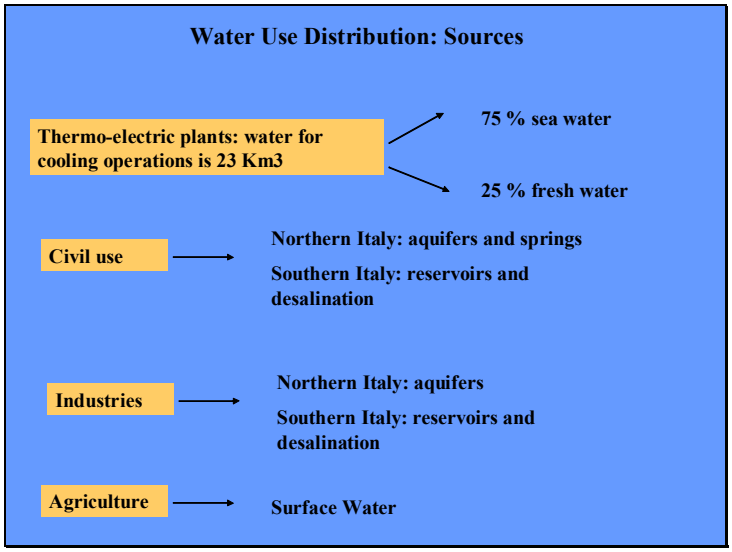

Surface Water: main factors causing limitations
From *Theoretical* to *Potential*
Irregularity of flows
From *Potential* to *Usable*
Existing network of water infrastructures


Groundwater Resource
Northern Italy
Abundant GWR, supplied by water courses
Central Italy
Quite rich in GWR, due to several water springs on the Appennine
Southern Italy
Usable aquifers are limited to the few coastal plain area and inland zones


Groundwater Resource: main problems
•Over-exploitation of aquifers leads to subsidence and salt intrusion
•Irregular distribution at the country level: about of 70 % of of 13 km³ annually available is located in the alluvial plains of the Northern regions
•Pollution due to fertilizers and pesticides used in agriculture and to heavy metals, solvents, chlorides etc. coming from industrial processes


National Availability
Northern Italy
Abundance of resources thanks to natural storing capabilities of lakes and glaciers. Usable resources are 50 % of the available ones
Southern Italy
Reduced due to scarcity of precipitation and of usable resource, that is less than 20 %
Great importance have the artificial reservoirs

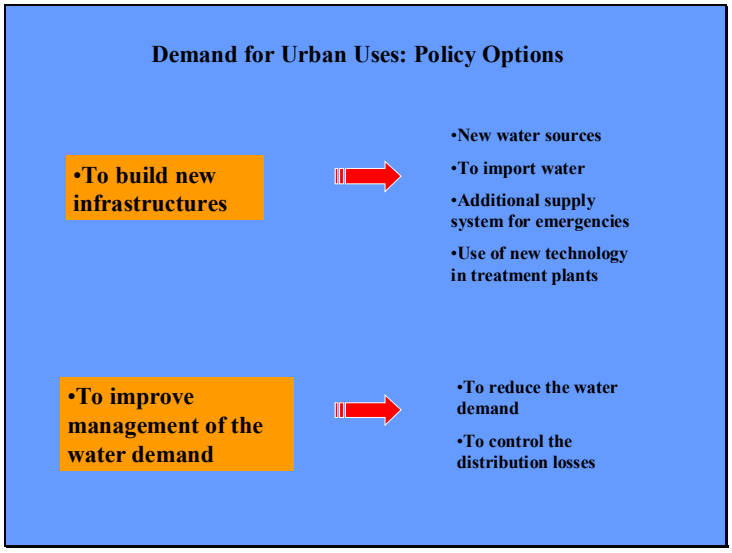

Water Use Distribution
Annual use of fresh water in 1998: 41.981 (Mm3)
Energy
14%
Civil
Municipalities
19%
Industries
19%
Irrigation
48%

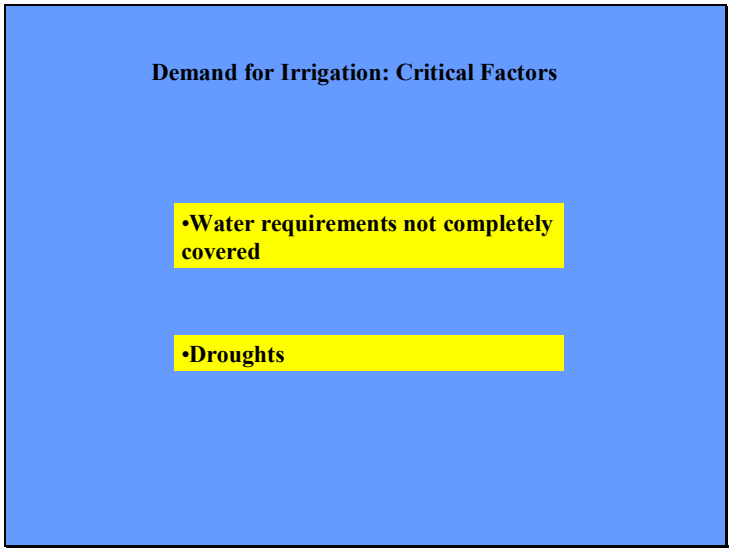

Water Use Distribution: Sources
Thermo-electric plants: water for cooling operations is 23 Km3
75 % sea water
25 % fresh water
Civil use
Northern Italy: aquifers and springs
Southern Italy: reservoirs and desalination
Industries
Northern Italy: aquifers
Southern Italy: reservoirs and desalination
Agriculture
Surface Water

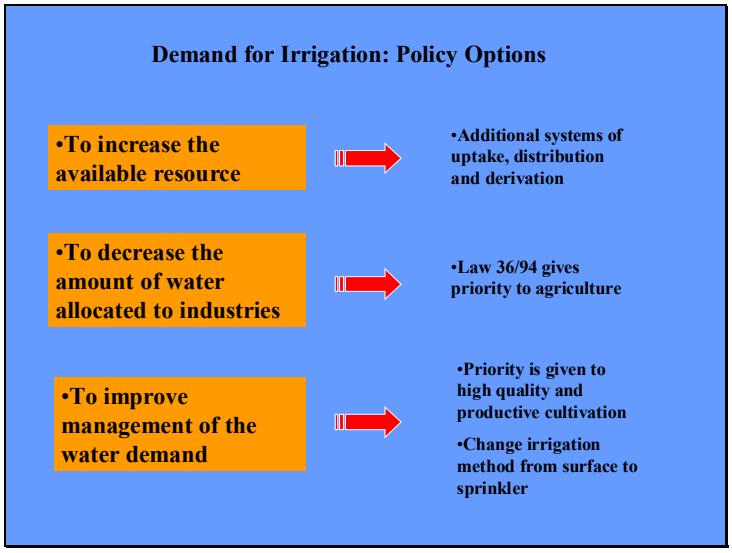
MANAGEMENT
AND
POLICY OPTIONS

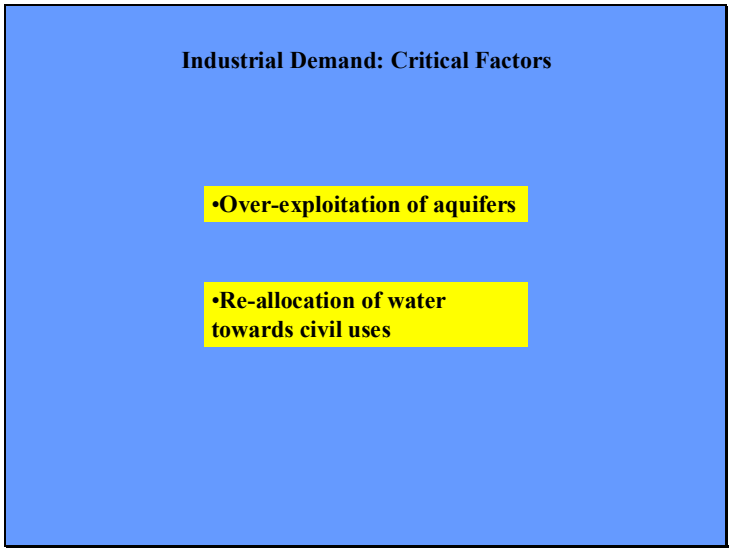
Demand for Urban Uses: Critical Factors

- **Growth of population near industrial sites**
- **Insufficient management of the distribution network**
- **Tourist presence**
- **Pollutant loads in aquifers**


Demand for Urban Uses: Policy Options
•To build new infrastructures
•New water sources
•To import water
•Additional supply system for emergencies
•Use of new technology in treatment plants
•To improve management of the water demand
•To reduce the water demand
•To control the distribution losses


Demand for Irrigation: Critical Factors
•Water requirements not completely covered
•Droughts


Demand for Irrigation: Policy Options
•To increase the available resource
•Additional systems of uptake, distribution and derivation
•To decrease the amount of water allocated to industries
•Law 36/94 gives priority to agriculture
•To improve management of the water demand
•Priority is given to high quality and productive cultivation
•Change irrigation method from surface to sprinkler


Industrial Demand: Critical Factors
•Over-exploitation of aquifers
•Re-allocation of water towards civil uses

Industrial Demand: Policy Options

- **The conjunctive use of the supply and distribution system serving irrigation**
- **A more efficient allocation of available resources**

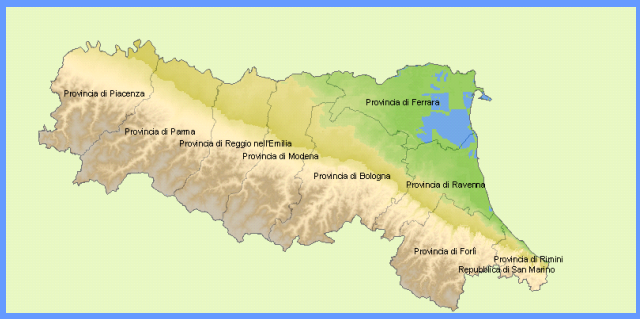
Report on Italy - Part 2

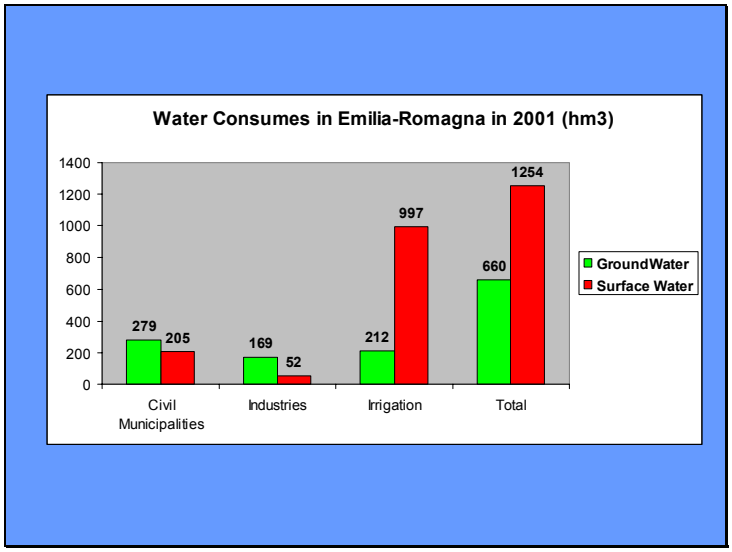
Proposed regions

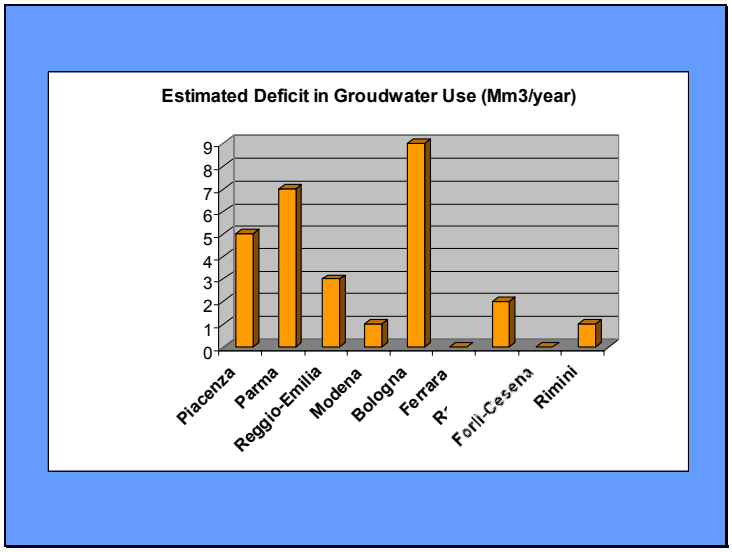
The Proposed Regions

- **EMILIA-ROMAGNA**
- **SICILY**

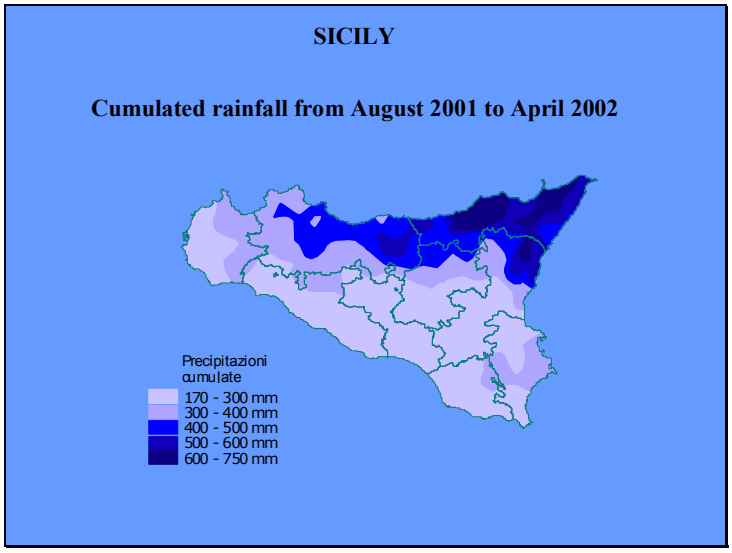
EMILIA-ROMAGNA

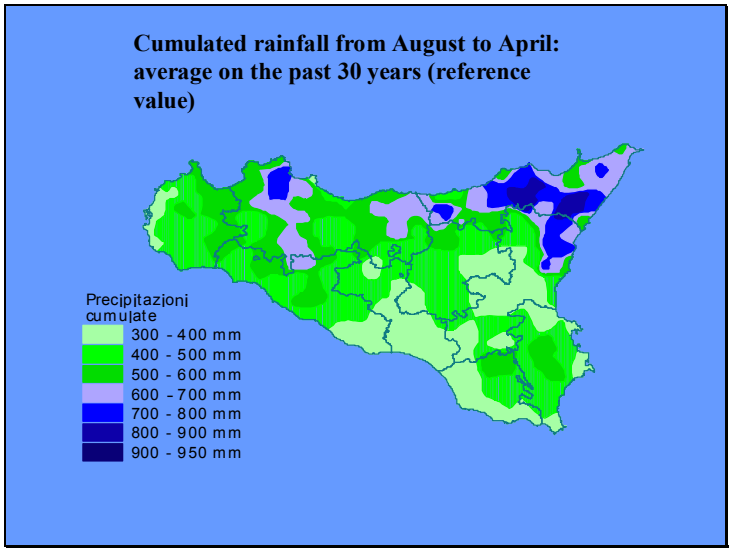



Water Consumes in Emilia-Romagna in 2001 (hm3)
1400
1200
1000
800
600
400
200
0
279
205
169
52
212
997
660
1254
Civil Municipalities
Industries
Irrigation
Total
GroundWater
Surface Water


Estimated Deficit in Groudwater Use (Mm3/year)
9
8
7
6
5
4
3
2
1
0
Piacenza
Parma
Reggio-Emilia
Modena
Bologna
Ferrara
Forlì-Cesena
Rimini

AREA	2000	2001	TREND % (2001-2000)	DIFF.
Adriatic Coast	39.475.000	40.690.000	+3,1%	+1.125.000
Appennine	2.812.000	2.835.000	+0,8%	+23.000
Cities	3.403.000	3.480.000	+2,3%	+77.000
Watering places	1.994.000	2.025.000	+1,6%	+31.000
Total	47.684.000	49.030.000	+2,8%	+1.346.000


SICILY
Cumulated rainfall from August 2001 to April 2002
Precipitazioni cumulate
170 - 300 mm
300 - 400 mm
400 - 500 mm
500 - 600 mm
600 - 750 mm


Cumulated rainfall from August to April: average on the past 30 years (reference value)
Precipitazioni cumulate
300 - 400 mm
400 - 500 mm
500 - 600 mm
600 - 700 mm
700 - 800 mm
800 - 900 mm
900 - 950 mm

Report on Israeli Water System: General Description and Data

- SUMMARY -

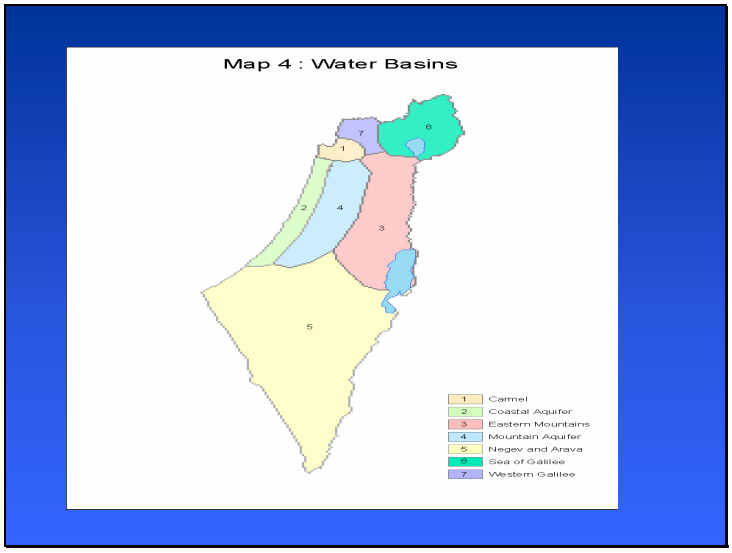
Prepared by:

Eli Feinerman – The Hebrew University of Jerusalem, and

Gadi Rosenthal – Kivun – Strategy & Economics Ltd.

June 2002

Geographic Location of Israel



Country Profile

- Area: 22,145 square kms.
- Length: 429km. Width: varies between 16 to150 km.
- Population: 6.4 million (90% live in urban areas).
- GDF per capita: 17,500 dollars.
- Climate: a short, cool and rainy winter and a long, hot dry summer.

Rainfall is poorly distributed: varies from 700 mm annually in the north to about 30 mm annually in the south.

Spatially Variable Aridity Index (AI)

(1) 0.5 – 0.65 (Dry sub – humid lands): Coastal Plain, the Northern Valley and the Galilee.

(2) 0.2 – 0.5 (Semi – arid) the Northern Negev, Northern Jordan Valley, Kinarot and Hula Valleys.

(3) 0.05 – 0.2 (Arid) Western Negev, Be'er Sheva Valley, Southern Jordan Vallry.

(4) > 0.05 (Hyperarid) Southern Negev, Dead Sea Basin, Arava Valley.

Approximately half of the area of Israel may be considered practically a dry desert.

Basic Existing Conditions of Israel's Water Economy

- General: – Very developed water economy (technologically & economically)
  - – Severe crisis
- Main features of the crisis
  - – Freshwater deficit
  - – Shortage for agricultural uses
  - – Deterioration of fresh water quality
  - – Environmental crisis:
    - ‹ Drying up of rivers and lake
    - ‹ Contamination of rivers

Factors Contributing to the Crisis

- Over pumping of fresh sources (more than natural recharge)
- Causing increasing salinity (from the sea and saline springs)
- Climatic changes: trend of decline of natural renewal of aquifers
- Hydro politics
- Population and economic growth: growing households & industrial demand
- Neighboring entities' demand

Factors Contributing to the Crisis

- Unsettled conflict about allocation scheme to agricultural sector, administrative vs. pricing
- Regulator's weakness
- Inefficient governmental allocation schemes
- Slow transfer from fresh to recycled water for agricultural irrigation
- Lack of awareness and enforcement of environmental - ecological concerns
- Over-bureaucracy of regulating systems

Water Institutions

- There is no private ownership of water in Israel. All water is publicly owned and its utilization controlled by the Water Commission.
- Allocation is administrative: the Commission issues permits for production (extraction) to suppliers as well as allocations (quotas) for consumers.
- Trading in water quotas is forbidden.

Pricing Practices

- Water prices are uniform throughout the country, varying only by sector and quality. Prices for agricultural use are lower than prices for industrial and urban use. Prices for brackish water are lower than prices for fresh water.
- Tiered pricing is levied on agricultural users.

Prices (US $ per m³)			
Agricultural :	fresh	0.22	(average)
	recycled	0.12	
Municipalities :		0.35	
Industrial uses :		0.30	

Pricing Practices

- Water prices for water delivered by the national company, Mekorot, are determined by the government in a process open to political pressure (skillfully applied by the agricultural lobby).
- Private water suppliers set prices with little government interference.
- Extraction Levy: new form of "scarcity prices" aimed at reflecting the "scarcity value" of water in the ground water aquifers.
- Prices charged by Mekorot on agricultural users are subsidized, with the government covering approximately 20% of the cost of supplying the water.

Israel: One Water Region

In principle, Israel should only be examined as a single geographic entity, for the following reasons:

- The National Water Carrier (NWC) connects all major sources of freshwater into a single network. In addition to this, there are some additional major pipelines connecting various regions.
- Recycled water. The Shafdan, a plant for the treatment of urban and industrial effluent of the greater Tel Aviv metropolitan area, is responsible for transferring recycled water to the southern region for agricultural use.

Israel: One Water Region

- Pricing policy. Water prices by quality and sector (agricultural, industrial, urban) are more or less uniform throughout the country.
- Water administration is highly centralized, with utilization controlled by the Water Commission. Some 60% of the water in Israel is supplied by the national water company, Mekorot, (wholly owned by the government), which is also the sole owner of the National Water Carrier and the Shafdan.

Long-term Average Fresh Water Sources

Basin	Average Annual Recharge (MCM)
• Coastal Aquifer	300
• Mountain Aquifer	360
• Sea of Galilee	550
• Other basins	280
• TOTAL	1490

General Water Supply Balance (MCM/year)[1]

	Normal year (1998)	Crisis year (2002, estimate)	Future average Year (2010)
Aquifers (including saline)	1975 (88%)	1432 (82.5%)	1398 (60%)
Desalination	—	5 (0.5%)	500 (19%)
Recycled	276 (12%)	298 (17%)	509 (21%)
TOTAL	2251	1735	2407

Water Demand by Sector (MCM/year)[1]

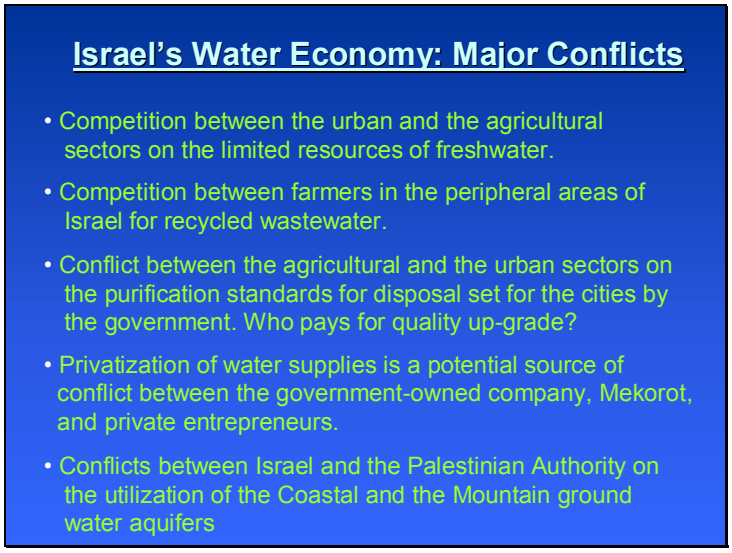
	1998		2002 (estimate)		2010 (projected)	
Domestic	694	31%	680	39%	875	36%
Industrial	129	6%	131	8%	167	7%
Agricultural	1326	59%	837	48%	1165	48%
Environment	4	—	2	—	40	2%
Jordan & PA	98	4%	85	5%	160	7%
TOTAL	**2251**	**100%**	**1735**	**100%**	**2407**	**100%**

The Salinity Problem

- Local spots of brackish water in certain regions, which together amount to about 160 mcm per year.
- Long run trend of increasing salinity over time in most natural water sources. This process results from a few factors:
  - Reduction of natural drainage and natural salt reaching the sea, due to the very intensive exploitation of Israel's water sources.
  - Intrusion of seawater in some locations along the coastal plain.
  - Import of salts with irrigation water from Lake Kinneret to the regions served by the National Water Carrier (NWC)
  - Irrigation with treated wastewater.

The New Strategy (Adopted in Principle)

- Intensive desalination
- Agricultural shift to recycled water
- Higher quality of treated effluents
- Water allocation for agriculture: more by prices, less by quota (Price Reform)
- Privatization (especially of new facilities), B-O-T
- Increased attention for environmental benefits

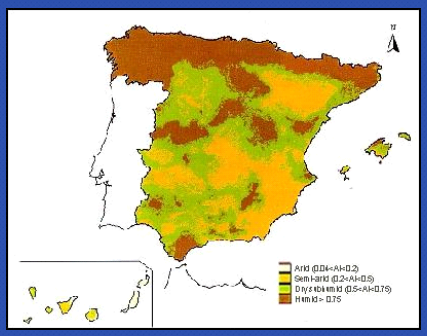

Israel's Water Economy: Major Conflicts
• Competition between the urban and the agricultural sectors on the limited resources of freshwater.
• Competition between farmers in the peripheral areas of Israel for recycled wastewater.
• Conflict between the agricultural and the urban sectors on the purification standards for disposal set for the cities by the government. Who pays for quality up-grade?
• Privatization of water supplies is a potential source of conflict between the government-owned company, Mekorot, and private entrepreneurs.
• Conflicts between Israel and the Palestinian Authority on the utilization of the Coastal and the Mountain ground water aquifers

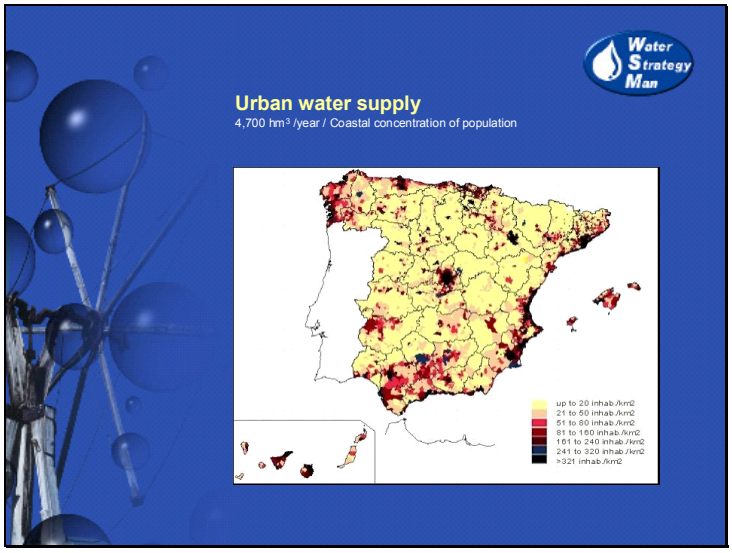
SPAIN

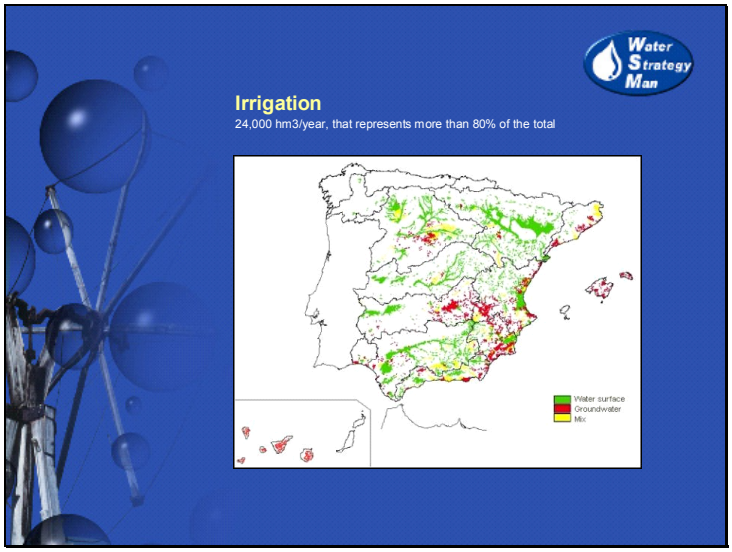
Range of circumstances and region analysis

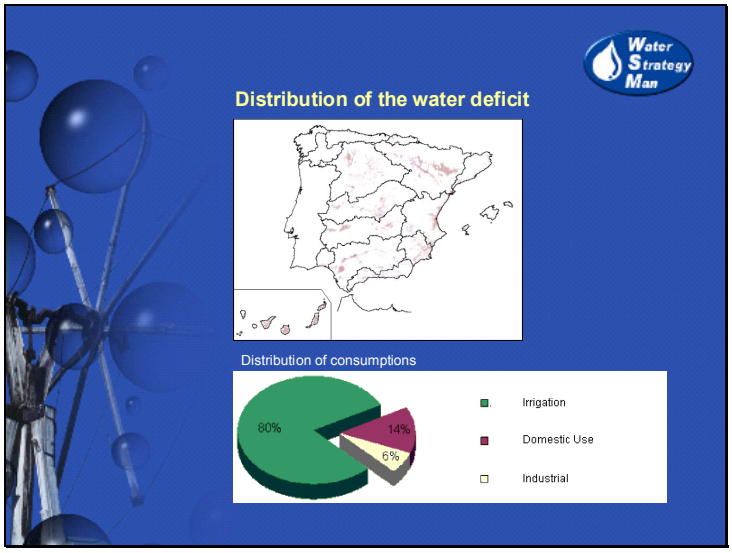
Cipriano Marin
INSULA
Syros Workshop July, 2002

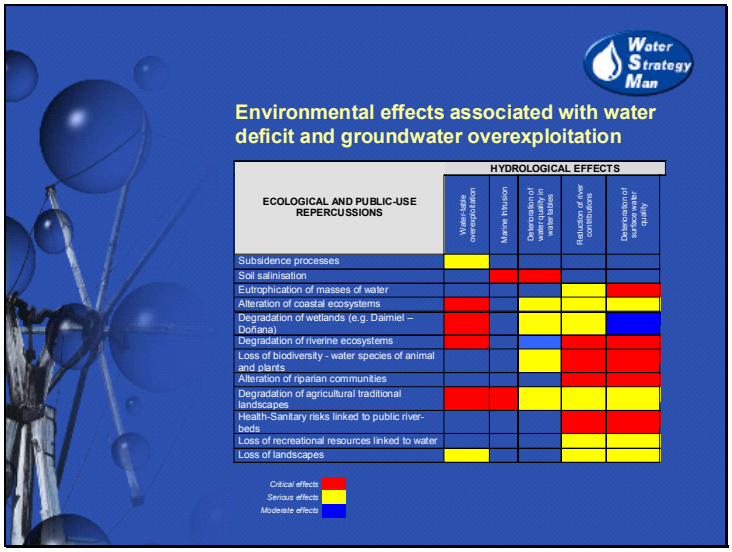
Climatic classification according with the UNESCO's humidity index

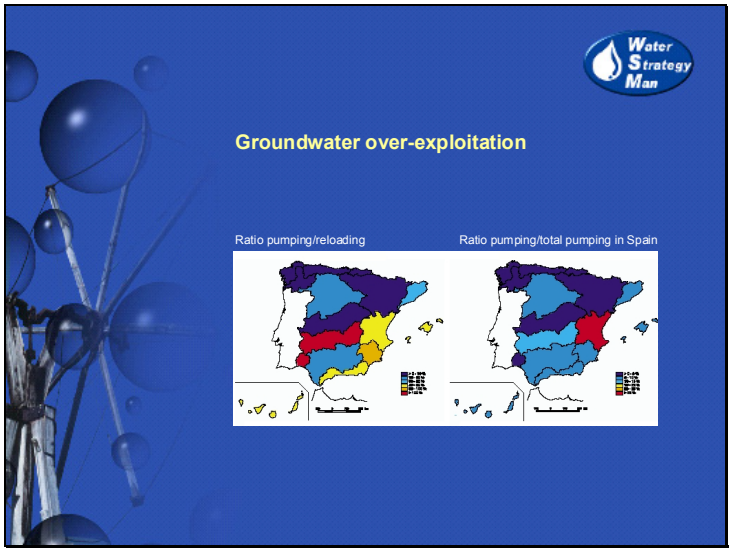


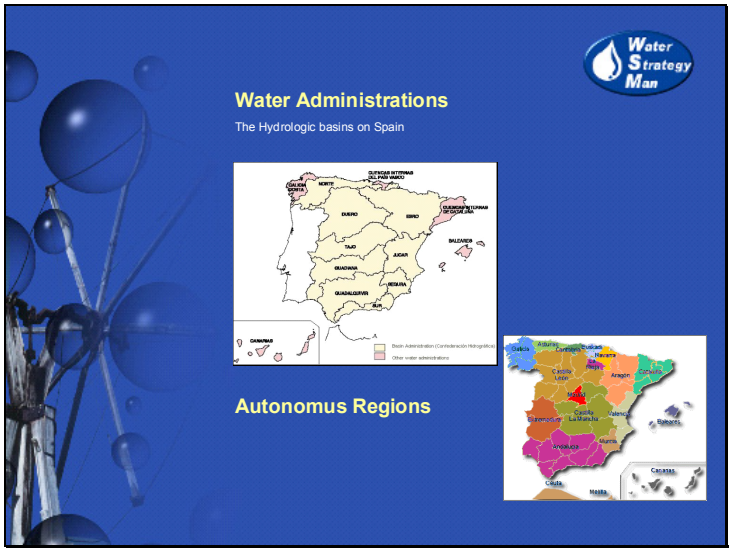

Water Strategy Man
Urban water supply
4,700 hm³ /year / Coastal concentration of population
up to 20 inhab./km2
21 to 50 inhab./km2
51 to 80 inhab./km2
81 to 160 inhab./km2
161 to 240 inhab./km2
241 to 320 inhab./km2
>321 inhab./km2

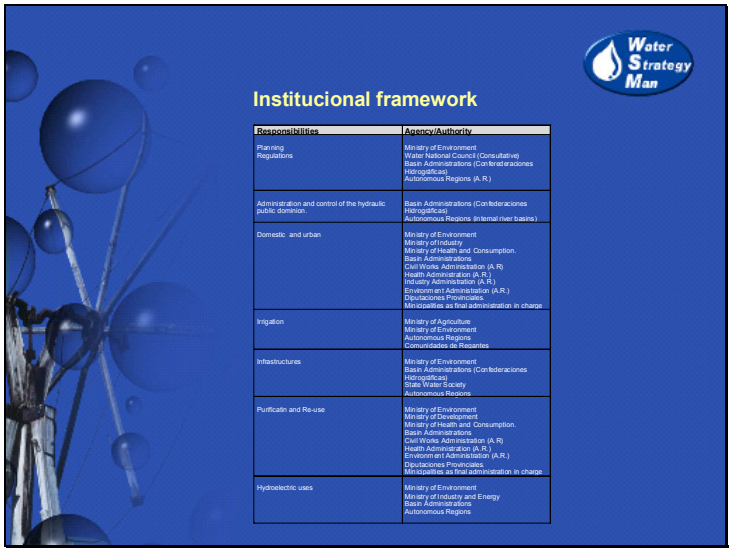

Water Strategy Man
Irrigation
24,000 hm3/year, that represents more than 80% of the total
Water surface
Groundwater
Mix

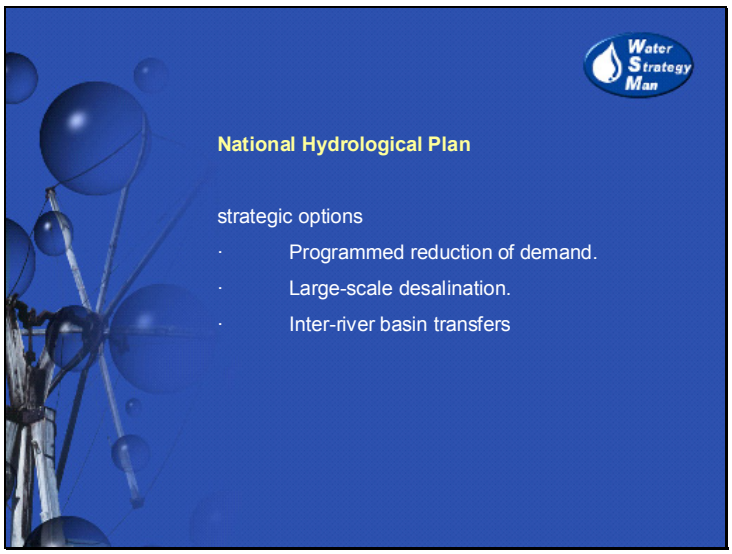

Water Strategy Man
Distribution of the water deficit
Distribution of consumptions
80%
14%
6%
Irrigation
Domestic Use
Industrial

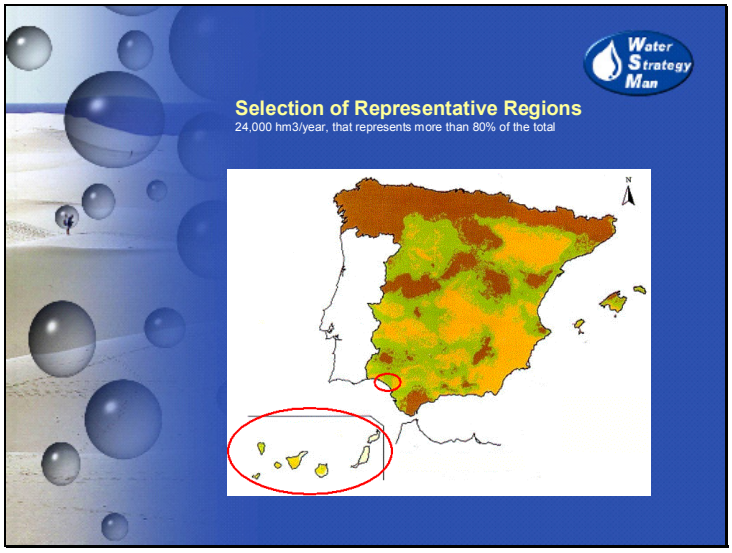

Water Strategy Man
Environmental effects associated with water deficit and groundwater overexploitation
ECOLOGICAL AND PUBLIC-USE REPERCUSSIONS
HYDROLOGICAL EFFECTS
Water-table overexploitation
Marine intrusion
Deterioration of water quality in water table
Reduction of river contributions
Deterioration of surface water quality
Subsidence processes
Soil salinisation
Eutrophication of masses of water
Alteration of coastal ecosystems
Degradation of wetlands (e.g. Daimiel – Doñana)
Degradation of riverine ecosystems
Loss of biodiversity - water species of animal and plants
Alteration of riparian communities
Degradation of agricultural traditional landscapes
Health-Sanitary risks linked to public river-beds
Loss of recreational resources linked to water
Loss of landscapes
Critical effects
Serious effects
Moderate effects

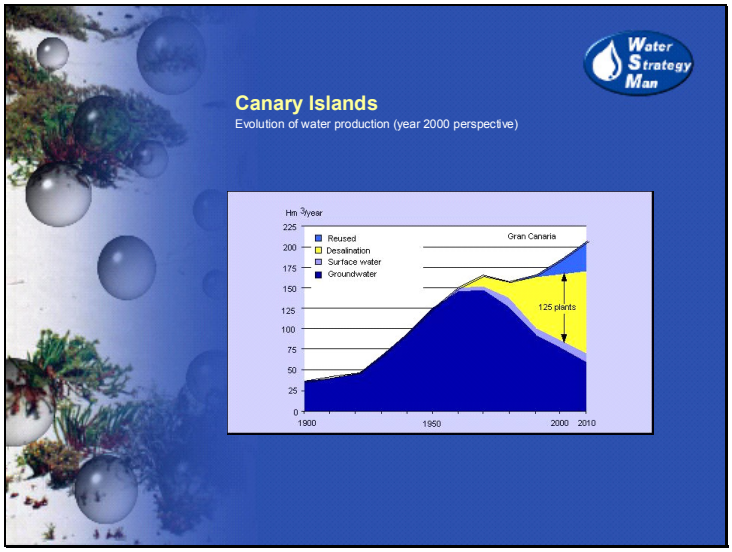

Groundwater over-exploitation
Ratio pumping/reloading
Ratio pumping/total pumping in Spain

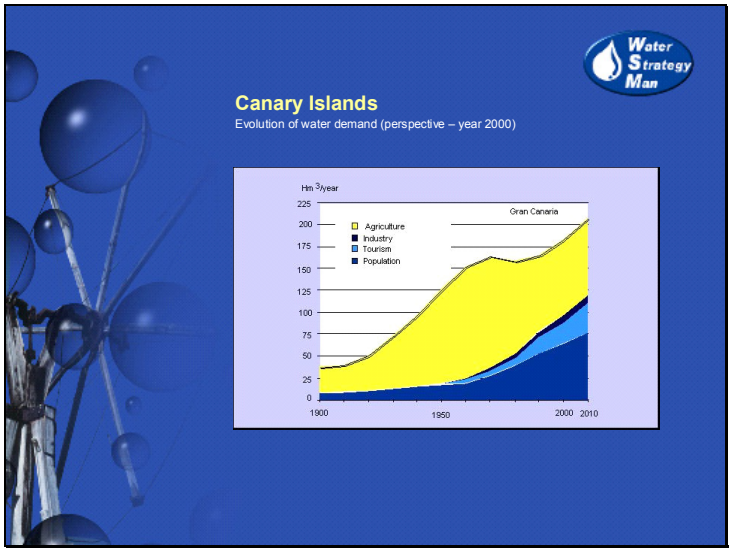

Water Administrations
The Hydrologic basins on Spain
Autonomus Regions

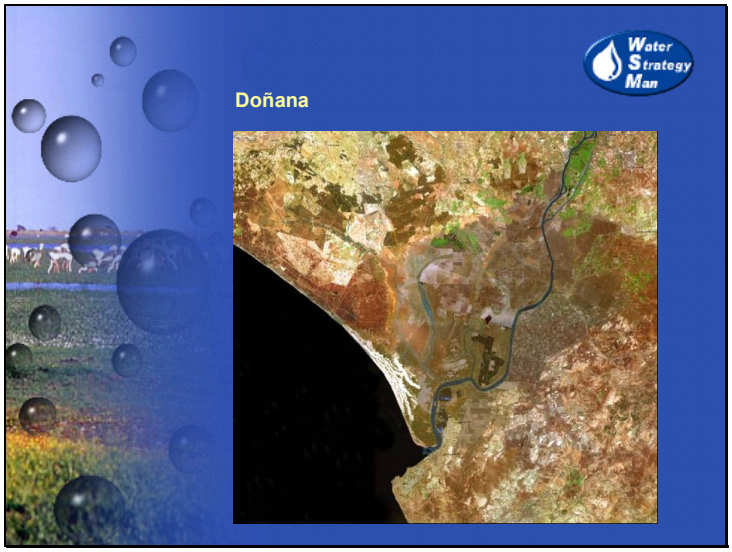

Water Strategy Man
Institucional framework
Responsibilities
Agency/Authority
Planning
Regulations
Ministry of Environment
Water National Council (Consultative)
Basin Administrations (Confederaciones Hidrográficas)
Autonomous Regions (A.R.)
Administration and control of the hydraulic public dominion.
Basin Administrations (Confederaciones Hidrográficas)
Autonomous Regions (internal river basins)
Domestic and urban
Ministry of Environment
Ministry of Industry
Ministry of Health and Consumption.
Basin Administrations
Civil Works Administration (A.R)
Health Administration (A. R.)
Industry Administration (A.R.)
Environment Administration (A.R.)
Diputaciones Provinciales
Municipalities as final administration in charge
Irrigation
Ministry of Agriculture
Ministry of Environment
Autonomous Regions
Comunidades de Regantes
Infrastructures
Ministry of Environment
Basin Administrations (Confederaciones Hidrográficas)
State Water Society
Autonomous Regions
Purificatin and Re-use
Ministry of Environment
Ministry of Development
Ministry of Health and Consumption.
Basin Administrations
Civil Works Administration (A.R)
Health Administration (A. R.)
Environment Administration (A.R.)
Diputaciones Provinciales
Municipalities as final administration in charge
Hydroelectric uses
Ministry of Environment
Ministry of Industry and Energy
Basin Administrations
Autonomous Regions


Water Strategy Man
National Hydrological Plan
strategic options
· Programmed reduction of demand.
· Large-scale desalination.
· Inter-river basin transfers

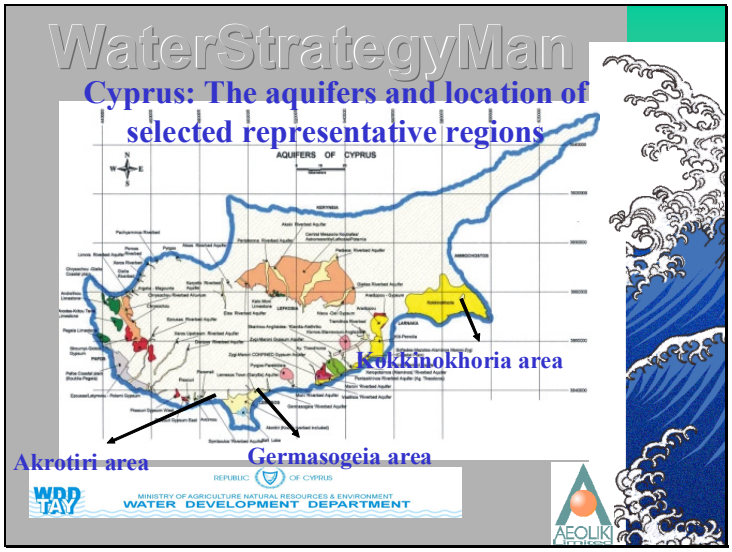

Water Strategy Man
Selection of Representative Regions
24,000 hm3/year, that represents more than 80% of the total
N

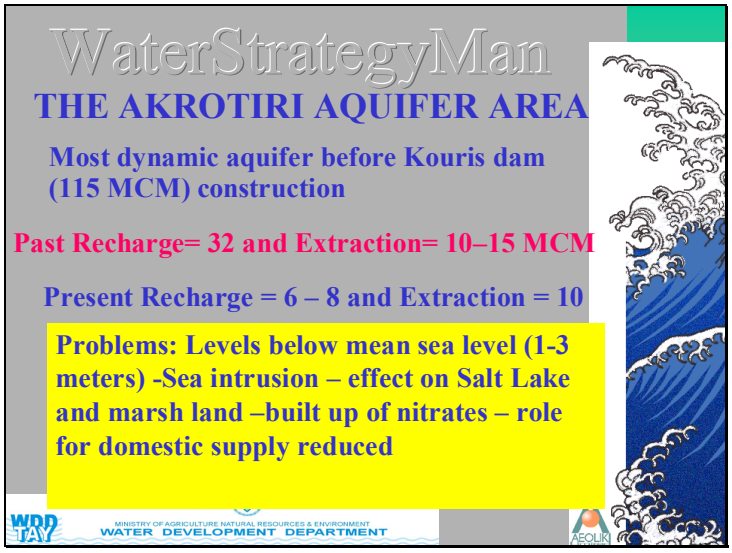

Water Strategy Man
Canary Islands
Evolution of water production (year 2000 perspective)
Hm 3/year
225
200
175
150
125
100
75
50
25
0
Reused
Desalination
Surface water
Groundwater
Gran Canaria
125 plants
1900
1950
2000
2010

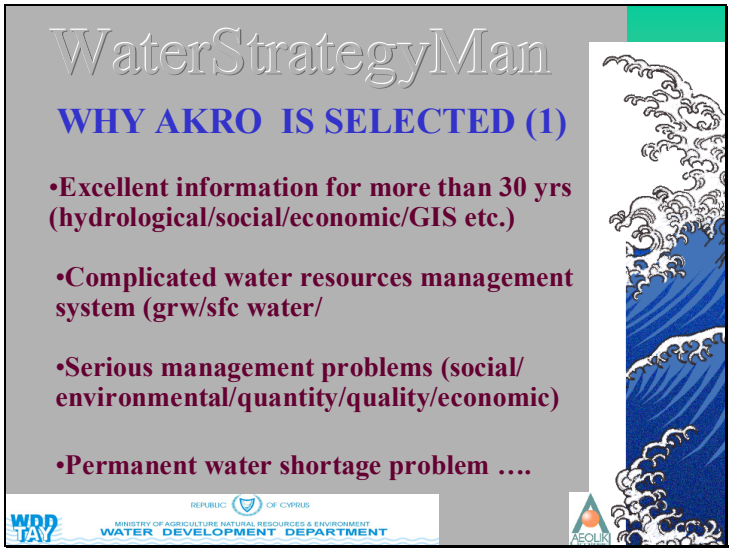

Canary Islands
Evolution of water demand (perspective – year 2000)
Hm 3/year
225
200
175
150
125
100
75
50
25
0
Gran Canaria
Agriculture
Industry
Tourism
Population
1900
1950
2000
2010

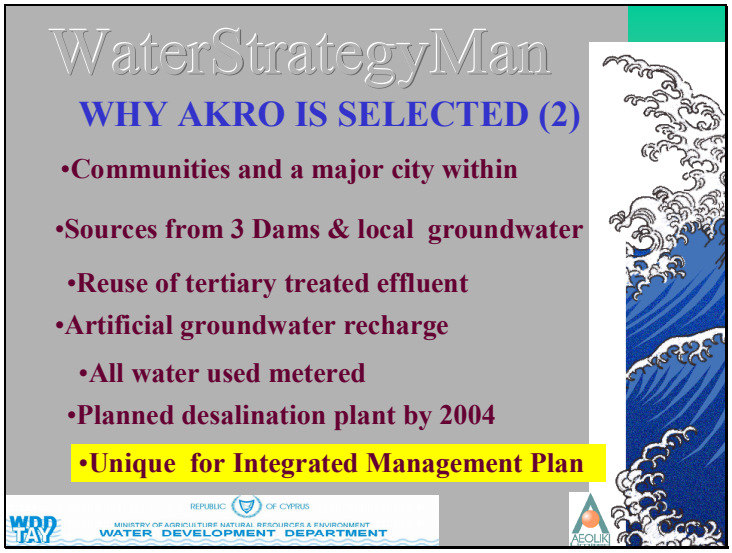

Doñana

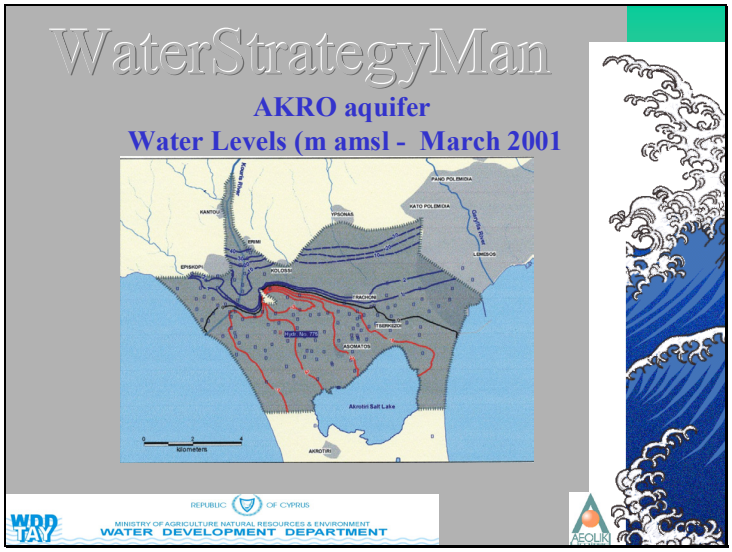

DEVELOPING STRATEGIES FOR REGULATING AND MANAGING WATER RESOURCES AND DEMAND IN WATER DEFICIENT REGIONS
WaterStrategyMan
WORKSHOP
Hermoupolis, Syros Island
8 July 2002
CYPRUS: SELECTED PARADIGM AREAS
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT
AEOLIKI

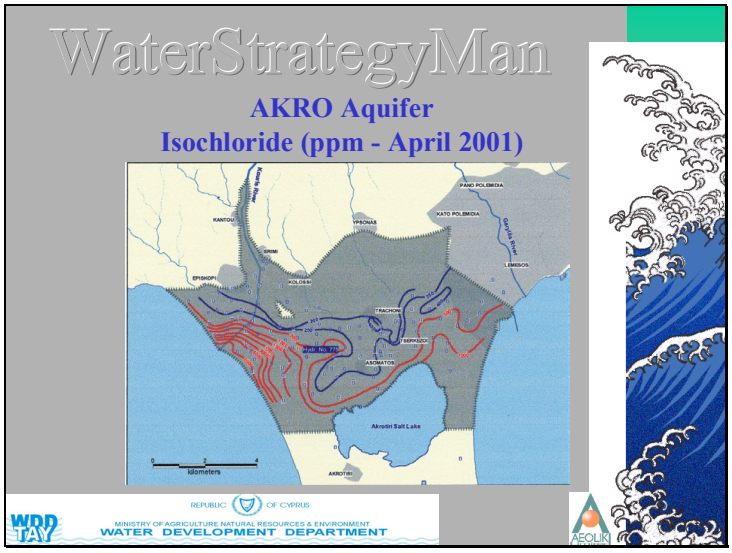

WaterStrategyMan
Cyprus: The aquifers and location of selected representative regions
AQUIFERS OF CYPRUS
Kokkinokhoria area
Akrotiri area
Germasogeia area
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT
AEOLIKI

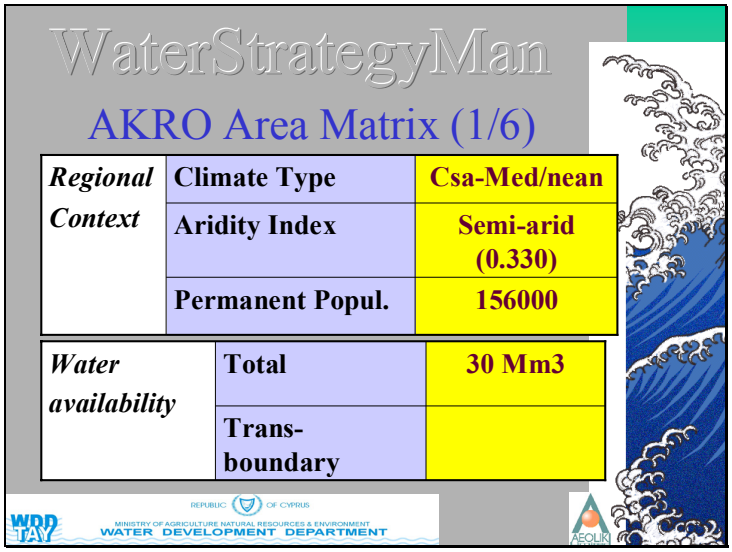

WaterStrategyMan
THE AKROTIRI AQUIFER AREA
Most dynamic aquifer before Kouris dam (115 MCM) construction
Past Recharge= 32 and Extraction= 10–15 MCM
Present Recharge = 6 – 8 and Extraction = 10
Problems: Levels below mean sea level (1-3 meters) -Sea intrusion – effect on Salt Lake and marsh land –built up of nitrates – role for domestic supply reduced
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT

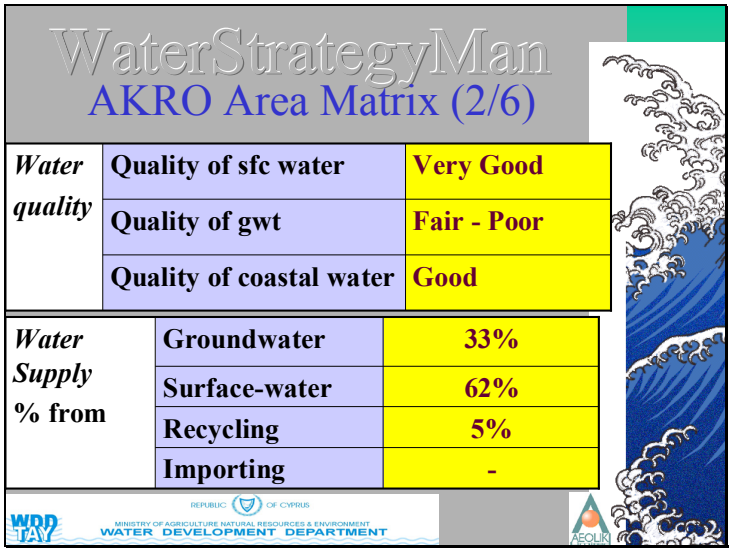

WaterStrategyMan
WHY AKRO IS SELECTED (1)
•Excellent information for more than 30 yrs (hydrological/social/economic/GIS etc.)
•Complicated water resources management system (grw/sfc water/
•Serious management problems (social/ environmental/quantity/quality/economic)
•Permanent water shortage problem ….
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT

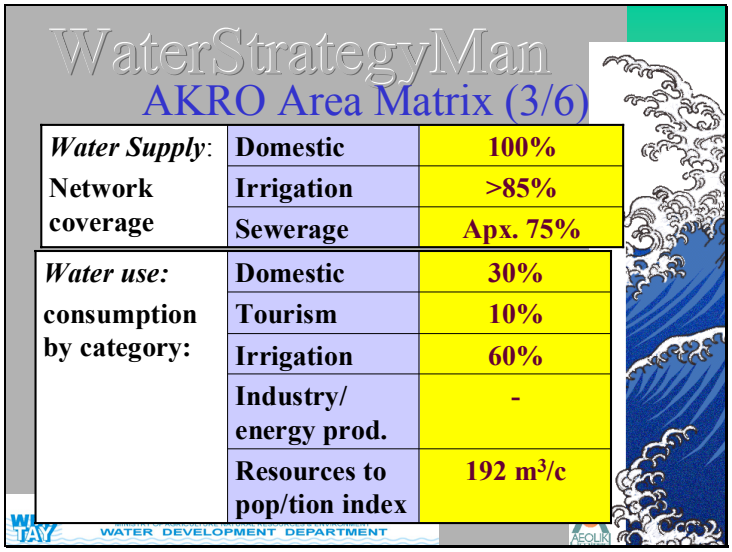

WaterStrategyMan
WHY AKRO IS SELECTED (2)
•Communities and a major city within
•Sources from 3 Dams & local groundwater
•Reuse of tertiary treated effluent
•Artificial groundwater recharge
•All water used metered
•Planned desalination plant by 2004
•Unique for Integrated Management Plan
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT

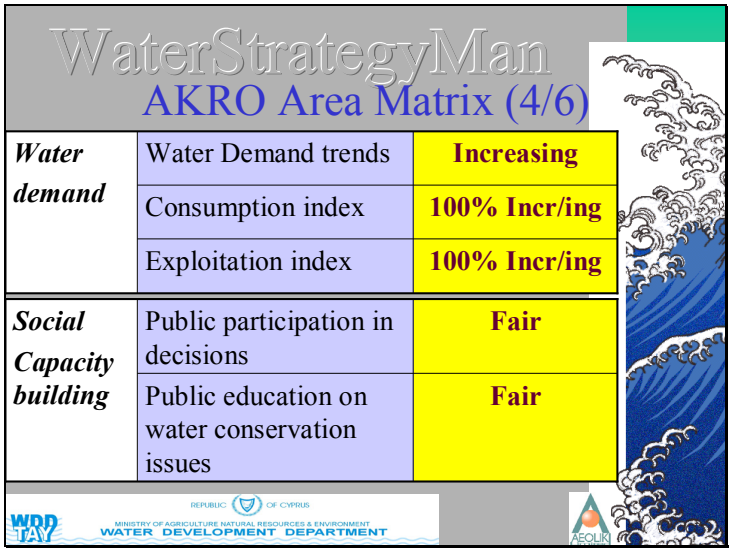

WaterStrategyMan
AKRO aquifer
Water Levels (m amsl - March 2001
Akrotiri Salt Lake
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT

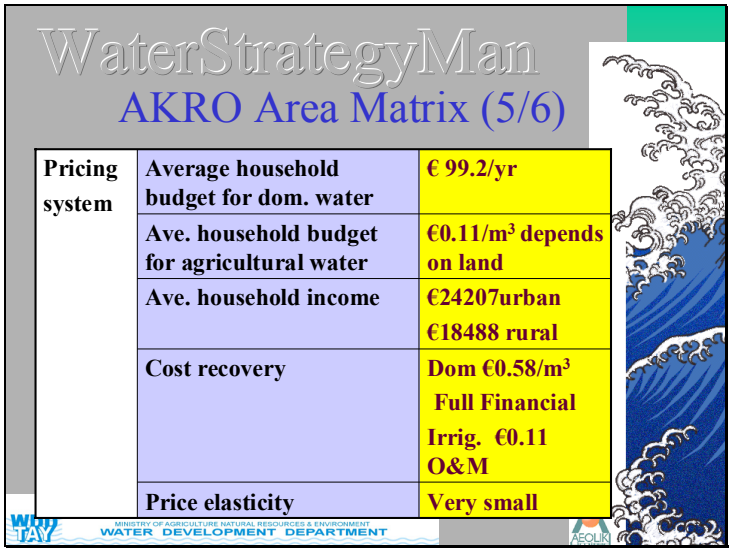

WaterStrategyMan
AKRO Aquifer
Isochloride (ppm - April 2001)
Akrotiri Salt Lake
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
AKRO Area Matrix (1/6)
Regional Context
Climate Type
Csa-Med/nean
Aridity Index
Semi-arid (0.330)
Permanent Popul.
156000
Water availability
Total
30 Mm3
Trans-boundary
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
AKRO Area Matrix (2/6)
Water quality
Quality of sfc water
Very Good
Quality of gwt
Fair - Poor
Quality of coastal water
Good
Water Supply % from
Groundwater
33%
Surface-water
62%
Recycling
5%
Importing
-
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE, NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
AKRO Area Matrix (3/6)
Water Supply: Network coverage
Domestic
100%
Irrigation
>85%
Sewerage
Apx. 75%
Water use: consumption by category:
Domestic
30%
Tourism
10%
Irrigation
60%
Industry/ energy prod.
-
Resources to pop/tion index
192 m3/c
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
AKRO Area Matrix (4/6)
Water demand
Water Demand trends
Increasing
Consumption index
100% Incr/ing
Exploitation index
100% Incr/ing
Social Capacity building
Public participation in decisions
Fair
Public education on water conservation issues
Fair
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE, NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
AKRO Area Matrix (5/6)
Pricing system
Average household budget for dom. water
€ 99.2/yr
Ave. household budget for agricultural water
€0.11/m3 depends on land
Ave. household income
€24207urban
€18488 rural
Cost recovery
Dom €0.58/m3
Full Financial
Irrig. €0.11
O&M
Price elasticity
Very small
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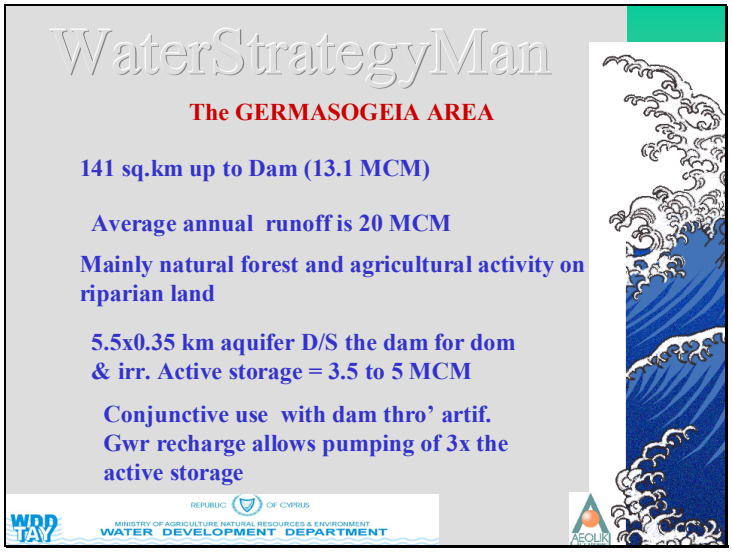
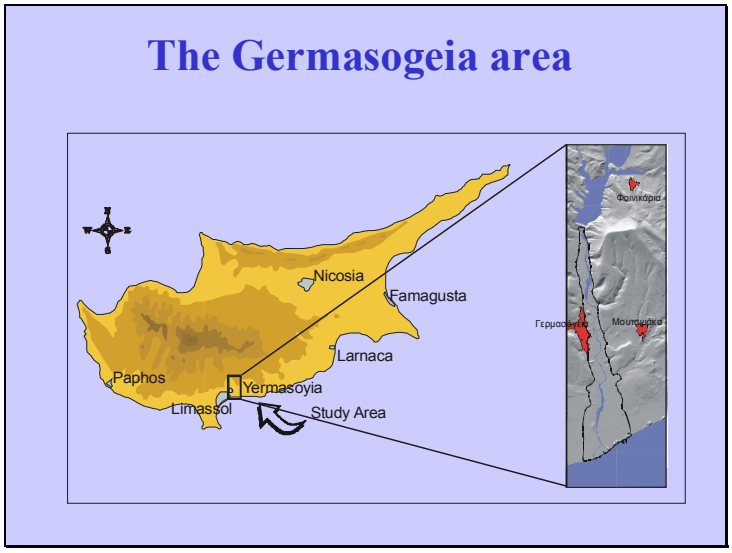
WATER DEVELOPMENT DEPARTMENT

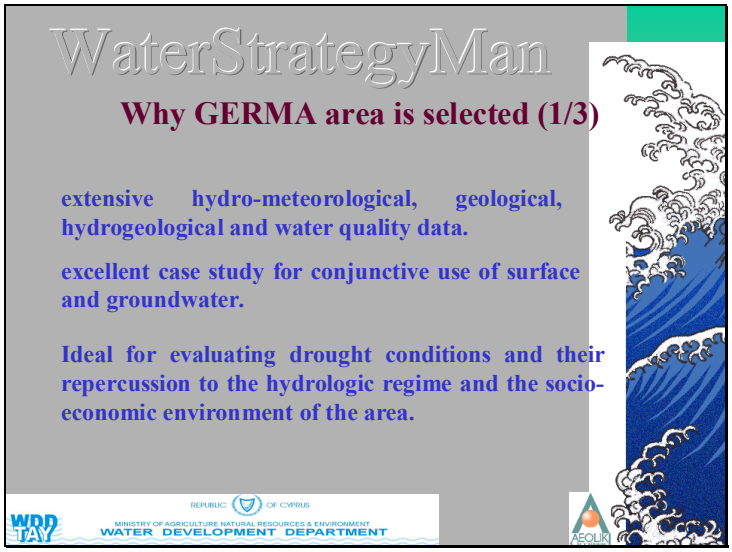
WaterStrategyMan

AKRO Area Matrix (6/6)

Water Resources Management	Water ownership	**State- (partly private)**
	Decision making level	**National**
	Water allocation per sector	**National**
Water Policy	Local economy basis	**Agri/tertiary**
	Development priorities	**Agri/tourism**




The Germasogeia area
Nicosia
Famagusta
Larnaca
Paphos
Yermasoyia
Limassol
Study Area


WaterStrategyMan
Why GERMA area is selected (1/3)
extensive hydro-meteorological, geological, hydrogeological and water quality data.
excellent case study for conjunctive use of surface and groundwater.
Ideal for evaluating drought conditions and their repercussion to the hydrologic regime and the socio-economic environment of the area.
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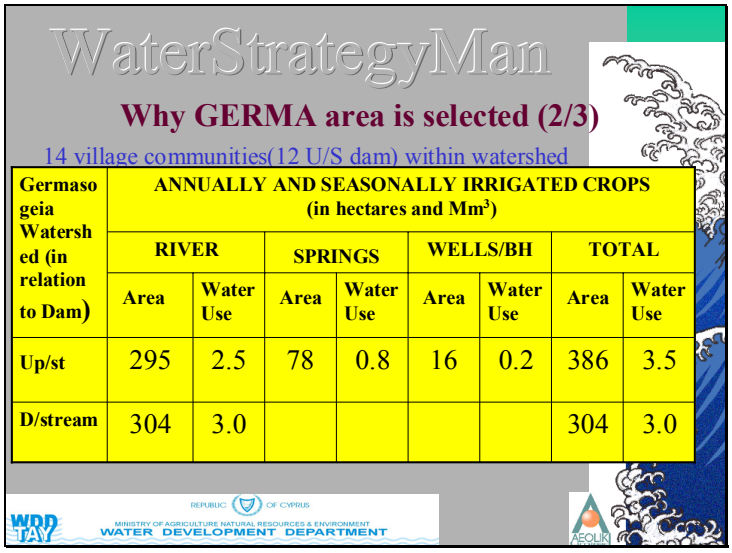
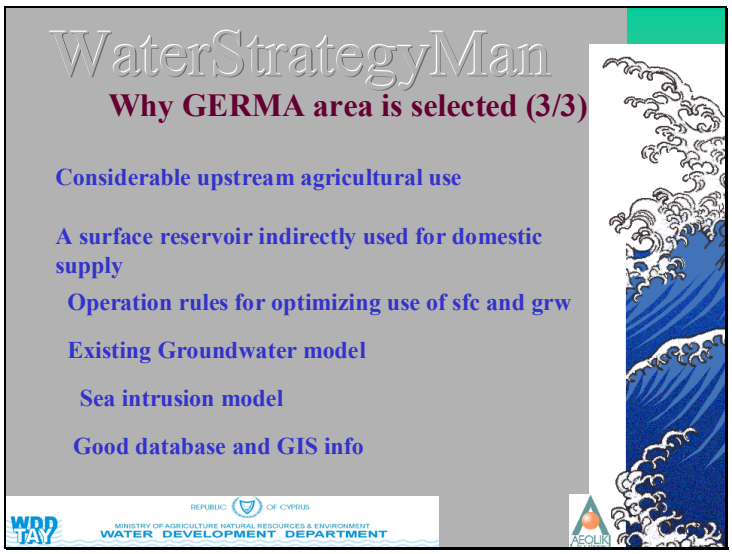
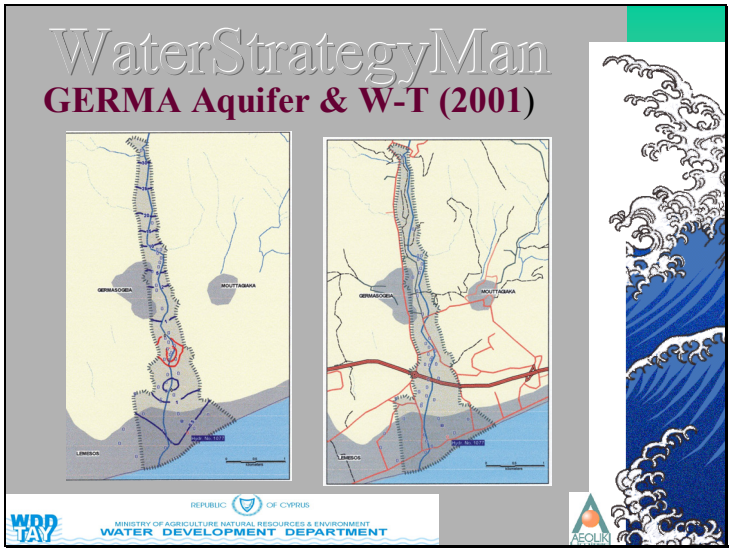
WATER DEVELOPMENT DEPARTMENT



Germasogeia Watershed (in relation to Dam)	ANNUALLY AND SEASONALLY IRRIGATED CROPS (in hectares and Mm^3)							
	RIVER		SPRINGS		WELLS/BH		TOTAL	
	Area	Water Use	Area	Water Use	Area	Water Use	Area	Water Use
Up/st	295	2.5	78	0.8	16	0.2	386	3.5
D/stream	304	3.0					304	3.0




WaterStrategyMan
GERMA Aquifer & W-T (2001)
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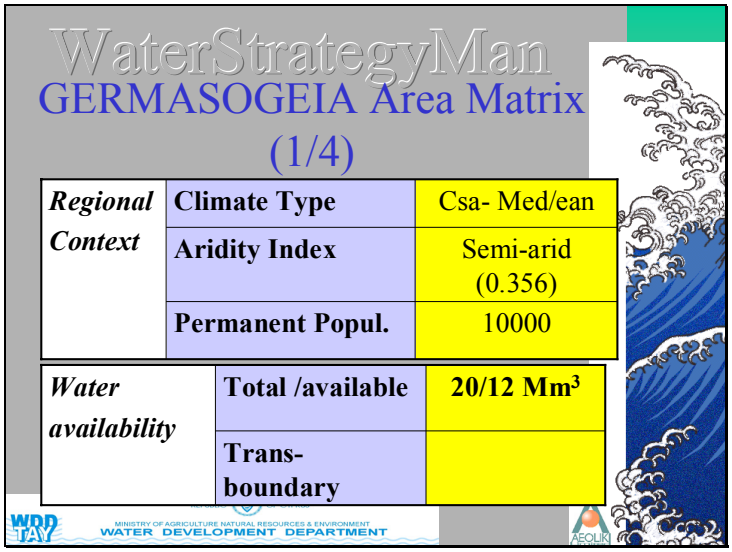
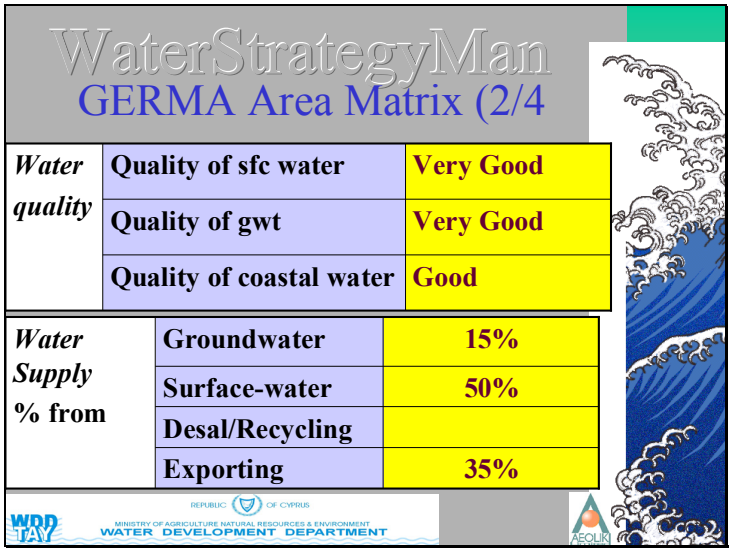
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
GERMASOGEIA Area Matrix (1/4)
Regional Context
Climate Type
Csa- Med/ean
Aridity Index
Semi-arid (0.356)
Permanent Popul.
10000
Water availability
Total /available
20/12 Mm3
Trans-boundary
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
GERMA Area Matrix (2/4
Water quality
Quality of sfc water
Very Good
Quality of gwt
Very Good
Quality of coastal water
Good
Water Supply % from
Groundwater
15%
Surface-water
50%
Desal/Recycling
Exporting
35%
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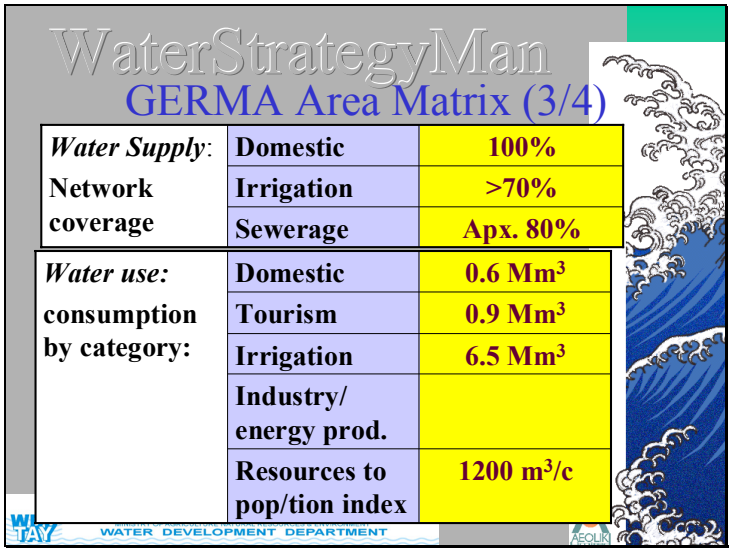
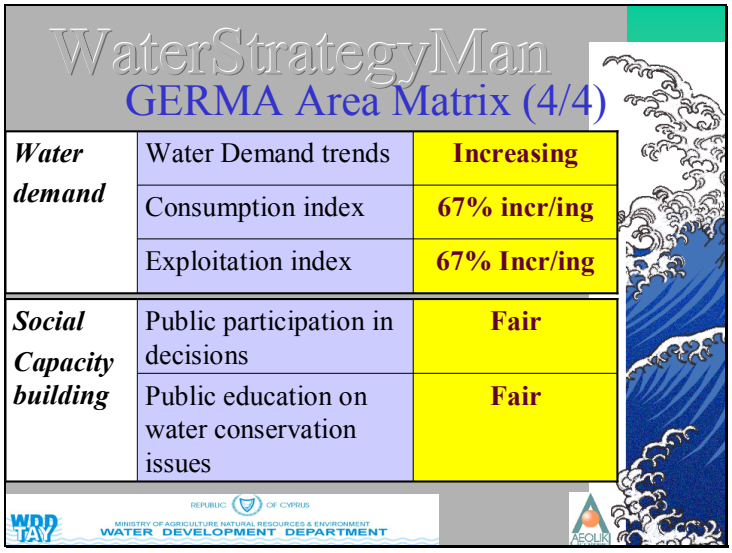
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
GERMA Area Matrix (3/4)
Water Supply: Network coverage
Domestic
100%
Irrigation
>70%
Sewerage
Apx. 80%
Water use: consumption by category:
Domestic
0.6 Mm3
Tourism
0.9 Mm3
Irrigation
6.5 Mm3
Industry/ energy prod.
Resources to pop/tion index
1200 m3/c
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
GERMA Area Matrix (4/4)
Water demand
Water Demand trends
Increasing
Consumption index
67% incr/ing
Exploitation index
67% Incr/ing
Social Capacity building
Public participation in decisions
Fair
Public education on water conservation issues
Fair
REPUBLIC OF CYPRUS
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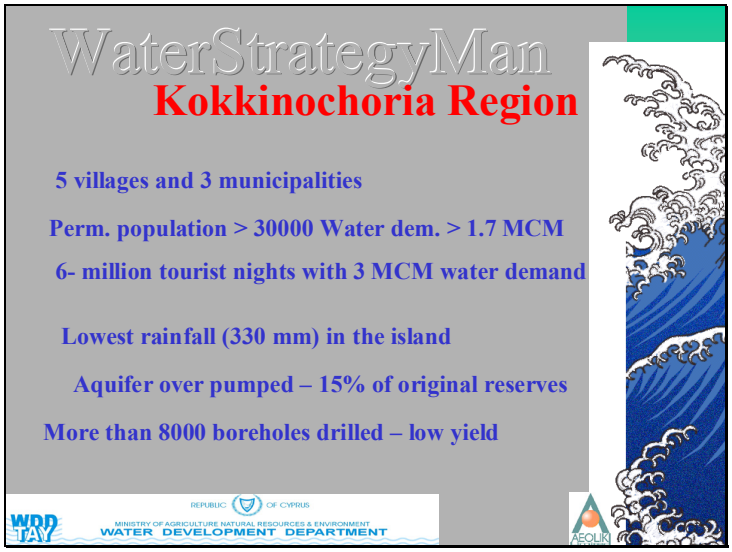
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
Kokkinochoria Region
5 villages and 3 municipalities
Perm. population > 30000 Water dem. > 1.7 MCM
6- million tourist nights with 3 MCM water demand
Lowest rainfall (330 mm) in the island
Aquifer over pumped – 15% of original reserves
More than 8000 boreholes drilled – low yield
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WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
Why KOKKI region is selected
early-potato producing area for export
Diminished grw (8 MCM) made up by SCP (17 MCM)
Last 10 yr drought reduced production
Thriving tourist industry made up income
Excellent farming experience – good soils – exportable potato produce should be maintained
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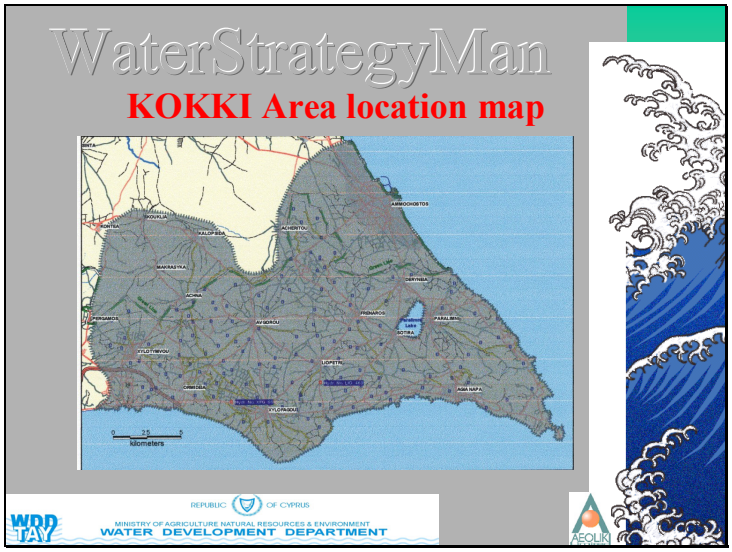
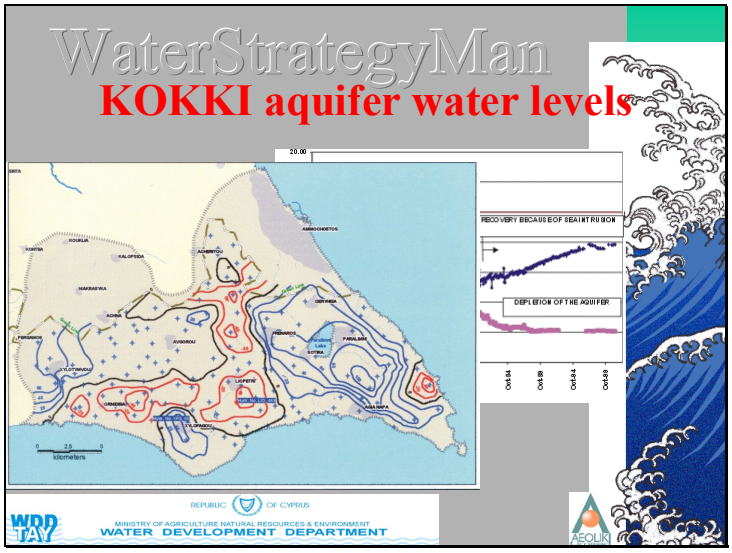
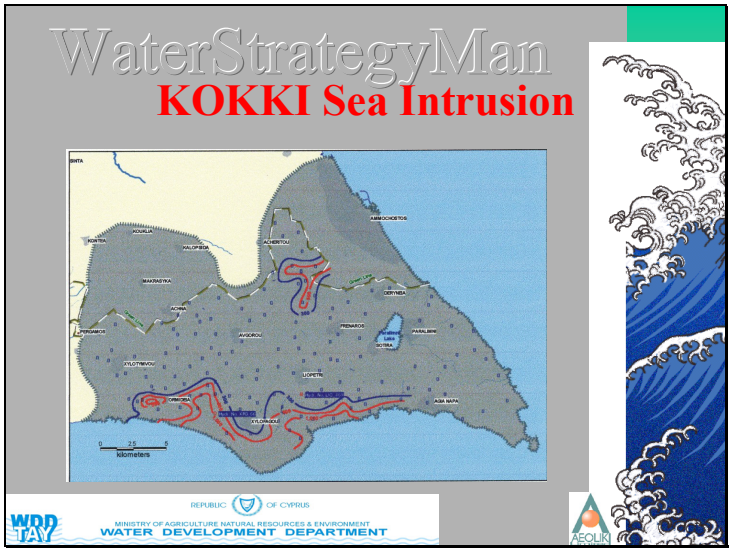
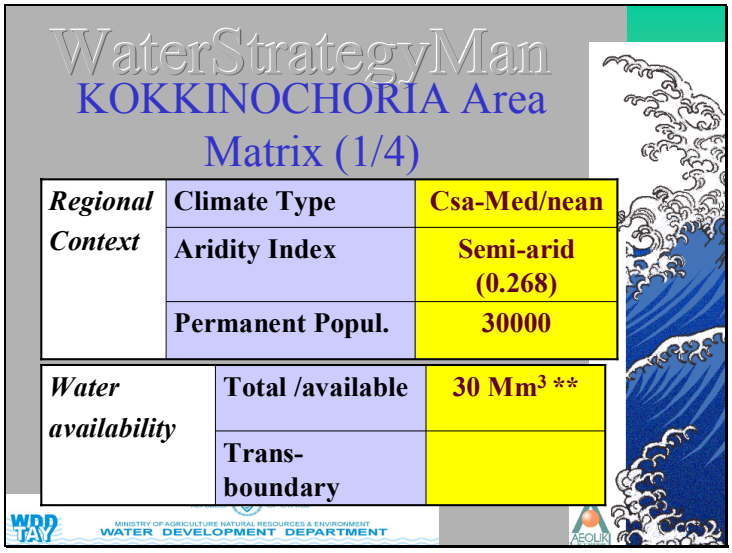
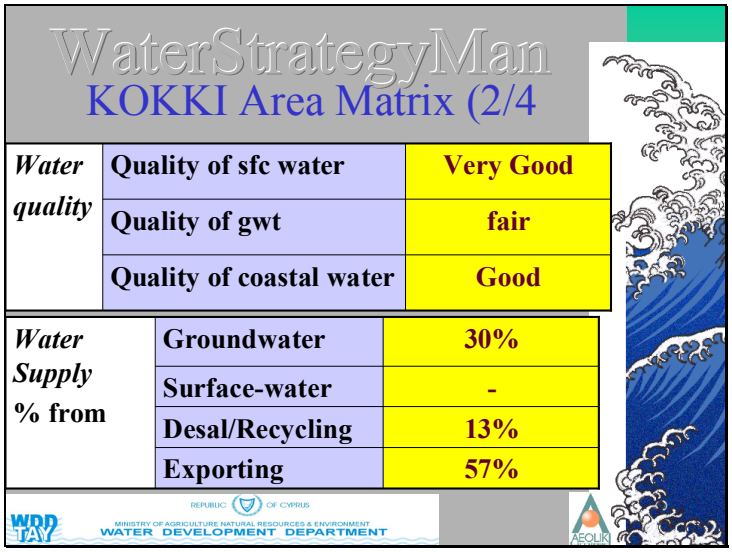
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT

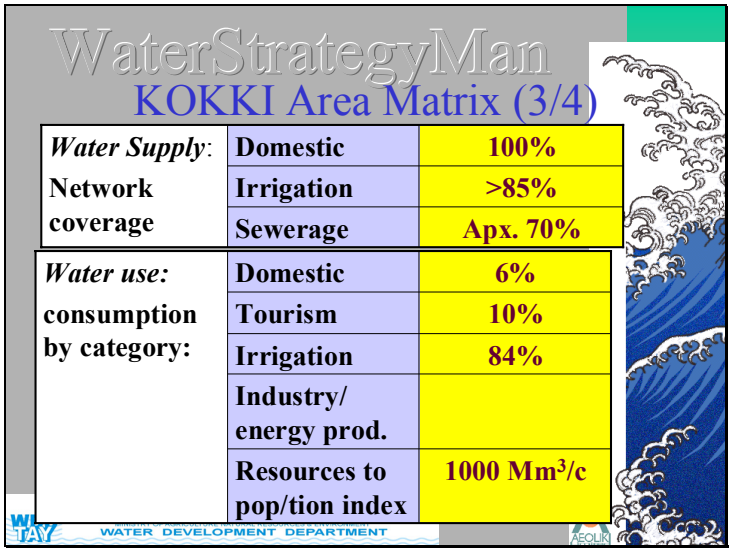

WaterStrategyMan
KOKKI Area location map
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT

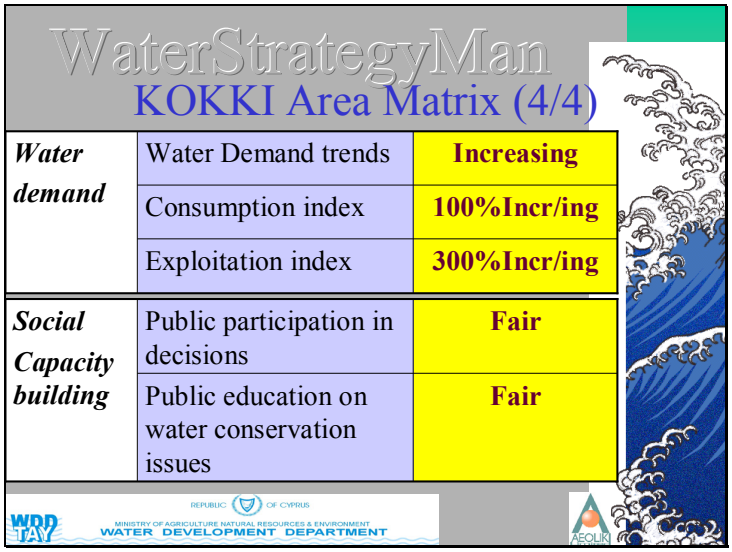

WaterStrategyMan
KOKKI aquifer water levels
DEPLETION OF THE AQUIFER
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
KOKKI Sea Intrusion
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
KOKKINOCHORIA Area Matrix (1/4)
Regional Context
Climate Type
Csa-Med/nean
Aridity Index
Semi-arid (0.268)
Permanent Popul.
30000
Water availability
Total /available
30 Mm3 **
Trans-boundary
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
KOKKI Area Matrix (2/4
Water quality
Quality of sfc water
Very Good
Quality of gwt
fair
Quality of coastal water
Good
Water Supply % from
Groundwater
30%
Surface-water
-
Desal/Recycling
13%
Exporting
57%
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
KOKKI Area Matrix (3/4)
Water Supply: Network coverage
Domestic
100%
Irrigation
>85%
Sewerage
Apx. 70%
Water use: consumption by category:
Domestic
6%
Tourism
10%
Irrigation
84%
Industry/ energy prod.
Resources to pop/tion index
1000 Mm3/c
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
KOKKI Area Matrix (4/4)
Water demand
Water Demand trends
Increasing
Consumption index
100%Incr/ing
Exploitation index
300%Incr/ing
Social Capacity building
Public participation in decisions
Fair
Public education on water conservation issues
Fair
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT


WaterStrategyMan
Thank you for your attention
REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE, NATURAL RESOURCES & ENVIRONMENT
WATER DEVELOPMENT DEPARTMENT
WDD
ΤΑΥ
AEOLIKI

WaterStrategyMan Project

Report on Portugal

WP2 WorkShop

Athens, 8-10 July 2002

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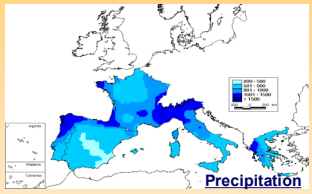
Range of circumstances in the country

Physical Characteristics



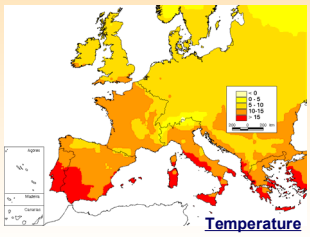
Precipitation

Climate

- Average yearly precipitation: 960 mm/year (North: 2000mm; South:600mm)
- Average temperature: 14 ºC
- Average sunshine: North - 1800 h/year South coast - > 3100 h/year

Altitude

- Average: 320 m (south: 200 m)
- Maximum: 2000 m



Temperature

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Range of circumstances in the country

Physical Characteristics

Water Resources:

- Groundwater: 7 km³/year
- Surface Water: 57km³/year (40% of it external)

Per capita:

Internal: 3600 hm³/year

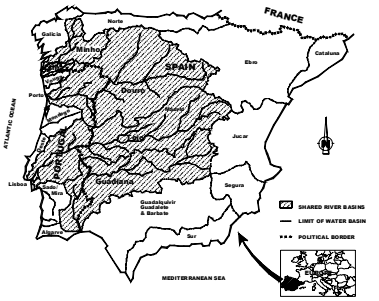
Total : 6200 hm³/year

(EU: 3200 hm³/year)

Water Storage:

7,8 km³ capacity

(50% for energy production)



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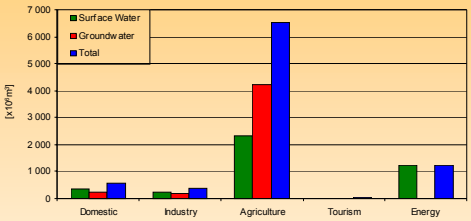
Range of circumstances in the country

Water Demand and Supply Status



Water use by activities

Major use:

Agriculture: 75%

(65% of it from groundwater)

Urban Water Sector Characterization:

- 85% of population connected to water supply network
- 64% of population connected to sewerage network (42% with wastewater treatment)

Efficiency

- Agriculture

  max. 60%, south of Tejo
- Urban water

  33% average losses

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Range of circumstances in the country

Environment and Protection

Surface Water Quality

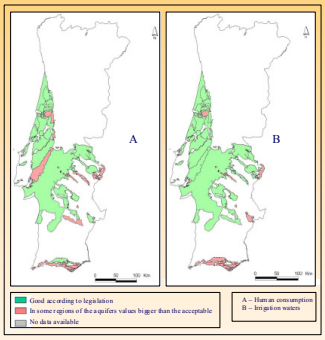
Pollutant loads exceeding recomended values for human consumption at:

- Shared rivers' bordering stretches
- Coastal areas

Shortages of Water

- North interior (bordering Douro) regions
- South (of Tejo river), namely in Guadiana basin,

in dry years



Groundwater quality for different sector uses:

- Problems in south coastal areas, and south of Tejo spots

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Range of circumstances in the country

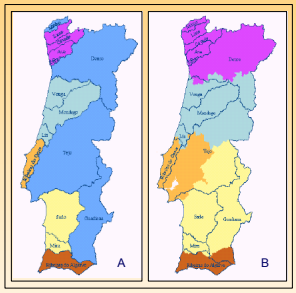
Water Laws and Regulations

National legislation is framed under

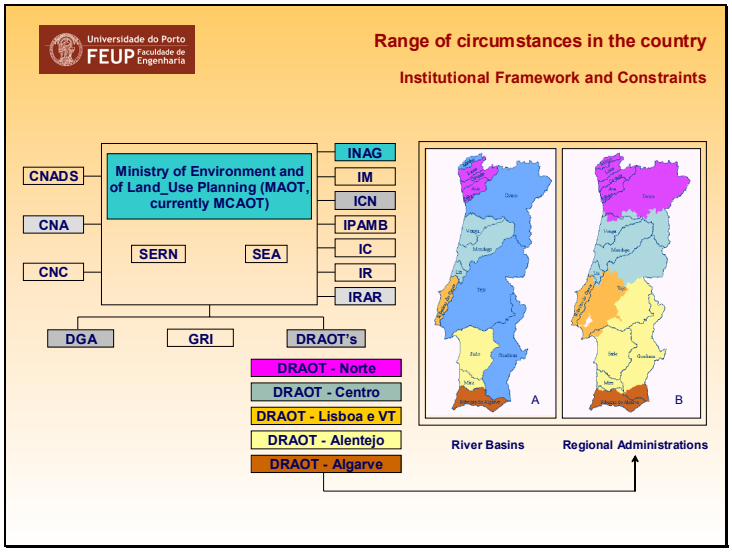
- International Law principles
- Portuguese-Spanish shared river agreements (namely the New Convention, active since 2000)
- EU water policy and Directives

Portuguese legislation (still) excludes from the public domain groundwater

Portuguese Water Management model is based on **shared responsability** between a National Water Institute (**INAG**) and Regional Environmental and Territorial Planning Boards (**DRAOT's**)



River Basins Regional Administrations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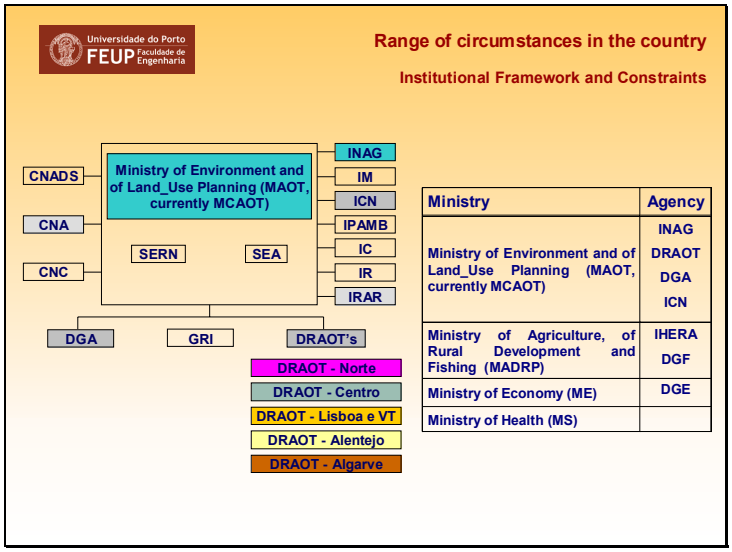
Range of circumstances in the country
Institutional Framework and Constraints
CNADS
CNA
CNC
Ministry of Environment and of Land_Use Planning (MAOT, currently MCAOT)
SERN
SEA
INAG
IM
ICN
IPAMB
IC
IR
IRAR
DGA
GRI
DRAOT's
DRAOT - Norte
DRAOT - Centro
DRAOT - Lisboa e VT
DRAOT - Alentejo
DRAOT - Algarve
A
B
River Basins
Regional Administrations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Range of circumstances in the country
Institutional Framework and Constraints
CNADS
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SERN
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IR
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GRI
DRAOT's
DRAOT - Norte
DRAOT - Centro
DRAOT - Lisboa e VT
DRAOT - Alentejo
DRAOT - Algarve
Ministry
Agency
Ministry of Environment and of Land_Use Planning (MAOT, currently MCAOT)
INAG
DRAOT
DGA
ICN
Ministry of Agriculture, of Rural Development and Fishing (MADRP)
IHERA
DGF
Ministry of Economy (ME)
DGE
Ministry of Health (MS)

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Range of circumstances in the country

Constraints

Category	Constraints
Natural	• Uneven spatial and temporal water resources distribution • Large dependence on transboundary water
Human	• Uneven population distribution • Tourism pressure located on coastal areas • Agriculture water use • Demand peaks on the dry season
Technical	• Old agriculture infrastructure • Big water supply network losses
Juridical	• Water resources laws very often ineffective • Overlapped and no co-ordinated institutional responsibilities • No actual national Water Law
Financial	• Non effective economic and financial regime • Pricing of water distorted and largely subsidised
Administrative and Institutional	• Management of water resources not made on a River Basin basis • No real National Water Authority • Incipient participation of Civil Society

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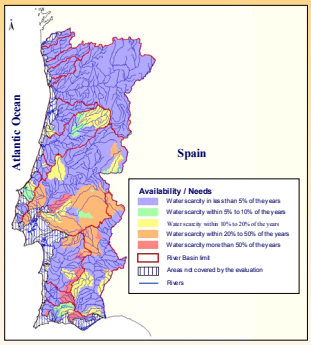
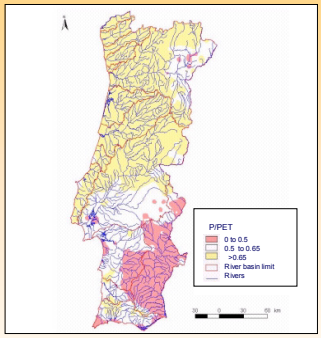
Selection of Representative Regions

Scarcity Context



Scarcity of water



Thornthwaites' aridity index

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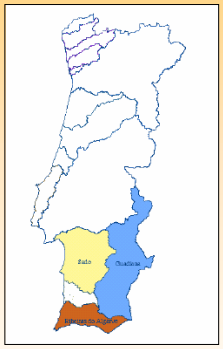
Selection of Representative Regions

Selected Regions

Sado
- Demands of water for
  - irrigation
  - industry
  - energy consumption

Guadiana
- Demands of water for irrigation
- Poor water quality
- Spanish flow regularization on dry periods

Ribeiras do Algarve
- Tourism pressure + Irrigation demands, on dry periods
- Current water imports



Candidate Regions Selected

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Selection of Representative Regions

Sado Region

Climate

Average yearly Precipitation: 622 mm/year

Average Temperature: 16 ºC

Average Sunshine duration: 2900 h/year

Altitude

average 127 m

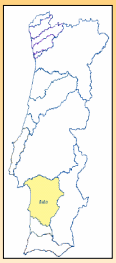
maximum 501 m

Water Resources

Groundwater: 796 hm^3/year

Surface Water: 918 hm^3/year

Water Storage: 771 hm^3/year



Area

8295 km^2

Population

292960

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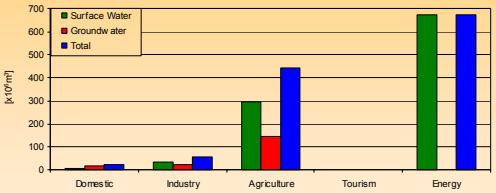
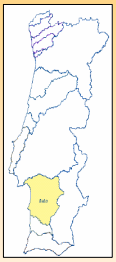
Selection of Representative Regions

Sado Region

Water Use by Activities





Urban Water Sector Characterization

- 97% of population connected to water supply network
- 87% of population connected to sewerage network (56% with wastewater treatment)

Efficiency

- Agriculture 60%
- Urban water 20% average losses

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Selection of Representative Regions

Guadiana Region

Climate

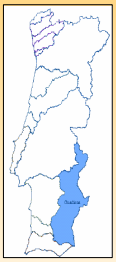
Average yearly Precipitation:	568 mm/year
Average Temperature:	16 °C
Average Sunshine duration:	2829 h/year

Altitude

average	237 m
maximum	1027 m

Water Resources

Groundwater:	429 hm^3/year
Surface Water:	3156 hm^3/year
Water Storage:	currently 460 hm^3/year, but in the near future more 3150 hm^3 due to Alqueva new multi-purpose hydraulic plant



Area

11601 km^2

Population

182580

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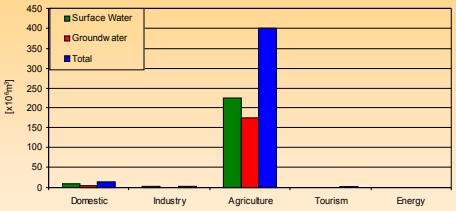
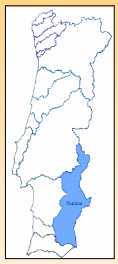
Selection of Representative Regions

Guadiana Region

Water Use by Activities





Urban Water Sector Characterization

- 84% of population connected to water supply network
- 83% of population connected to sewerage network (67% with wastewater treatment)

Efficiency

- Agriculture 60%
- High Urban water losses

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Selection of Representative Regions

Ribeiras do Algarve Region

Climate

Average yearly Precipitation: 840 mm/year

Average Temperature: 18 ºC

Average Sunshine duration: 3180 h/year

Altitude

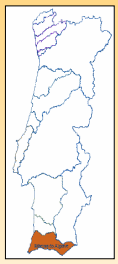
Altitudes ranging from 0 to 100 m, only few spots above these values

Water Resources

Groundwater: 272 hm^3/year

Surface Water: 327 hm^3/year

Water Storage: 63 hm^3



Area

3837 km^2

Population

324100

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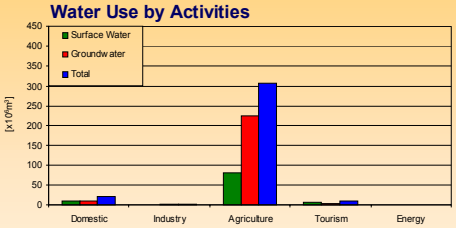
Selection of Representative Regions

Ribeiras do Algarve Region

Water Use by Activities



Urban Water Sector Characterization

- 82% of population connected to water supply network
- 73% of population connected to sewerage network (72% with wastewater treatment)

Efficiency

- Agriculture 60%
- Urban water 37% average losses

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Selection of Representative Regions

Summary Matrix

Natural conditions and infrastructure		Sado	Guadiana	Ribeiras do Algarve
Regional Context	Climate Type	Cs: Mediterranean Temperate	Csa (Temperate)	Cs: Mediterranean Temperate
	Aridity Index	AI =0.54 Dry Sub-humid	AI =0.46 Semi-Arid	AI =0.68
	Permanent Population	292,960	182,580	324,100
Water availability	Total Water Resources/ Availability (hm^3)	1768 /1714	7800 (2300)	620 /599
	Trans-boundary water	No	5500	No
	Inter-basin water transfer	Yes (-2 hm^3 -10 hm^3)	Yes (2 hm^3 -30 hm^3)	Yes (30 hm^3)
Water quality	Quality of surface water	Poor	Poor	Poor
	Quality of groundwater	Good	Poor	Poor
	Quality of coastal water	Good	Good	Good
Water Supply	Percentage of supply coming from:			
	Groundwater	16%	55.5%	71.5%
	Surface water	84%	56%	19.7%
	Desalination, Recycling	-	-	-
	Importing	-	0.5%	8.8%
	Network coverage:			
	Domestic	97%	84%	82%
	Irrigation	72%	76%	77%
	Sewerage	87%	83%	73%

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Selection of Representative Regions

Summary Matrix

Economic and Social System		Sado	Guadiana	Ribeiras do Algarve
Water use	Water consumption by category: (hm^3) • Domestic • Tourism • Irrigation • Industrial and energy production	 24.3 0.6 441 730.1	 14.0 1.37 400 3.3	 21.8 10.9 305 2.4
	Resources to population index	6035	42720 (12600)	1912
Water demand	Water Demand trends	Increasing	Increasing	Increasing
	Consumption index	68%	5.4% (18.2%)	55%
	Exploitation index	70%	12%	57%
Pricing system	Average household budget for domestic water	0.75%	0.89%	0.90%
	Average household budget for agricultural water	0,06 €/m^3	0,06 €/m^3	0,07 €/m^3
	Average household income	13562 €/year	13562 €/year	13573 €/year
	Cost recovery	Low (37%)	Low (23%)	Low (40%)
	Price elasticity	Very small	Very small	Very small
Social capacity building	Public participation in decisions	Poor	Poor	Poor
	Public education on water conservation issues	Poor	Poor	Poor

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Selection of Representative Regions

Summary Matrix

Decision Making Process		Sado	Guadiana	Ribeiras do Algarve
Water Resources Management	Water ownership	Public (partly private)	Public (partly private)	Public (partly private)
	Decision making level (municipal, regional, national) regarding: Water supply for each sector	National/Municipal	National/Municipal	National/Municipal
	Water resources allocation for each sector	National	National	National
Water Policy	Local economy basis	Agriculture and industry	Agriculture and Tertiary sector	Tourism
	Development priorities	Agriculture	Agriculture	Tourism and Agriculture

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Relation between range of circumstances in the country and water related problems

PNA's Planned Actions Axis

- Legal and Institutional Framework
- Environmental Sustainability
- Sustainable Demand Management
- Integrated Management of Water Resources
- Citizen Information and Participation
- Economic and Financial
- Knowledge, Study and Applied Research on Water Resources

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Relation between range of circumstances in the country and water related problems

Legal and Institutional Framework action axis

Program	Measures	Main Interventions	Types
Implementation of the New Portuguese-Spanish Convention	Portuguese-Spanish shared river basins	- Definition of bilateral joint measures - Definition of environmental flows - Definition of estuaries management measures - Water monitoring of international river stretches	P; External Relations P; External Relations P; P&P; External Relations P&P; External Relations
Legal and Institutional Framework adequacy	Legal Framework adequacy	- Elaboration of the "Water Law" - Compilation of Water legislation - Establishment of a coastal waters' legal framework - Implementation of a integrated system for cadastral and licensed use	L&I L&I L&I L&I; P&P
	Administrative Reinforcement	- Adequate Administration to the implementation of RBP - Promote and educate human resources on water resources management	L&I; P; E&F P&P
	Identify and create River Basin Districts and Administrations		P; L&I; E&F

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Relation between range of circumstances in the country and water related problems

Environmental Sustainability action axis

Program	Measures	Main Interventions	Types
Protection, Rehabilitation and Promotion of water resources quality	Minimization of drought effects	- Establishment of a methodology (i) to characterise drought periods (ii) to manage water resources on drought - Elaboration of a Contingency Plan for drought periods	 P P P&P; L&I
Environmental and Biologic Conservation	Environmental Flows (E. F.)	- Study of E.F. regimes - Adequate hydraulic plants to guarantee permanent E.F.	P P&P; E&F
	Ecosystem conservation and rehabilitation	- Assessment of environmental risks - Management and recuperation of fluvial ecosystem	P P; P&P; E&F

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Relation between range of circumstances in the country and water related problems

Sustainable Demand Management action axis

Program	Measures	Main Interventions	Types
Guarantee of water supply for human use and for activity sectors	Domestic and industrial supply	- Promotion and creation of pluri-municipal systems - Increase of level of water supply guarantee, by creation of reserves - Construction and rehabilitation of infra-structure	P&P; E&F P&P; E&F P&P; E&F
	Irrigation	- Increase of level of water supply guarantee, by creation of reserves - Construction and rehabilitation of infra-structure	P&P; E&F P&P; E&F
Conservation of water resources	Efficiency on use of water: domestic and industrial supply	- Promotion of efficient use of water - Identification and reduction of systems' water losses and of non-accountable consumption	P&P P&P
	Efficiency on use of water for irrigation	- Identification and reduction of systems' water losses and more rational use of water	P&P

Integrated Management of Water Resources action axis

Citizen Information and Participation action axis

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Relation between range of circumstances in the country and water related problems

Economic and Financial Sustainability action axis

Program	Measures	Main Interventions	Types
Promotion and Consolidation of Water Market		- Assessment of fiscal instruments - Definition of financing models - Analysis of adequacy of management entities to the water market	E&F E&F E&F
Economic and financial regime application	User-pay principle	- Implementation of the principles of user-pay and polluter-pay principles - Revision and application of E&F regime to public hydro domain - Studies on water pricing - Establishment of a water pricing policy - Definition of E&F regime applicable to (i) domestic water supply and (ii) irrigation systems	P&P; E&F E&F; L&I E&F P; E&F L&I
	Cost of water	- Assessment of all costs to be internalised - Assessment of real costs of the systems - Establishment of "rough water" price - Studies for fixing taxes and tariffs	E&F; P&P E&F;P&P E&F E&F; P

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Relation between range of circumstances in the country and water related problems

Knowledge, Study and Applied Research on Water Resources action axis

Program	Measures	Main Interventions	Types
Monitoring and Information Systems	Monitoring systems	- Improve monitoring of: (i) surface water (ii) groundwater - Ecological and biological monitoring network	 P&P P; P&P P; P&P
	Cadastral, information systems and GIS	- Urban water supply and wastewater infrastructure (i) cadastral system (ii) quality control system - Creation of a system to support water resources management - Maintain and explore an effective water resources information system	 P&P P&P P; P&P P&P
Studies and Investigation		- Development of hydrological and hydraulic studies - Development of DSS on economic water use	P&P P; P&P
Assessment of National Water Plan (PNA) and River Basin Plans (RBP's)		- Systematic assessment of the Plans - Control of Plans application	P&P P&P

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Relation between range of circumstances in the country and water related problems

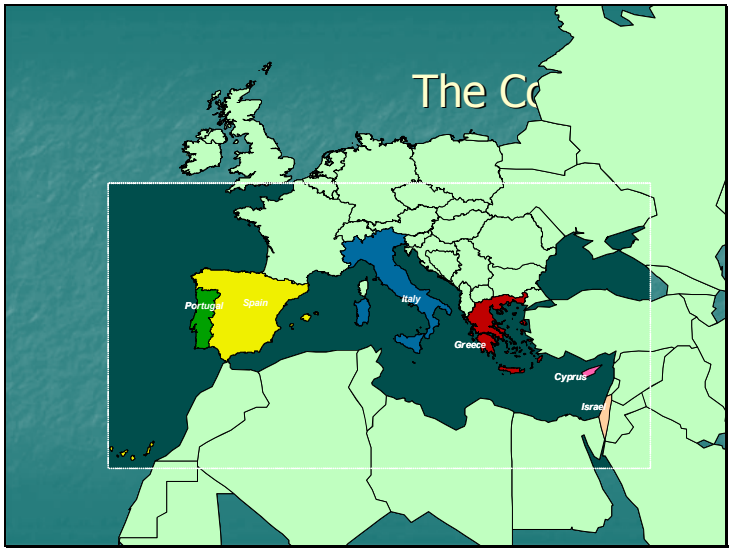
Program of measures: Short term (2006) Investment Plan (Million Euro)

Program	Sado	Guadiana	Rib. of Algarve
Protection and Rehabilitation of water resources quality	62,7	94,3	100,3
Water supply for human use and for activity sectors	363,7	318,7	134,1
Ecosystem conservation and rehabilitation	3,0	6,8	13
Drought, Floods and Pollution Accidents Prevention and Minimisation	31,8	39,1	4,1
Valorisation of Water Resources	11,3	5,3	0,9
Planning and Management of Hydro Domain	3,6	1001,5	37,2
Legal and Institutional Framework	2,4	5,7	0,7
Economic and Finance	0,5	0,5	0,3
Citizen Information and Participation	0,1	0,1	0,3
Knowledge and Research on Water Resources	10,3	10,0	1,2
Assessment of National Water Plan (PNA) and River Basin Plans (RBP's)	0,8	0,8	0,2
TOTAL	490,2	1482,7	292,3
% of 20 years Planned Investment	51%	66%	82%

WSM Workshop

Exercise 1: Constructing a Typology of Water Deficient Regions

NTUA, July 2002



The goals

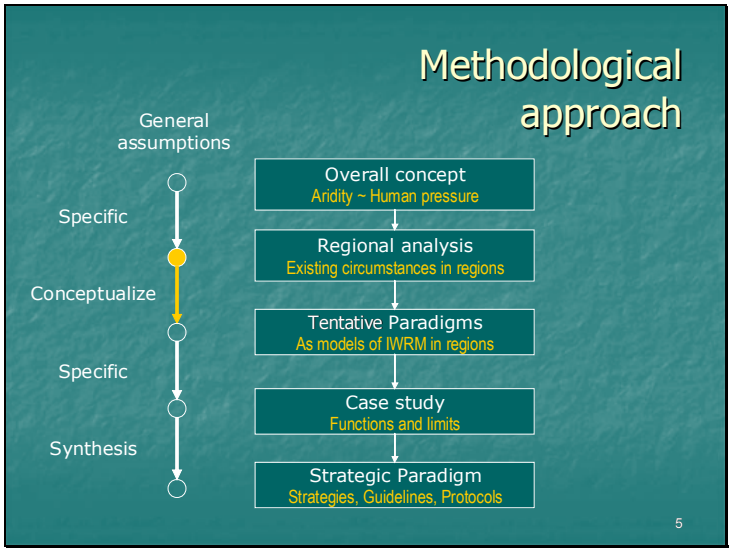
- Identification of Commonalities and Gaps between the selected regions
- Development of a Typology of water deficient regions
- Conceptualization into Paradigms

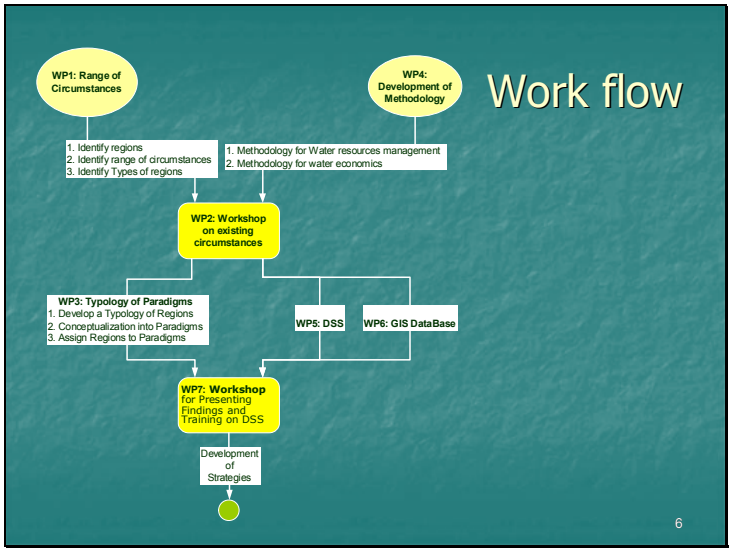
3

Semantics - Concepts

- Paradigm
  - A tentative construction of reality accepted by most people in an intellectual community, because of its effectiveness in explaining a complex process, or set of data
- Case (study)
  - An example, instance, or occurrence supporting or convincing arguments or evidence
- Type
  - A kind, class, or group having distinguishing characteristics in common

4

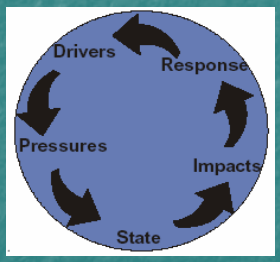

Methodological approach
General assumptions
Specific
Conceptualize
Specific
Synthesis
Overall concept
Aridity ~ Human pressure
Regional analysis
Existing circumstances in regions
Tentative Paradigms
As models of IWRM in regions
Case study
Functions and limits
Strategic Paradigm
Strategies, Guidelines, Protocols
5


Work flow
WP1: Range of Circumstances
WP4: Development of Methodology
1. Identify regions
2. Identify range of circumstances
3. Identify Types of regions
1. Methodology for Water resources management
2. Methodology for water economics
WP2: Workshop on existing circumstances
WP3: Typology of Paradigms
1. Develop a Typology of Regions
2. Conceptualization into Paradigms
3. Assign Regions to Paradigms
WP5: DSS
WP6: GIS DataBase
WP7: Workshop for Presenting Findings and Training on DSS
Development of Strategies
6

Identification of Commonalities and Gaps between the selected regions

A framework for Indicators

- *Driving forces:* Human influences and activities that when combined with environmental conditions underpin environmental change
- *Pressures:* Pressures exerted on resources and ecosystems from human activities
- *State:* Condition of resource and ecosystem
- *Impacts:* Results of pressures on the current state
- *Responses:* Policies, laws, programs etc



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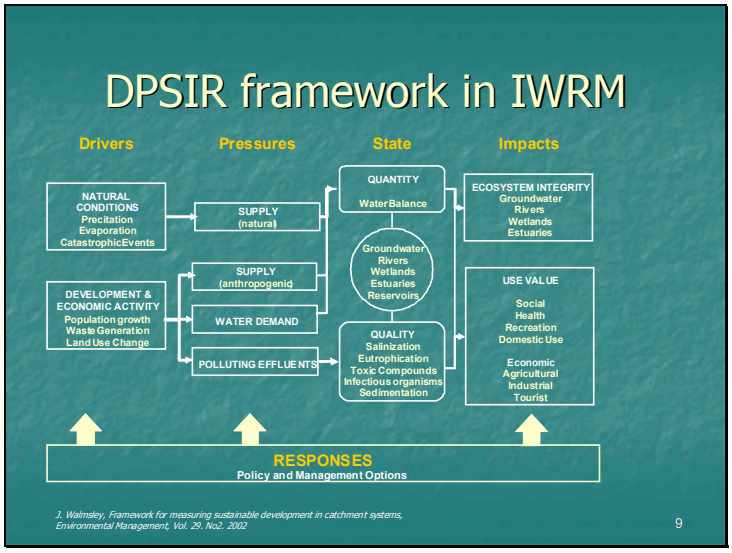

DPSIR framework in IWRM
Drivers
Pressures
State
Impacts
NATURAL CONDITIONS
Precitation
Evaporation
CatastrophicEvents
DEVELOPMENT & ECONOMIC ACTIVITY
Population growth
Waste Generation
Land Use Change
SUPPLY (natural)
SUPPLY (anthropogenic)
WATER DEMAND
POLLUTING EFFLUENTS
QUANTITY
WaterBalance
Groundwater
Rivers
Wetlands
Estuaries
Reservoirs
QUALITY
Salinization
Eutrophication
Toxic Compounds
Infectious organisms
Sedimentation
ECOSYSTEM INTEGRITY
Groundwater
Rivers
Wetlands
Estuaries
USE VALUE
Social
Health
Recreation
Domestic Use
Economic
Agricultural
Industrial
Tourist
RESPONSES
Policy and Management Options
J. Walmsley, Framework for measuring sustainable development in catchment systems, Environmental Management, Vol. 29, No2. 2002
9


Selected regions - Greece
Attica - The capital and surrounding areas
Half of the country's population
Permanent water deficits due to population size
Local water resources insufficient to meet demand
Dependence from other Water Regions
Polluted and eutrophic aquifers
Thessaly - intensively cultivated plains
Seasonal water deficit due to irrigation demand
Antiquated agricultural activities and practices
Cyclades islands – important tourist destination
Summer peak for irrigation and urban demand
Salinization due to over-abstraction
Summer peak can reach up to thirty times the permanent population
Limited water resources (mostly aquifers)
Thessaly
Attica
Cyclades
10


Selected region – Attica, Greece
Special characteristics
Metropolitan area
No usable river basin
Driving forces
Periodic droughts
Population growth
Land use change
Pressures
Water Demand
Reduced supply
State
Permanent water deficit
Aquifer pollution
Impacts
Public health concerns
Ecosystem degradation
Responses
Interbasin transfers
Network development
Public awareness
Pricing control
11


Selected region – Thessaly, Greece
Special characteristics
Dynamic agricultural region
Industrial activities
Driving forces
Intensive agriculture
Antiquated cultivation methods
Pressures
Conflicting uses
Seasonal water deficit
Agrochemical pollution
State
Water deficit during irrigation period
Groundwater overexploitation
Impacts
Economic impacts
Social discomfort
Environmental impacts
Responses
Interbasin transfers
Subsidies for irrigation water
12

Selected region – Cyclades, Greece

- Unique circumstances
  - Population surge in the tourist period
- Driving forces
  - Aridity
  - Tourism
- Pressures
  - Conflict with traditional agricultural activities
  - Seasonal water demand
  - Limited natural supply
- State
  - Seasonal water deficit
  - Groundwater overexploitation
- Impacts
  - Economic impacts
  - Public health impacts
  - Salinization of aquifers
- Responses
  - Surface reservoirs
  - Desalination
  - Water transport by ships

13

Selected Region - Israel

- Israel is examined as a single geographic entity due to:
  - National Water Carrier single network
  - Uniform Water prices (more or less) throughout the country
  - Highly centralized water administration

14

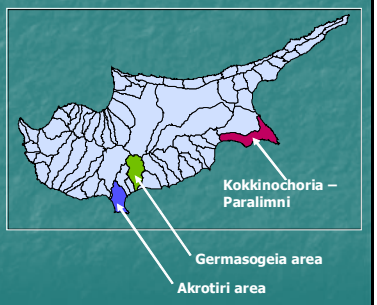
Selected Region - Israel

- Unique circumstances
- Driving forces
  - Aridity
  - Centralized management
  - Transboundary issues
  - Population growth
- Pressures
  - Increasing demand
  - Transboundary dependencies
- State
  - Water deficit
  - Over pumping
- Impacts
  - Water deficit
  - Salinisation
  - Conflicting uses: Domestic vs irrigation
- Responses
  - Reuse of water
  - Desalination

15

Selected Regions - Cyprus

- Selection based on deficiency and aridity, social and economic characteristics, and complexity of the water system
- Regions:
  - Akrotiri
  - Germasogeia
  - Kokkinochoria



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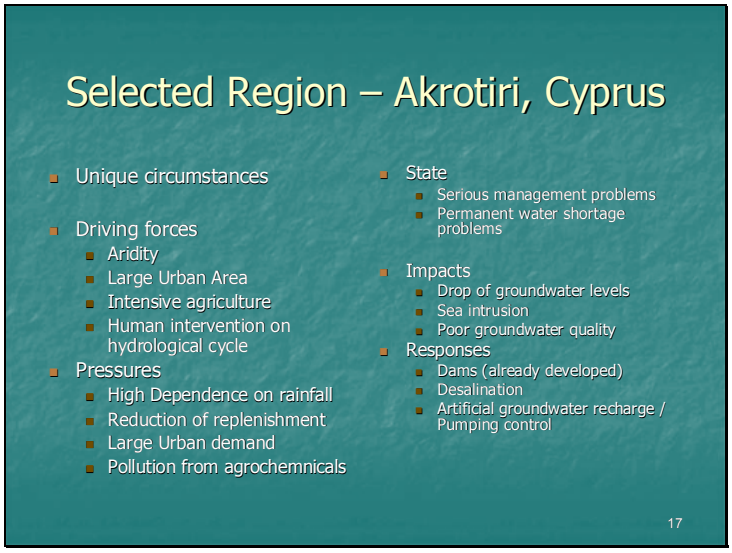
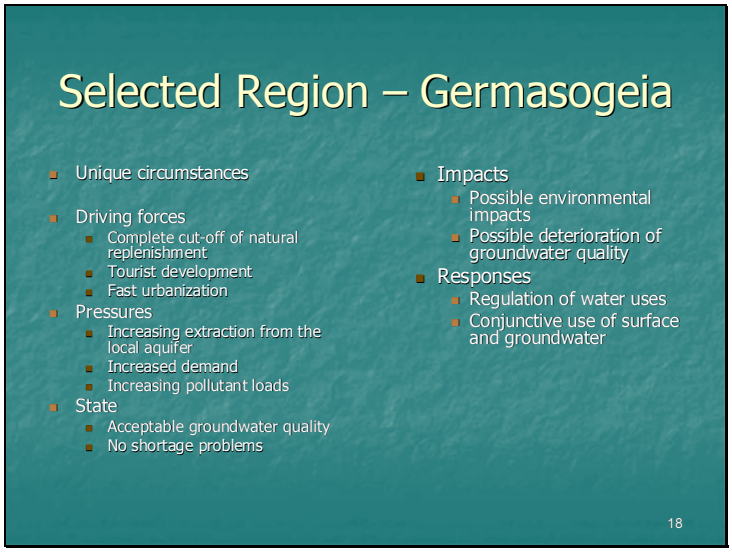

Selected Region – Akrotiri, Cyprus
Unique circumstances
Driving forces
Aridity
Large Urban Area
Intensive agriculture
Human intervention on hydrological cycle
Pressures
High Dependence on rainfall
Reduction of replenishment
Large Urban demand
Pollution from agrochemnicals
State
Serious management problems
Permanent water shortage problems
Impacts
Drop of groundwater levels
Sea intrusion
Poor groundwater quality
Responses
Dams (already developed)
Desalination
Artificial groundwater recharge / Pumping control
17


Selected Region – Germasogeia
Unique circumstances
Driving forces
Complete cut-off of natural replenishment
Tourist development
Fast urbanization
Pressures
Increasing extraction from the local aquifer
Increased demand
Increasing pollutant loads
State
Acceptable groundwater quality
No shortage problems
Impacts
Possible environmental impacts
Possible deterioration of groundwater quality
Responses
Regulation of water uses
Conjunctive use of surface and groundwater
18

Selected Region – Kokkinochoria, Cyprus

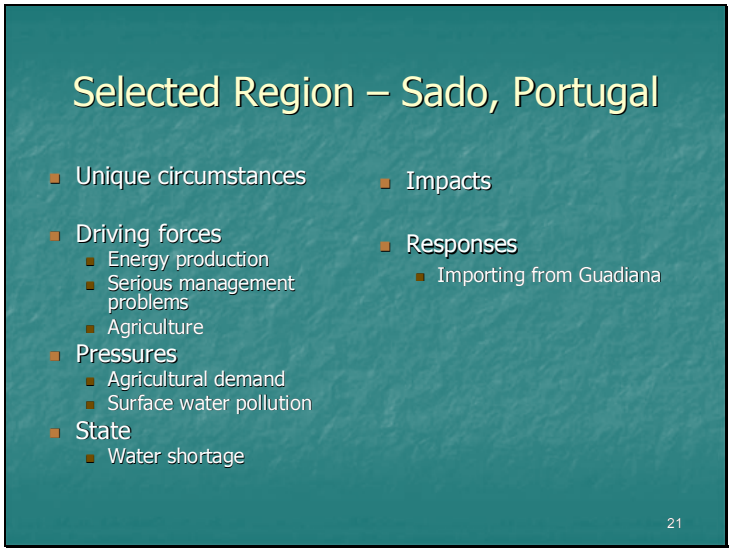
- Unique circumstances
- Driving forces
  - Important tourist location
  - Dynamic agricultural region
- Pressures
  - Very high water demand for tourism
  - Very low rainfall
  - Conflict with Agricultural demand
- State
  - Water shortage
  - Groundwater overexploitation
- Impacts
  - Economic Impacts for tourism and agriculture
  - Salinization
  - Drop in water table
- Responses
  - Alternative supply sources
  - Demand management
  - Change of cropping pattern

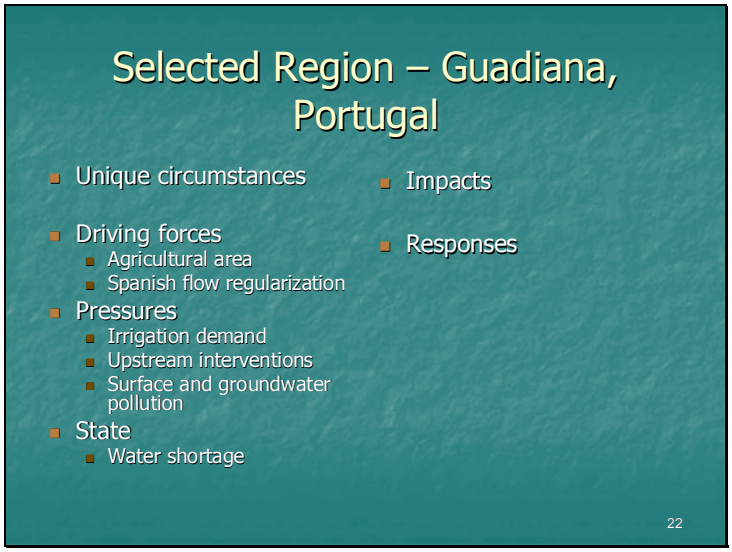
19

Selected Regions - Portugal

- Selection based on the forces driving the water deficit
  - Sado: main problems related to irrigation demand and energy consumption
  - Guadiana: water deficit due to irrigation demand, poor water quality and to Spanish flow regularization
  - Algarve: large number of tourists, particularly in the summer, and conflict with irrigation demand
- In Guadiana basin, part of Sado basin and Algarve region, aridity index is less than 0.5

20


Selected Region – Sado, Portugal
Unique circumstances
Driving forces
Energy production
Serious management problems
Agriculture
Pressures
Agricultural demand
Surface water pollution
State
Water shortage
Impacts
Responses
Importing from Guadiana
21


Selected Region – Guadiana, Portugal
Unique circumstances
Driving forces
Agricultural area
Spanish flow regularization
Pressures
Irrigation demand
Upstream interventions
Surface and groundwater pollution
State
Water shortage
Impacts
Responses
22

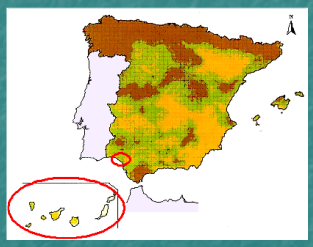
Selected Region – Algarve, Portugal

- Unique circumstances
- Driving forces
  - Agricultural area
  - High tourist influx
- Pressures
  - Irrigation demand
  - Surface water pollution from agriculture and urban effluents
  - Conflicting uses – irrigation vs tourist demand
- State
  - Water shortage in the summer months
- Impacts
- Responses
  - Importing from Guadiana

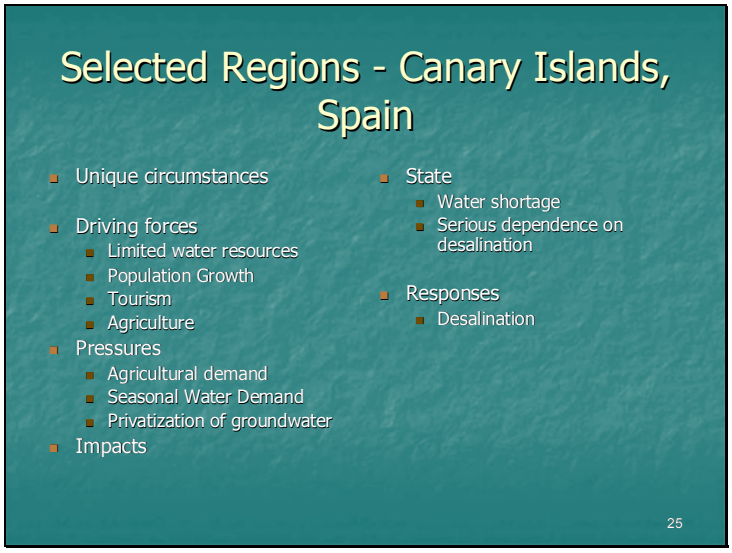
23

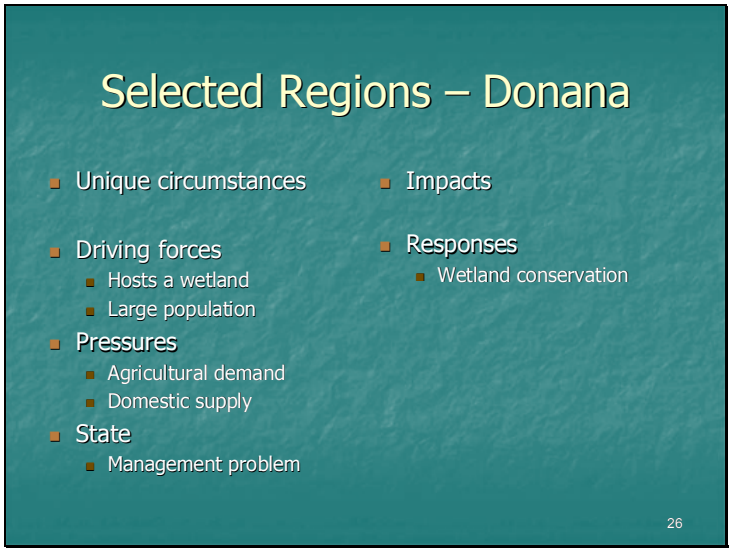
Selected Regions - Spain

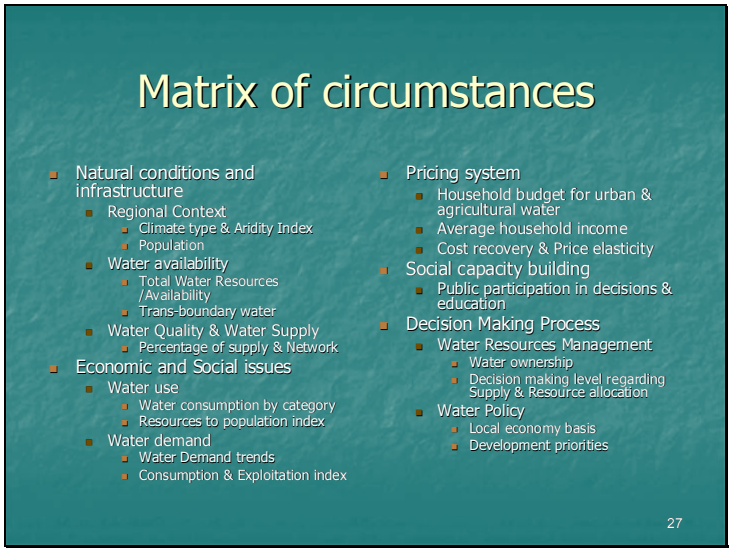
- Selection based on disarrangements between resource availability, consumption increase and conflicts between different water uses
  - Canary Islands: main problems related to irrigation demand, rapid population growth and tourist development
  - Donana: hosts an important wetland and a large population

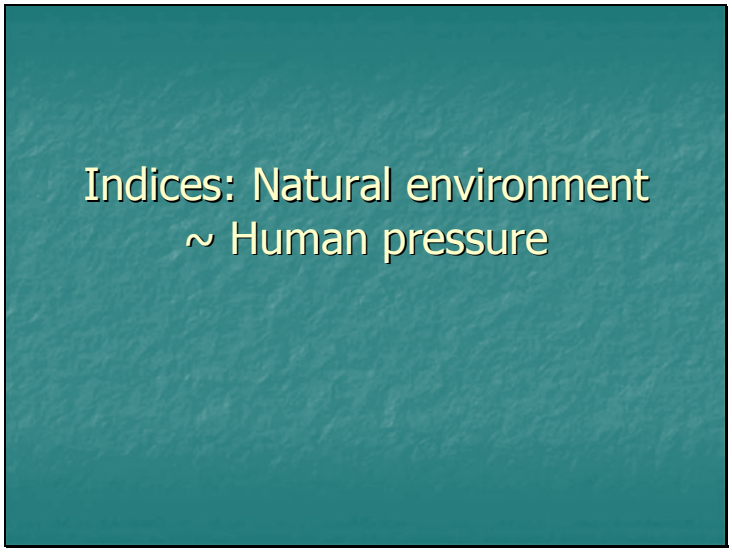


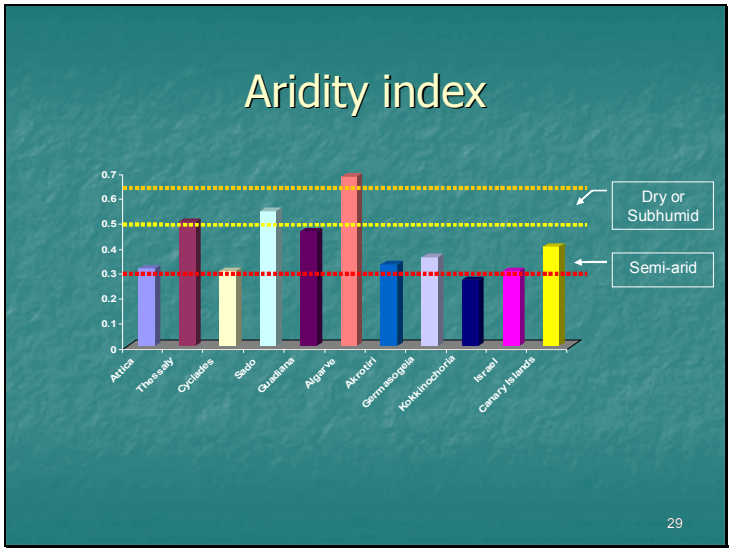
24

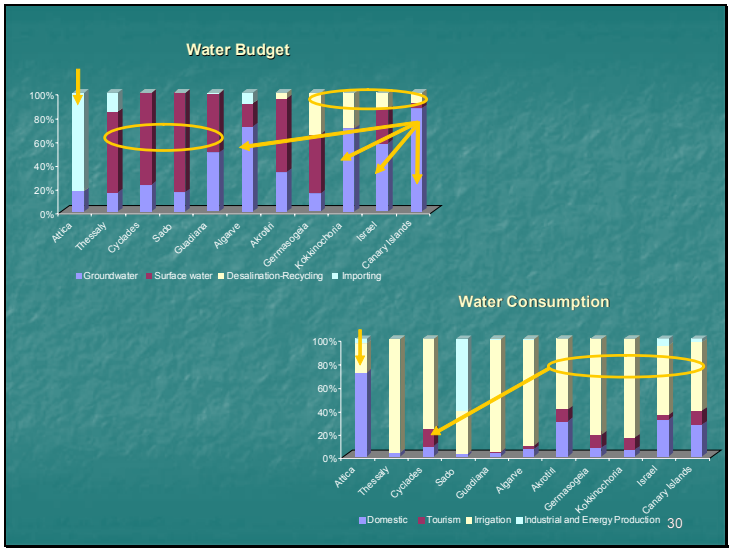

Selected Regions - Canary Islands, Spain
Unique circumstances
Driving forces
Limited water resources
Population Growth
Tourism
Agriculture
Pressures
Agricultural demand
Seasonal Water Demand
Privatization of groundwater
Impacts
State
Water shortage
Serious dependence on desalination
Responses
Desalination
25

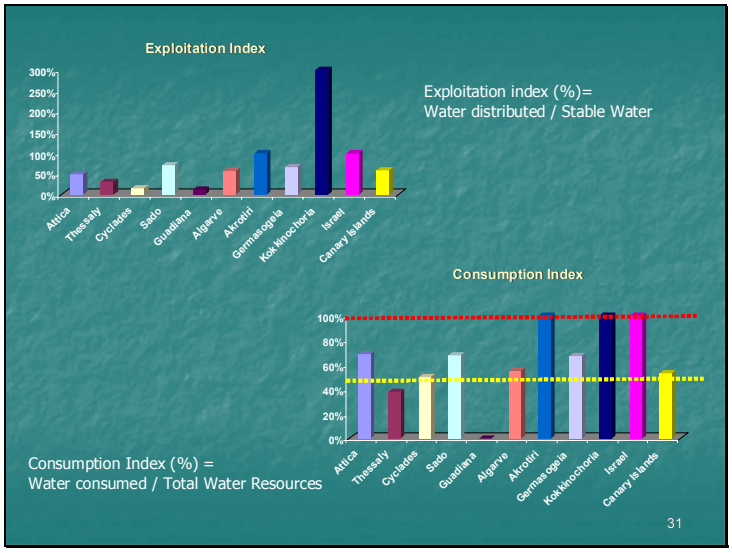

Selected Regions – Donana
Unique circumstances
Driving forces
Hosts a wetland
Large population
Pressures
Agricultural demand
Domestic supply
State
Management problem
Impacts
Responses
Wetland conservation
26

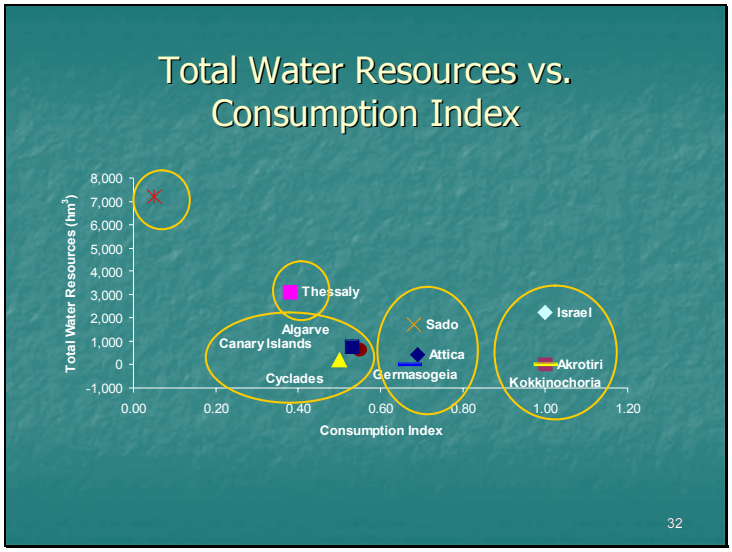

Matrix of circumstances
Natural conditions and infrastructure
Regional Context
Climate type & Aridity Index
Population
Water availability
Total Water Resources /Availability
Trans-boundary water
Water Quality & Water Supply
Percentage of supply & Network
Economic and Social issues
Water use
Water consumption by category
Resources to population index
Water demand
Water Demand trends
Consumption & Exploitation index
Pricing system
Household budget for urban & agricultural water
Average household income
Cost recovery & Price elasticity
Social capacity building
Public participation in decisions & education
Decision Making Process
Water Resources Management
Water ownership
Decision making level regarding Supply & Resource allocation
Water Policy
Local economy basis
Development priorities
27


Indices: Natural environment ~ Human pressure

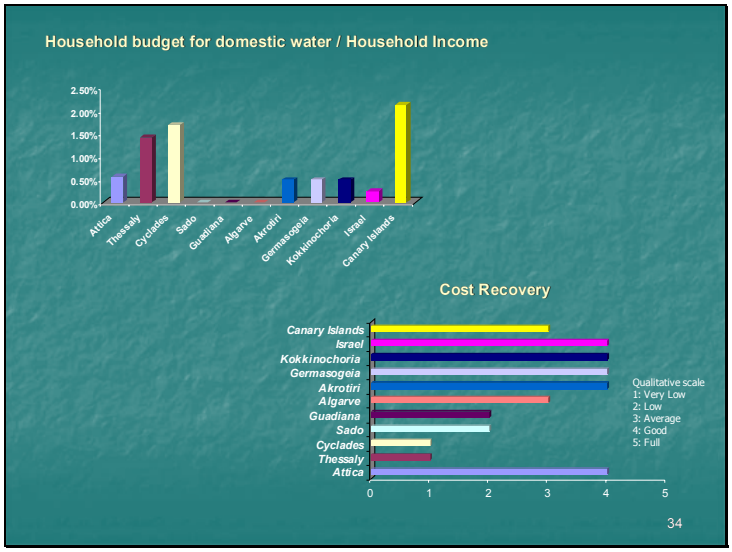

Aridity index
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Dry or Subhumid
Semi-arid
Attica
Thessaly
Cyclades
Sado
Guadiana
Algarve
Akrotiri
Germasogeia
Kokkinochoria
Israel
Canary Islands
29

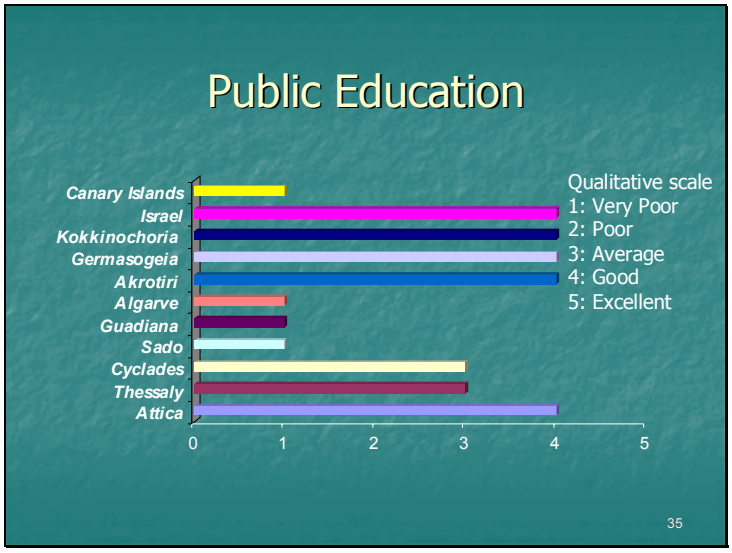

Water Budget
100%
80%
60%
40%
20%
0%
Attica
Thessaly
Cyclades
Sado
Guadiana
Algarve
Akrotiri
Germasogeia
Kokkinochoria
Israel
Canary Islands
Groundwater
Surface water
Desalination-Recycling
Importing
Water Consumption
100%
80%
60%
40%
20%
0%
Attica
Thessaly
Cyclades
Sado
Guadiana
Algarve
Akrotiri
Germasogeia
Kokkinochoria
Israel
Canary Islands
Domestic
Tourism
Irrigation
Industrial and Energy Production
30


Exploitation Index
300%
250%
200%
150%
100%
50%
0%
Attica
Thessaly
Cyclades
Sado
Guadiana
Algarve
Akrotiri
Germasogeia
Kokkinochoria
Israel
Canary Islands
Exploitation index (%)=
Water distributed / Stable Water
Consumption Index
100%
80%
60%
40%
20%
0%
Attica
Thessaly
Cyclades
Sado
Guadiana
Algarve
Akrotiri
Germasogeia
Kokkinochoria
Israel
Canary Islands
Consumption Index (%) =
Water consumed / Total Water Resources
31


Total Water Resources vs.
Consumption Index
Total Water Resources (hm³)
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
0.00
0.20
0.40
0.60
0.80
1.00
1.20
Consumption Index
Thessaly
Algarve
Canary Islands
Cyclades
Sado
Attica
Germasogeia
Israel
Akrotiri
Kokkinochoria
32

Indices – Economic and Social system, Development

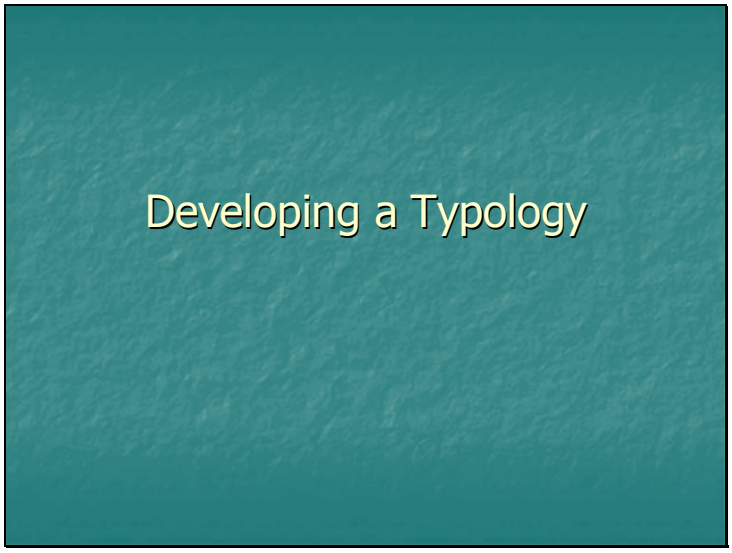


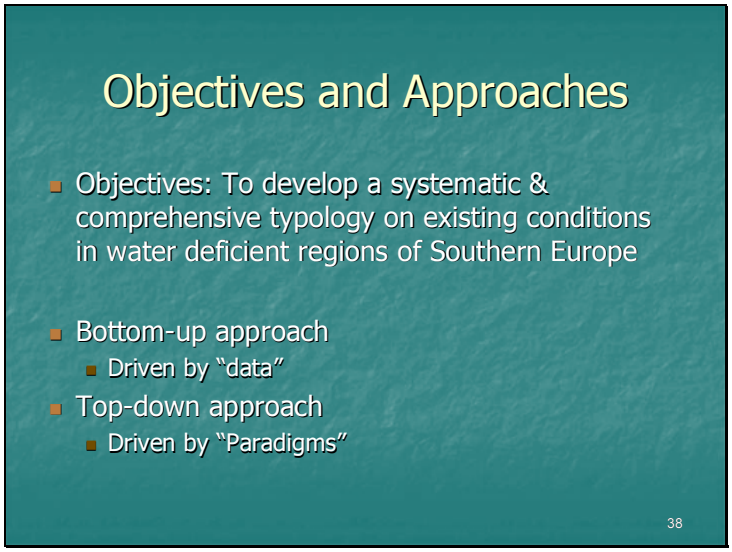


Development Priorities

	Urban Growth	Agriculture	Tourism	Supply Enhancement
Attica	+			++
Thessaly		++		
Cyclades			++	
Sado		++		
Guadiana		++		
Algarve		+	++	
Akrotiri		+	++	
Germasogeia		+	++	
Kokkinochoria		+	++	
Israel				++
Canary Islands			++	

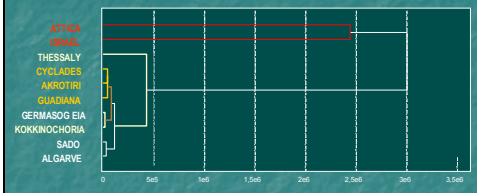
36


Developing a Typology

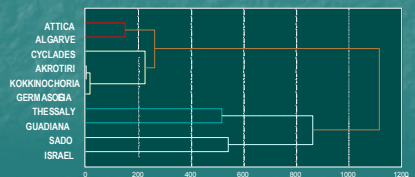

Objectives and Approaches
Objectives: To develop a systematic & comprehensive typology on existing conditions in water deficient regions of Southern Europe
Bottom-up approach
Driven by "data"
Top-down approach
Driven by "Paradigms"
38

Bottom-up: Using the data obtained

Linkage Graph 1 – All variables

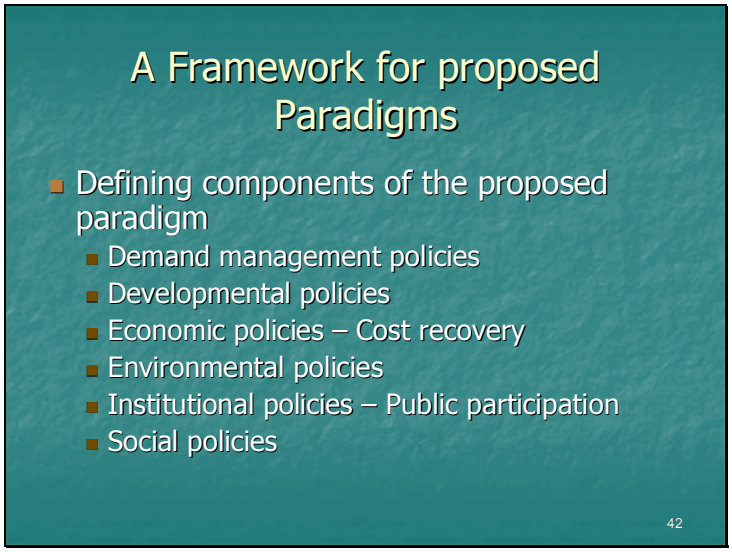


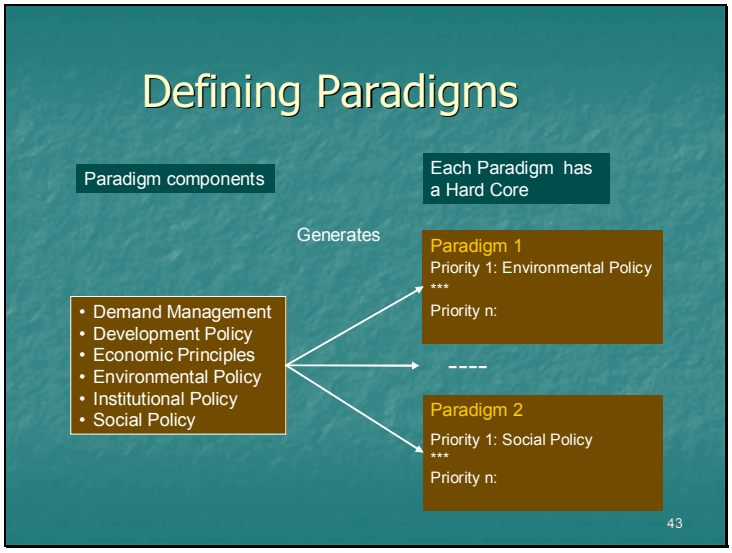
Linkage Graph 2 – Without Population, Transboundary water quantities, Resources to Population ratio, and Income



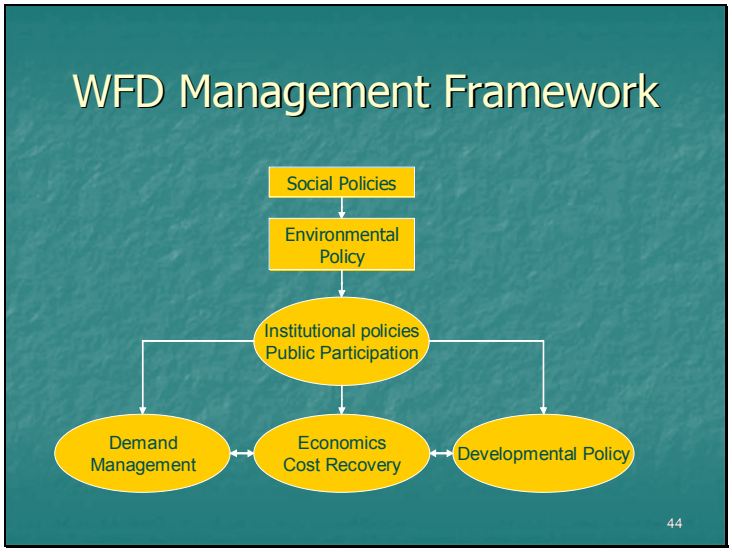
40


The Top-down approach


A Framework for proposed Paradigms
Defining components of the proposed paradigm
Demand management policies
Developmental policies
Economic policies – Cost recovery
Environmental policies
Institutional policies – Public participation
Social policies
42


Defining Paradigms
Paradigm components
Each Paradigm has a Hard Core
Generates
• Demand Management
• Development Policy
• Economic Principles
• Environmental Policy
• Institutional Policy
• Social Policy
Paradigm 1
Priority 1: Environmental Policy
***
Priority n:

Paradigm 2
Priority 1: Social Policy
***
Priority n:
43


WFD Management Framework
Social Policies
Environmental Policy
Institutional policies Public Participation
Demand Management
Economics Cost Recovery
Developmental Policy
44

Significant Indicators for a Typology

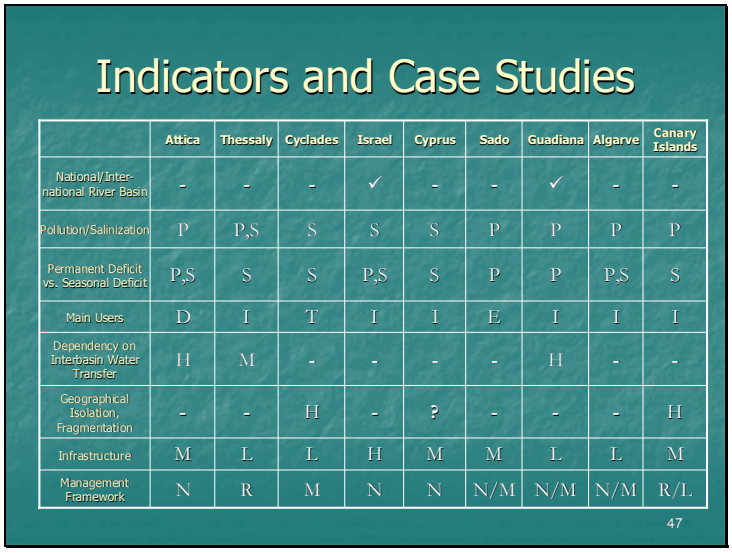
- Existence of a National/International River shed
- Pollution/Salinization
- Permanent Deficit vs. Seasonal Deficit
- Main water Users and Conflicts
- Dependency on Interbasin Water Transfer
- Geographical (or Political) Isolation, Fragmentation
- Infrastructure
- Management Framework

45

Role of Indicators in the Strategic Paradigm Components

	Demand Management	Economic Principles	Environmental Policy	Institutional Policy	Development Policy	Social Policy
National/Inter-national Water sheds			***	***	**	
Pollution/ Salinization		***	***		**	
Permanent vs. Seasonal Deficit	***				***	***
Main Users		***			***	***
Dependency on Interbasin Transfer				**	***	
Geographical Isolation, Fragmentation		*		**	**	**
Infrastructure	**	***	**		***	
Management Framework	*	*		*		*

46



Indicators and Case Studies

	Attica	Thessaly	Cyclades	Israel	Cyprus	Sado	Guadiana	Algarve	Canary Islands
National/Inter-national River Basin	-	-	-	✓	-	-	✓	-	-
Pollution/Salinization	P	P,S	S	S	S	P	P	P	P
Permanent Deficit vs. Seasonal Deficit	P,S	S	S	P,S	S	P	P	P,S	S
Main Users	D	I	T	I	I	E	I	I	I
Dependency on Interbasin Water Transfer	H	M	-	-	-	-	H	-	-
Geographical Isolation, Fragmentation	-	-	H	-	?	-	-	-	H
Infrastructure	M	L	L	H	M	M	L	L	M
Management Framework	N	R	M	N	N	N/M	N/M	N/M	R/L

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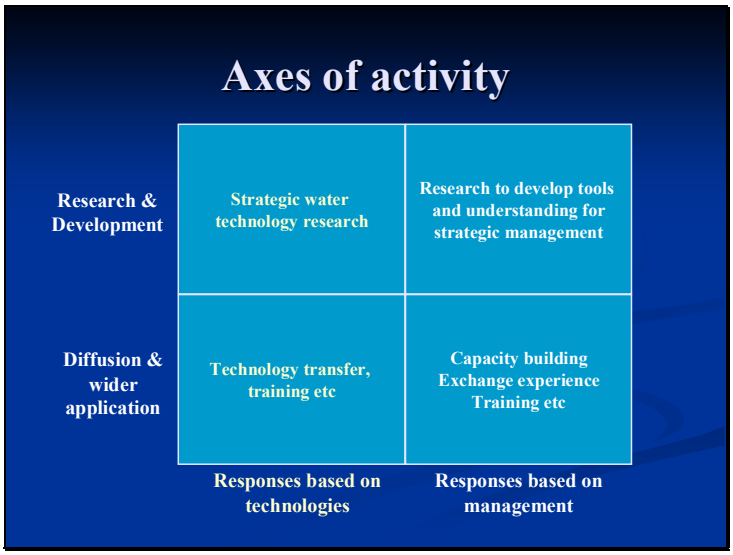
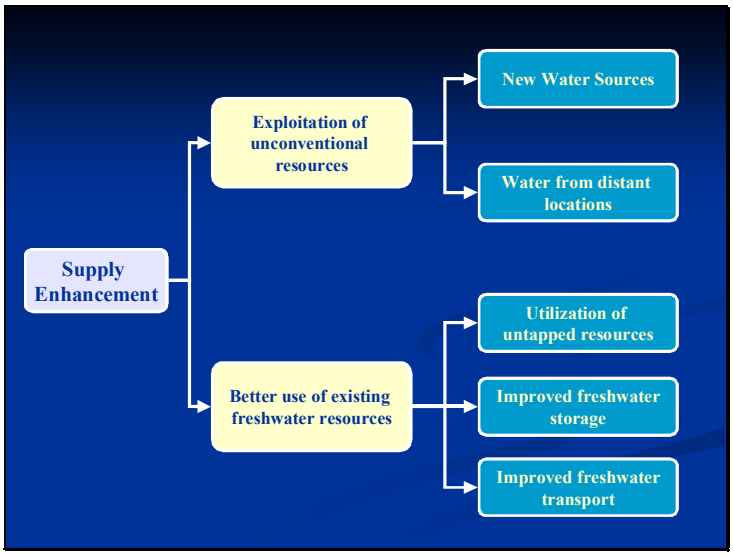
Demand Reduction &
Supply Enhancement
Options


Water resources problems
Current water resources problems in EU and third countries require:
Technological
Management Responses
Wider application of existing technologies and techniques
Further research and development of new technologies
New management approaches


Axes of activity
Research & Development
Diffusion & wider application
Strategic water technology research
Research to develop tools and understanding for strategic management
Technology transfer, training etc
Capacity building Exchange experience Training etc
Responses based on technologies
Responses based on management


Technology Responses
Supply Enhancement
Better use of existing resources
Exploitation of unconventional water sources
Demand Reduction
Industry
Agriculture
Personal Demand
Pollution Prevention / Correction


Supply Enhancement


Supply Enhancement
Exploitation of unconventional resources
Better use of existing freshwater resources
New Water Sources
Water from distant locations
Utilization of untapped resources
Improved freshwater storage
Improved freshwater transport

Utilization of untapped resources

- Groundwater
  - Sources
    - Private wells in shallow aquifers
    - Exploitation of deep and karstic aquifers
  - Main problems related to:
    - Water quality
    - Abstraction difficulties
- Urban waters
  - Sources
    - Rainfall
    - Stormwater
  - Main problems related to:
    - Lack of knowledge of water flow paths
    - Potential Pollution
- Surface waters
  - Exploitation of winter surface runoff
  - Advantages
    - Commonly employed technique
    - Economic and environmental benefits in comparison to large dam construction
- Surplus freshwater transfer from neighbouring regions

Improved Freshwater Storage

- Evaporation prevention from surface reservoirs
  - Objective: Reduction of losses from evaporation (5 to 10 % of reservoir volume)
  - Mechanisms:
    - Compartmented reservoirs
    - Reflective coatings
    - Surface films
    - Mechanical covers for small reservoirs
- Artificial recharge of underground aquifers
  - Objective: turn surface water of unreliable quantity and quality into a safe source for supply
  - Solution to the over abstraction problem
  - Forms of charging:
    - Open Recharge (increase of surface water levels)
    - Well Recharge

Improved Freshwater Transport

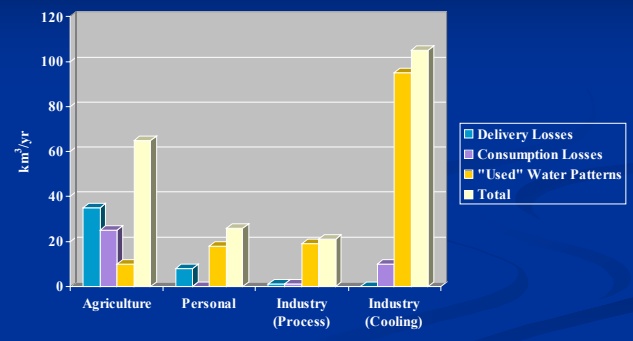
- Reduction of losses from open channels
  - Applied to large scale interbasin transfers to solve regional water shortages
  - Techniques
    - Compacted earth
    - Rigid surfaces
    - Membranes
    - Soil sealants
- Reduction of losses from pipes
  - Development of methods for:
    - Detection with sonar devices
    - Remedy through pressure restriction and pipe replacement
  - Need for improvement of existing technologies

Unconventional Supply

- Cloud Seeding
  - Rainfall increase between 10 and 25%
  - Increased precipitation in favour of agriculture
  - Technology still under evaluation
  - Possible impacts on other sectors / regions
- Tanker Transport
- Wastewater Reuse / Recycling
  - Reuse: "transmission" of wastewater (treated or untreated) directly to a specific intended use
    - Crop Irrigation
    - Street cleaning
  - Recycling: utilisation within the same end user category
    - Industrial cooling
- Desalination
  - Technologies
    - Distillation (MSF, MED)
    - Membrane technologies (Reverse Osmosis, Electrodialysis)
    - Crystallisation (Freeze Melting)
    - Ion Exchange
  - Significant drop in water costs (still water production costs are three times higher)
  - R&D Efforts:
    - Development of competing technologies with less energy requirements
    - Reduction of energy costs with the exploitation of Renewable Energy Sources

Demand Reduction

Mass Balance and Water Use in EC



ECOTEC based on UNEP data, 1990

Demand Reduction Potential

- New technologies for demand reduction are very specific to the end user
- Large potential for agricultural and industrial activities
- Personal demand reduction is based on the introduction of water saving devices

Agricultural Demand Reduction

- Scheduling services
  - Estimation of actual water requirements
- Improvements in irrigation technologies
  - Reduction of losses in delivery / use
  - Technologies
    - Surface Irrigation
    - Sub Irrigation
    - Drip Irrigation
    - Sprinkler Irrigation
    - Enclosures
- Reduction of the actual quantity needed
  - Increase of salt tolerance
  - Decrease of water consumption

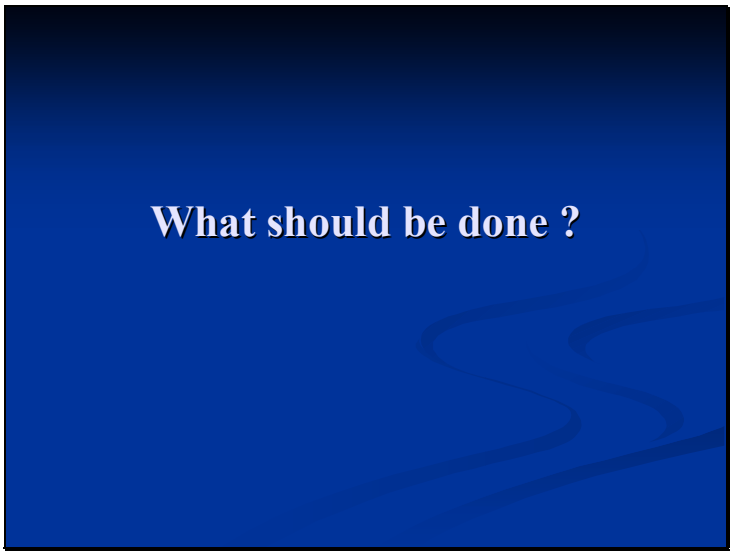
  - Genetic Improvement
  - Introduction of crops with specific characteristics

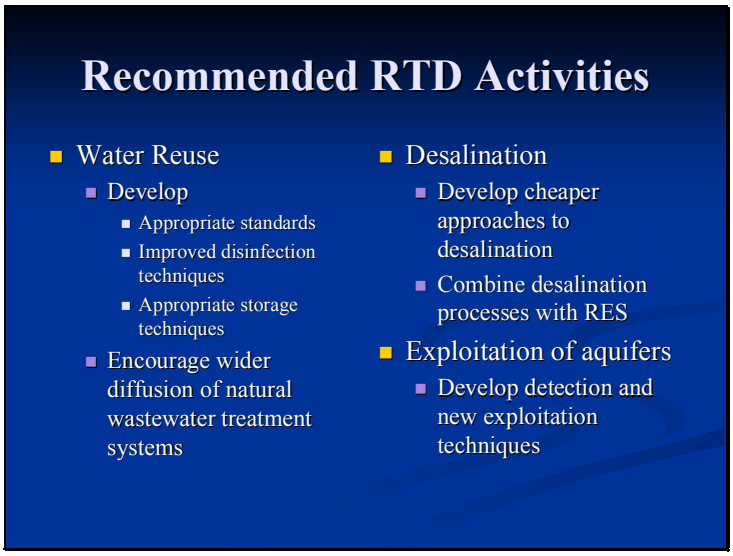
Industrial Demand Reduction

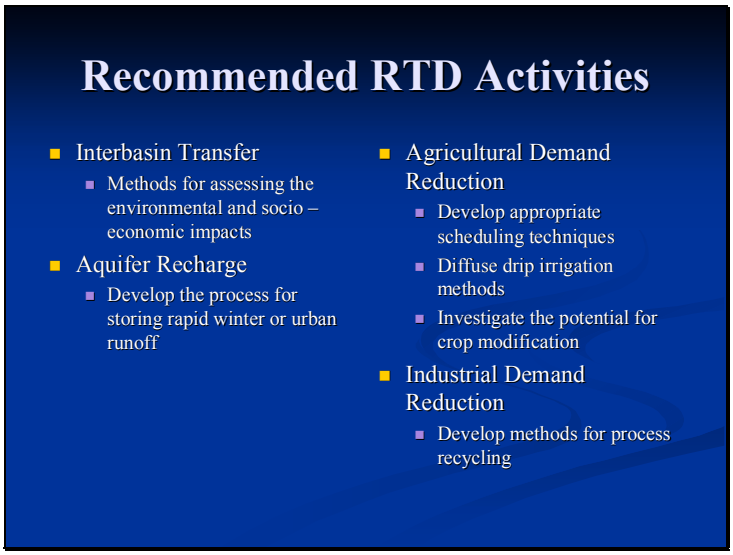
- Process Recycling
- Operation changes
  - Modernization and better control of process equipment in order to reduce water consumption
- Process changes
- Input (raw materials) substitution
- End product changes

Personal Demand Reduction

- The introduction of water saving plumbing features can reduce consumption up to 35 %
- Economic, social and regulatory barriers can be overcome through:
  - Economic instruments
  - Education and awareness
  - Use of standards


What should be done ?


Recommended RTD Activities
Water Reuse
Develop
Appropriate standards
Improved disinfection techniques
Appropriate storage techniques
Encourage wider diffusion of natural wastewater treatment systems
Desalination
Develop cheaper approaches to desalination
Combine desalination processes with RES
Exploitation of aquifers
Develop detection and new exploitation techniques


Recommended RTD Activities
Interbasin Transfer
Methods for assessing the environmental and socio – economic impacts
Aquifer Recharge
Develop the process for storing rapid winter or urban runoff
Agricultural Demand Reduction
Develop appropriate scheduling techniques
Diffuse drip irrigation methods
Investigate the potential for crop modification
Industrial Demand Reduction
Develop methods for process recycling

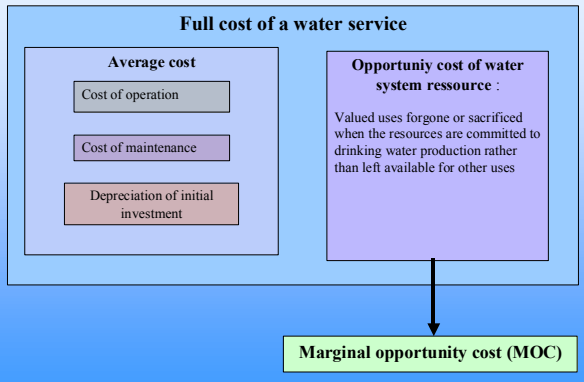
International Office for Water

THE ECONOMIC DIMENSION OF WSM

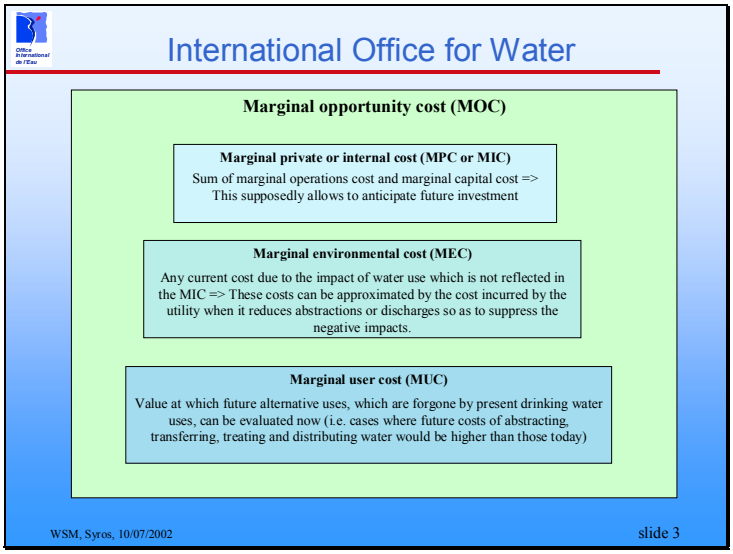
- *Review and evaluation of available methods for the assessment of economic costs and environmental impacts from water supply and use and assessment of their applicability to the identified Paradigms*
- *The evaluation of alternative water resources allocation scenarios for the Paradigm regions*
- *The development of alternative integrated water resources management options, for each paradigm, taking into account economic and environmental costs.*

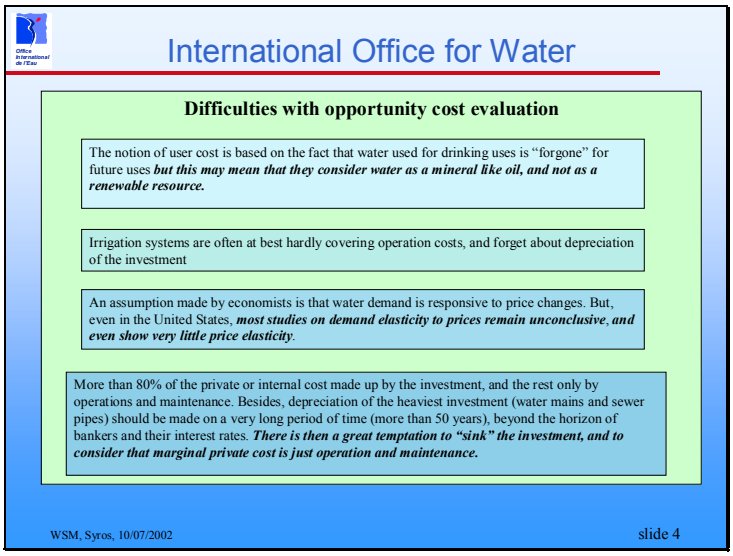
WSM, Syros, 10/07/2002 slide 1

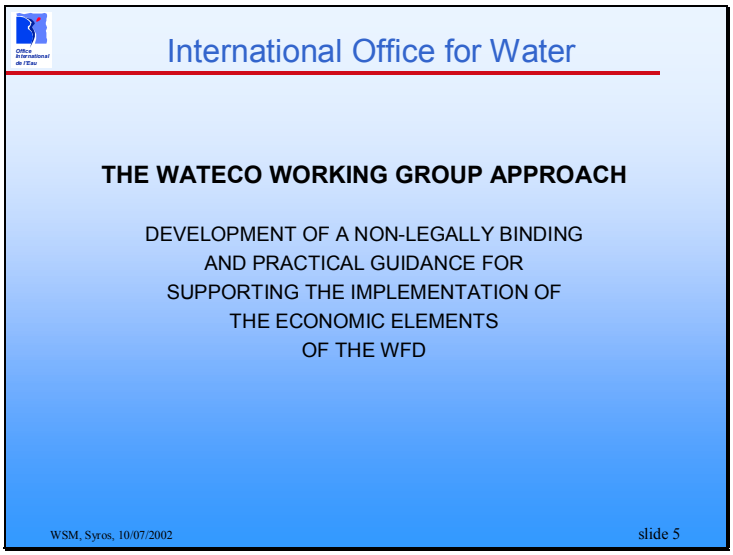
International Office for Water

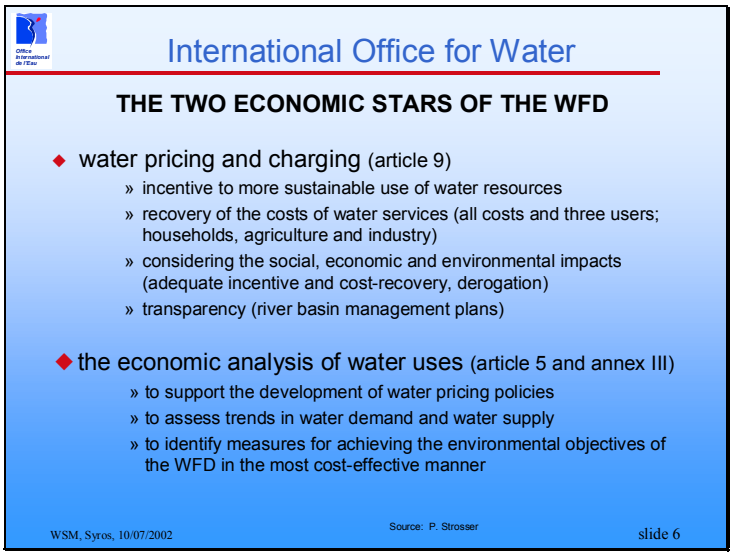


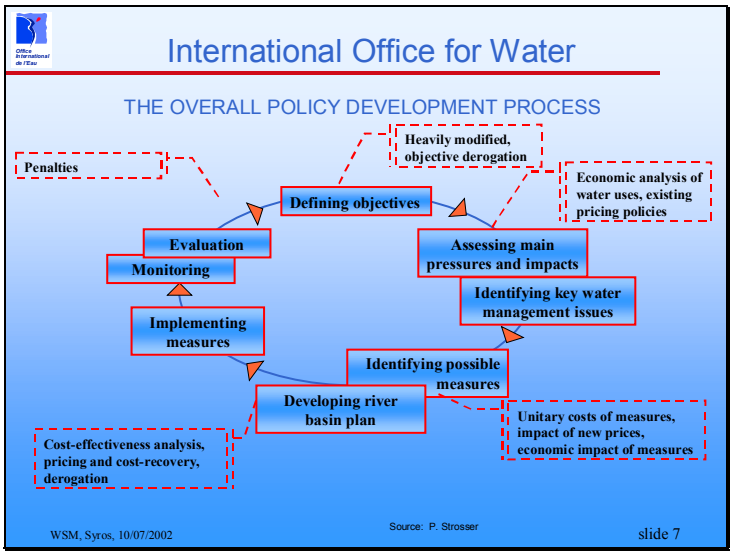
WSM, Syros, 10/07/2002 slide 2

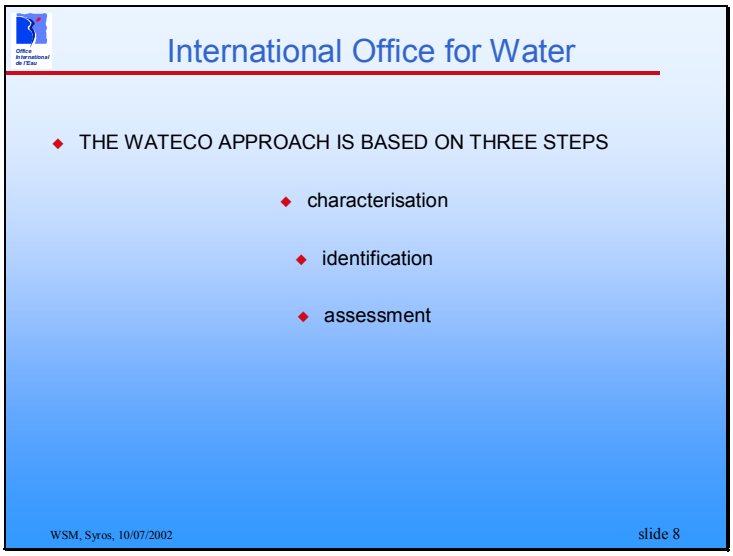

International Office for Water
Marginal opportunity cost (MOC)
Marginal private or internal cost (MPC or MIC)
Sum of marginal operations cost and marginal capital cost => This supposedly allows to anticipate future investment
Marginal environmental cost (MEC)
Any current cost due to the impact of water use which is not reflected in the MIC => These costs can be approximated by the cost incurred by the utility when it reduces abstractions or discharges so as to suppress the negative impacts.
Marginal user cost (MUC)
Value at which future alternative uses, which are forgone by present drinking water uses, can be evaluated now (i.e. cases where future costs of abstracting, transferring, treating and distributing water would be higher than those today)
WSM, Syros, 10/07/2002
slide 3

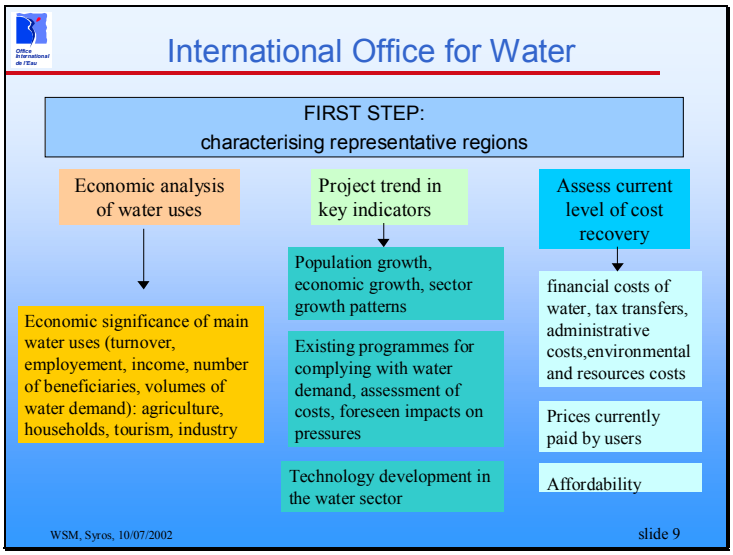

International Office for Water
Difficulties with opportunity cost evaluation
The notion of user cost is based on the fact that water used for drinking uses is "forgone" for future uses but this may mean that they consider water as a mineral like oil, and not as a renewable resource.
Irrigation systems are often at best hardly covering operation costs, and forget about depreciation of the investment
An assumption made by economists is that water demand is responsive to price changes. But, even in the United States, most studies on demand elasticity to prices remain unconclusive, and even show very little price elasticity.
More than 80% of the private or internal cost made up by the investment, and the rest only by operations and maintenance. Besides, depreciation of the heaviest investment (water mains and sewer pipes) should be made on a very long period of time (more than 50 years), beyond the horizon of bankers and their interest rates. There is then a great temptation to "sink" the investment, and to consider that marginal private cost is just operation and maintenance.
WSM, Syros, 10/07/2002
slide 4

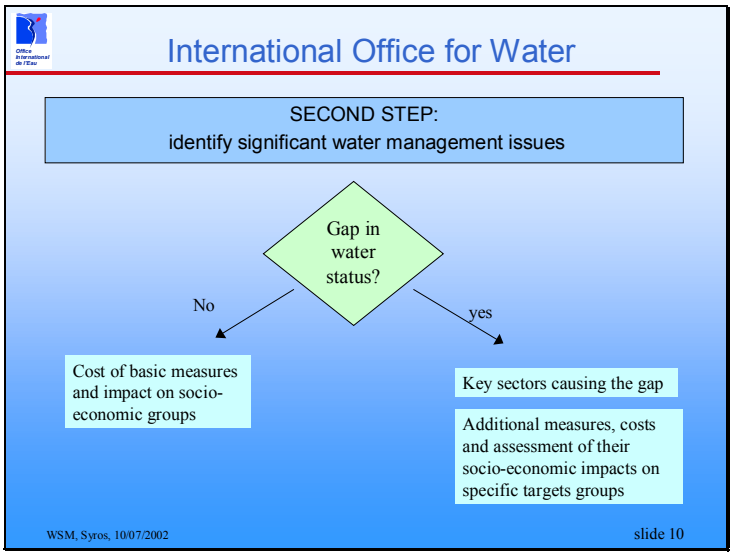

International Office for Water
THE WATECO WORKING GROUP APPROACH
DEVELOPMENT OF A NON-LEGALLY BINDING
AND PRACTICAL GUIDANCE FOR
SUPPORTING THE IMPLEMENTATION OF
THE ECONOMIC ELEMENTS
OF THE WFD
WSM, Syros, 10/07/2002
slide 5

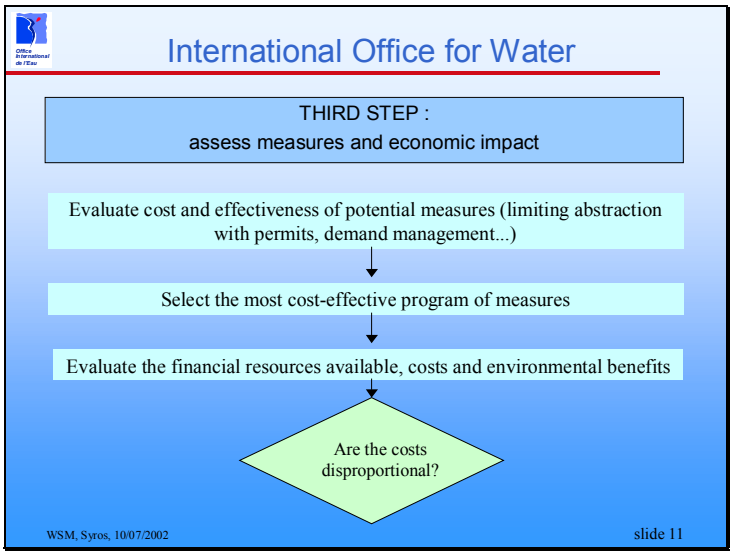

International Office for Water
THE TWO ECONOMIC STARS OF THE WFD
water pricing and charging (article 9)
» incentive to more sustainable use of water resources
» recovery of the costs of water services (all costs and three users; households, agriculture and industry)
» considering the social, economic and environmental impacts (adequate incentive and cost-recovery, derogation)
» transparency (river basin management plans)
the economic analysis of water uses (article 5 and annex III)
» to support the development of water pricing policies
» to assess trends in water demand and water supply
» to identify measures for achieving the environmental objectives of the WFD in the most cost-effective manner
WSM, Syros, 10/07/2002
Source: P. Strosser
slide 6

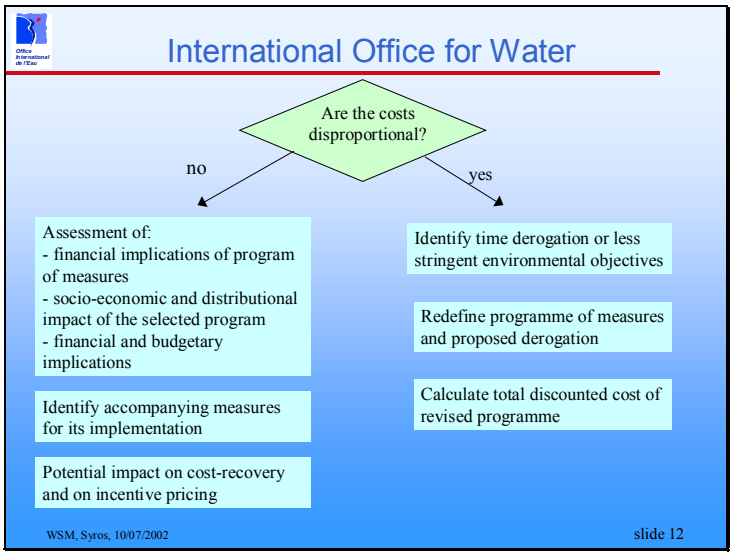

International Office for Water
THE OVERALL POLICY DEVELOPMENT PROCESS
Heavily modified, objective derogation
Penalties
Economic analysis of water uses, existing pricing policies
Defining objectives
Evaluation
Monitoring
Assessing main pressures and impacts
Identifying key water management issues
Implementing measures
Identifying possible measures
Developing river basin plan
Unitary costs of measures, impact of new prices, economic impact of measures
Cost-effectiveness analysis, pricing and cost-recovery, derogation
WSM, Syros, 10/07/2002
Source: P. Strosser
slide 7

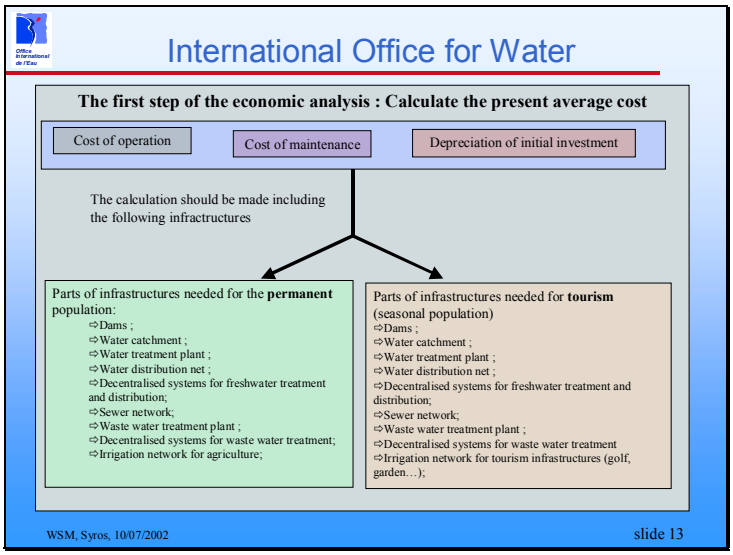

International Office for Water
THE WATECO APPROACH IS BASED ON THREE STEPS
characterisation
identification
assessment
WSM, Syros, 10/07/2002
slide 8

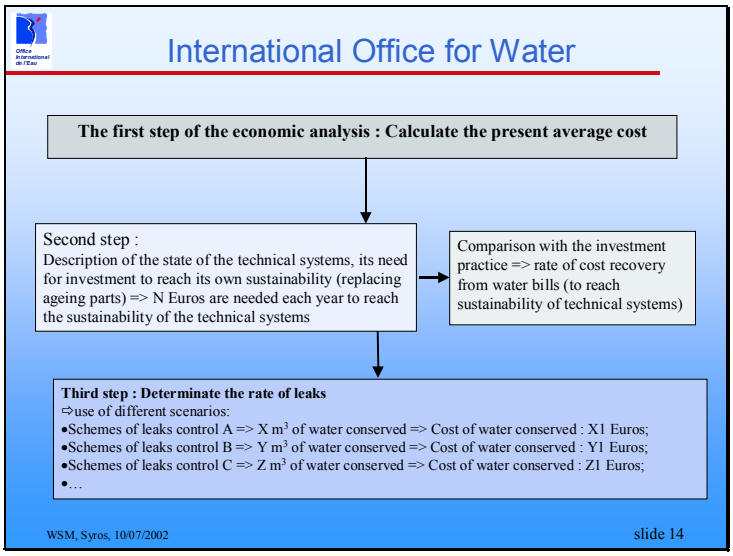

International Office for Water
FIRST STEP:
characterising representative regions
Economic analysis of water uses
Economic significance of main water uses (turnover, employement, income, number of beneficiaries, volumes of water demand): agriculture, households, tourism, industry
Project trend in key indicators
Population growth, economic growth, sector growth patterns
Existing programmes for complying with water demand, assessment of costs, foreseen impacts on pressures
Technology development in the water sector
Assess current level of cost recovery
financial costs of water, tax transfers, administrative costs,environmental and resources costs
Prices currently paid by users
Affordability
WSM, Syros, 10/07/2002
slide 9

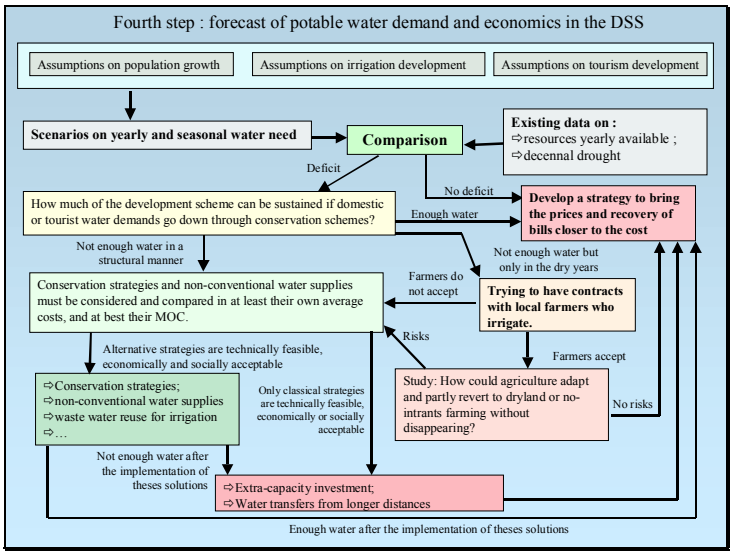

International Office for Water
SECOND STEP:
identify significant water management issues
Gap in water status?
No
yes
Cost of basic measures and impact on socio-economic groups
Key sectors causing the gap
Additional measures, costs and assessment of their socio-economic impacts on specific targets groups
WSM, Syros, 10/07/2002
slide 10


International Office for Water
THIRD STEP :
assess measures and economic impact
Evaluate cost and effectiveness of potential measures (limiting abstraction with permits, demand management...)
Select the most cost-effective program of measures
Evaluate the financial resources available, costs and environmental benefits
Are the costs disproportional?
WSM, Syros, 10/07/2002
slide 11

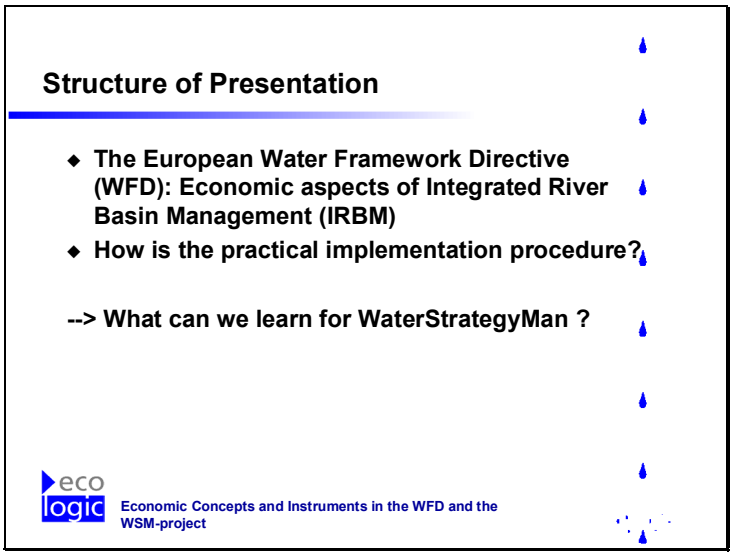

International Office for Water
Are the costs disproportional?
no
yes
Assessment of:
- financial implications of program of measures
- socio-economic and distributional impact of the selected program
- financial and budgetary implications
Identify accompanying measures for its implementation
Potential impact on cost-recovery and on incentive pricing
Identify time derogation or less stringent environmental objectives
Redefine programme of measures and proposed derogation
Calculate total discounted cost of revised programme
WSM, Syros, 10/07/2002
slide 12


International Office for Water
The first step of the economic analysis : Calculate the present average cost
Cost of operation
Cost of maintenance
Depreciation of initial investment
The calculation should be made including the following infractructures
Parts of infrastructures needed for the permanent population:
⇨Dams ;
⇨Water catchment ;
⇨Water treatment plant ;
⇨Water distribution net ;
⇨Decentralised systems for freshwater treatment and distribution;
⇨Sewer network;
⇨Waste water treatment plant ;
⇨Decentralised systems for waste water treatment;
⇨Irrigation network for agriculture;
Parts of infrastructures needed for tourism (seasonal population)
⇨Dams ;
⇨Water catchment ;
⇨Water treatment plant ;
⇨Water distribution net ;
⇨Decentralised systems for freshwater treatment and distribution;
⇨Sewer network;
⇨Waste water treatment plant ;
⇨Decentralised systems for waste water treatment
⇨Irrigation network for tourism infrastructures (golf, garden…);
WSM, Syros, 10/07/2002
slide 13


International Office for Water
The first step of the economic analysis : Calculate the present average cost
Second step :
Description of the state of the technical systems, its need for investment to reach its own sustainability (replacing ageing parts) => N Euros are needed each year to reach the sustainability of the technical systems
Comparison with the investment practice => rate of cost recovery from water bills (to reach sustainability of technical systems)
Third step : Determinate the rate of leaks
⇨use of different scenarios:
•Schemes of leaks control A => X m3 of water conserved => Cost of water conserved : X1 Euros;
•Schemes of leaks control B => Y m3 of water conserved => Cost of water conserved : Y1 Euros;
•Schemes of leaks control C => Z m3 of water conserved => Cost of water conserved : Z1 Euros;
•…
WSM, Syros, 10/07/2002
slide 14


Fourth step : forecast of potable water demand and economics in the DSS
Assumptions on population growth
Assumptions on irrigation development
Assumptions on tourism development
Scenarios on yearly and seasonal water need
Comparison
Existing data on :
⇨resources yearly available ;
⇨decennal drought
Deficit
No deficit
How much of the development scheme can be sustained if domestic or tourist water demands go down through conservation schemes?
Enough water
Develop a strategy to bring the prices and recovery of bills closer to the cost
Not enough water in a structural manner
Not enough water but only in the dry years
Conservation strategies and non-conventional water supplies must be considered and compared in at least their own average costs, and at best their MOC.
Farmers do not accept
Trying to have contracts with local farmers who irrigate.
Risks
Alternative strategies are technically feasible, economically and socially acceptable
Farmers accept
⇨Conservation strategies;
⇨non-conventional water supplies
⇨waste water reuse for irrigation
⇨…
Only classical strategies are technically feasible, economically or socially acceptable
Study: How could agriculture adapt and partly revert to dryland or no-intrants farming without disappearing?
No risks
Not enough water after the implementation of theses solutions
⇨Extra-capacity investment;
⇨Water transfers from longer distances
Enough water after the implementation of theses solutions


eco logic
Economic Concepts and Instruments in the Water Framework Directive (WFD)
Relevance to the WaterStrategyMan-Project
Eduard Interwies, Research Fellow
Ecologic, Institute for International and European Environmental Policy, Berlin
Hermoupolis, Greece 8/07/2002


Structure of Presentation
The European Water Framework Directive (WFD): Economic aspects of Integrated River Basin Management (IRBM)
How is the practical implementation procedure?
--> What can we learn for WaterStrategyMan ?
eco logic
Economic Concepts and Instruments in the WFD and the WSM-project

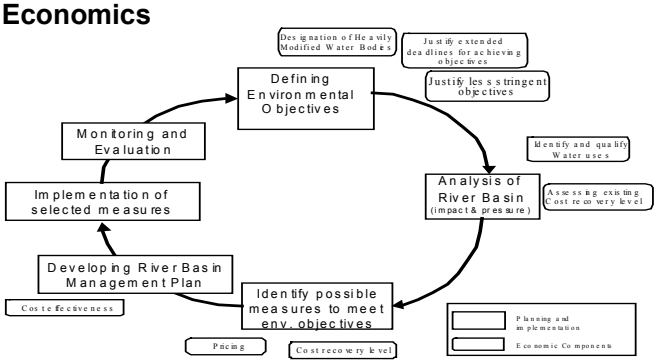
The European Water Framework Directive

- re-orders European water legislation;
- imposes the **Integrated River Basin (Water Shed) Management Approach**
- thus affects administrative structures and
- reduces the importance of frontiers in Europe
- introduces/reinforces the **use of economic concepts** in water resource management (cost recovery, polluter pays etc.).

--> Chances and difficulties!

eco logic Economic Concepts and Instruments in the WFD and the WSM-project

Main Steps of the WFD Process & Role of Economics



eco logic Economic Concepts and Instruments in the WFD and the WSM-project

Central economic aspects of the WFD: Overview

- cost recovery (including internalisation of environmental and resource costs of water use)
- economic incentives for rational water use
- selecting the most cost-effective set of measures to reach the environmental aims

--> issues of importance for water deficient regions?

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Central economic aspects of the WFD: cost recovery

- „Member States shall take account of the principle of recovery of the costs of water services, including environmental and resource costs [...] and in accordance in particular with the polluter pays principle. Member States shall ensure by 2010

  - an adequate contribution of the different water uses, disaggregated into a least industry, households and agriculture, to the recovery of the costs of water services“ (Art. 9 (1)).

eco logic Economic Concepts and Instruments in the WFD and the WSM-project

Central economic aspects of the WFD: „social“ cost recovery

- “Member States may in so doing have regard to the social, environmental and economic effects of the recovery as well as the geographic and climatic conditions of the region or regions affected” (Art. 9 (1)).

--> important, realistic restriction of the cost recovery principle: danger of misuse? (political consensus through transparency!)

eco logic Economic Concepts and Instruments in the WFD and the WSM-project

Central economic aspects of the WFD: incentives

- “Member States shall ensure by 2010

  - that water pricing policies provide adequate incentives for users to use water resources efficiently, and thereby contribute to the environmental objectives of this Directive” (Art. 9 (1)).

eco logic Economic Concepts and Instruments in the WFD and the WSM-project

Central economic aspects of the WFD: measures

- [...] (b) make judgements about the most cost effective combination of measures in respect of water uses to be included in the programme of measures under Art. 11 based on estimates of the potential costs of such measures (Annex III).

Ambitious aims:

how can they be achieved?

--> Information as a first step (see also Bernard´s paper)!

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Requirements of the WFD for 2004

For each river basin:

1. analysis of characteristics
2. review of the impact of human activities on water bodies
3. economic analysis of water uses

(according to Article 5, Annex II, III and V)

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Economic Analysis of Water Use

(required until 2004!)

Contain enough information for :

- calculations for taking into account the cost recovery principle
- judgments on the most cost-effective combination of measures
- calculations for water pricing policies giving incentives for the efficient use of water

eco logic Economic Concepts and Instruments in the WFD and the WSM-project

Economic Analysis in the WFD

- Possibly the most interesting, powerful, difficult (and controversial?) new element introduced to European water management though the WFD!
- Issue of moving from historical (Federal States) to "Ecological" boundaries (River Basins)!
- Increasing role of economic instruments (and economists)!

eco logic Economic Concepts and Instruments in the WFD and the WSM-project

Practical implementation

- Guidance document on economic aspects of the WFD prepared by the WATer ECOnomics working group (WATECO)
- endorsed by the Water Directors meeting in Sevilla in June, final version end of July
- National implementation has started (in form of guidance for administrations, pilot projects etc.)

--> WSM should build around this work!

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What does this mean for WSM?

- WATECO-work focussed on the information basis needed by 2004 (required economic analysis!)
- not a lot on cost-effective sets of measures (use of instruments), will be focus of WATECO work after 2004
- only first thoughts on practical calculation of environmental and resource costs (mitigation?)

--> WSM "ahead of times"!

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The way ahead for socio-economics in WSM

- Build on the principles of the WFD
- On information: Use existing results of WATECO as a basis, test them in co-operation with national and regional authorities (the have to do the "job" anyway)
- move forward with identifying (sets of) measures "in practice", integrate results into future WATECO (and national) work
- move forward on estimating future demand (supply), scenario building (here: seasonal dimension important)

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Possible economic instruments

- "adequate" cost recovery: change tariff structures (no average cost pricing): be realistic, no "textbook" approach (for DSS)
- integrate environmental costs: develop/ improve (abstraction) charges and fees
- water conservation measures (look at financing)
- "smart" metering solutions
- IMPORTANT: develop compensation programs for loss in income (increase acceptability), based on long-term sustainable growth

--> find the right "mix"!

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The Water Framework Directive

Economic aspects in Research projects

Characterisation of river basin : linking biophysical and economic information	Where will we be in 2015? Assessing trends in water demand and supply	Selection cost-effective measures for achieving the environmental objectives of the WFD	Assessing existing and future levels of the recovery of the costs of water services	Linking the economic analysis with the information, consultation and participation process
FIRMA	EUROCAT	CYPRUS	METRON	FIRMA
PEGASE	EUROMARKET	AgriBMPWater	EUROMARKET	HARMONICOP*
EVALUWET	AQUALIBRIUM	MULINO	AQUALIBRIUM	
	Water Strategy Man		WADI	
			MEIF	

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Economic Concepts and Instruments in the Water Framework Directive (WFD)

Relevance to the WaterStrategyMan-Project

Eduard Interwies, Research Fellow
Ecologic, Institute for International and European Environmental Policy, Berlin

Hermoupolis, Greece 8/07/2002

Water Resources Planning and Management in the 21st Century

Capacity Building
&
Institutional Mobilization

Evan Vlachos
Sociology and Civil Engineering
Colorado State University

The Five Crises

- An **Engineering** Crisis: Supply and Demand
- An **Ecological** Crisis: Quality
- An **Organizational** Crisis: Institutional Mobilization and Coordination
- A **Methodological** Crisis: Data and Modeling
- A **Perceptual** Crisis: Public Awareness, Involvement and Participation

Changing Approaches to Planning and Management

1960s	Feasibility studies, Elitist planning, Extrapolative orientation
1970s	Environmental Impact Assessment, Indicators/Principles & Standards, modeling/data
1980s	Cumulative Impact Assessment, foresight emphasis, "User pays," "Polluter pays" principle
1990s	Sustainability, Equity/Efficiency/Effort, Normative Planning
2000s	Globalization, Integrated/Holistic/Comprehensive, "Co-evolution"

Evolution of Water Resources Approaches

	Approach	Emphasis
1960s	Traditional	Subsystem government power
1970s	Rational	"Administrative," Political rationality, Environmental, social calculus
1980s	Transitional	Free market, budget reform, budget
1990s	Managerial	Muddling through with a purpose
2000s	Transformational	Holistic, integrated, heterarchical

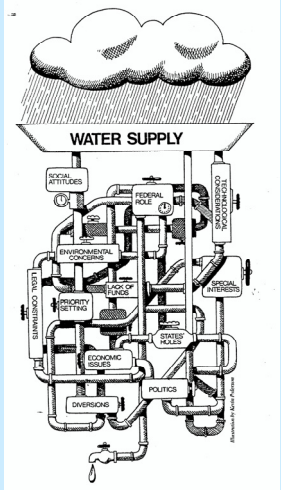
Complexification

A. **Conceptual** = shifting paradigms/complexity/ chaos/heterarchization

B. **Methodological** = multi-/GIS, ES, AI, DSS/ systems/computational prowess

C. **Organizational** = participatory/anticipatory/ contingency emphasis

D. **Substantive** = new focus/areas of concern



The water management maze:
The complications of supplying the demand.

TOWARDS IWRM

A. UNDERPINNING PRINCIPLES ≈ "PHILOSOPHY"

B. CRITERIA & STANDARDS ≈ "PLANNING"

C. CROSS-CUTTING PRACTICES ≈ "MODELING"

D. IMPLEMENTATION MECHANISMS ≈ "MANAGING"

A. IWRM Principles/Premises

Principle I: Water as a finite and vulnerable resource

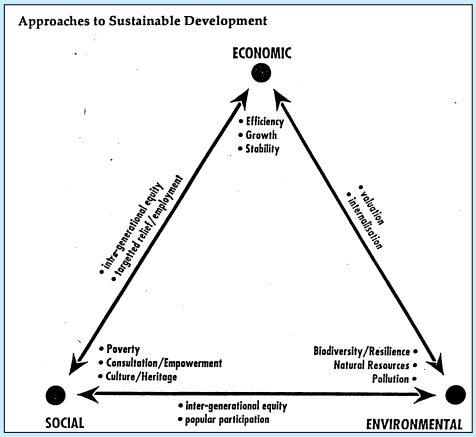
Principle II: Participatory approach

Principle II: The important role of women

Principle IV: Water as an economic good

B. CRITERIA & STANDARDS

- ECONOMIC EFFICIENCY
- EQUITY
- ENVIRONMENTAL/ECOLOGICAL SUSTAINABILITY



EQUITY

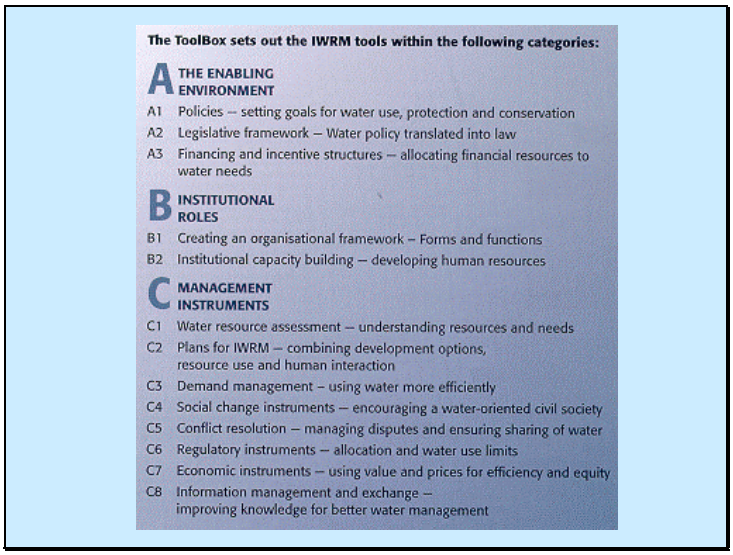
- **Procedural Equity -** access to and influence on the planning process and decisions: transparency, public participation
- **Consequential Equity -** equity of outcomes, parity,proportionality, priority, classical distributive justice

C. Cross-Cutting Practices

1. **Basin-Wide/Watershed Emphasis**
2. **Integration of Supply and Demand Approaches**
3. **Intersectoral Emphasis**
4. **Regulatory and Institutional Frameworks**
5. **Transboundary Interdependencies/Geopolitics**
6. **Participatory and Transparent Governance**


International River Basins of
EUROPE
© Copyright Transboundary Freshwater Dispute Database, 2000


Czech Republic
Slovakia
Austria
Hungary
Moldova
Slovenia
Croatia
Romania
Bosnia-Herzegovina
Serbia
Montenegro
Bulgaria
Albania
FYROM
Greece
400 km



Integrated WRM

- **Vertical Integration**
- **Horizontal Integration**
- **Interdisciplinary Integration**
- **Functional Integration**
- **Stakeholder Integration**

Requisites for the Transition

- The Need for New Paradigms
  - Sustainability, heterarchy, co-evolution
- The Understanding of New Contexts
  - "Raplexity," interdependence, globalization
- The Emergence of New Methodologies
  - Cumulative, synergistic, diachronic impacts
  - Indicators, DSS, data-information, judgement
  - Computational prowess

Towards a "Vigilance" Strategy

Environmental Scanning

[Monitor trends and developments]

Organizational Mobilization

[Improve management]

Decision Support Systems

[Intelligence, interpretation, implementation]

Contingency Planning

[Wider range of alternatives and options]

Emerging Operational Principles

- **Envisioning**

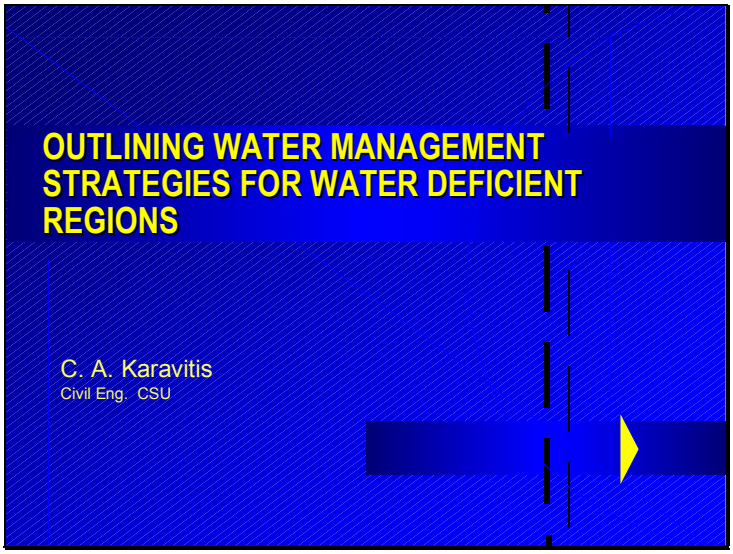
  Share the dream, share the goals

- **Empowerment**

  Joint decision making, power sharing

- **Enactment**

  Implementation, civic engagement


OUTLINING WATER MANAGEMENT STRATEGIES FOR WATER DEFICIENT REGIONS
C. A. Karavitis
Civil Eng. CSU

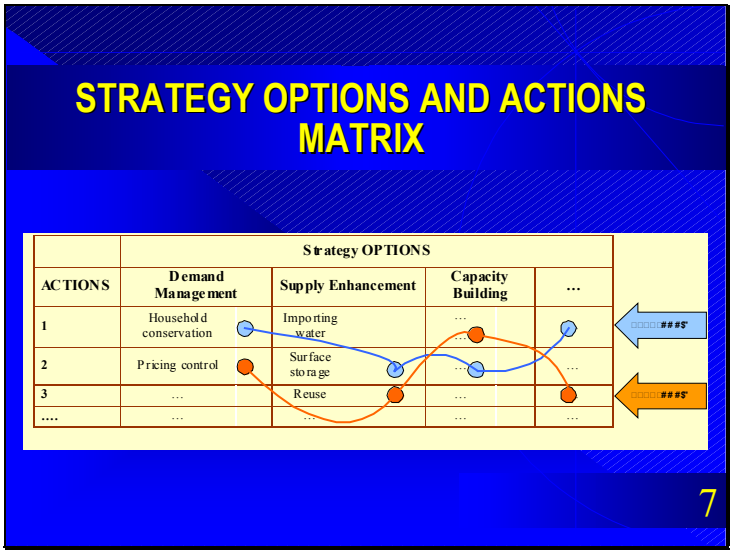

DEMAND MANAGEMENT
Water saving/conservation
recycling/reuse
zoning/land use changes and policies
legal, regulatory and administrative measures
prioritizing demands
metering
technological adjustments (agricultural, urban, industrial
Forecasting system
2


SUPPLY ENHANCEMENT
System improvement/conservation
surface - ground water storage
interbasin/intrabasin transfers
water importation
conjuctive use
weather modification
desalination
3


ECONOMIC OPTIONS
Economic Incentives/Pricing
Water budget changes
Cost recovery
Customer consultation/stakeholders involvement
Existence of guaranteed standards and measurable indicators
Spread of risk/insurance
4


ENVIRONMENTAL OPTIONS
Existence of explicit environmental standards/enforcement
Legal and administrative mandates
environmental regulations
Impact assessment
Risk assessment and management of uncertainty/vigilance
5


INSTITUTIONAL/SOCIAL OPTIONS
National water policy setting/adequacy Public participation
Conservation campaigns
Alternative dispute resolution/conflict management
Clarity of vision, goals and objectives
Institutional mobilization
Capacity building
Administrative apparatus
6


STRATEGY OPTIONS AND ACTIONS MATRIX
Strategy OPTIONS
ACTIONS
Demand Management
Supply Enhancement
Capacity Building
…
1
Household conservation
Importing water
2
Pricing control
Surface storage
3
Reuse
….
7