



**Institutional and Economic Instruments for Sustainable
Water Management in the Mediterranean Region**

Stakeholder Assembly Workshop

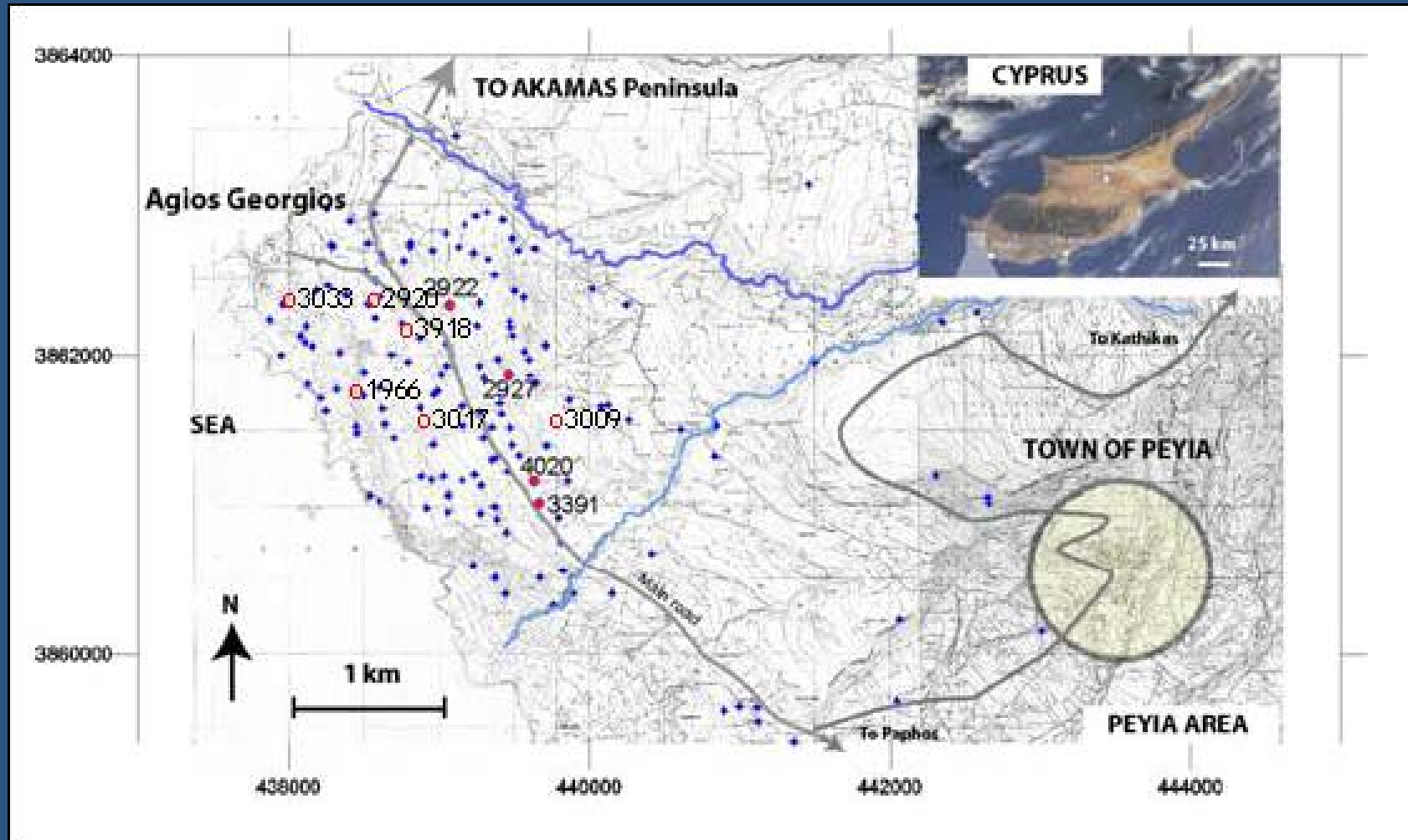
Discussing alternative instruments for improved
water management in the Mediterranean Basin

15th – 16th July 2008

Tunis International Center for Environmental Technologies

Tunisia

Overview of selected management issues



General overview of the study area. Blue dots are boreholes while blue lines are seasonal rivers. The locations of the water supply wells are indicated in red.

Overview of selected management issues

Pegeia aquifer

- **Brief description**
- **Area:** About 20 km². **The main aquifer measures only a few km².**
- **Thickness of aquifer:** 50 -300 m fractured carbonates (chalk and massive limestones)
- **Discharge(2005):** About 1.1 mio m³, 1 mio m³ for domestic water supply for Pegeia Community and tourist areas, and about 0.1 mio m³ for irrigation
- **Domestic W.S.(2007):** From four water supply wells water is extracted for more than 5000 houses and tourist units (End 2006 about 5000 water meters). The four W.S. boreholes are located within the main irrigated area. The one borehole hydr.nr. 4020 is in operation since 2004. Since June 2004 additional water for domestic purposes has been supplied from Asprogremmos treatment plant. Since July 2007 another three new borehole have been connected to the system. **Due to the growth of tourism in the Pegeia area, the demand on water has increased during the last years.**
- **Ground water monitoring:** The water table and salinity evolution have been monitored for several years in the Pegeia aquifer, but the monitoring network may have to be optimised.

Overview of selected management issues

Pegeia aquifer

- **Sea intrusion:** Although the Pegeia coastal aquifer is not yet subject to dramatic seawater intrusion, degradation of the water quality due to excessive pumping has been observed in some locations.

A first protective measure that has been taken in the past few years has been to limit and decrease the extraction rates by forcing the farmers to use water from the Paphos Project (The coastal part of the aquifer area is included in the Paphos Irrigation Project).

- **Protection of aquifer:** Being a locally important aquifer, supplying water for the Pegeia Municipality and the expanding tourist area, it is a major issue to protect the ground water resources from the **seawater intrusion** and other (agriculture) **contamination**.

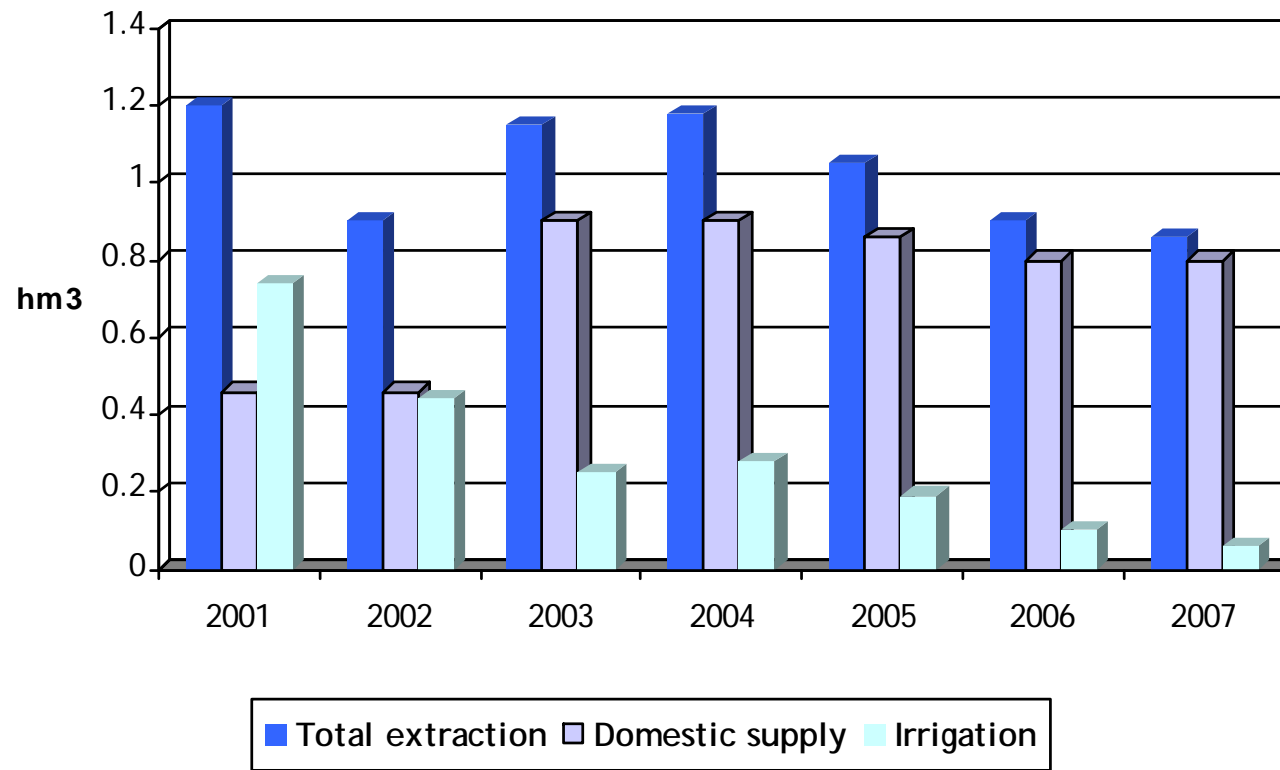
- **Measures have to be taken:**

a) quality: Use of **small sewage treatment units** for every house or group of houses. The recycled water can be used for irrigation.

Control of, in particular, **fertilizers** and other **pollutants** used in agriculture as well as avoiding pollution from **oil** and **petrol** used already in some pumping boreholes.

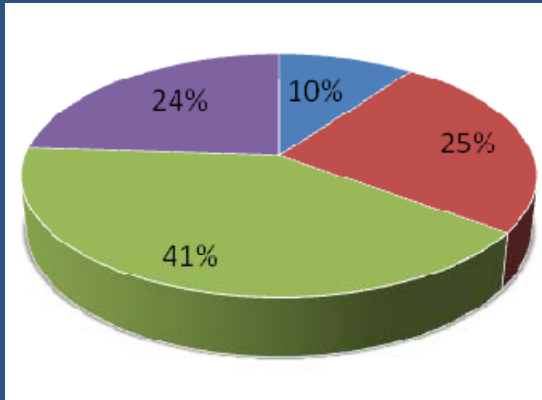
b) quantity: Control of **losses** in the distribution system. Control of **water use**, especially during the summer period (many houses have swimming pools and use domestic water to fill the pools and replenish the water, which evaporates). A significant amount of domestic water is used by the tourist units.

General data	<p>Groundwater vulnerability Groundwater in the area was until 2005 in nearly equilibrium state, however the low rate of replenishment, the high extraction rates, the application of fertilizers, the increasing tourist development make the aquifer vulnerable to pollution due to sea intrusion and seepage of domestic wastewater.</p>
	<p>Water level decline (m) Until 2005, there has been increase of the water level.</p>
	<p>Sustainable and Developed groundwater yield (m³/yr) Extraction should not exceed 1 hm³/yr. The annual amount that can be extracted from boreholes is about 2 – 2.4 hm³ but this should be considered as strategic reserves</p>
	<p>Change in groundwater quality characteristics NA</p>
	<p>Groundwater treatment requirements No treatment required at present, as quality meets drinking water quality standards</p>
Sharing water	<p>Total groundwater abstraction / Groundwater recharge (%) GW/Replenish= 1.675/1.6=1.05 or over 5%. These are average numbers not on a year by year basis</p>
	<p>Total groundwater use (m³/yr) See figure 30, for the years 2001 - 2005</p>
	<p>Groundwater as a percentage of total use of drinking water in the region(%) 100%</p>
Valuing water	<p>Range of cost of groundwater extraction (£CY/m³) 0.02- 0.05 £CY/m³</p>
	<p>Groundwater abstraction charges/levies Ground water abstraction charges are not practiced</p>
Governing water	<p>Groundwater Extraction Monitoring Monthly water level measurements – monthly abstraction measurements from water supply boreholes, water quality measurements twice a year (full ionic analysis and nitrates). It is absolutely necessary to monitor all boreholes in the area and to equip them with water metres.</p>
	<p>Groundwater Extraction Permit issuing A permit is needed from the District Office to drill a well. No regulations exist with respect to depths to drill which aquifers to penetrate and from which aquifer to pump water. Following the drilling of a well no further control is exercised by the District Office.</p>
	<p>Participation in decision-making Until now no public participation was practiced for water management decisions in the area.</p>

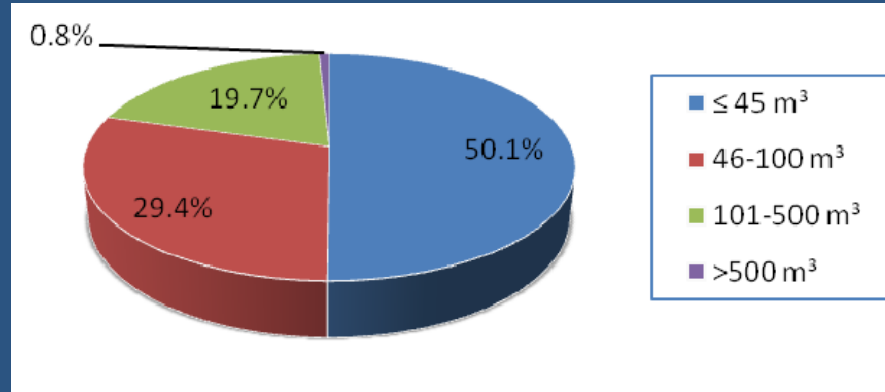


Year	Replenishment (hm³)	Abstraction (hm³)	Outflow to sea (hm³)	Dh (m)
2001	0.81	2.3	0.025	-1
2002	1.3	1.3	0.040	2
2003	2.4	1.5	0.030	0
2004	2.4	1.6	0.030	1
2005	1.2	1.2	0.050	0
Average	1.6	1.64	0.035	

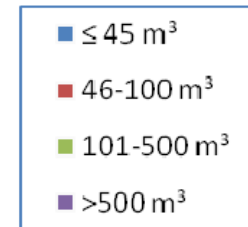
Overview of selected management issues



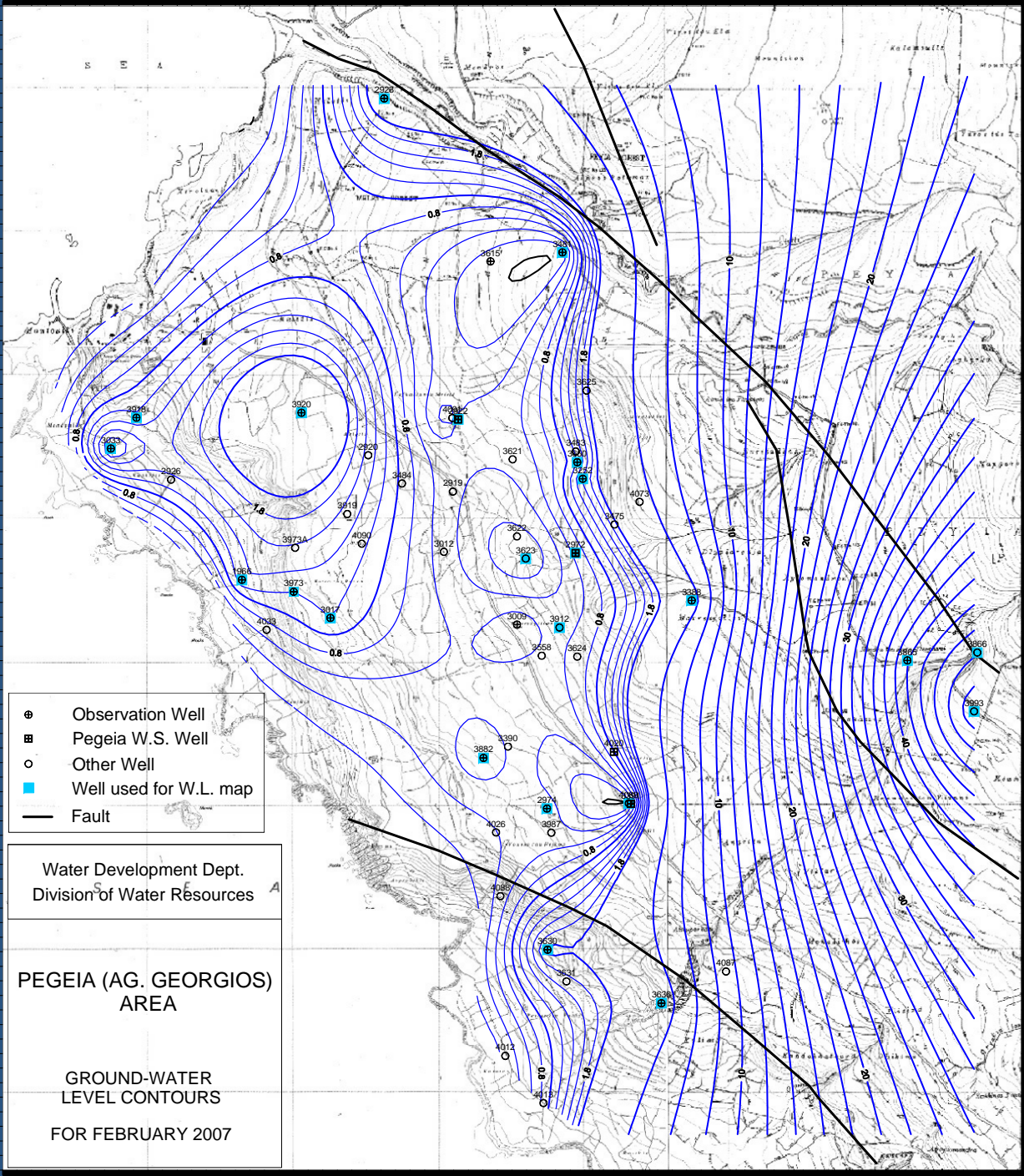
WATER USE



WATER CONSUMERS



3863600 3863400 3863200 3863000 3862800 3862600 3862400 3862200 3862000 3861800 3861600 3861400 3861200 3861000 3860800 3860600 3860400 3860200 3860000 3859800



- ⊙ Observation Well
- ⊠ Pegeia W.S. Well
- Other Well
- Well used for W.L. map
- Fault

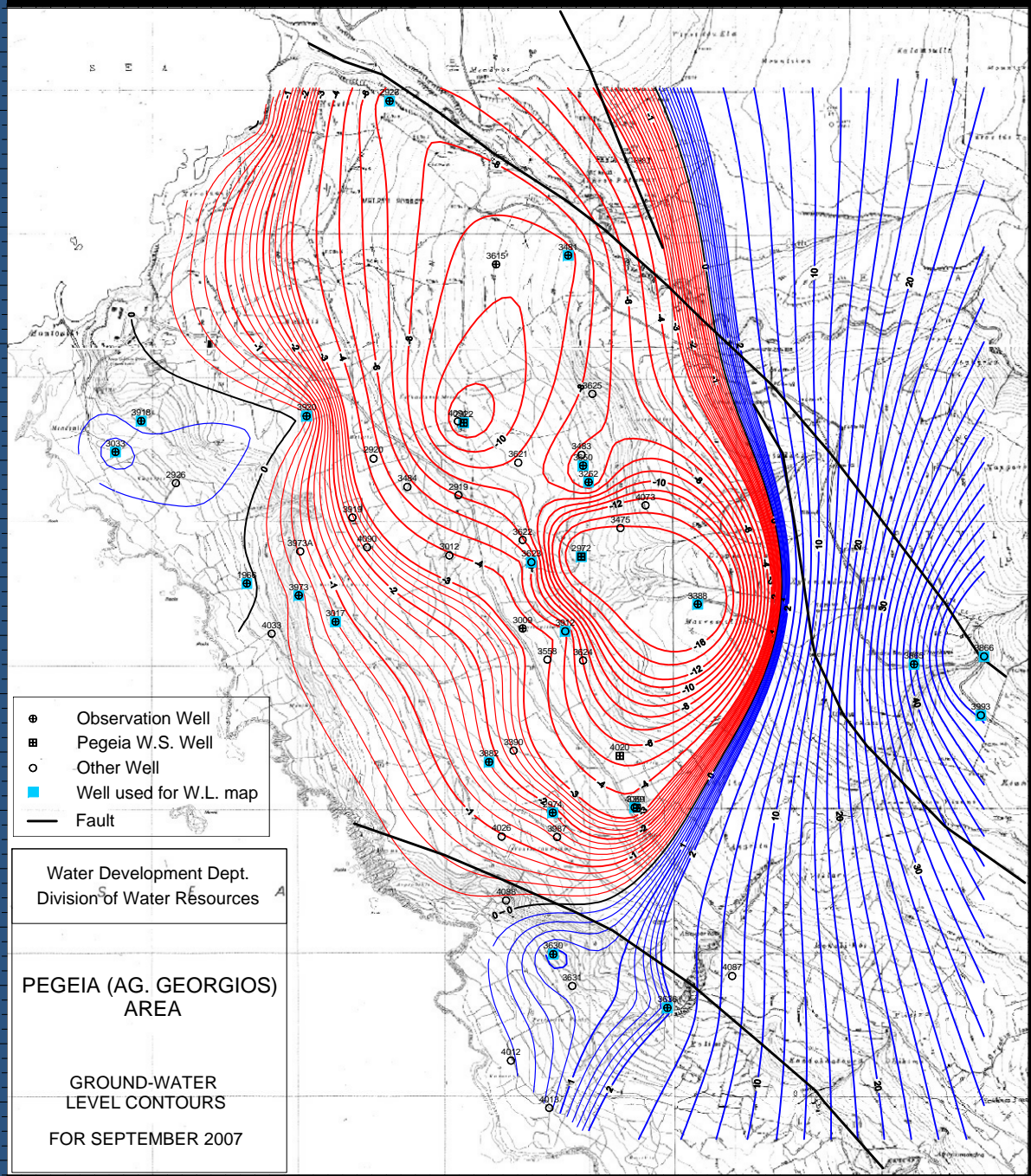
Water Development Dept.
Division of Water Resources

**PEGEIA (AG. GEORGIOS)
AREA**

**GROUND-WATER
LEVEL CONTOURS**

FOR FEBRUARY 2007

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- ⊙ Observation Well
- ⊠ Pegeia W.S. Well
- Other Well
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- Fault

Water Development Dept.
Division of Water Resources

PEGEIA (AG. GEORGIOS) AREA

GROUND-WATER
LEVEL CONTOURS
FOR SEPTEMBER 2007

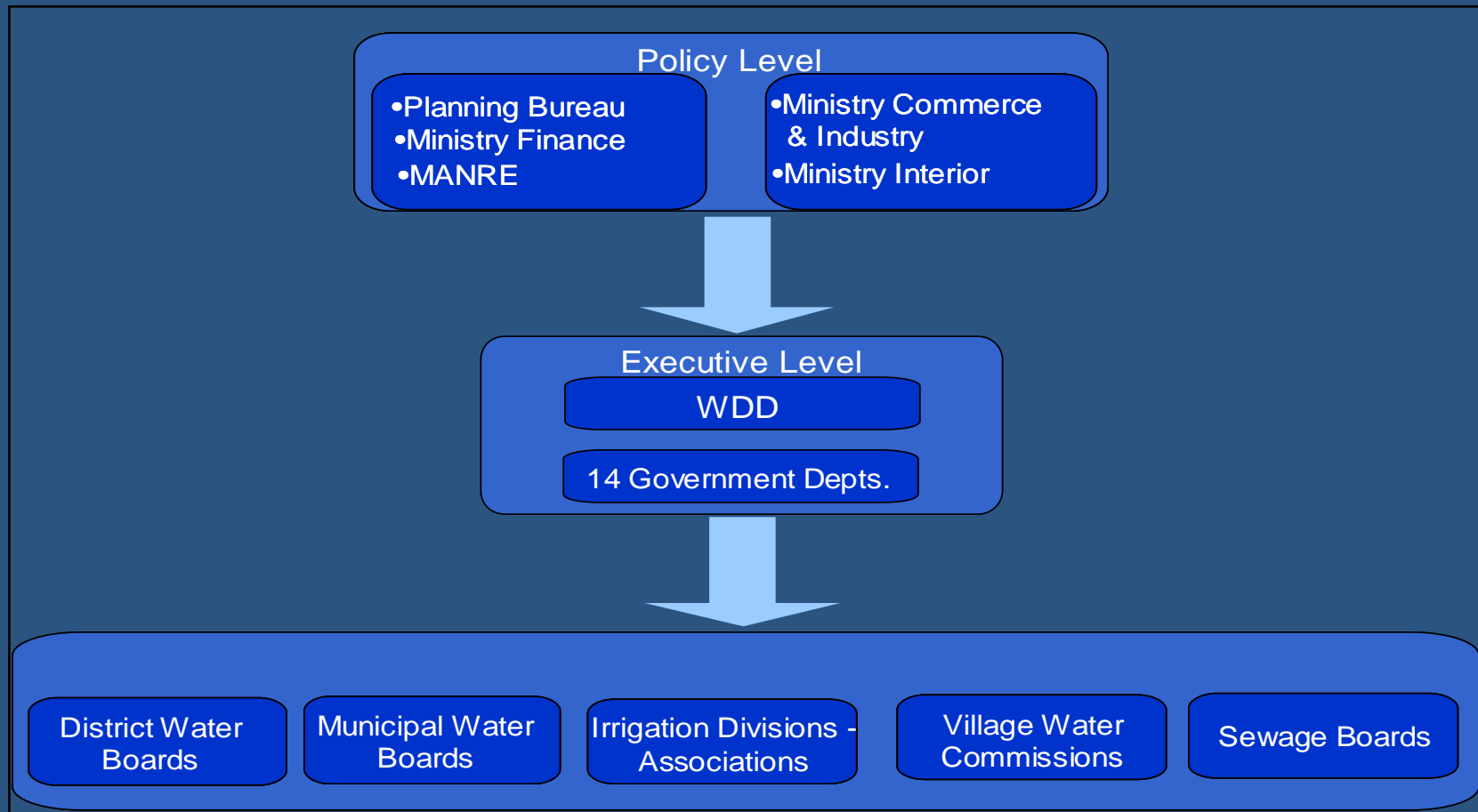
Overview of selected management issues

Stakeholder	Features of Stakeholder	Problems perceived	Capacity and motivation to solve identified problems	Possible actions to be undertaken by stakeholder
Pegeia Municipality	Management of domestic water supply	<ul style="list-style-type: none"> ■ Meeting water demand for domestic purposes; ■ Lack in additional water supply sources; 	<ul style="list-style-type: none"> ■ Limited capabilities for exerting influence to the policy makers; ■ Positive attitude regarding the construction of desalination plants; ■ Negative attitude regarding restrictions in issuing building permits 	<ul style="list-style-type: none"> ■ Infrastructure improvement; ■ Raise awareness on water use and water conservation; ■ Cooperation with policy makers;
Water Development Department	Implementation of Government's water policy	<ul style="list-style-type: none"> ■ Water scarcity problems; ■ Need for improvement of the water management practices; ■ Limited feedback from the end users on the water quantities required; 	<ul style="list-style-type: none"> ■ WDD has the capacity to influence the decision making process; ■ Within the framework of applying the WFD initiated and organised public information campaigns; 	<ul style="list-style-type: none"> ■ Infrastructure improvement; ■ Enhancement of the General Public information campaign on water use and conservation practices;
Farmers	Individuals;	<ul style="list-style-type: none"> ■ Lack in additional water supply resources; ■ Cost of the water ■ Water and climatic conditions (drought periods); ■ Bananas plantations are not considered to be in the priorities of the policy makers; 	<ul style="list-style-type: none"> ■ Limited capabilities for exerting influence the decision making process; 	<ul style="list-style-type: none"> ■ Cooperation with other stakeholders;

Overview of selected management issues

Developers	Housing construction and real estate development companies	<ul style="list-style-type: none"> ■ Lack in additional water supply resources; ■ Water scarcity problems might influence the development in the future; 	<ul style="list-style-type: none"> ■ Capacity to exert influence on the decision making process; ■ Negative attitude regarding restrictions in issuing building permits; 	<ul style="list-style-type: none"> ■ Cooperation with other stakeholders; ■ Mobilise political pressure;
Hotel Industry	Hotels and hotel apartments in the area	<ul style="list-style-type: none"> ■ Lack in additional water supply resources; ■ Water scarcity problems influence hotel operations; ■ Cost of the water; 	<ul style="list-style-type: none"> ■ Capacity to exert influence on the decision making process; ■ Positive attitude regarding the installation of desalination plants; ■ Negative attitude regarding water restrictions; ■ Negative attitude regarding water tariff reformation; 	<ul style="list-style-type: none"> ■ Cooperation with other stakeholders; ■ Mobilise political pressure;
Locals	Individuals - Cypriots	<ul style="list-style-type: none"> ■ Lack in additional water supply resources; ■ Water and climatic conditions (drought periods); ■ Water wastage by the swimming pools of foreigners; 	<ul style="list-style-type: none"> ■ Limited capabilities for exerting influence on the decision making process; ■ Positive attitude regarding the installation of desalination plants; ■ Negative attitude regarding water restrictions; ■ Negative attitude regarding water tariff reformation; 	<ul style="list-style-type: none"> ■ Cooperation with other stakeholders;
Locals - foreigners	Individuals - Foreigners (50% of Pegeia population are foreigners)	<ul style="list-style-type: none"> ■ Inefficient management of available water resources; ■ Pressures from rapid development; ■ Water and climatic conditions (drought periods); ■ Lack in information and transparency on water issues; 	<ul style="list-style-type: none"> ■ Limited capabilities for exerting influence on the policy makers; 	<ul style="list-style-type: none"> ■ Cooperation with other stakeholders;

Overview of selected management issues



Overview of selected management issues

The main obstacles encountered for better efficiency in water management are :

Fragmentation of responsibility

Lack of an umbrella law covering water

Relaxed supervision and control

Lack of effective water pricing

Sluggish enforcement of water legislation on the excuse of socio-economic issues

Lack of information to interested parties

Overview of selected management issues

- Pegeia aquifer is a locally important aquifer, supplying water for the Pegeia Municipality and the expanding tourist area.
- It is a major issue to protect the ground water resources from the seawater intrusion and other (agriculture) contamination.
- Degradation of the water quality due to excessive pumping has been observed in some locations.
- Probably significant losses in the distribution system and over-consumption of water, especially during the summer period have to be identified, and the appropriate measures have to be taken.
- The water table and salinity evolution have been monitored for several years in the Pegeia aquifer, but the monitoring network may have to be optimised
- The building construction development in the area is booming and this is another pressure on water issues
- **Improvement in the management of the aquifer and in the distribution of the domestic water is needed.**

Current efforts for problem mitigation

■ **Irrigation methods improvement**

As a result of a successfully implemented program (subsidies, long-term low interest loans and effective extension/demonstration program), farmers shifted from flood-irrigation to micro-irrigation. Now days there are few margins for further improvement in water application technology.

■ **Reduction of losses**

The unaccounted water in the main urban domestic supply distribution networks is estimated to be 15 – 20% and about 20 – 30% in the rural communities. The measure is applied on a regional basis (on a water body level). Where applied so far, water consumption has been reduced substantially.

■ **Water conservation measures**

In order to ensure conservation and rational use of water, the WDD embarked on a Strategic Plan, providing financial incentives for the promotion of technological adjustments aiming to water conservation. These includes subsidies for borehole drilling, introduction of improved irrigation systems, or installation of reuse systems of the grey water in the lavatories and the irrigation of gardens of houses.

Current efforts for problem mitigation

- **Cost recovery**

As a result of a successfully implemented program (subsidies, long-term low interest loans and effective extension/demonstration program), farmers shifted from flood-irrigation to micro-irrigation. Now days there are few margins for further improvement in water application technology.

- **Water supply restrictions**

During drought periods, water supply restrictions are imposed on all sectors, leading to a rationalization of water consumption.

However, these measures raised a number of objections from various social groups, and especially by agricultural organizations, hotel owners, who demanded that the tourist industry should bear either none or a very small restriction of water supply, and environmental organizations.

Current efforts for problem mitigation

- **Promotion of the use of surface water for irrigation purposes**

Farmers were forced to use the water of the Pafos Irrigation Project instead the water from the aquifer

- **Provision of fresh water from Asprokremmos treatment plant**

Since June 2004 additional water for domestic purposes has been supplied from Asprokremmos treatment plant.

- **Groundwater Extraction Monitoring**

Monthly water level measurements – monthly abstraction measurements from water supply boreholes, water quality measurements twice a year (full ionic analysis and nitrates).

- **Waste Water Treatment Plant**

Municipality of Pegeia together with the WDD has started the process for the design and construction of a sewerage collection network and a waste water treatment plant.

- **Desalination Plants**

WDD has initiated the procedure for the construction of a desalination plant to cover the drinking water needs of Pafos district

Hotels and other tourist developments assess the possibility to construct their own desalination plant to cover their needs for drinking and irrigation water

INECO Participatory Process

Date: 15 November 2007
Venue: SPE Cultural Centre – Pegeia Pafos
Title: INECO Cyprus Stakeholders Workshop 1 Pre-meeting
Number of Participants: 25

Date: 26 -27 October 2007
Venue: Coral Bay Hotel – Pegeia Pafos
Title: INECO Cyprus Stakeholders Workshop 1
Number of Participants: 50

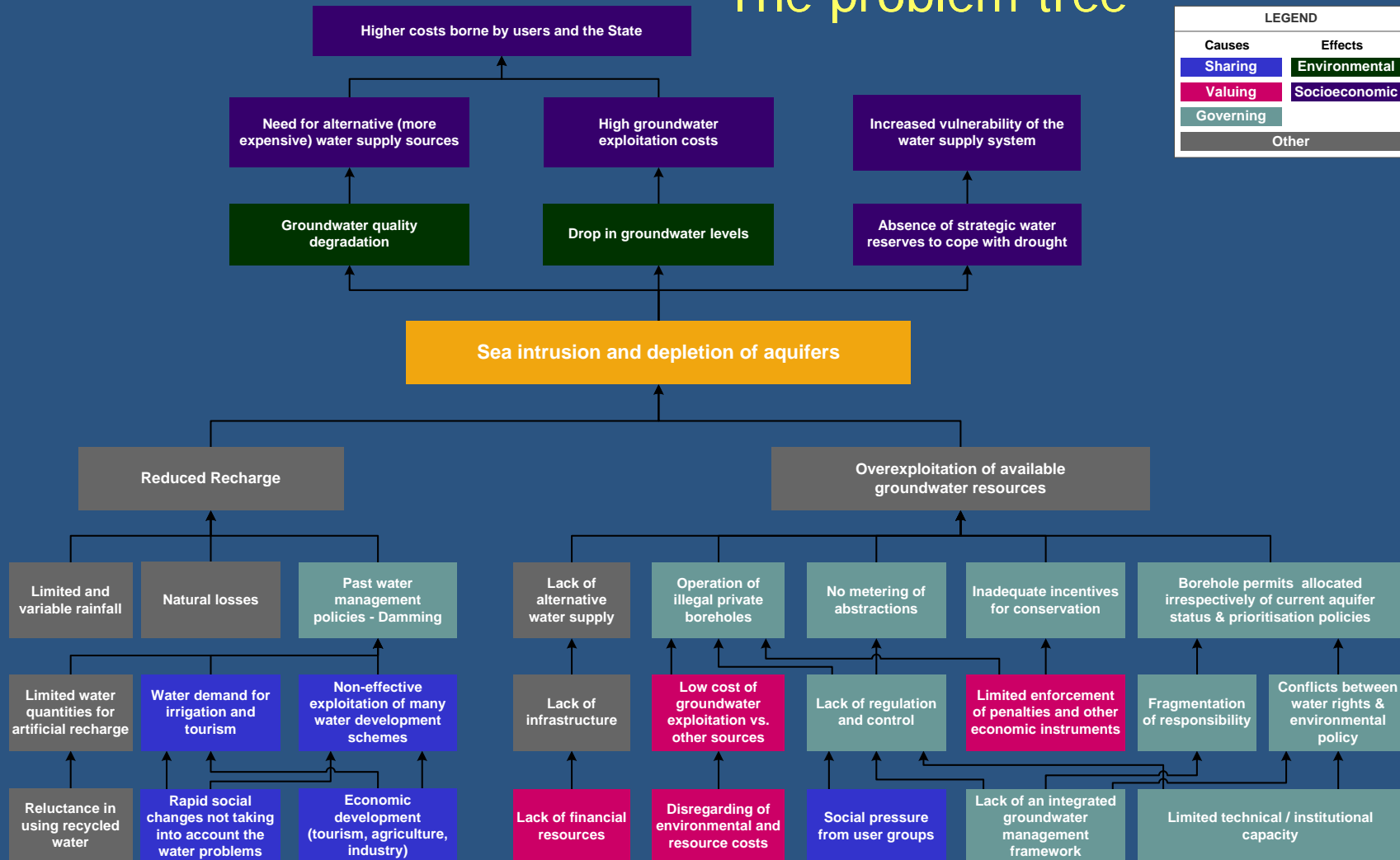
Date: November 2007 - May 2008
Venue: Pegeia municipality boarders
Title: Individual meeting and consultations with the stakeholders (Municipality, WDD , locals)
Number of Participants: ~ 150

Date: 15 May 2008
Venue: SPE Cultural Centre – Pegeia Pafos
Title: INECO Cyprus Stakeholders Workshop 2
Number of Participants: 23

Objective tree analysis Problem tree analysis

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The problem tree



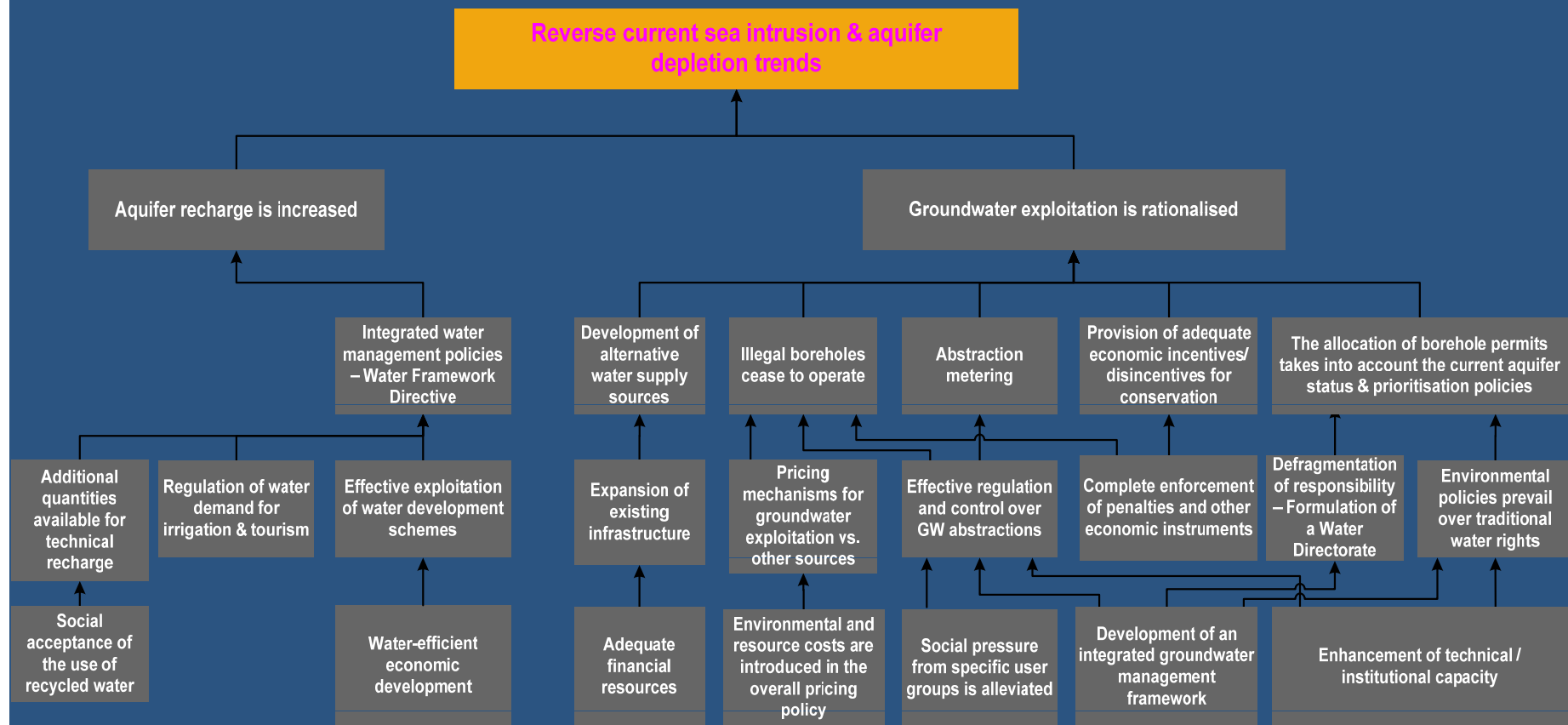
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The stakeholders opinion

- Locally important aquifer (Pegeia Municipality and the expanding tourist area;
- Protection of the aquifer from the seawater intrusion and other (agriculture - sewage seepage) contamination;
- Excessive pumping has been observed in some locations;
- Significant losses in the distribution system and over-consumption of water, especially during the summer period have to be identified, and the appropriate measures have to be taken;
- The water table and salinity evolution have been monitored for several years in the Pegeia aquifer, but the monitoring network may have to be optimise;
- The existing and forseen building permits exceed the capacity to provide water to Pegeia and this is another pressure on the aquifer sustainable management;
- Impacts from agricultural practices (water quantities – nutrient pollution) ;
- Lack of water conservation culture among the Pegeia residents;
- Lack of information (... and transparency);
- **Improvement in the management of the aquifer and in the distribution of the domestic water is needed.**

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The objective tree



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The stakeholders opinion

- Development of additional water supply sources
 - Technical issues (desalination plant, rain harvesting, reduce losses, use unexploited water resources of the area, use of small sewage treatment units, transfer of fresh water from a neighbouring country through a water pipeline);
- Improving freshwater efficiency
 - Cost recovery (water tariff reform);
 - Introduction of seasonal water rates;
 - Regular water audits for large consumers;
- Enhance water system efficiency (domestic – irrigation)
 - Financing (subsidies for water conservation measures);
 - Economic incentives (change of cropping patterns);
- Regulation of abstractions
 - Monitoring & control;
 - Penalties & fines;
 - Reduce groundwater abstractions for tourist units – desalination units for tourist units;
 - Economic incentives (subsidies for conservation) and disincentives (abstraction charges, penalties)

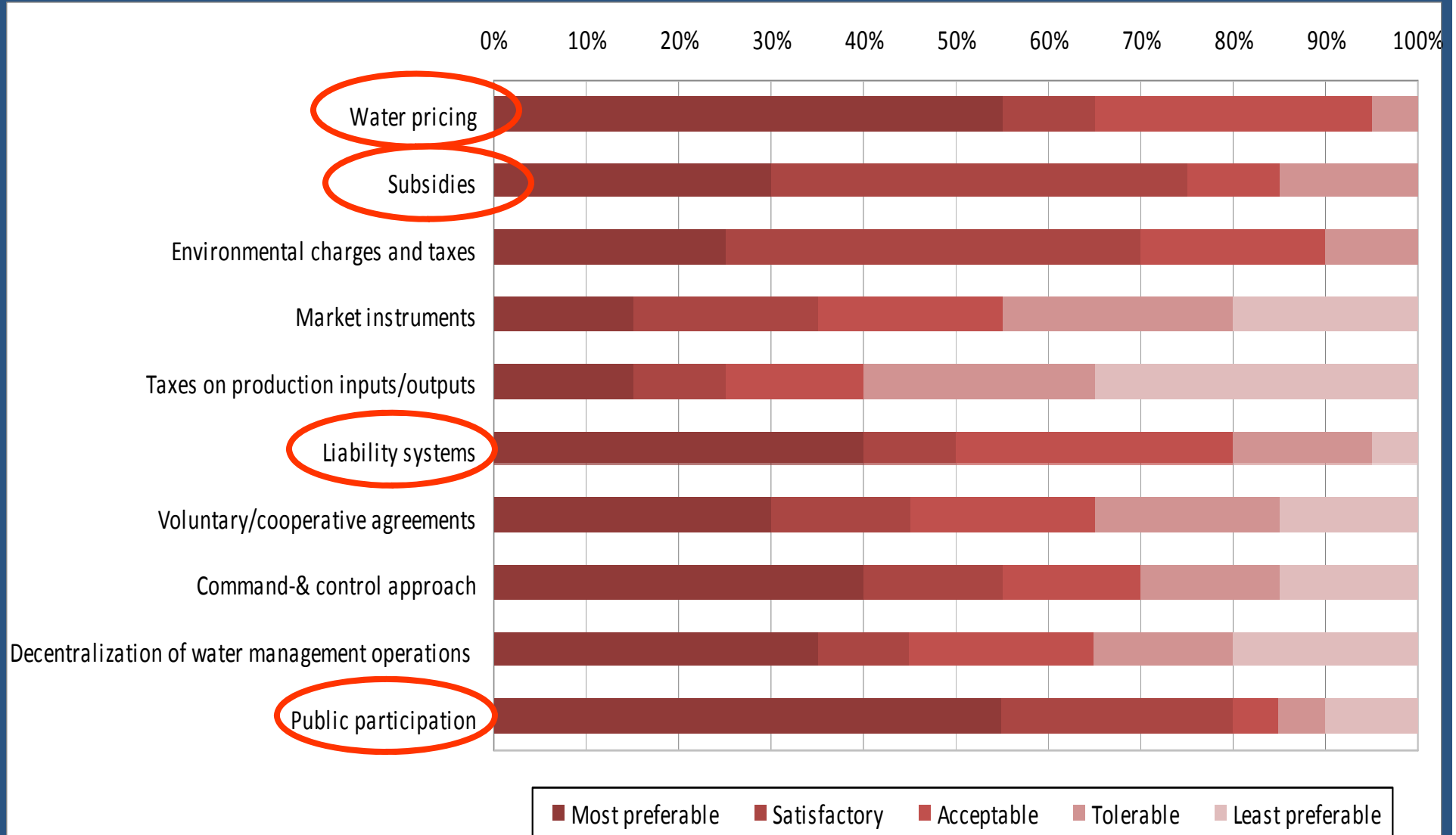
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The stakeholders opinion

- Enhancing awareness
 - Regular awareness campaigns on water saving practices
 - Information disclosure (regular open meetings / hearings)
 - Citizens' jury and panels (identification of areas of disagreement or agreement)
 - Transparency in water issues
- Overall planning and integration
 - One body responsible for planning/authorization

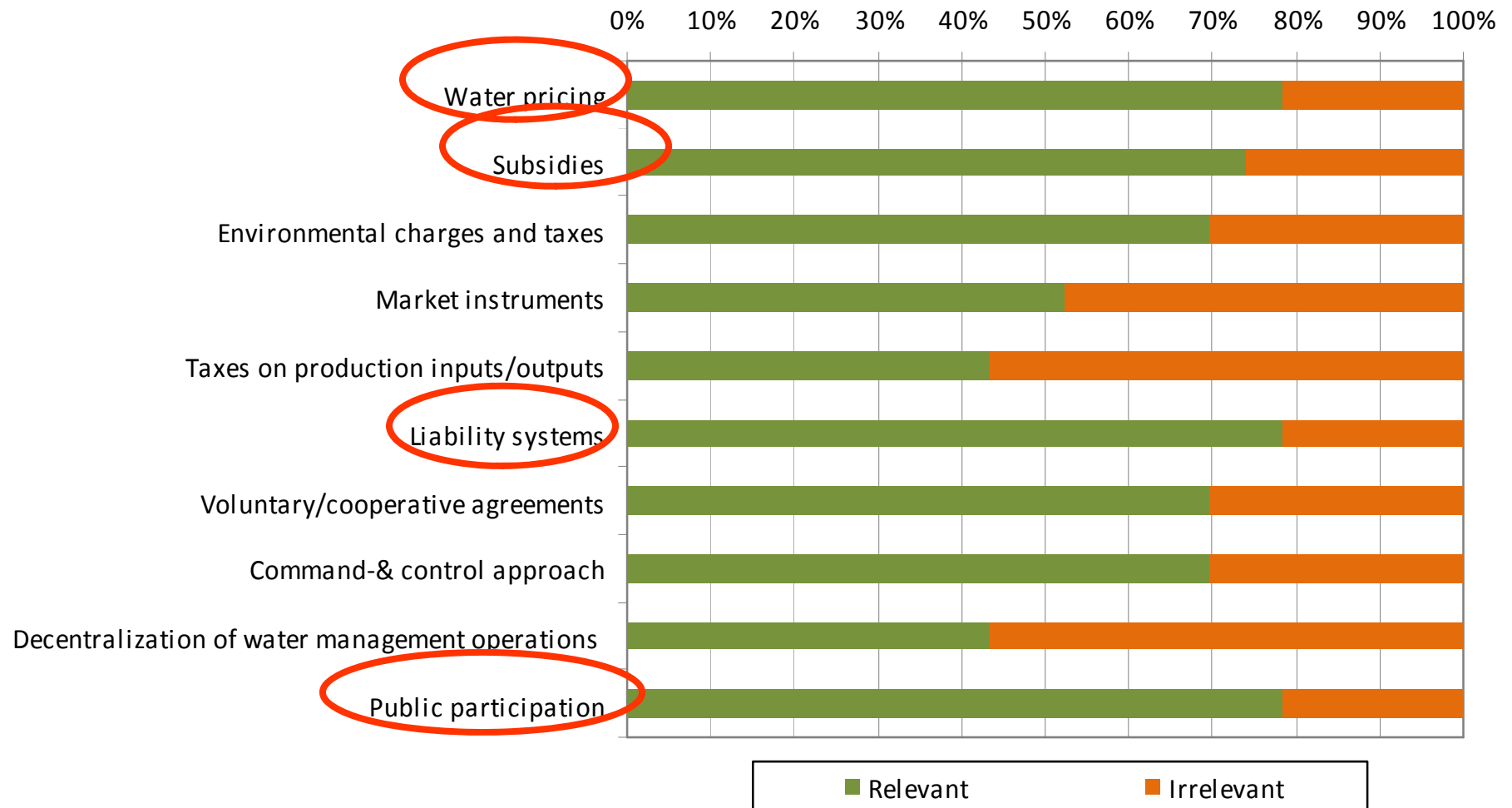
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The stakeholders preference on options



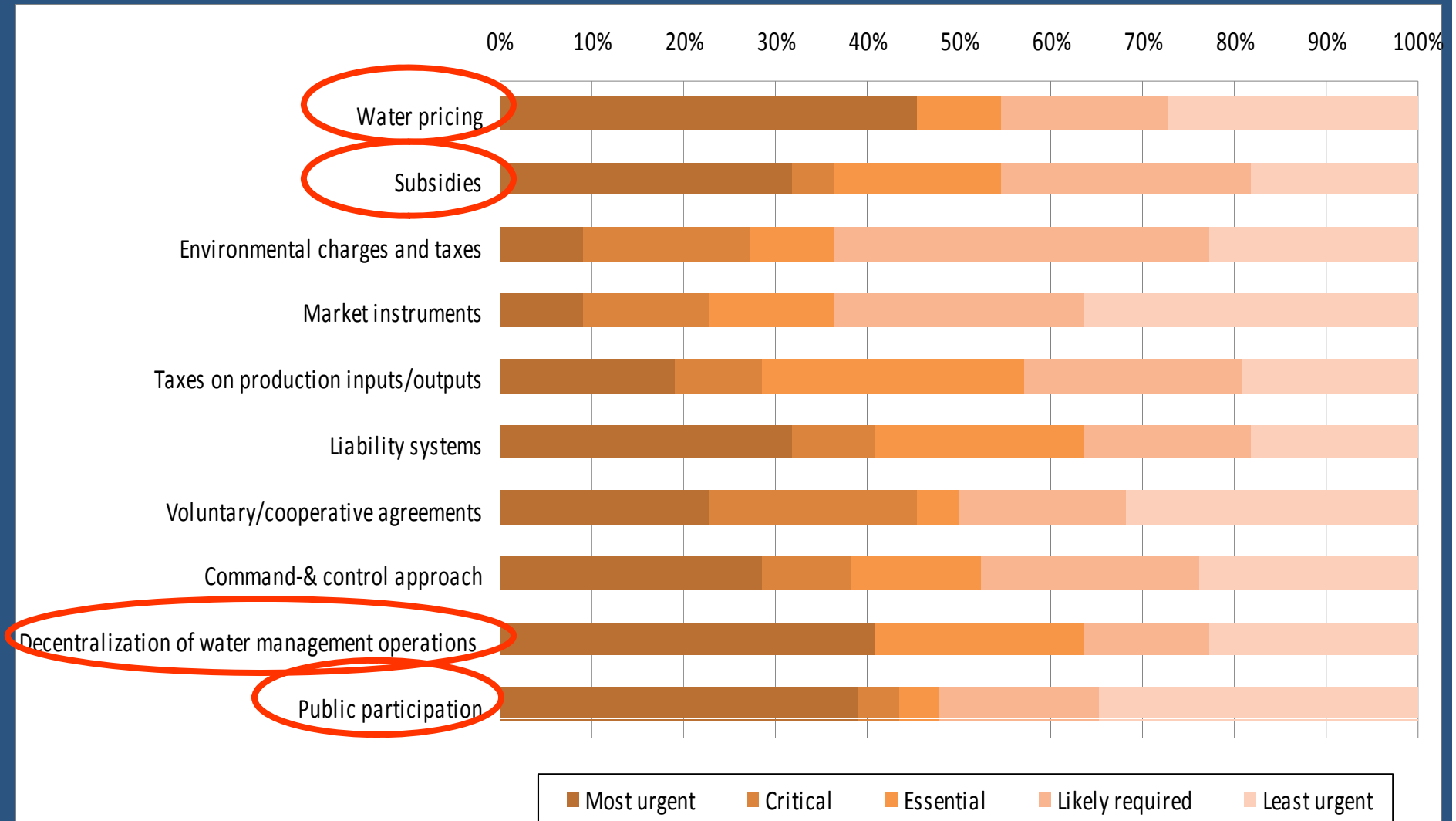
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Relevance and feasibility to address Pegia'a WM problems



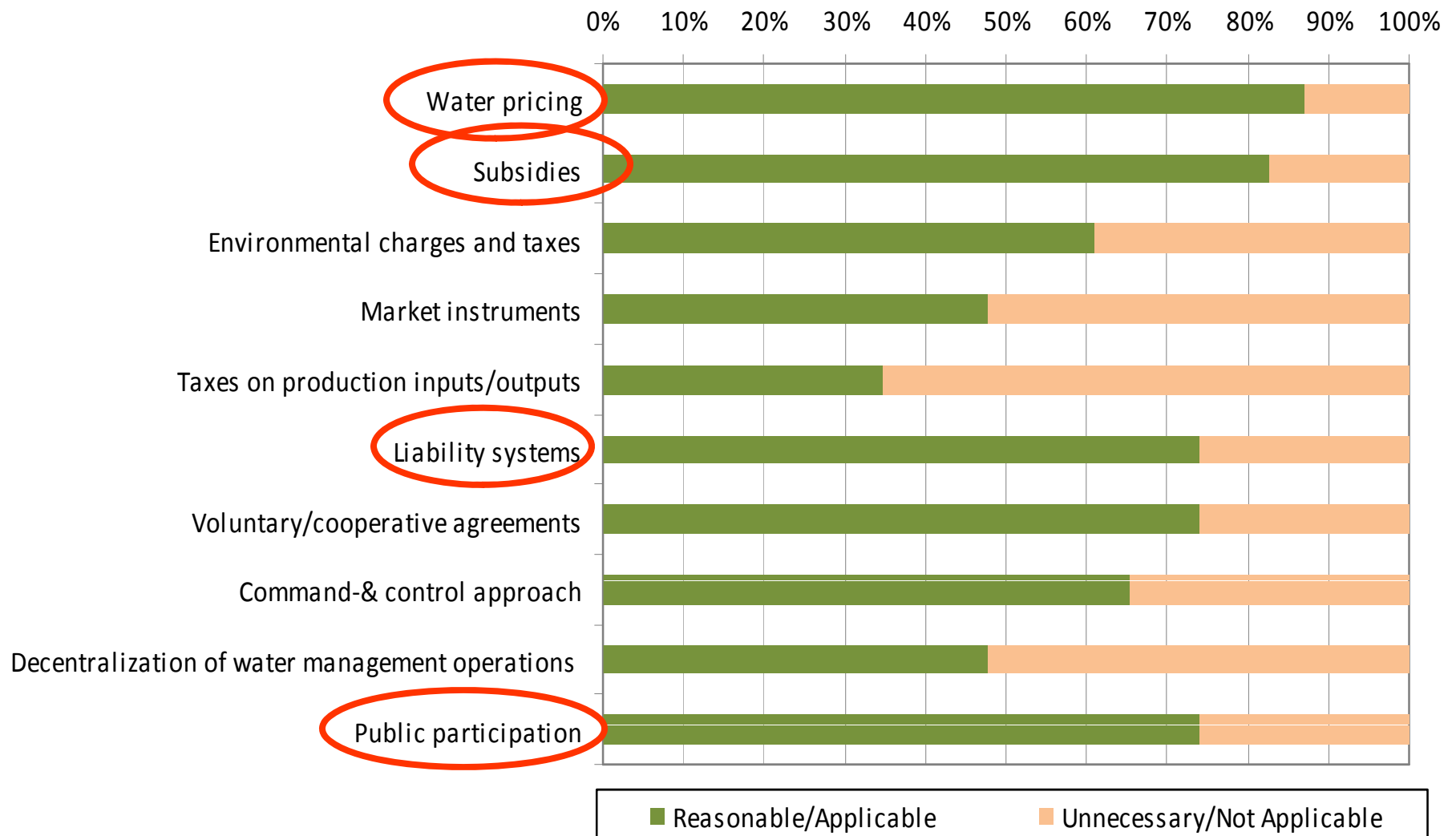
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Measures ranking



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Measures General View



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Measures Proposal (based on stakeholders' consultation)

- **Water pricing**
- **Subsidies**
- **Liability systems**
- **Public participation**
- **Voluntary systems**

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Water pricing

- Water for domestic supply (including tourism)
 - WDD provides bulk water supply to Town Water Boards – Municipal Authorities – Community Boards from Government Works (80% of total consumption) – Share of own sources from 1 – 30%
 - Pegeia : Own resources 60% - WDD 40%
 - Water for municipal supply (including industrial, commercial and tourist sectors) is sold at full cost; However in the last seven years the water tariff for the domestic sector does not reflect the full cost as formed with the recent introduction of the expensive desalination water (subsidy as high as 34%)
 - In 2004, the Government of the Republic of Cyprus proceeded in a major reform of the bulk domestic water tariffs. Currently the bulk domestic tariff for supply from the Government Water Works for the district of Pafos is equal to 0.56 €/m³ .
 - The water tariff structure imposed by the Water Boards for all major urban areas is made of two parts : a fixed charge and a volumetric charge. Tariff rates are progressive : the volumetric charge increases as consumption increases
 - Rural water supply is partially subsidized for capital expenditures to a degree varying according to the population and other factors, varying from 83% for communities with < 100 people, to 50-75% for more
 - Tourism charges are different from domestic charges
 - Affordability indicator (water expenditure/average GDP) equal to 0.4%. In industrialised countries, water is considered "expensive" when it weights more than 1.5% of households' income.
 - 30% increase in the average volumetric price for domestic use is estimated to be sufficient to apply the full cost recovery principle. Affordability index will rise by almost 50% to reach 0.6% which is still less than half the "limit" of 1.5%.
 - Abstraction charges : Have not been applied in the past. However, it is considered as a potential measure that could be adopted for the river basin district of Cyprus : Member states need to ensure by 2010 that water pricing policies provide adequate incentives for users to use water resources efficiently and adequate contribution of the different water uses

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Water pricing (continued)

- Water for agriculture
 - **Until 2003** : different tariffs on a local basis, according to the Irrigation Scheme, and the quality of services provided, ranging from 0.08 €/m³ at the lowest to 0.12 €/m³ .
From 2004 : gradual increase of tariffs in order to reach by 2007 the uniform charge of 0.19 €/m³. However, due to the persisting drought period of the last years, the Council of Ministers in 2007 postponed the final increase of 0.01 €/m³ in order to alleviate the difficult condition that the farmers are experiencing.
 - Current irrigation water tariffs encourage cultivation of high water consuming crops. Increasing the tariffs to cover the full average unit costs would make many crops, such as citrus, unprofitable (direct effect). Furthermore, expensive surface water could lead to excessive use of local groundwater supplies. This would result to saline intrusion and further degradation of the aquifer reserves causing larger inequities between farmers depending on government and those on non-government schemes (indirect effect).
 - Parliament is reluctant to raise tariffs of irrigation water for political and economic reasons since this might discourage irrigated agriculture and lead further urbanization with all its associated social problems.

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Subsidies

borehole drilling for garden irrigation(680 €);

Subsidy for borehole drilling for home gardens for households connected to the water distribution networks for all municipalities and villages (subject to well permit and inspection of site after permit and before drilling)

	1997-2002	2003	2004	2005	2006	2007
<i># installations</i>	240	95	170	250	545	1058
<i>Budget allocated (€)</i>	70,000	30,000	55,000	85,000	215,000	620,000
<i>Water savings (m³)</i>	300,000	100,000	200,000	300,000	700,000	1,300,000

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Subsidies (continued)

installation of reuse systems of the grey water in the lavatories and the irrigation of gardens of houses (1,700 € for households and 60% of the cost for the rest of the cases);

The subsidy covers installation of a system for the treatment of grey water and its reuse in lavatories and garden irrigation of a household, school, playing grounds, swimming pools, gyms, hotels, industries, etc., connected with distribution networks of all municipalities and villages.

	1999-2002	2003	2004	2005	2006
<i># installations</i>	20	15	20	10	35
<i>Budget allocated (€)</i>	25,000	20,000	35,000	20,000	60,000
<i>Water savings (m³)</i>	650,000	450,000	600,000	400,000	1,350,000

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Subsidies (continued)

the connection of borehole with lavatories(€680);

The subsidy covers connection of wells with home lavatories, schools, offices, shops, institutes etc. connected with distribution networks of all municipalities and villages for the purpose of conserving drinking water that is used for lavatories (subject to application, inspection and provision of technical advise by WDD).

	1997-2002	2003	2004	2005	2006	2007
<i># installations</i>	70	20	50	60	175	535
<i>Budget allocated (€)</i>	30,000	20,000	35,000	40,000	110,000	365,000
<i>Water savings (m³)</i>	300,000	100,000	200,000	300,000	700,000	1,200,000

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Subsidies (continued)

introduction of hot water recirculators (290 €)

introduction of improved irrigation systems;

As a result of a successfully implemented program (subsidies, long-term low interest loans and effective extension/demonstration program), the flood-irrigated area declined from 13,400 ha in 1974 to 2,000 ha by 1995. Over the same period, micro-irrigation cover has increased from 2,700 ha to 35,600 ha. There are few margins for further improvement in water application technology.

The estimated potential water savings can reach 50% of drinking water demand.

The annual budget allocated for these incentives is 2.0 mill € (1.5 mill € for subsidies and 0.5 mill € for accompanying awareness and promoting campaigns) for 2008 and 2.0 mill € (1.5 mill € for subsidies and 0.5 mill € for accompanying awareness and promoting campaigns) for 2009.

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Liability systems

- Legislation measures for domestic water conservation ('hose ban')
 - Water Conservation (Special measures) Law of 1991 applied within Water Board areas, Municipalities and Village water supply areas :any person using water through a hose for washing sidewalks or streets, verandas and vehicles is guilty of a criminal offence and could be imprisoned for up to 3 months and or be fined up to 1000 € or both. Policemen or other licenced persons (WDD personnel) having grounds to believe that a person is committing such an offence could issue a fine of up to 110 € in lieu of taking this person to court
 - The measure is applied sporadically especially during drought periods
- Legislation measures for groundwater conservation - Wells Law (Cap 351)
 - A permit is needed from the District Officer before a well or borehole is sunk or constructed;
 - Relaxed supervision and control, light penalties, issuing of covering permits and interference in the process by non-technical bodies has resulted in a large number of illegal drilling of wells

The relative sluggish enforcement of the water legislation on the excuse of socio-economic conditions is considered as one of the weak points of the National water situation

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Public participation

- WDD has initiated the public participation process within the framework of implementing the WDD
 - Presentations;
 - Questionnaires;
 - Awareness campaigns;
- Public participation within the framework of INECO and AQUASTRESS
 - Pegeia - INECO;
 - Larnaca / Gender issues- INECO;
 - Episkopi Lemessos - AQUASTRESS;



Institutional and Economic Instruments for Sustainable
Water Management in the Mediterranean Region

Stakeholder Assembly Workshop

Thank you