Towards a Sustainable/Strategic Management of Water Resources: Evaluation of Present Policies and Orientations for the Future

The Mediterranean area

Executive Summary

Introduction

The study 'Towards a Sustainable/Strategic Management of Water Resources: Evaluation of Present Policies and Orientations for the Future', was jointly carried out by the European Commission's General Directorate XVI (Regional policy and Cohesion) and the Institute For Prospective Technological Studies (IPTS) of the EC's Joint Research Centre.

The study had a two-fold objective:

- To provide DG XVI with a tool for the evaluation of interventions in the domain of water resources management in the Mediterranean countries,
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- To serve as a building block for the development of the relevant section of the European Spatial Development Perspective:'*prudent management and development of the natural and cultural heritage*'.

The project focussed upon essential aspects of sustainable water management, considering water as an economic good, both in its own right and as a required input for many regional development activities.

The project included an initial diagnosis phase in which the relevant data on water supply, demand and institutional and financial management were assembled for seven Mediterranean countries - Portugal, Spain, France, Italy, Greece, Cyprus and Malta. The data concerned the present (reference year: 1990) and extrapolated future trends, up to the year 2015. On the basis of these data, different parameters linked to the management of water quantity and quality, the demand for water in each of its uses, were assessed, with the goal of identifying possible strategies for reducing overall consumption through either increased efficiency or adaptation of activities to the hydrological and stochastic constraints.

The scale of application considered for the study was the river basin since it represents the natural geographical and hydrological unit for water management and enables a better reflection of the differences between the areas of interest. In addition, the river basin is the reference unit for water management and planning put forward by the future European Framework Directive on Water Resources.

In the Mediterranean countries, like anywhere else, water resources management is undoubtedly one key priority issue to be faced by future generations. For many years and still today, water has been subject to well-sounding and non-committing statements, e.g. 'water is essential for life', both in literature and in policy. However, the current concern of facing ever increasing scarce water availability and quality problems, further leading to other environmental or public health problems, will inevitably have to stand as a meaningful incentive to shift to a different behaviour towards management of water resources. Already some evidence can be given to illustrate the importance to lean towards a sustainable management of water resources.

- In the Adour-Garonne river basin (France), abstraction for irrigation purposes has been on the rising trend, with +75 % between 1981 and 1994 and usually occurs during the summer period when precipitation is low.
- Another example is found in Sicily where water demand in 1990 was about 1 530 million m^3, while the total resources availability was evaluated at 1 578 million m^3. The limit of availability in the year 2000 is foreseen to be 1 896 million m^3. It indicates that further exploitation of surface water and groundwater appears difficult in the medium-term and will likely be over-passed in the long run.
- Finally in Greece, water management has mainly been based upon solving water problems by providing additional resources. For instance, in Thessaloniki, there is an old poorly maintained supply network. From the few data available, it is estimated that losses are between 40 to 50 %. Yet, to tackle water shortages, it has been decided to divert a river to the city.

An additional Mediterranean specificity concerns sectoral water demand for irrigation and tourism. Irrigation takes up an overwhelming share of the total water used, e.g. more than 80 % in Spain and Greece. Whilst the Mediterranean basin accounts for the leading destination in the world, tourism has not only an impact on drinking water, but also on leisure activities, e.g. landscape irrigation for golf courses. Irrigation and tourism have a common feature that effect on water economy: the variation in demand and pressure on the natural resources, which are higher during peak summer season. Finally, ***islands, including Malta and Cyprus, should be envisaged from a different perspective*** and require specific measures because of their particular self-reliant management conditions. They are very much dependent on precipitation's. Renewable water resources are scarce and expensive to exploit. Rainfall is highly variable which can sporadically lead to hydrological drought. For instance, in Cyprus, water shortages are likely to occur over the next 25 years because of inconstant precipitation's and overexploitation of groundwater.

The present situation in the Mediterranean countries

Water - A scattered and irregular resource

***In the seven countries, climatic, geographical and hydrogeological conditions create an imbalance in the distribution of natural water resources*.** In Spain, 81 % of water are located in the northern part. But, by the year 2020, the majority of the Spanish population will tend to be located in Andalucia, Madrid and Mediterranean coast, and when considering the hydrological balance, it is expected that some of these areas will aggravate the already present water stress conditions.

Water is not always characterised by its scarcity, but rather by its irregularity of precipitation in spatial as well as temporal terms, and its high potential evapotranspiration in some parts, representing a key factor in agriculture. ***The internal renewable resources*** for the seven countries concerned are around 554 km^3/year, i.e. roughly ***46 %*** of the total European figure. It is interesting to compare this figure with the ***present annual total water demand*** for France, Portugal, Spain, Italy, Greece, Cyprus and Malta that is 150 km^3, i.e. approximately ***61 %*** of the total for the whole of Europe.

On the most western coasts, and in particular in mountainous areas, masses of moist air give rise to heavy rain. The heaviest precipitation is yielded in Ipiros (***1 700 mm***) river basin (north-west of Greece) as well as in the Norte III (1 606 mm) and Galicia Costa (1 577 mm) river basins (north-west of Spain).

The lowest rainfall occurs in the in Guadiana I (521 mm), Guadalquivir (591 mm), Sur (530 mm), Segura (***383 mm***), and Júcar (504 mm) river basins (south-east of Spain) and Attiki (400 mm) river basin (south-east of Greece). Cyprus and Malta also register low rainfall values, with respectively 497 mm and 570 mm.

Within a same country, e.g. Greece, values vary from 400 mm (Attiki river basin) to 1 700 mm (Ipiros river basin).

Values range from ***1 075 mm*** in the Guadiana II river basin (south-east of Spain) to ***463 mm*** in the Artois-Picardie river basin (north of France). The potential evapotranspiration has been estimated from over 900 mm in the Guadiana I (977 mm), Guadalquivir (991 mm), Sur (969 mm), Segura (963 mm) river basins (south-east of Spain). No figures were available for Greece, Cyprus and Malta.

The actual evapotranspiration is considerably lower, ranging from about ***173 mm*** in Attiki river basin (south-east of Greece) to ***1 146 mm*** in Eastern Macedonia river basin (north-east of Greece), because optimum soil moisture conditions for evapotranspiration to yield its potential rate do not always exist.

The per capita internal renewable water resources indicator registers its lowest values in Malta (134 m^3/inhab/year) and Attiki (103 m^3/inhab/year) river basin (south-east of Greece), as a consequence of both structural water shortages and densely populated areas. The highest value is found in Western Central Greece river basin, i.e. 33 072 m^3/inhab/year.

For the purpose of the study, only internal renewable resources were considered. But part of the total resources of certain countries is generated in upstream countries through transboundary rivers. Among the countries of interest, one can quote that almost 50 % of the water that flows in the Portuguese rivers come from Spain. The data produced for the study gives a value of 41 585 hm^3. If the total yields for the Spanish river basins whose rivers flow into Portugal were taken into account, the total internal renewable resources would amount to 70 452 hm^3. Moreover, 25 % of the available resources in Greece come from external resources in non-European member states. No specific rules regulate quality and quantity parameters, which creates downstream problems.

Water - An overexploited and threatened resource

***Water availability cannot be considered independently of water quality*.** Increasing urban development in coastal areas (e.g. Lisboa and Athens and Thessaloniki), the disappearance of the terrace farming (e.g. in Cyprus) as well as desertification and soil erosion common in the Mediterranean countries (e.g. Segura, Sur, Guadalquivir, Júcar and Ebro river basins in Spain and southern-eastern Greece), have contributed to greater supply irregularities. Areas prone to *desertification* are characterised mainly, albeit not always, by steep relief and climate with strong seasonal variations in temperature and rainfall; especially periods of intense rainfall after an extended hot and dry season (erosion and flooding). Spain is greatly subject to soil erosion and desertification, mainly on meteorological grounds (long droughts, flash flood). Nonetheless, desertification can also be triggered by anthropogenic activities, e.g. decrease of forest cover and intensive farming. Some figures can be put forward to demonstrate the extent of the problem: According to a 1988 hydrological study carried out by the IARA, the loss of land cover in Andalucia is estimated around 284 million ton/year (73 tons/ha/year). This figure was appraised only on 52 % of the Andalucian territory. Erosion affects around 20 % of the Spanish territory. In the future, it is expected that more than 30 % of the Spanish territory could suffer from the erosion process. Desertification and erosion have an impact on the hydrological cycle; namely the loss of land cover automatically increases the surface run-off and decreases the soil's absorption capacity.

The quality matter also concerns ***pollution and depletion of groundwater***, commonly induced by anthropogenic activities or natural reasons, leading to a reduction in its availability and quality. As far as pollution is concerned, point source or diffuse substances will have an impact on the reduction of the storage capacity of usable resources, and of the value for use, for example a shift from drinking water purposes to industrial ones, leading to higher costs for supply. Water resources development itself can impact water quality. Thus, the intense development of a coastal aquifer has the potential for saltwater intrusion. In Malta, over-pumping of the Mean Sea Level and Perched (mainly used by farmers) aquifers has been leading to the decline of the water table as well as to saltwater intrusion. During the period August 1995 to July 1996, 20.2 million m^3 were abstracted, while the sustainable extraction is estimated to be around 18 million m^3. In Italy, groundwater overexploitation is particularly acute in Calabria, Salento and Sardinia. As most of the reservoirs can be classified as trophic, the exploitation of this kind of resource as drinking water is often not possible and must be carefully considered, practically on a case by case basis. Finally, in Cyprus, pollution of groundwater is characterised by intensive agricultural activities, with the use of fertilisers. High nitrate pollution loads have been detected in water supply systems and consequently, a number of boreholes had to be abandoned.

Pollution of agricultural origin

Most important agricultural pollution problems are related to nitrate and pesticides concentrations in groundwater and surface water. This phenomenon can constitute a threat to the quality of drinking water and may also lead to eutrophication. In particular, nitrates concentrations have caused eutrophication in coastal waters, thereby contributing to the algal bloom. This is the case of Guadiana, Guadalquivir and Mediterranean river basins (Spain) where aquifers show important nitrate pollution.

In Greece, nitrates are polluting rivers and aquifers, e.g. in Attiki, although there are no big scale aquifers. The major cause of nitrates pollution is agriculture in Thessalia, Ipiros, and Peloponnese because of excessive use of fertilisers. In Italy, concerns in the Po valley and north-east Region mainly regard pollution caused by pollutants used in agriculture. It is now estimated that still 2 to

2,5 millions inhabitants are supplied by sources exceeding the legal standards of nitrates or atrazine. In addition, only the main distribution schemes feature quality control facilities and treatment plants where treatment is not confined to chlorinating.

Pollution of urban origin

Serious environmental problems are present in many Mediterranean river basins/regions due to an *inadequate control of urban origin pollution*. The limited control of urban wastewater discharge into watercourses is due to the fact that wastewater treatment plants have not been built or only part of the treatment cycle is available.

Such a situation derives mainly from (i) limited availability of financial resources to build sewerage networks and treatment plants, (ii) long construction time of these infrastructure, (iii) actual water quality of effluent different from that assumed at the design stage, (iv) inadequate operation of wastewater treatment due to limited organisation and competence as well as limited financial resources of responsible local government.

For instance, the Tiber River Basin is characterised by quality problems because of the proximity of the city of Rome. Already four wastewater treatment plants have been built in the Rome metropolitan area. Nonetheless, present problems are related to the presence of chemicals not abated in conventional treatment plants. The Rome wastewater treatment plant that is one of the largest in Europe only treats biological pollutants (BOD and COD abatement), but does not treat nitrates, bacteria, denitrification and heavy metals. So, the effects of those plants on the Tiber River are less than expected.

In Portugal, sewage and wastewater systems in medium-sized cities (Viseu, Castelo Branco, Beja, and Aveiro) are poor and the pollution produced by these urban areas flows into the reservoirs that supply most of the downstream cities. Eutrophication in reservoirs has its origin in the lack of wastewater treatment plants.

In Spain, the White Paper on Water (*Libro Blanco del Agua*) recognises the impossible fulfilment of the EC Directive 91/271 on Urban Wastewater.

Quality problems related to drought

In Mediterranean countries, ***drought*** can no longer be considered as an exceptional event, but rather as a ***natural phenomenon*** linked to the climate and the hydrological system management. *Drought refers to an unusual deficit of precipitation over a rather extended period*. The typically Mediterranean climatic conditions are characterised by extended periods of dry spells and wet periods with a regime of irregular precipitation, with flash flood, associated with low probabilities of occurrence.

Drought can have an impact on the ecological demand. In Italy, the 1989-1991 drought reduced the flow of some rivers. If the drought were to continue, the ecological quality of the rivers could be greatly influenced. Also, the extraordinary low level of precipitation in the 90s' in Spain had consequences on the decrease of run-off, of more than 60 % in the Tajo, Guadiana, Guadalquivir, Sur river basins and Canary islands, and a significant reduction in the storage average regulation capacity of reservoirs. This extreme situation had also an adverse effect on aquatic ecosystems and

landscape in a lot of regions, i.e. dry rivers, deterioration of rivers quality, impact on ecosystems, turning into not only a water shortage problem, but into a large environmental problem.

Water - A coveted resource

Water demand differs in quantity, quality, flexibility and ability to charge for the use. The ***present annual total water demand*** for France, Portugal, Spain, Italy, Greece, Cyprus and Malta is 150 km^3, i.e. approximately ***61 %*** of the total for the whole of Europe. A factor that notably affects the way, in which demand is shared, is *the importance of irrigation* in these countries. Up to 1990, water demand for irrigation sharply increased, but a degree of stabilisation is expected by 2015. In order of scale importance, irrigation takes up an overwhelming share of the total water used, e.g. more than 80 % in Spain and Greece, although it does not always represent a high added value in the irrigated agricultural production to the country's Gross Domestic Product (e.g. 6 % in Cyprus). Agricultural demand is followed by urban drinking water and industrial demand.

Energy cooling demand has increased because France has been developing a vast programme for nuclear power stations. And in Malta, urban demand represents the greatest sector for water demand, accounting for approximately 65 to 67 % of the total demand. This high percentage is partially explained by the high population density.

Urban use: an almost achieved priority

Urban use patterns in river basins are related to population characteristics, location, socio-economic, cultural factors as well as the level of the water supply systems. Another factor can relate to supply network losses, which can be sometimes as high as 40 to 50 % (estimates) such as in Thessaloniki (Greece). ***Losses*** are expressed as the difference between the volume of water originally supplied and the volume metered by the various users. These losses may be due to inefficiency in the network, management failures or the obsolescence of waterworks and mains. However, losses can also take into account failures in the metering of the actual volume consumed by users due to technical causes (incorrect reading, meter inefficiency) or for other reasons (unauthorised connections and unaccountable uses, i.e. washing of streets, pavements...) which result in significant increase in the amount of water considered as unavailable. To date, no accurate information on network losses are available.

Finally, *tourism* will impact on drinking water demand in coastal areas. In Malta, although tourism accounts for 7.9 % of the total water demand, the per capita average use can reach 250 to 450 l/day.

Differences in the patterns of urban use in the countries of interest show marked contrasts between river basins within a same country. Hence highest values can be found in coastal areas and in river basins with big urban areas, e.g. in France, ranging from 402 hm^3 in the Artois-Picardie river basin to 1 695 hm^3 and 2 191 hm^3, respectively in Rhône-Méditerranée-Corse and Seine-Normandie.

In Greece, the situation in big cities is precarious. Almost half of the Greek population – around 4 million – is concentrated in the greater Athens area. Thessaloniki has 1 million inhabitants. This population concentration results in a demand for urban water of 289 hm^3 in Attiki (where Athens is located) In order to produce additional supply for Athens, water has been transferred from 200 km. Greece had originally around 4 000 municipalities, it has now less than 1 000 as a result of combining small villages and municipalities to create larger units. Yet, some of the supply systems

are so dispersed that increasing investment in water supply does not imply that every part of the villages can be supplied because of the large distances. In relation to this issue, no planning policy has been designed.

Irrigation: a Mediterranean specificity

As previously stated, irrigation accounts for more than 50 % of the total water demand. *Irrigated areas have vastly grown*, particularly in Spain and France, pushing further water exploitation. Furthermore, techniques, crop types and average irrigation water doses differ from country to country as well as the level of dependence upon irrigation. Some countries would use irrigation as a complement to rainfall yields, but in general irrigation stands as the main source for water.

Spain records one of the highest demand levels in the European Union. Cereal crops account for almost 30 % of the total irrigated area, however they record low water efficiency. The most significant water demand values are registered in the Ebro (6 310 hm^3), the Duero (3 606 hm^3), and the Guadalquivir (3 140 hm^3) river basins. Traditionally, Spanish water planning in agriculture has been oriented towards the supply-driven policy of building large-scale water resources projects to develop new irrigated areas. In addition, present irrigation techniques are fairly water-consuming. The technique used in the Ebro basin is the gravity system, which records the lowest application efficiency (0.5 to 0.7 %). Another factor is linked to the tariff system usually based upon a fixed charge per hectare, which represents a hindrance to introduce ***water efficiency***. The discrepancies between river basins can be mainly explained by structural variables, i.e. production orientations and exploitation surface, but can also be contingent to the water allowance, and the technical and institutional characteristics.

In France, because of the current policy, increases in irrigated land and a move towards developing maize crops have been observed, especially in the mid-west and south-west (Adour-Garonne river basin). The French Institute for Environment has recorded that the irrigated surface has tripled within 25 years – 539 000 ha in 1970 to 1 620 000 ha in 1995. The increase has been significant in the western and south-western parts of France, particularly in Poitou-Charente (mid-west) where irrigated agricultural areas have been increased by a factor ten between 1970 and 1988.

The Adour-Garonne river basin registers the highest value, i.e. 2 028 hm^3 (against 22 hm^3 in the Artois-Picardie river basin). Abstraction for irrigation purposes exceeds drinking water and industrial abstractions and has been on the rising trend (+75 % between 1981 and 1994). Problems of water management in the Adour-Garonne catchment are linked to irrigation, During the period from 1 July to 31 October, irrigation can account for 85 % of the net water consumption. This net water consumption cannot always be met by flow reserves. Nonetheless, irrigation has been restrained by a reduction in infrastructure building (reservoirs).

Increasing pressures on the resources

The Mediterranean countries have mainly controlled water by the *supply-side management* approach, e.g. building of dams, attempting to correct defects of natural distribution in spatial terms. Such behaviour has contributed to develop the prospect of a balance between supply and demand. Nonetheless, this balance between both trends has now become increasingly precarious.

Exploitation and water consumption indices measure the pressure on the resource. They provide a rough indication of pressure, as they do not take into account neither the ecological water demand nor the spatial and temporal variability of supply and demand. However, they do indicate the threshold beyond which water might be subject to shortages. Beyond 100 %, the resource is considered to be under structural shortages, i.e. *water stress*.

With respect to internal renewable resources, present total water demand amounts to percentages that range from 58 % in the Ebro river basin (northern Spain) and south-eastern Greece, up to 124 % in the Sotavento and Barlavento river basin (South of Portugal), 102 % in Attiki river basin (south-western Greece) and ***228 %*** in the Segura river basin (south-eastern Spain).

If it is considered that in a first approximation the returns for agricultural, urban and industrial, and energy demands account for 20, 80 and 95 % respectively, of the water applied to each one of the uses, the water consumption index ranges from 1 % to 168 % for the Mediterranean basins concerned. In the case of the Segura river basin, the value can be explained by the existence of inter-basin transfers: the Segura river basin receives water from the Tagus river basin (approximately 300 hm^3/year).

If agricultural water consumption is considered, Spain and Italy are clearly the two countries with the highest water consumption in Europe, owing to their significant demand for irrigation that is the use that produces the smallest return.

The future of water in the Mediterranean countries

A prospective of water demand

The development of *accurate scenarios* will be an issue of utmost importance. Presently, some of the countries have developed or are in the process of developing sectoral and overall water demand scenarios at the river basin level. Nonetheless, others have not yet elaborated such projections, even at a more general level, i.e. Greece and Italy.

Methodologies (variables, hypotheses and scenarios) for determining the water demand forecast assumptions are heterogeneous which makes the comparability between countries difficult. In addition, the definitions of water demand and use greatly differ between countries. And confusion exists between the normative aspects (needs) and realities (demands). All these elements have posed obvious constraints on the accurate reliability of the figures and extrapolations presented.

The year 2015 was chosen for water demand projections. *Although it was possible for most countries to make use of future forecasts for different time limits, in some cases data were not available*. For instance, in Spain the data contained in the White Paper on Water are, for what is referred to the second planning horizon, up to the year 2012. For France, data referred to the year 2010 and 2020. In these cases the data for the year 2015 were interpolated, constant annual growth rates being assumed.

Globally, the total urban water demand estimated for 1990 is somewhat similar to the 2015 forecast. A slow increase has been observed across all river basins. This increase can be partly explained by

the overall improvement of the connection rate to the public water supply system and the population growth in all river basins, except Italy that records a very low rate of population growth, sometimes even negative. Future projections indicate that the total population will not be greater than the present one.

As far as irrigation water demand is concerned, future trends are more heterogeneous, although projections show an increase. The most significant rises can be observed in Cyprus where the figure doubles from 1990 to 2015 (156 to 390 hm^3), and in the Iberian Peninsula – Ebro river basin: 6 310 to 9 879 hm^3, Duero river basin: 3 603 to 5 022 hm^3, Tajo river basin: 1 875 to 3 355 hm^3, and Segura river basin: 1 639 to 2 220 hm^3. In Portugal, the most important rise concerns the Tejo river basin: 2 662 to 3 357 hm^3. In view of the important uptake of this sector in Spain, it is important to underline the discrepancies in numbers for future irrigated areas. Hence the River Basin plans foresee 1 200 000 hectares whilst the Ministry of Agriculture, in the 'National Plan for Irrigation', puts forward 200 000 hectares, of which 100 000 will be considered for the year 2008.

On the other hand, it is worth noting the slight decrease occurring in some Spanish river basins. Hence irrigation water demand will slightly decrease in the Norte I: 475 to 309 hm^3, Norte II: 55 to 36 hm^3, and Galicia Costa: 532 to 346 hm^3. In fact, in these river basins, no potential extension of irrigated areas has been foreseen.

Predicted changes in irrigation water use will most likely be dependent on the future developments of both the Common Agricultural Policy and national and regional agricultural and water conservation policies.

A prospective pressure on resources: likely unsustainable development

Exploitation and water consumption indices measure the pressure on the resource. They provide a rough indication of pressure, as they do not take into account neither the ecological water demand nor the spatial and temporal variability of supply and demand. However, they do point out the threshold beyond which water might be subject to shortages. *Exploitation indices*, which exceed 50 %, already indicates local occasional shortages. ***Beyond 100 %, the resource is considered to be under structural shortages*** - Hence by 2015, two groups can be distinguished: the river basins whose resources will remain sufficient (France) and river basins/countries threatened by shortages (southern and central Portugal, Spain, Malta and Cyprus). Most of the Iberian Peninsula registers values above 50 %. The highest exploitation index value for the Segura river basin (Spain) will have risen to 304 %, mainly due to the increase in the agricultural demand.

The *water consumption index* will range between 1 % and 227 % in the year 2015. Values over 100 % are mainly explained by water re-use and water transfers practices.

A prospective look at water supply

Based upon the future exploitation index findings, most of the river basins will be under water stress conditions in relation to natural resources as most of these have already reached the very limits of exploitation of their existing available resources.

However, to a broader extent, the knowledge concerning the natural resources is still scarce and in this respect, there are still some uncertainties concerning their evolution, notably when it concerns

their irregularity and the interrelation between flows and pollutants concentration into the hydrological cycle.

As regards climate change scenarios, while in certain areas an increase in precipitation is expected, other areas will suffer from decreased precipitation. Moreover, the temporal and spatial distribution of the changes in precipitation are uncertain. The impact on water resources will have consequent impacts on the human infrastructure, its food supply, settlements, cultural systems and industry. Due to the intensification of the hydrological cycle, an increase in extreme events is assumed, which will be disruptive for natural and human systems. Water quality problems are also caused, since the run-off takes the nutrients as well as the pesticides from agricultural land and transfers them into the river systems and lakes.

It is expected that the water quality will slightly improve following the big investments currently carried out by the countries concerned, in particular in compliance with the EC directive on wastewater 271/91. However, problems linked to desertification, flooding and overexploitation of aquifers will become more acute.

In addition, intensive use of the available resource has increased treatment requirements because of the poor quality of the source, thereby leading to increasing production costs for less productivity. In this respect, in many river basins/regions, the ***conjunctive use of groundwater and surface water*** will become/has already become a key issue because the depletion of aquifers is very high. In Tuscany, Apulia and Sardinia (Italy), the water table has sunk threatening the long-term exploitation of the resource. To restore the quantity and quality of groundwater, these regions are now considering two potential solutions: a) to recover the original storage of the aquifer by artificial recharge, b) to attempt the reclaim of the groundwater quality. These two priorities must be tackled in the future, thereby securing the durability of the resource. In some regions, where the authorities have been developing management plans according to law 189, the Water Research Institute has been involved in a process of defining criteria for mapping groundwater resources and quality. Some Geographical Information Systems have already been developed. However, no map on the location of aquifers, which covers the whole territory, is available. In the Artois-Picardie river basin (France) 96 % of the drinking water supply comes from groundwater. Nevertheless, the SDAGE (*Schéma Directeur d'Aménagement et de Gestion des Eaux*) has introduced the provision according to which co-ordinated use of surface water and groundwater is envisaged whenever it is technically and economically possible.

Also, the gradual integration of *re-use and recycling of wastewater* in management practices could represent a competitive solution to complement resources in coastal areas, balance conflicts between uses, and represent an alternative to water transfers from far-off regions. In some arid areas, the re-use and recycling of wastewater already provides for the greatest part of irrigation water. As regards desalination, its use is very heterogeneous and mainly developed in islands, e.g. Canaries and Balearic Islands, Malta and Cyprus. In Malta, seawater desalination already accounts for 50 % of the total water production. Re-use of wastewater is essentially practised in irrigation in the coastal Mediterranean and Southern areas as well as in the islands. Desalination of seawater and brackish water is still scarce and accounts for the same percentage as the re-use of wastewater in the total resources. Presently, the use of non-conventional resources only represents 1 % of the available conventional resources.

Water management and planning in the Mediterranean countries

Institutional framework

It is too early for a thorough appraisal as concerns strengths and weaknesses of the institutional water management and planning systems. The institutional framework has theoretically been set up. A look at the various frameworks demonstrates that national laws provide for a combination of instruments and programmes. However the difficulties lie in the enforcement of the legislation and the administrative structure, which involves translating the regulatory objectives into a decentralised strategy; hence the *organisational framework* is usually characterised by a mixture of competence's shared between River Basin Authorities and regional administration. In addition, the debate related to water policy is often a discussion regarding sectoral-consuming development policies, i.e. agricultural policy.

The *institutional framework* is illustrated by one predominant framework law which includes some common features e.g. considering water as a public domain, protecting the resource, through ensuring a minimum flow, controlling use and pollution, increasing users' participation and dealing with water rights and markets. In relation to the introduction of minimum ecological functions of water, it is interesting to note that Malta, given its peculiar situation of water stress, has not yet included environmental or ecological considerations in its water resources legislative framework.

The national/regional interface is illustrated by two concepts, namely '***deconcentration***' (Mawhood, 1993), consisting in transferring competence's for water resources planning and responsibilities for collecting and allocating funds to the different units, and '***devolution***', implying that autonomy and independence are granted to regional governments and/or regional and local entities, over which the national authority has little control (Carey, 1995). This reflects partly the will to translate regulatory objectives into targets and actions, taking into consideration the regional disparities — and applying the subsidiarity principle — and partly the intention to deliver the potential benefits of demand management. Furthermore, the very decentralised system allows for maintaining water rights; for example at the local level, water users' associations (e.g. in Cyprus and Spain) and local committees for water (e.g. in France) provide support for reflecting the water needs.

The two-abovementioned concepts have been integrated within a third concept of ***'hydrological segmentation'*** of the country, i.e. via the creation of river basins, as planning units, and river basin authorities/committees. Some countries have long since established a decentralised water management system (e.g. in Spain, the first river basin authority was set up in 1926). Also, France established river basin authorities in the 1964 law, whilst in Italy and Greece, river basin authorities have only recently been instituted. River Basins plans have been legally instituted in Portugal, Spain, Italy and Greece, and in France the reference planning instrument is *Schéma Directeur d'Aménagement et de Gestion des Eaux* (SDAGE) and *Schéma d'Aménagement et de Gestion des Eaux* (SAGE). Some of these countries have been only at the dawn of introducing such planning instruments, e.g. Portugal, Italy and Greece, where the regions still hold the current position for water management.

However, all this reasoning results in a very complex, sometimes inflexible, structure, based upon a mixing of both *administrative* (regional authorities) and '*hydraulic*' *management* (river basin authorities) responsibilities, which presently leads to considerable delays in implementing the overall water management and planning strategy (e.g. in Greece, Italy and Spain). In Spain, two

national hydrological plans were drawn up, in 1933 and in 1993. Nonetheless, both of them remained at a draft stage. The first one was never approved because of political changes and the second one because of the generalised societal rejection. To illustrate the complexity and the relative slow process of the legislation enforcement, the River Basins plans, as provided for in the 1985 Water Act were only completed in 1997, i.e. twelve years later. The consequences of this extensive process are the potential obsolescence of some estimates on the resources and demand, as well as on the cost/benefit analysis of the policies proposed. In Italy, the successive laws have just been adding new elements to the previously existing management framework, with little coherence. This has led to a situation in which responsibilities for different aspects of water management and planning are dispersed both horizontally (different ministries) and vertically (different regional and sub-regional levels). Boundaries of responsibilities seem to be diffuse and little co-ordination takes place: an example is the relation between Regions, in charge of drawing Regional Water Sanitation Plans according to the 1976 Merli Act and River Basin Authorities, entrusted by the 1994 Galli Act with the preparation of River Basin Plans. Also, in Cyprus, the complex, albeit comprehensive, structure often hampers policy implementation. A rationalisation of the concertation mechanisms is necessary in order to minimise overlaps of responsibilities curtailing institutional efficiency.

The developing concept of integrated water resources management implies co-ordination and the introduction of *concertation mechanisms* — in France, concertation is a legally binding concept introduced in the 1992 law — between the different policy, implementation and operational levels. Thus, at the policy level, interministerial committees have been set up in France and Greece, for example. Also, national water councils or national committees for water, bringing together ministries, regional governments, river basin authorities, and professional and economic organisations, have been created to act as advisory bodies. These can be assisted by regional water councils. At the local/operational level, the water users' associations (e.g. in Spain and Cyprus) provide a mechanism to ensure their active participation within the resource and demand management process.

Economic framework

At all levels, water policy has financial and economic assumptions. These may range from the user, who is concerned with water prices to the decision-maker, which is liable to attribute a value to water for different competing uses. In all the countries of interest for the study, pricing is quite a sensitive issue, which raises all kinds of debate, in particular as to its social and ethical meaning, i.e. paying for an essential commodity, considered as a free good of unlimited supply. Furthermore, the limitation to applying 'correct pricing' to achieve water policy objectives, e.g. demand control management, is that water has other *non-economic characteristics*, for example it is a common heritage, dependent on climate, and geographic and stochastic conditions, as well as being considered as an essential resource to support life.

Prices still differ according to use and river basin/region, and are usually higher for domestic and industrial uses than for irrigation, which is greatly subsidised. Until 1993, in some countries (Italy and Portugal) domestic charges were low but with the consequence of reducing the investment level since the pricing policy aimed partly at being socially and macroeconomically sustainable. Furthermore, pricing can be affected by 'unaccountable factors', for example network leakage's or illegal drilling. In Malta, for instance, the unaccounted-for water has represented 60 % of the total demand. Therefore, it has serious consequences on economic losses. Today, in most Mediterranean countries there is already a high price allocated to domestic use. If the price is increased, the effect

on water use will not be so significant. The reduction in demand will rather stem from adopting a different attitude to the value of water and a different sensitivity to environmental issues.

Agricultural prices are still lower than any other uses, partly because of still predominant subsidising systems in irrigated agriculture. In addition to subsidising, pricing discrepancies be partially affected by other 'unaccountable factors', e.g. networks' leakage's or illegal drilling.

The process of achieving *full cost recovery* is still hampered by the large subsidising system. Subsidies can take the form of grants, as in Malta and Portugal, or low-interest loans, as in Cyprus, France, Greece, Italy, Portugal and Spain, or both. In Italy, Portugal and Spain, subsidising has aimed at covering financial shortfalls and is usually covered by regional and national governments and the European Union. As a counterbalance, *subsidies* can make the system dependent on the public economy, and therefore very vulnerable to national budget restrictions. In irrigation, the low prices and heavy subsidising can be partly explained by the current policy of the use of supported commodity prices to protect farm incomes, although some changes might arise depending upon the reform and impact of the common agricultural policy.

Shifts in economic factors other than direct pricing may have an effect on water use. The sector most affected by this issue is undoubtedly irrigation. Besides, the gradual elimination of subsidies for electricity consumption, used widely throughout the agricultural sector in some countries, could make the farmers more sensitive to energy costs for irrigation. Also, temporary subsidies may be used to shift farmers away from intensive crops and towards more adequate water saving technologies and irrigation methods. Most countries have revised their pricing mechanisms, partly to increase the charging system transparency. Thus, France, Portugal, Italy and Malta have introduced a new pricing structure, whereas in Spain and Cyprus, reforms are under debate. As to Greece, no mention has been made of reviewing the current pricing mechanism.

A step forward in agricultural pricing would be allocating a price that forces a *managerial approach* to irrigation water as an incentive to introduce *water conservation* and create an *economic framework* required then for the management and rehabilitation of systems. In other words, to introduce the concept of ***'economic sustainability'*** of a system. A new financial concept should be introduced, namely encompassing long-term provisions for reaching an economic sustainability of the irrigation system. Nevertheless, given the disparities between areas, a differential policy should be implemented so that allocating an economic value is also socially acceptable. This consideration is of utmost importance in countries where national, regional development and cohesion are linked.

However, strictly applying economic criteria in some Mediterranean regions would not appear feasible for geographic reasons, for example remote parts, and low population density in some areas. Water supply would then imply heavy investment with low or non-existent economic viability.

Demand control can also be achieved through other management tools, e.g. reviewing the licensing system for abstraction. The licensing system for water abstraction obeys the different principles in the countries covered by the study and is operated by the regional authorities or river basin authorities. The abstraction system is still very *complex*, but the main underlying principles are to ensure that resources, both surface water and groundwater, are not overexploited and also, in some cases, to ensure the rational distribution of water according to the uses; in other words, to prioritise water allocations (e.g. in Greece, Italy, Portugal and Spain). Presently, only Spain and Italy have

mentioned reforming aspects of the licensing mechanism for abstraction control. Thus, future developments of the licensing system will be oriented towards more flexible legal conditions. In Italy, Article 27 of the Galli Act allows the possibility that land reclamation consortia, with the prior authorisation of the relevant authorities, can 'use or transfer to third parties water running in the irrigation canals of the consortium for hydropower or other productive uses, as long as these uses involve the return of water and they are compatible with other subsequent uses', leading to the emergence of some form of 'water market', driven by the theoretical reallocation of scarce resources to their most effective uses. In Spain, the draft reform of the 1985 Water Act, presented by the government in May 1997, put forward amendments aiming at making the present situation more flexible. Aspects are related to the reform of the permits system, permitting transactions between individuals and intending to introduce market mechanisms, flexibilising and facilitating transfers of permit rights.

A progressive shift towards private involvement in water services

It is acknowledged that governments and other public authorities play an important role in drinking water supply by ensuring protection of the resource, equal distribution to users, regulation of quality and quantity and, in some cases, by controlling monopoly abuse by water companies. However, the private sector also has a role to play. In this context, the necessary private involvement in the water sector was recently reaffirmed by the international community, i.e. in the 1998 International Conference on Water and Sustainable Development, in order to assist in ensuring adequate infrastructure and services. The countries most concerned by the relationship between public and private involvement are France, Portugal, Spain and Italy, whilst in Greece, Cyprus and Malta, public intervention prevails.

In Portugal and Italy, the shift from public to private water services management has been newly introduced (1993 and 1992 respectively). Delegated management has been expanding because of new requirements and constraints, which have arisen, in particular as far as investment funding is concerned for meeting the requirements of Directive 91/271/EEC. Until now, it has been too early yet to assess the impact of the private involvement in the water sector. However, the evaluation of the impact will still prove difficult as long as regulatory performance indicators are not clearly set out. These parameters would allow each distributor to take internal measures and, at the national level, would lead to prepare the different stages according to the available financial resources.

Towards a sustainable management of water resources: orientations for the future in the Mediterranean basin

Resulting from the foregoing discussion on institutional, environmental and socio-economic aspects of water management, the present major issue consists in re-creating a culture, which involves managing water as an irregular and scarce resource, in which the scarcity is determined not only by physical reasons, but also mainly by its socio-economic and ecological costs. Consequently, the long tradition of supply management is now to be integrated with the broader approach of 'demand management'.

In principle, the decisions related to resources management should be 'economically efficient, environmentally non-damaging, politically feasible, territorially equitable and socially acceptable'.

In accordance with the criteria of sustainability, the new institutional management mechanisms should encompass a combination of regulatory means and market instruments, designed to introduce 'scarcity indicators' as incentives to water saving. Those changes should result from open proposals, which cannot be rigid and should be adjusted to local circumstances and characteristics of the Mediterranean water stressed regions. Finally, strong national and regional political stewardship, which embraces regulation and direct action, and stable institutional basis to support measures, is required.

Furthermore, sustainable demand management requires integrated objectives of water issues with other policy areas. Hence because of the high share of water allocated to agriculture in the Mediterranean countries, horizontal integration of *water policy and agricultural policy* (Common Agricultural Policy - CAP) is a key point for achieving sustainable water management. The CAP has already introduced some instruments for the management of the agricultural market and rural development. Nonetheless, further developments are required to reach a balance in policy objectives. *The interlinkage between water policy and spatial planning policy*, in particular within the context of the European Spatial Development Perspective, is also essential to compound the process of policy integration. Water is not only a resource 'per se', but also a physical medium. Water should be considered in the planning process as another form of a 'naturally' given 'infrastructure', necessary for the development of regions.

Based upon a consultation process with the countries concerned, specific recommendations creating conditions for a sustainable water resources management and planning system in the Mediterranean basin have been established. These orientations have been included in a general Action Plan.

The general Action Plan offers a conceptual framework, setting out medium- and long-term recommendations for reaching sustainable water resources management and planning, adapted to the Mediterranean characteristics. This framework encompasses: integrating demand and supply management under the generic term of resource demand management, improving knowledge building and flow, adopting a new culture to the value of water, acting on both reducing the quantitative and qualitative pressure on the resources, and increasing the integration of policies. These recommendations have then been applied to each of the countries, with an attempt to take into account the specificity and reflect the actual needs of the regions/river basins in terms of future actions, particularly in water stressed areas. In other words, to identify what changes are necessary in both policy and objectives in water management to pursue the sustainability paradigm on either the medium or the long-term.

The main priorities identified across the countries are:

I. Improving knowledge on the resource, ecosystems and use

This line of recommendation concerns all river basins/regions.

France

Medium-term recommendations:

- It is necessary to set out indicators in order to understand the global dynamics of the hydrological cycle (interrelation between the quality and quantity. Improving knowledge

also concerns improving quality networks which presently do not enable to understand diffuse pollution mechanisms.
- It is necessary to establish an observatory in each sub-catchment (sous-bassin) in order to obtain more accurate data on resources availability, demand, abstraction as well as on quality parameters.

Greece

Long-term recommendations:

- There is a need to develop a national water quantity and quality database.
- There is a need for a centrally organised Hydrographical Service. The purpose of that service would be to collect, organise and maintain a high quality database of the country's water resources.

Italy

Medium-term recommendations:

- Determine a methodology for collecting data in order to produce information.
- Update the systems for collecting and processing hydrometeorological data.
- Facilitate the information exchange among national, regional and provincial organisations involved in data collection in order to avoid duplication of measures, and provide access to validated and updated information.
- Put more emphasis on present and future water demand estimations, which are presently greatly lacking in Italy.

Spain

Medium-term recommendations:

- A greater co-ordination between the ROEA (*Red Oficial de Estaciones de Aforo*) and SAIH (*Sistema Automático de Información Hidrológica*) is necessary.
- It is important to restore and maintain the monitoring networks in order to carry out accurate water resources and ecosystems assessment. The great number of existing networks and organisations in charge of their management require co-ordination efforts and the establishment of procedures for information homogenisation/harmonisation and exchange.
- It is compelling to undertake actions in order to improve the quality monitoring networks as concerns the site definition, stations density, sampling parameters and frequency. In addition, the process should involve the establishment of a biological monitoring network as complement to the already existing chemical analysis networks.

Cyprus

Medium-term recommendations:

- Based upon the census of water resources availability, the main element to be determined is a minimum threshold of water for each use and ecosystems functions, related to natural and anthropogenic environment.

II. Reducing agricultural water demand

France

Long-term recommendations:

A sustainable agricultural water demand management and planning involves:

- Improving knowledge on the influence of water stress on crops productivity
- Implementing less water consuming crops
- Improving knowledge on crops water needs
- Developing decision-support management tools for irrigation practices and for determining better irrigation time-scale, taking into account climate constraints and crops water needs
- Considering soil water storage and heterogeneity's linked to climate, in order to control irrigation and promote water saving
- Modernising irrigation techniques and technologies, including promoting prenormative research specific to surface irrigation
- Supporting farmers for best irrigation practices ('Irrimieux' initiative in France)

Application scale: Adour-Garonne, Rhône-Méditerranée-Corse and Loire-Bretagne river basins

Greece

Medium-term recommendations:

- Incentives have to be granted in order to extend metering to control abstraction and agricultural use. The present system of small land properties does not facilitate the installation of metering. Only the TOEV are equipped with meters. However, metering is not always profitable because of the installation and operational costs, in particular for remote areas.
- The implementation of the principle of cost recovery should be introduced as one of the instruments for better water use. Even a partial cost recovery policy could lead, e.g., to more efficient irrigation systems, if government were to require such systems for the granting of limited subsidies.

Application scale: Northern, Eastern and Central regions of Greece.

Italy

Long-term recommendations:

In agriculture, criteria and tools to ensure the best use of water should encompass:

- Assessing the way of conveying water. Free-surface canals can cause considerable losses due to evaporation and undergo deterioration for fouling and algae and aquatic weeds. Conveying water in pressurised pipes is preferable as it allows the transported quantity to be better tailored in respect of the effective demand required
- The soil and surface types are important in order to determine the optimal ratio between the irrigated area and the quantity of distributed water
- The most determining factor is the interaction between the technique used for water distribution and the type of crops to be irrigated. Sprinklers and drip irrigation should be considered in Italy in future irrigation practices.

Application scale: southern regions and Po catchment

Portugal

Long-term recommendations:

- There is a need to introduce a gradual process for allocating a price to irrigation water, along with other economic instruments.
- Transparency of costs is important, and should be a pre-requisite for infrastructure funding e.g. the clear calculation of water costs (cost of m^3).
- It is necessary to introduce a new concept based upon full cost recovery, i.e. financial sustainability of the system, the internalisation of environmental costs and preparing the system in order to rehabilitate and modernise existing systems, representing long-term provisions for reaching a financial sustainability of the irrigation system.
- An institutional framework should be set up in order to encourage water and infrastructure users to adopt a type of self-managing organisations, on a voluntary basis. An alternative proposal could be that some minimum organisational management, involving all users, on a river basin basis could condition financial support.

Application scale: all river basins

Spain

Long-term recommendations:

- Considering the important uptake of agriculture, measures aimed at improving efficiency 'per se', if not couple with economic incentives, will not be effective in reducing water demand. The way towards reducing demand should be a 'combination of normative measures (reduction of 'water allowance') and economic incentives. This process should be supported by education programmes and technical assistance.
- The application of the full cost recovery in surface water irrigation could be phased in gradually, over a fairly long period, during which a percentage of the production could continue to be subsidised. A differential policy could be established according to the different areas within the country, based upon the expected irrigation profits, depopulation risks, and the degree of competition for water by different sectors. In addition, it is important to consider the level of social cohesion brought about by the agricultural output.

- This economic measure should be accompanied by other non-structural mechanisms, aiming at restricting supply and concentrating plots, incentives for the collective rationalisation of distribution networks (in particular in the case of pressurised networks)
- The interrelation between long-prospects of political decisions both in water policy and agricultural policy is a key point for sustainable water management, in particular as concerns socio-economic aspects. Improving resource management efficiency in agriculture implies a shift in practice and allocation of water. Leaning towards demand-side management implies the use of water-conserving irrigation techniques, the selection of types of crops under the criteria of best soil conservation and water efficiency.

Application scale: Ebro, Júcar, Segura, Sur, Guadiana and Guadalquivir river basins

III. Improving and restoring water quality

Greece

Long-term recommendations:

- There is a higher potential for reducing pesticides and chemicals through the use of promising modern techniques and biotechnology for plants that resist pathogens than decreasing the use of fertilisers.
- It is necessary to develop recycling processes as well as clean technologies in order to reduce industrial pollution.
- There is a need to map the location of landfills.

Application scale: Northern, Eastern and Central Greece

Spain

Medium-term recommendations:

- In Spain, progress is required in nitrate control as one of the issues tackled by the farmers' assistance offices (Extension agraria).
- Use of sewage sludge in agriculture is regulated by council directive 86/278/CEE and 91/271/CEE. General rules should be established for spreading of sludge, including appropriate restrictions on application with protection zones with groundwater resources intended for drinking water purposes.

Application scale: Tajo, Duero, Miño, Guadiana, Guadalquivir and Ebro river basins

Cyprus

Long-term recommendations:

- It is important to introduce legislation setting out limit values and environmental objectives for the use of fertilisers and pesticides, in line with the application of the European Directives on water quality.
- Spatial planning policy can be used to reduce groundwater and surface water pollution. One approach can be to establish protection zones to preserve water recharge areas or potential valuable water source from pollution.

IV. Managing crisis

France

Medium-term recommendations:

- Crisis management plans should include on-going measures (monitoring…), but also responses according to progressive event phases. If necessary, successive warning level could be set up, involving new actions in each phase.
- Whenever possible, flood management should take into account aquifer recharge in order to improve the aquifer capacity storage or the quality.

Application scale: all the river basins with a particular emphasis in the Rhône-Méditerranée-Corse river basin.

Italy

Medium-term recommendations:

- Identifying a sequence of dry years, on historical records of hydrology, coupled with assessing the vulnerability of the system and measuring the minimum acceptable flow could be a potential combination for declaring a drought.
- Introducing efficiency in the system is the preliminary answer to preclude drought and to better cope with acute needs in a situation of drought.

A Drought Policy should entail:

- Assessing the vulnerability of reservoirs to drought and significant surface sources for municipal use
- Developing a Drought Watch System
- Developing regional drought management plans
- Developing non-conventional resources for non-drinking purposes, including for fire fighting
- Defining criteria for evaluation of compensation measures that should be borne by the users who suffered from drought occurrence.

Responses should entail:

- The largest reservoirs are designed to cope with multiannual recognition; i.e. transfers from one reservoir to another can be made. In addition, reservoirs for multipurpose use are usually managed according to technical specificity agreed upon among the users. In the case of declaration of crises, planning should be reversed so that the available storage should be entirely kept for drinking water supply.
- In agriculture, changing crop patterns or changing the ways by which natural water is collected, e.g. micro-catchments and mini-reservoirs, should be envisaged.
- Developing an inflow-outflow model in the case of minimum flow.

Application scale: southern regions characterised by semi-arid climate

Portugal

Long-term recommendations:

- River basin plans should design their own criteria for definition of drought.
- Statistical criteria should be used for declaring droughts.
- Since there are activities in water stressed areas, anticipated plans should be prepared to cope with drought situations.
- In water planning, drought should be considered as a natural phenomenon, therefore uses should be restricted so that the source does not become too vulnerable when drought occurs. Forecasts should be envisaged in order to anticipate e.g. the crops' needs and the type of crops to be grown.

Application scale: all river basins

Spain

Medium-term recommendation:

- Based upon the last experience, it is important to set up a drought early warning system, so that already designed emergency plans can be activated in advance. This anticipated identification of drought requires the development of warning indicators based upon the available information – precipitation, reservoirs' storage, aquifers' level – so that these indicators can be calculated on a regular basis with a view to indicating the potential hints for a drought and identifying the different development stages.

Application scale: Tajo, Guadiana, Guadalquivir, Sur, Segura, Júcar river basins and Canary islands

Cyprus

Long-term recommendation:

- The preparation of a 3-year Drought Management Plan, including risk management and risk minimisation practices, and emergency measures is required:

The drought management plan should include:

- Development of an integrated national drought watch system
- Development of a comprehensive database in support of the drought watch system
- Development of water conservation-awareness programmes
- Conduct post-drought audits and response efforts. Audits could include SWOT analysis and provide a basis for revising drought policies to improve future responses
- Assessment of potential effects of drought on regional hydrology and its implications for society and economy.

A number of recommendations were proposed as tasks assigned to the Community and national levels. These mainly concerned improving water resources management and promoting a better integration of policies. Improving water resources mainly relate to the improvement of management capacities and improving the knowledge of potential, monitoring and evaluation of quantities and qualities. Integration of policies is linked to integrating spatial planning and water management policies, in order to ensure the reduction of development through better water management in particular in water stressed areas.

Hence going towards a sustainable water management and planning in France, Portugal, Spain, Italy, Greece, Cyprus and Malta, means ensuring that the approach encompasses economic efficiency, environmental integration and social equity. The concepts, ideas and tools can be ubiquitously valid, nevertheless their application is even more important in water stressed areas, rather than in the whole Mediterranean basin where not all the regions suffer from stress.

Conclusion - Transboundary water management issues

Finally, an important issue in the Mediterranean area has been that two or more countries can share river basins, therefore it is important to consider the transboundary aspect of water management and planning. In this context, it was asserted that the European Commission should be aware of the transnational character of rivers whenever infrastructure funding occurs because of mutual impacts. Although the transboundary aspect mainly affect Spain and Portugal, and to some extent Greece, proposals were put forward by the other countries.

Recommendations have chiefly related to the future INTERREG III concerning the transnational co-operation for spatial development. Spain proposed to include measures in the new INTERREG III that should be classified according to three lines: (i) prevention of risks, i.e. flood, drought, erosion, desertification…, (ii) improvement of water demand-side management, and (iii) improvement of the access to water use.

Portugal recommended potential areas to be included in the future INTERREG III initiative should mainly concern: Common monitoring systems for parameters. Efforts should be undertaken in order to improve the monitoring network system for quantity and quality in order to enhance the quality, homogenisation and comparability of the data. And, setting up co-operation procedures for the management of international river basins.

Italy put forward that under INTERREG III, it is important to design a homogenous monitoring system/a common methodology across the Mediterranean countries in order to establish a common basis for coping with drought, protecting groundwater resources, enlarging the re-use of wastewater, reducing the coastal pollution and improving the desalination option in tourist areas as well as in small islands.