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NETWORK ON GOVERNANCE, SCIENCE AND TECHNOLOGY

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Executive Summary

This report aims at analyzing the water cycle economics of the Mediterranean countries involved in the NOSTRUM project. This analysis is a synthesis of the National Reports part I and part II delivered by each of the 15 countries partners during the year 2005. This report constitutes a preliminary version of the deliverable 3-1 (Work Package 3 – task a), some questions requiring a more important study before being published.

In almost all Countries, Central Authorities play a major part in the Water Resource Management. They remain the prior investor and responsible actor. Competences relating to water are distributed mainly between the following departments: Agriculture, Civil Engineering or Equipment, Internal affairs, health and Environment. However this dispersion does not exclude environmental concerns.

Water Resource management in the Mediterranean consortium is achieved either by a centralized basin management (i.e. Egypt) or by a decentralized one (i.e. France). Hence, the territorial fields of competence of the management authorities generally result from a compromise between the physical structures and the governance structure. This trade off comes from the own respective characteristics of each Country. However, even if in many fields of the exploitation of water, organizing competition is inapplicable, there remains segment where it could be enforced as for instance, treatment, distribution, allocation of resources. That means that efficiency can be reinforced by opening these sectors to competition. The privatization of the distribution and the wastewater services could involve marked up prices for taking into account the effective costs of water. However, reaching this goal means that competition is fair and fairly organized by the local water authorities.

Municipal public services, or sometime national services, are in charge of both the distribution of fresh water and waste water management in the urban and rural areas. From an economic viewpoint, water distribution and wastewater treatment may be considered as natural monopolies. That means that the local utility service is a centralized network and cannot be shared with another holder. This matter of fact may explain why competition plays only a very limited role: the local public utility service is seldom dissociated from the natural water monopoly. As a consequence, in most Countries, the charged prices are artificially low because of their high subsidization. As a consequence, water firms are discouraged economically and structurally to compete in the water sectors.

Only a few Mediterranean water users are directly auto-supplied. Useful water quantities account for overall the 2/5 of the total used in the Mediterranean countries and only 30% if power plants are disregarded. Most of water used is exchanged and delivered to the users by intermediate organizations, producer-distributors. This water is partially delivered under conditions of market. Whereas water production, transportation and conditioning generates costs (direct and external), these services are underscored (more or less) compared to their effective costs. In most Mediterranean Countries, this matter of fact is particularly true for irrigated waters and irrigation taxes are totally dissociated from costs. This situation reflects also the great inequality of tradable value of the water service according to its uses. In the Mediterranean area, drinking water (as “consumer good”) has a much higher tradable value than water considered as a productive input (agricultural, industrial).

Considering the distribution of tradable water, urban drinking water supply tariff policies tend to increase the rate of coverage costs and reduce subsidies rate. Concretely, that involves that on the same invoice wastewater and water services are joined together. The goal is to balance the operational account (except the investments depreciation).

However, this trend does not exclude strong differentiated tariffs. These one are mainly due to the will of combining social consideration, savings in water incentives (strong progressiveness with section social) and geographical equalizations and distributions between users according to their economic capacity.

Furthermore, the water of irrigation coverage costs of the collective systems using surface water (mobilized thanks to public investments) remains generally very weak. Clearly, for agriculture, water is not only an economic good but equally a patrimonial good. As a consequence, agricultural practices aim at insuring some social stability. However, water scarcity results. One may wonder about the alternative tools of assistances that could be implemented in the agricultural sector. The actual quasi-exemption of water payment cannot support the improvement effort for a more efficient irrigation system. Note that the the farmers water demand is relatively elastic (insofar as they can change farming or techniques of irrigation) while domestic uses and needs are much less. Consequently, in theory, the water shortages are more penalizing for the households' well-being. However, from a social point of view, the changes of farming methods are not always possible and are often bad perceived by farmers.

Briefly, it seems that the water value depends on several criteria such as geography, culture and sociology (the value of water depends on the habits and the associate symbolic system, History and political systems.

In each Mediterranean Country, most of the sector-based policies such as agricultural, industrial, environmental, economic policy in general and even Foreign Policy have strong involvement on water management. Water imposes constraints because of its specific geography (scarcity means water disposal at the required moment and location), its financial charges due to its use and conservation means.

"Water policies" is the whole set of decisions that the national and local authorities have to take and implement in order to solve the short or long term "water problems". The objectives of the Water policies may be expressed as the following ones:

- To ensure the security of water supply in quantity and qualities. That needs in particular to take into consideration increasingly restrictive standards, at acceptable cost for the users and without impacting on the resources and the environment;
- To prevent risks of shortage and rupture of balance between supply and demand;
- Managing the scarcity and arbitrating the conflicts of use;
- To ensure at the simultaneously the protection of water against pollutions and thus the health of the users.

The instruments to be implemented to meet these aims depend sometimes on physical, socio-economic, regulatory even geopolitical constraints. The scarcity of the resource and the increasing demographic pressure are data to be taken into account. As well as the costs of installations and the productions of water necessary to answer the new requests increase, and than the efforts of safeguarding of the resource are them-also expensive, it proves that part of the urban and rural populations of the countries of the South, is able to take part in the recovery of these costs only to a small extent.

Beside litigation and control oriented Instruments (Regulations, Liability), Economic Instruments seems to be an interesting way to achieve environmental goals and to reach specified quality (and quantity, also) standards. However, the choice of appropriate economic instruments may be complex.

The most popular instrument among NOSTRUM partners' countries is the "Polluter Pays principle". Its application shifts the initial cost of using a natural resource to polluters and users. That changes therefore relative prices of the resource. It is also notable that markets of water rights start to develop but that remains still a rare option.

In most Countries, the DSS tools described in the national reports are either gobal general or very specific instruments. They are focused generally at the basin level. They could help in determining the population needs in all sectors or allow technical advices for a better irrigation management. Hence, if general tools (even universal) are lacking especially those dedicated to an “optimal” decision-making, the crossing of these various tools (basis data, simulators etc) could help to develop satisfactory socio-economic water policies and insuring a sustainable management of the resource.

1 Introduction

1.1 Context

This report focuses on Water Cycle Economics analysis in the countries of the Mediterranean basin. It forms part of the Work Package 3 of the NOSTRUM DSS project and constitutes a preliminary version of the Deliverable 3-1, some question requiring a more important study.

This report is based on information provided by each of 15 partners in the National Reports Part I and Part II. The countries for which relevant information has been obtained are: Algeria, Croatia, Cyprus, Egypt, France, Greece, Israel/Palestine, Italy, Lebanon, Morocco, Portugal, Spain, Syria Arabic Republic, Tunisia and Turkey

Figure 1: view of the NOSTRUM Space

This report objectives are the following ones:

Chapter II: Undertakes a study of water management and current uses in the Mediterranean Countries. Water Policy and Institutional setting are detailed for each Country.

Chapter III: Focus on Governments' attitude towards water resources. The main Economic tools and instruments adopted for managing water will be explored – especially with respect to command and control vs. market based instruments – and will be studied how they are linked to the predominant right's regimes.

Chapter IV: Detail the contribution of Economic instruments in DSS Tools when it is possible

Chapter V: Presents conclusion, policy recommendation and final remarks

1.2 Methodology

1.2.1 Methodology used

This analysis of Water Cycle Economics is based on data collected from the National submitted by the NOSTRUM project partners. The report presents these data and information in a general context. Along the different chapter, a cross-comparison of the main information is provided and where it is possible graphics and tables are elaborated.

The data have been completed an effort has been made so as all date to be presented on a common basis focusing on the same scales. Sometimes, the information have been integrated with the available statistics from the international databases (essentially FAO-Aquastat) and with results issued from OCDE and Plan Bleu reports. (see bibliography below)

To complete the analyse some theoretical aspects have been detailed from specialized economics books.

1.2.2 Problems and shortcomings of methodology

The main problem encountered during the conduction of the thematic report was the lack of available information. Demand and use of Water data presented failures also mainly of validity, homogeneity and synchronism. Concerning Water Management, another difficulty came from quite a lack of precision about the Economic Instruments and policies in use in some countries. This was also the case for Water Policies implemented.

2 Water Management in the Mediterranean Countries

2.1 Water Management organization and policies

The water resources in the Mediterranean countries are limited and threatened. The natural water resources are very unequally distributed between the countries (72% in North, 23% in the East, 5% in the South) and between the populations. Moreover, the Mediterranean littoral is affected by an important demographic pressure which increases further during the tourist seasons (the summer, generally). Thus, in summer, during the period dries, the demand for agricultural and urban water is strongest. The water policies are dependent on these contrasted situations associated with the physical and geographical constraints.

In the Mediterranean basin, the water policies are based on some great principles which are:

- *Unit Principle*: the management of a resource is done in its entirety,
- *Preservation Principle of the aquatic ecosystems*: the environmental aspect must be taken into account during the use of the resource,
- *Dialogue Principle*: the use of water must be based on a dialogue with all the users
- *Economic principle of water value*: water is an economic good of which exploitation is costly[1]
- *Management Principle on a world scale*: the stock management shared requires principles of international law[2]

These principles are accepted in most of the countries and often they are reinforced to ensure an integrated resources management, the prevention of the water quality deterioration, the minimization of the differences between supply and demand. The majority of the countries adopted convergent strategies by introducing reforms of institutional and legislative structures which allow the application of new concepts of management:

- the administrative decentralization/deconcentration
- costs recovery
- funds reallocation

In almost all Countries, the Central Authorities play a major part in Water Resource Management. They are the principal investor and responsible actor. Competences relating to water are distributed mainly between the Agriculture, Civil Engineering or Equipment, Internal affairs, health and Environment.

1 In most of the countries, water rights are based on the public domain principle. In the Palestinian Territories, according to article 4 of the Resolution of Oslo (1995), the rights of the water of the Palestinian people were recognized by Israel and it was agreed to manage the conflicts related to water by a joint dialogue committee for the period 1996-2000. In the countries of the Maghreb, the Moslem and usual rights were subjected to deep reforms with the period of French colonization or protectorate which imposed the hydraulic public domain. However, the rights of users existing could be preserved partly but they were specified and regulated. Moreover, in many religions like Islam and the Judaism water is regarded as a gift of God. Even if the states implemented legislations regarding water as a "state-owned property", this change is often badly perceived by the populations especially in the Moslem countries since according to Charia, water could neither be the subject of any property (even official), nor subjected to any control. This social perception continues to have much influence on the water policies.

2 The International law concerning the cross-border water resources is rather basic. It rests primarily on the convention of May 24, 1997 adopted by the General Meeting of the United Nations on the uses of the multinational rivers at ends other than navigation. This convention recommends the reasonable and equitable use water, the obligation not to cause appreciable damage with the other states because of this use as well as the mutual use of information.The international law of water regulates the only conflicts which the States decided to subject to him. Most of the time, the States prefer to adopt the doctrines which are appropriate according to their geographical situation on the transborder river basin and sometimes according to the economic pressures exerted by the companies implied in projects concerning the water uses of this basin.

The Water Resource of our Mediterranean consortium are mainly managed by basin either centralized or decentralized. This matter of fact comes from the differences between Natural Resource geographical characteristics and Water uses geographical areas. It determines:

- Either a strong centralization links to one prevailing arterial line. This one may be river which concentrates all the resource (Egypt) or an infrastructure who unifies Water production and distribution (case of Israel and Cyprus)

- Or a decentralized management because of the multiplicity of major River Basin (like in Spain and France). Another reason of Decentralized Basin Management is due to a strong hydrographical partitioning which block water transfers (for example, in Italy, Greece, Lebanon)

Generally the decentralized Basin boundaries result from a compromise between hydrographical and administrative limits. To these territorial frames corresponds regional water management organizations. Currently, it seems that these structures are running only in Spain and in France. “Water agencies” are in progress in Morocco and Algeria.

Decisions concerning Water Resource allocation are taken at Basin Level. Basin institutions relay and adapt the objectives of water policy which most of the time aims at:

- Ensuring the security of water supply, in quantity and qualities (in particular taking into consideration increasingly restrictive standards), at acceptable cost.
- Preventing shortage risks by managing the scarcity and arbitrating the use conflicts;
- Ensuring water protection against pollutions.
- Protecting Water Resource and environment to be in the Integrated Water Management framework.

Water supply and wastewater treatment are often local issues with limited central government oversight, except as seen above with respect to water quality and pollution regulation. The supply and wastewater are considered as Natural Monopoly (see box 1 below).

Box 1: Notes on Natural Monopoly

Natural Monopoly exists when average costs of a firm are decreasing in all production level (Sharkey (1992)). One firm which satisfies all the demand will have lower costs than two firms or more that share the same demand level. This situation can be found in industrial activities (power and gas distribution or network utilities) which present high fixed costs. If one firm meets the whole demand, fixed cost can be assessed over a greater number of buyers and that reduces the unit cost consequently. This market failure raises a prices problem because fixing the price level at marginal cost does not cover the involved expenditures. Then the producer makes a loss because of the discrepancy between average and marginal costs. Natural monopoly is linked to technical characteristics of the production: scale returns (an input increasing leads to a production increasing proportionally higher). To solve this problem, a regulator may be induced to fixe the price of good.

In fact the role of competition in these sectors has been very limited not only because of the natural monopoly characteristics but also because of government regulation and artificially low pricing that would deter competition. Governments at local or national levels made decisions that led to substantial inefficiency in the allocation of water and to inefficiency in Water Company. However, there is now an increasing recognition that in some areas of the water allocation, supply and processing chain, efficiency can be improved and competition can play an important role. The possibilities for such competition are coming to the fore as water and water treatment move toward privatization and prices rise to reflect real costs.

Until now, water private firms are few but are huge companies. They are mainly French, Spanish and English. However, the trend is to merger water companies which supply a large range of service well beyond water services (cable, TV, phone, energy, building, etc.). Furthermore the trend to delegate local public utilities is growing up specially in France, Spain and Italy.

	Public Supply	**Ownership**	**Management**	**Economic Regulator**	**Environmental Regulator**
France	Municipal	Public	Both	Municipal	Central gvts
Greece	Municipal	Public	Public	Adm. Centrale	Central gvts
Italy	Municipal	Public	Public	Adm. Centrale et Régionales	Central and Regional gvts
Portugal	Municipal / Regional	Public	Public	Adm. Centrale	Central and Regional gvts
Spain	Municipal	Public	Both	Adm. Centrale	Central / Independent gvts
Turkey	Municipal	Public	Public	Adm. Centrale	Central and Regional gvts

Table 1: Institutional organizations in some NOSTRUM Countries

2.1.1 Water Management Organization and Policies in NOSTRUM Countries

ALGERIA

The Algerian Ministry of Water Resources is responsible for the Water management in the country and manages water through eight specialized directorates. The 1996 Water law defined five hydrological basins and five management authorities (Basin Committees) which includes different partners as administration, local partners, and users. These Committees are charged to discuss all the questions related Water and mainly Water allocation between different users.

Recently, the government has set-up four new agencies for water supply and wastewater management. These are :

- "Algérienne des Eaux" (ADE) provides water to the public in the whole of the country. Water Management is decentralized which give decision making power to regional agencies. The finances have been devolved to these regional bodies.
- The "Office National d'Assainissement" (ONA) whose important task is to develop a policy of re-utilisation of treated waste water.
- The "Agence Nationale des Barrages et des Grands Transferts" will be responsible for the dam and the transfert of water over great distances.
- The "Office National de l'Irrigation et du Drainage" for the management of the irrigation structure.

The main missions of the agencies are the following: development and actualization of hydraulic register and Data, sensitizing (control of pollution), contribute to the financing of projects, applications of Pollution taxes, development of regional development plans.

Water policy focused almost exclusively on supply management by national public institutions, with little attention to sustainability, cost recovery, and operations and maintenance.

The Water law n°05-12 (08.04.2005) considers now Water as a commodity. Thus, a new Water Holding will oversee the whole of water management agencies. The contract is currently in negotiation with Suez. The society should be remunerating up to 60 millions €. In return, Suez should direct Algerian investments through a joint firm under its control.

Although, Algerian price system has to take into consideration the social solidarity principle[3], the rules governing Water Resources Management institute the Water real Cost Principle through price systems. This principle supposes that all Water Service exploitation costs as well as cost-effectiveness obligation must be taken into account. Moreover, the contractor or delegated firm beneficiates a real legal protection whether Water Service price is not equal to its real cost. In this case, the law stipulates that subsidies could be paid to cover the difference between real and additional costs.

The price system is based on pricing logic according to territorial areas[4] and consumption volume bands. This is called progressive pricing. There is two pricing classes one concern wastewater treatment the second water consumption.

CROATIA

The Croatian Water Act water management master plan determines water management that means activities, decisions and measures aimed at the maintenance, improvement and realisation of water regime in particular in catchments area. “Hrvatske Vode” (Croatian Water Management Enterprise – CWME) has to implement national and local water management according to the Water Act. Five water management departments compose the CWME corresponding to the five hydrographical basins level. Each department has several sub-units on the tributaries and littoral rivers level.

CWME aims at protecting population against harmful effects of Water, preserving water resource and allocating Water. These missions are based on the Water Management Plan which determines the distribution, supply and properties of water, water requirements and the method of providing sufficient water quantity. It provides for protection from pollution, natural hazards (as floods) and ensures an integrated water regime.

Water price is low in Croatia because supply cost is low. It seems that the country aims at implementing real costs pricing principles. There are no aids for industry while, in the opposite, agriculture is entirely subsidizing.

There are many small water supply companies.

Water Services are still public utilities but it appears that Croatian government intends to privatize them. Then, in wastewater sector privatization have been started.

CYPRUS

The Cypriot Ministry of Agriculture, Natural Resources and Environment, is responsible for Water Resources assessment and Development. This charge is shared out among the geological Survey Department which assesses groundwater resources, and the water development department (WDD) which assesses the surface water resources. This last one is also responsible for planning water development projects and holds the function of recommending plans to government for the allocation of water resources as well as water rates.

Water pricing is an integral part of Cypriot Government policy on water. Water for municipal use (industrial, commercial, and tourist purposes) is sold at full cost, while irrigation water is highly subsidized. There is a variety of water charges and no uniform policy of water rates.

The Water Domestic supply is sold by the WDD to town water boards, municipal boards and community boards. The price for domestic bulk supply does not reflect the full cost which increased

[3] Law n°05-12 art. 138
[4] These territorial areas are linked to hydrographical basins divisions.

significantly after costly desalinisation introduced in 1997. It was announced recently that domestic water price would rise by as much as 100% due to the EWFD requirement of full cost recovery for all water services.

Industrial Water Supply, where the water is provided through the domestic water supply, is charged at full cost and with progressive rates. Where industry withdraws water from private boreholes, the water is not charged.

In general, Town, Municipal or Community Water boards buy water in bulk quantities from the WDD. However, towns or rural communities can also use their own boreholes or spring water to supply water to the consumers within their water supply boundary.

The Government-controlled part of Cyprus is divided into 37 water authorities (Water Boards) each having its own tariff structure. Theoretically, each municipalities (large or not) and rural communities have their own Water Board or is supplied by the Water Board of the neighbouring large cities. The water board buys great quantities of water from the WDD, i.e., water from the reservoirs that is treated in the water treatment plants, and is responsible for the distribution of water to the consumers. They also use their own boreholes to supply water to the consumers within their water supply boundary.

EGYPT

In Egypt, the Contemporary water legislative framework is the result of the Irrigation and Drainage Law 12/1984. The Ministry of Water Resources and Irrigation (MWRI) is in charge of Water Resources Research, development and distribution. It undertakes the Construction, Operation and Maintenance of Irrigation and Drainage Networks. The Directorate is an administrative unit responsible for the operation, maintenance and rehabilitation of irrigation system in its boundaries. There are, now, 30 directorates divided into 60 inspectorates, further divided into 175 Districts.

In Egypt, Water supply as well as wastewater treatment service is entirely undertaken by the government. There are no significant economic indicators available. During these 20 last years, the infrastructures of irrigation, water supply and sanitation were depreciated. The efficiency of the water supply network is less than 50%. The unfavourable conditions of part of the water supply network can explain the high unit costs derived from Data given in the Egyptian National Report – Part I. The same report point out also high costs for sanitation sector.

In the recent years, concerning the irrigation sector, the term of “global efficiency” applies really at least on a basin scale. This efficiency is essentially due to drainage water reuse. It seems that this system also benefits with the other sectors but also the environment

There are no plans for privatisation or organizing a market-based water sector. Nevertheless, water supply market in remote tourist resorts in Sinai and the Red Sea Area depends mainly on private desalinisation companies. However the scale of such market is negligible.

In 2004 , two presidential decrees had a great impact on the Water and the Sanitation sector :

- creation of a Holding Company for Drinking Water and Sanitation and its affiliated Companies that include the General Economic Authorities for Drinking Water and Sanitation. This company had increased the water supply and sanitation service tariffs.

- Creation of the Central Authority for the Drinking Water and Sanitation Service which aims at regulation and monitoring for quality and consumer-price control.

FRANCE

The current French Water Policy rests on underlying principles which appears through successive Water Acts from 1964 to 2004. The main acts are detailed below

The 1964 Water Act relating to Waters System and Distribution, recognized the necessity to preserve aquatic environments and, as a consequence of, water cycle. This text remains the base of the French Water Management and aims at ensuring a better Waters Distribution and at fighting against pollution. Six administrative units were created corresponding to Hydrographical Basins Decision Authorities were also implemented (Basin committees) and linked to financial agencies (Water Agencies). These agencies take royalties being used to finance through pluri-annual programs:

· Investments intended to protect the resource,
· To fight against diffuse pollution
· The capital expenditures corresponding to measurements of depolluting and cleansing.

The 1992 Water Act was the outcome of several years of intense debates triggered by the need to adapt environmental policy to institutional decentralisation, but it was also a response to the growing pressures of European Directives. The most important feature of this framework law is that it unifies the legal regime of all categories of water under the heading “patrimoine commun de la nation”. The law strengthened the constraints on public water services but gave an official possibility to local authorities to create a public service for the management of decentralised sanitation services.

Water prices for domestic use are defined by the “Agences de l’eau” and change between different basin according to regions and according to the type of service (public/private, level of treatment). To meet the increasing requirements of EU Directives and public expectations for high water quality, water companies have to use complicated and high-technology treatment plants to supplement simple, natural processes for treating drinking water.

The 1992 French Water Law forbids in its 13 article the use of flat rate structure and recommends the volumetric or the two-part pricing structure. A fixed part is priced through different but non exclusive ways: (1) the liable person: the subscriber, the number of served flats, the number of inhabitants and/or the duration of stay; (2) the connection: the size of water pipe determines the level of fixed part; (3) the level of consumption (e.g. x € per y cubic meter).In France, water and wastewater budget is separated from the general district budget and must be balanced by the only receipts coming from water consumers.

It is a cost recovery principle. This law insists on efficiency objective and on the necessity not to waste water, when water is scarce. The cost recovery appears to be a secondary objective.

With the new French water Act of 2005, many districts will have to adapt their pricing structures to generate more incentives to save water. That involves increasing block rate, seasonal prices when high population fluctuations, etc., especially in water scarce areas. This change will not be easy to implement, especially when users (households, industries, etc.) have an access to an alternative water resource such as private tube-wells or rainwater recovery systems. These Acts compels these users to install meters and incites water users to save all type of water (included “alternative waters” and especially groundwater) and not only water from public water network.

The main actors in the water supply subsystem are the communes, who are in charge of the provision of many public services, like water and sewerage. They usually set up joint boards (syndicats intercommunaux), so that there are both very large undertakings in urbanised areas, often operated under direct labour. This concerns 40% of the communes, but only 20% of the population.
There are practically no systems operated by citizens' associations at infra-municipal levels. Around 1% of the population is on their own well. Conversely, there are still (in 1995) 17% of French (rural) population on septic tanks and other decentralised sewerage systems.

For France, as a whole, supplying drinking water accounts for 49% of the price of water and waste water collection and treatment 51%. Prices are higher when water is managed at inter-municipal level and when water management is delegated to the private sector or when it is managed jointly by the public and private sectors. But organisation and management choices often correspond to different offered services and constraints.

GREECE

The EU Water Framework Directive (2000/60/EC) has been transposed into the national legislation through the law 3199/9-12-2003 on "Water protection and the sustainable management of the water resources". The objectives of this law are following:

- long term protection of water resources
- prevention of deterioration, the protection and the remediation of degraded water resources and wetlands,
- the prevention, reduction and the phase out of pollution,

There is an important seasonal variation in the volume of water consumed and it is noted that the highest demanded is located during the strongest periods of dryness. The installation of devices of storage and redistribution associated with a water resource saving are the essential points of the water policy in Greece.

The law n° 3199/99-12-2003 also identifies 13 River Basin Districts (RBDs) according to administrative units of the country. Regional Water Directories and Councils will be established within each RBD with the responsibility of implementing the Water Framework Directive at the Basin Level. Public participation is integrated through the establishment of the National and Regional Water Councils. The Law also explores the most effective options for setting up legal coordination mechanisms for managing cross-boundary Rivers.

Water prices vary considerably throughout Greece and are set by municipalities with the exception of Athens, where prices need to be approved by Ministry of Environment, Physical Planning and Public Works.

Water charges are based on volumetric rates and are progressive. The price per cubic meter increases with the level of consumption. A maximum price ceiling exists for domestic consumption. This is a banded pricing system. In fact, the price of drinking water is an average calculated from a typical bill for a standard consumption defined by INSEE as 120 m^3. Sometimes, local authorities introduce a fixed proportion. The pricing systems vary in the number of bands (from 2 to 9) and their progressiveness (the ratio of price between the top and bottom bands can vary from 2 to 10).

Average prices per m^3 consumed rose steeply (in 1975 and in 1992 – after major shortage) and were multiplied by 3 to 8 depending on the consumption band. These changes were part of a water saving strategy for the high consumption bands while keeping prices down for the underprivileged.

Volumetric Rates for industry are generally higher than for households with charges including flat rate pollution charges and wastewater charges.

The agricultural sector consumes around 75% of water in Greece with the surface of irrigated areas rising in recent years. Farmers are not charged for irrigation supplied by individual projects. They pay a small fee per hectare of cultivated area served by collective irrigation projects to the Local Land Reclamation Board.

In Greece, it is difficult to identify a coherent pricing system policy for irrigation water because of the institutional context, the complexity of hydrological system and the importance of the use of underground water (40% of agricultural demand).

he supply of clean and sanitarily appropriate water to every citizen in the country, from both underground and surface sources, is the responsibility of the Public Administration.

In cities with over 10,000 inhabitants, municipal companies manage water and wastewater services. In smaller towns and rural areas communities are directly responsible. There is no further private sector involvement.

ISRAEL/PALESTINE

Water is considered as a public good. There is no private or governmental water ownership included groundwater located on private land. All water resources are controlled by the State. Ideological factor (Zionism) calls for country development through agriculture. Consequently, Irrigation is very developed.

The ideological and cultural factors provide explanation for present water policies which are frequently inconsistent with economic and environmental considerations. Israel's water management system has been designed to subsidize agricultural production.

In most cases, water users pay for the actual quantity of water they consume. Prices are determined jointly by the Ministers of National Infrastructures and Finance after the approval of the Knesset's Finance Committee, in conjunction with national water supply company, Mekorot. This company is responsible for managing Water Resources, developing new sources and ensuring regular water delivery to all localities. Mekorot is in charge of the wholesale supply of water to urban communities, industries and agricultural users.

A trend to privatization of water utilities is currently observed. This is considered as a way of improving efficiency and service quality, acquiring funds and investments, encouraging water saving and encouraging competition in the Water Sector. Desalinisation plants on Mediterranean coast have also to be privatized.

Water price system is apparently based on two principles:

- real costs pricing
- progressive pricing (households uses) with water meters

ITALY

Under the law 183/89, Italy have been divided 11 river basins of national significance, 18 interregional river basins, regional river basin and experimental river basin (Serchio River) each one with a different Basin Authority.

The operative instrument of the River Basin Authorities is the River basin plan. For fresh Water, according to law 36/1994, Italian Regions design the Optimal Territorial Area (ATO) for water management, managed by an authority named Authorities of the Optimal Territorial Areas (AATO).

In Italy, the major use of water is for irrigation (about 45% of the total water withdrawn). The Law n°36/164 entrusts the « Reclamation and Irrigation Boards » (RIB) to manage the irrigation system and purposes. Public law associations of farmers control the management and distribution of water resources over a certain area.

The competencies for the determination of a price belong to Local authorities on the basis of the "Reference Price ", defined through the articulation of the cost components according to a normalized method elaborated by the Ministry of Public Works in agreement with the Ministry of Environment following the proposal of the Surveillance Committee for the Use of Water Resources. The Managers of the Resource are responsible for the application of the Tariff. Tariffs can be adjusted to favour the essential domestic uses according to household revenues, and there is the

possibility of increasing them for holiday and seasonal tourism infrastructures. A « Part of the Tariff » is defined, due for the Integrated Water System as payment for the sewage system counting the whole volume consumed as a discharge.

The Tariff for Industrial Uses is determined on the basis of the Quality of Water discharged and it can be lowered if the industry uses some kind of recycled water.

In the system established by law 36/1994, the prices are set to cover the totality of costs in a longe-range term with a tariff structure that cover all the Water Cycle. Water charges are based on volumetric rates: in certain IWS they are progressive[5] while in others the volumetric price of water is constant. However, consumers have always to pay a fixed price for connection to water network.

For Domestic uses, the sanitation sector applies a constant volumetric price based on the water consumed, without a fixed basic price as for the water supply. The tariff is projected to increase in the future to cover the costs of supply and infrastructure.

LEBANON

Currently, Lebanon's Water sector is going through a major restructuring program. The program has four main components: public/private partnerships, water services pricing and tariff restructuring, village level conflict prevention and environmental assessment. The program envisages the tariff restructuring at regional level, analysing utility costs and revenues, establishing criteria for pricing policies, and developing analytical tools for pricing services.

The regional Water and Wastewater Establishments were developed after merging the 21 water authorities. These establishments have authority over the water resources existing within their regional boundaries. They are in charge of planning and implementation of water projects according to the National Master Plan, set by the Ministry of Energy and Water.

There are no River Basin Management Authorities but 16 River Basin Areas have been identified corresponding to the main Water courses of the country.

Several issues have to be taken into consideration for the development of a river basin management authority:

- Induce administrative changes (by indicating the authority boundary for each of the authorities);
- Develop a set of legislations, regulatory, and enforcement mechanisms that would guard the implementation of the planned activities;
- Encourage community participation through the development of a participatory network. This helps in reducing the conflicts between the upper and lower end river users; in addition to ensuring the sustainability of the set of activities of the river basin authority.

The tariff structure is fixed whereby the subscribers pay an annual fixed rate regardless the amount of water being consumed. For domestic and industrial sectors, the annual fixed rate varies across areas. Concerning the agricultural sector the annual fixed rate does not include operation and maintenance cost of irrigation projects.

Wastewater treatment plants are almost inexistent.

A major water sector privatisation study was launched in 2001. It aims at enhancing of water and wastewater sector. The irrigation sector would remain under the government jurisdiction.

MOROCCO

[5] Price per cubic meter increasing with the level of consumption.

The Superior Council of Water and Climate (*Conseil supérieur de l'eau et du climat*) is the principal institution involved in the water resources management. It has the mandate to coordinate the development of water resources by examining the development policies of the sector, approving the regional master plans related to the development of water resources (prepared by the Directorate of Rural Equipment), resolving conflicts over the allocation of the water resources and establishing policies for water quality conservation. The General Directorate for Hydraulics (*DGH or Direction générale de l'hydraulique*) is in charge of the secretariat of the Council and brings together the main services concerned in this sector, elected representatives, socio-professional organisations, local authorities and representatives of the different types of water users.

To reinforce the existing institutional framework related to water management, the Water Law 10-95, has provided for the creation of regional River Basin Agencies. Those Agencies are created to constitute the regional settings where the concerned parts elaborate the participative decisions of water management. The principal responsibilities of the RBA consist of the development of water resources, the allocation of water as defined by master plan and the control of water quality. RBA reinforce the network of existing institutions in charge of different water management functions. Actually there are 7 River Basin Agencies.

The pricing adjustment plan, in Morocco, proposed for schemes in financial imbalance should help to improve the covering of the cost of recurrent charges (operation, maintenance and renewal by 2010).

In this case, operation and maintenance costs are fully covered by users through the price of the water service. A large part of capital costs, and by the way of the full financial cost, remains to be largely supported by the local authorities. Other wise, volumetric pricing methods are actually encourage water saving. A pricing system in progressive blocks, where the price of water increases according to the volume consumed, have a really dissuasive effect on the consumption of water depending on the progression of the prices and their level.

Morocco has implemented the privatization of the Water Resources Management sector. French and other foreign operators now control large water management concessions in a number of urban areas such as Casablanca. Here, a company called Lydec, which represents a consortium of French firms, was selected in 1997 to take over the water and electricity distribution management (until 2027).In 1998, Lydec invested a little more than 80 million $ (50% in sanitation service). Its success in patching up both the water and power networks, increasing revenues, and connecting more customers, has been widely praised.

PORTUGAL

The Instituto da Água is the national body in charge of the development and implementation of water policies but water management is fragmented, hampering planning activities and efficient management and monitoring of water resources. A new Water Law foresees the Establishment of a National Water Authority and Regional Authorities.
The Administration’s consultation bodies (the National Water Council and the River Basin Councils) are dominated by the administration and strong economic lobbies. Public participation is poor.

The new Water Law which will transpose the European Framework Directive in Portugal is expected to implement the licensing and financial regime, already included in national legislation since 1994, as well as revise water prices. In 2002, the National Water Plan which covers the whole national territory and the Plans of the Hydro graphic Basin which covers the different basins, have been approved.

SPAIN

In Spain, water resource planning, policymaking, and coordination of actions with respect to water management are the responsibility of the Ministry of Environment and the Territory and Biodiversity

Secretariat. National Water Council is an advisory body constituted by representative of the State, water agencies, autonomous communities, external experts and users.

Water management is organised in basin district which are in charge of elaborating water management plan at basin level, as well as operating public infrastructures, manage water supply and sanitation, and supervise the implementation of water policy. Regional governments are responsible for maintaining riverbanks, as well as supply and sanitation.

Spain has the highest water cost at source in the whole of the EU, because of the large investments needed for its infrastructures; yet, the country has one of the lowest water prices for the consumer.

The tariff system follows the principle of social equity for families (progressive tariff structure and by steps), with fixed volumetric prices or per housing units. The tariff system in Barcelona is “prospective” prices : the future cost and investment for water supply and sanitation infrastructures are object of a contract between the water distribution firm and the local authorities. Each house has a water meter and there are three ranges of volumetric prices.

Water prices for agriculture are extremely low, and have unchanged for decades.

TUNISIA

The main institution involved in the Tunisian water sector is the Ministry of Agriculture which has four General Directorates dealing with water resources:

- the General Directorate of Water Resources carries out monitoring and evaluation activities in the field of water resources,

- the General Directorate of Large Hydraulic Works responsible for the dams construction

- the General Directorate of Hydraulic Studies and Works develops activities related to general hydraulic studies, construction of hillside dams, development of Large-Scale schemes and management of the dams

- The General Directorate of Rural Engineering in charge of irrigation, rural equipment and also responsible for drinking water supply to the rural population.

At regional level there are some institutions linked to the Ministry of Agriculture: the regional agricultural development offices. Theses institutions are in charge of developing and managing (with water users associations - AIC) the regional public irrigation schemes. The services of the state or AIC are responsible for the operation and maintenance of irrigation network as well as of the distribution of water to the farmers.

During the 1990s a national strategy to satisfy the increasing demand coming from domestic, industrial and tourist sector was established. Investments in public works (dams, wells and other infrastructure) had entitled the country to mobilise 67% of its Water resources. The final objective of the planned strategy was to reach a 95% exploitation capacity.

The price of water depends on the volume of water consumption. The water charge in agriculture is applied according to volume. The State offers subsidies to the farmers for irrigation water (for up to 20-30% of its real exploitation cost) and it also offers incentives (60% of the needed investment: 40% by loan and 20% by subvention) for the use of modern irrigation techniques. The water tariffs have a progressive structure, they are calculated according to the kind of use and to the quantity used: for domestic and tourism, the price is based on the volume of water used; for the industry, price is fixed both on the volume of water used and on the quality of the wasted water. Since 1998,

ONAS fixed 5 tariff steps for domestic sanitation. The current tariff structure does not allow recovering the full costs.

TURKEY

Water tariffs for domestic and industrial uses, together with other sector uses, in metropolitan municipalities are undertaken by the decision of the Metropolitan Municipality Council according to the "Tariffs Regulations", defined by the Council of each metropolitan municipality. In the identification of the drinking water and waste water tariffs; the O&M, amortization, rehabilitation and expanding costs are generally considered. Another factor is the profit rate of not less than 10% of all expenditures. This indicates that the water in Turkey is being priced not as a basic need but as an economic good. The commercialization of water supply services and profit-oriented approaches to the provision of water are becoming common even in other than metropolitan municipalities in Turkey.

Drinking water and waste water tariffs regarding domestic use and industrial use by public institutions within the boundaries of each metropolitan municipality are calculated for each month of the year by considering the Wholesale Price Indices defined by SIS together with the Metropolitan Municipality Council decision. The subscribers (households) for domestic water are classified under three groups defined by the water consumption value as m^3/day criteria. In the identification of water consumption ratios for each household and industry, the consumption figures of the previous year; estimations about rainfall in following years, drought conditions, and seasonal fluctuations in the past and future are considered.
The water tariffs for other municipalities having a population of over 2,000, which are managed by the body of the municipality responsible for the basic urban services, are established by the decision of the Municipality Council. The legal procedure as determined by the Municipality Councils is to read water meters of subscribers in intervals of 30-40 days and to bill subscribers accordingly.
The tariff system for domestic use is built by steps, with a fixed basis (determined by municipality) and a volumetric price increasing for major users. The tariff system for water treatment of domestic waters is based on a percentage of the price of water supply. A 15 % additional tax is charged to domestic users.

2.1.2 Conclusion

As seen above, many institutions share the responsibilities or intervene in the process of Water management. These institutions according to their interdepartmental or ministerial status respectively exert two functions which are:

1 – Infrastructures and Resources Development in operational ministries endowed with budgetary means and lawful capacities

2 - Consultation and coordination of the users and the conflicts arbitration (for example, the "Higher Council of Water and the Climate" in Morocco and the "Water Commission" in Israel)

However, the water resources distribution among the various uses is often assigned at institutions having at the same time a sectorial responsibility. In this case, these institutions can be considered both judge and judged. For example, in many countries, the ministries for agriculture are often responsible for the resource allocations between various uses. Thus, in Egypt, in Tunisia, in Syria, the ministry for agriculture and/or for irrigation is in charge of water management.

Among the ministerial departments, it is necessary to differentiate those which have an operational function of investment and those endowed with lawful capacities. The administrations responsible for the important investments are often those which have the most weight in the decisions. Generally, facing the "operational" ministries, the Department of the Environments, in load of the natural resource protection, ecosystems and the control of pollution in the Eastern and South Mediterranean countries are recent structures which lack competences and influence.

This scattering of institutional competences requires an adequate legislative framework for rational use of the resources and the environmental protection. In most of the countries, the water management is centralized. In Morocco or in Algeria regional institutions were created, such as the Agencies or the Hydrographical Basin Committees in order to support the participation of the actors concerned, to arbitrate the conflicts and to conclude the policies of development at the local level
The investments are distributed between the sectors in plans which define the allowances of the water resources and the budgets corresponding.

2.2 Institutional setting

In order to manage water use, two demand-side oriented reforms would be particularly efficient in water sector. These are metering (to increase price sensitivity) and retail water and treatment that reflect costs.

In scarcity periods, metered pricing is an important mechanism for reducing the use of water whatever the sector households, industrial or agriculture. The objective of metering is to ratio water by price rather than by regulation. Meter allows users to face different tariffs for different quantity permitting water companies to raise water price during some identified periods (scarcity) in order to decrease consumption. Most water meters are simple, but optimal pricing may require more sophisticated systems. Moreover metering is costly because of installation and maintenance cost as well as meter reading costs. Consequently, metering is most appropriate in localities or urban areas that are subject to shortages.

Policy makers are increasingly considering that water users should pay for the full costs, often including pollution as one of these costs. One example of the changed objectives is given by European Water Framework Directive which stipulates that Members State must ensure an adequate contribution of different water user group to the recovery of water service costs, disaggregated to agricultural, household and industry users. One reason for the increasing popularity of the cost-recovery approach is that, in times of budget shortages, the costs of providing water are rising, especially as a result of the introduction of stricter water quality regulations and the need for significant maintenance on existing infrastructure. Theoretically, variables as well as fixed costs should be recovered from the users.

However, charging prices for marginal use that based on marginal cost of production may not always be feasible because of the inflexibility of supply. That is, at times there may be no additional marginal supply. Identifying a relevant marginal cost in this situation is not possible, but finding a price that would equate supply and demand is possible. Thus it is very important to know about the features of the demand curve for water when setting prices during scarcity. Price rationing will normally yield superior efficiency outcomes compared to physical water rationing.

The economic losses from below-cost pricing are substantial. Water may be used for purposes which the consumer has a value below the current water cost, such as intensive irrigation on arid land, while other consumers with much higher values for water are left in a position of shortage. For example, when farmers receive water at prices below cost, they may adopt an inefficient mix of crops and/or adopt an inefficient irrigation technology.

2.2.1 Current practices in the NOSTRUM countries

ALGERIA

Water real cost principle through price system has been instituted but the law also stipulates that in particular cases subsidies could be paid to cover the difference between real and additional costs. Then, the expected advantages of this pricing instrument could be non-existent.

Moreover the tariff system is based on progressive pricing but the use of water meter (how and when) is not specify.

CROATIA

Real cost principle appears to be used.

CYPRUS

Water for municipal use is subject to full cost but agricultural use are widely subsidizing.

FRANCE

Cost recovery principle since 1992 and Water meters are used.

GREECE

Theoretically real cost principle is adopted with the EU Water Framework Directive Transposition. Water meters are used at least in urban areas

ISRAEL

Water price system is based on real cost principle and progressive pricing with water meters.

ITALY

Tariff is projected to cover the real costs of supply and infrastructure.

MOROCCO

Real cost recovery projected. Water meters are used.

TUNISIA

The current tariff structure does not allow recovering the full costs. Progressive Tariff are used so we imagine that water meters are also used

TURKEY

. Use of Water meters

2.2.2 Conclusion

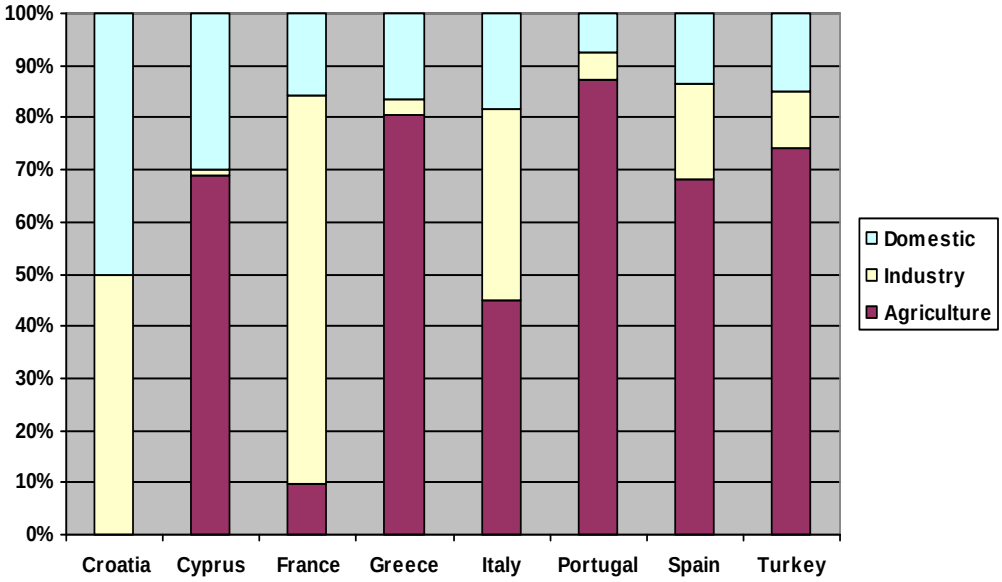
One at least of the Economic instruments to manage water demand is used by most of Nostrum Countries. But the effectiveness of these instruments should be weak.

In most of the countries, prices for municipal water depend on the principle of progression by bands in order to encourage the water savings. Prices for waste water are done according to a percentage of the drinking water tariff. Their ceiling is often fixed at a maximum rate determined by the legislation (for example, 30% of the water tariff in Turkey, and 35% in Egypt). In Turkey, the administrations of water and waste water with autonomous budget, created after 1980 in the large cities, can apply stronger tariffs.

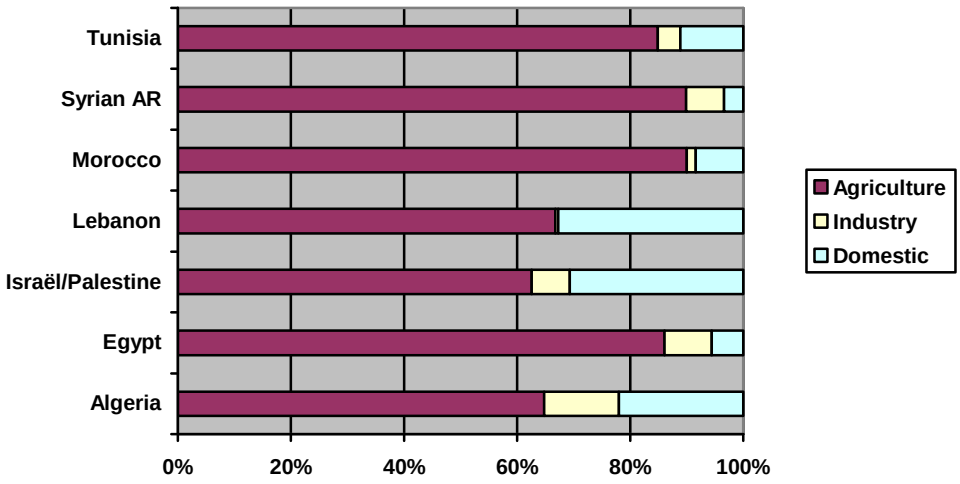
If considering graphs 1 and 2 below related to water use in the NOSTRUM countries, it appears that agriculture constitutes the main water use. This sector is widely subsidized and often not concerned by real cost principle. Agricultural water is generally regarded as non tradable. The

applied tariffs are very weak in the countries where they often take the form of subsidies per irrigated hectare covering enough the costs of operation and maintenance. In Egypt, all agricultural water is dealt with by the State. The subsidies are fixed at the hectare irrigated by the central government and they take account of the cost of operation and maintenance as well as of the farmer's ability to pay. In Morocco, the farmers receive a water allocation by culture and not for the whole of his farm. It is indebted that it consumed it or not. In Tunisia, a progressive system initially relating to the covering of the costs of operation and maintenance is considered and tested in certain zones where are exist users associations.

In the countries objectives in the short and middle term, programmes of modernization of the irrigation networks are in study in order to reduce the water losses (Morocco, Cyprus).



graph 1: Water use in Northern Mediterranean Countries (%)



graph 2: Water use in Southern Mediterranean Countries

The Irrigation management concerning operation and maintenance tend to be delegated to associations of users with more or less important roles. In Tunisia, this system is very advanced

and associations take part even in the decisions of investments. This principle also develops in Morocco and in Turkey. In Turkey, the transfer of the operation and maintenance of the networks of irrigation to users associations made possible to reduce the water losses which rise with more than 50% on average and to improve the rate of costs recovering.

During scarcity period, one may wonder about the meaning of reducing industrial or household demands.

Box 2: Social problems posed by the price of water

The question of modifying the water price structure to take into accounts the environmental constraints and cost of the resource comes up to the difficulties of acceptability. Can a "social" water price contribute on the one hand to the achievement of the economic objectives of effectiveness and on the other hand to the objectives of conservation of the resource?

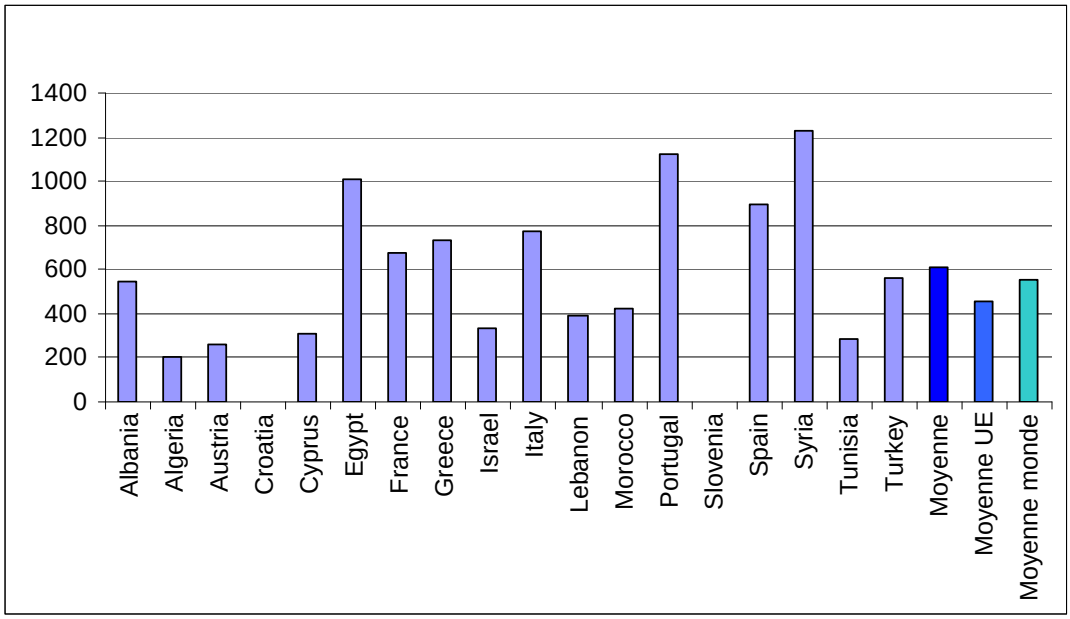
This question is often comparable with the difficulty in reconciling efficiency and equity but these two approaches necessarily do not lead to contradictory options. Under certain conditions, the price systems of water can contribute to the effectiveness while making it possible to pursue goals of equity. One of the approaches suggested by OECD consists in defining the part of the demand for water corresponding to the need fundamental and the access to water should be guaranteed for the households with low income. Beyond this element, the tariffs should correspond to the objectives of the environmental and economic policy.

2.3 Water Demand Analyses

Like the resources, the Water demands of the Mediterranean populations equitably did not set out again between the countries and the industrial sector. Egypt, Italy, France, Spain and Turkey attract approximately 63% of the total demand for water.

The total demands for water of each country are very varied and are not proportioned with their population.

It is in the East that the demands per inhabitant are lowest whereas those of the South are a little higher than that of north. In Egypt, the strong water demand must be related to the irrigation.



Graph 3: Water consummation per inhabitant and per year in cubic meter – FAO-Aquastat

The countries where the demand per inhabitant is lowest are Israel/Palestine, Algeria and Tunisia are those where the deficiency of the offer is remarkable.

Taking into account the losses of transport and remarkable distribution in agriculture and water the supply of the communities, the quantities of water used are lower than the requests and gross output.

Until now, the Water demands were covered mainly by the exploitation of fresh waters of the natural environment. The regular collecting of surface or underground water was initially the mode of mobilization prevailing according to inexpensive techniques in investments. However the semi-arid climate of certain Mediterranean areas associated a demand for increasingly seasonal water involved the need for having of stocks and regulating installation.

In the majority of the Mediterranean countries, irrigation is prevalent except for France and Croatia, followed by the domestic uses then industrial. The notable industrial uses ratio in France is explained by the importance of the energy sector (thermal power stations).

The two principal uses of the water resource, the irrigation and domestic, in fact strongly are located and correspond to activities located on reduced parts of the territory. This concentration supposes sometimes important efforts of installation and transport of water.

Moreover, in the Mediterranean, irrigated agriculture presents a serious difficulty. The water demands are highest when the renewal rate of the resources is weakest.

2.3.1 Urban water:

The Demand analysis for urban (or municipal) water includes the supply to households of two services:

- Drinking water distribution,
- The provision of evacuation systems of waste water, in which the sanitation is an essential component.

Drinking Water distribution

Generally, the productions of drinking water account for only one weak total quantities of water mobilized and used in the Mediterranean countries:

- Less than 10% in the countries with strong water demand for irrigation (Egypt, Syria)

- 15 to 20% in the countries of North

- 30 to 40% in the countries where the demands for water irrigation are modest or are reduced by the competition of the demands for urban water (Algeria, Israel, Lebanon, Palestinian Territories)

For the countries European (France, Greece, Italy, Portugal, Spain) the access rate ranges on average from 80 to 90 percent. In the other NOSTRUM countries, this rate varies between 70 and 85 percent with important inequalities on the territory. Large cities are often well served but between 20 to 30% of the rural populations has a limited access. The supplying gaps were raised which depend either on a resource reduction (cyclical dryness) or of failures in the system of production, of water conveyance or distribution. These failures are generally due to infrastructures lacking or in bad condition. They affect especially the small rural centres (Turkey, Morocco, Algeria, Egypt).

The rate of not counted water, including the rate of the physical losses and the rate of the accounting losses, is defined as the share of the produced water not-charged to the users varies between 30 and 50%. Except for France, Italy, Spain, Greece and Israel where the rate is from 8 to 10%. Algeria has a remarkable not counted water rate of 60%. This important rate, of which the greatest part comes from the physical losses is due to the bad management and the insufficient

maintenance of the networks which involve frequent cuts involving intermittent servicing. (S.Burak, 2002).

Moreover, the increase of Urbanization rates and littoral development of mega poles, the urban demands for water are strongly concentrated. According to a report of “Plan Bleu” (2004), “more than thirty agglomerations would require each one more than 100 000 m3 per day, sometimes more than one million, and monopolize a great part of the efforts of adduction and distribution of drinking water in north as in the south”

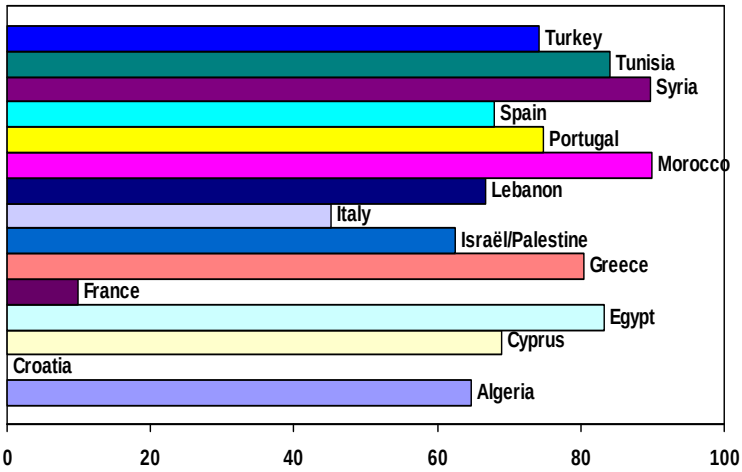
Sanitation

The connection rates to the sanitation network remain lower than the access rate of drinking water network, especially in the rural zones. The connection rates to the water purification plants are even less low. Generally, unitary and mixed sanitation systems exist in the large cities.

Concerning the water purification, there is a strong disparity between the North-Mediterranean countries (France, Italy, Portugal and Spain) and those of the South and the East. In these countries, the water purification plants are insufficient and are badly operated. Except in Tunisia, Cyprus and Israel where advanced techniques of treatment are implemented for reloading the aquifer with treated waste water.

The problematic use of the water purification plants generally comes from a bad maintenance, badly adapted technologies or too important operation cost for the cities what leads to a difficulty of costs recovering by the receipts. Many obsolete plants exist in Turkey and in Morocco. Lebanon recently launched an equipment program. The current tendency is to implement systems with easily exploitable technologies and accessible operating costs (for example activated sludge).

2.3.2 Irrigation



graph 4: Water use for Agriculture in %

The contribution of Agriculture to the national GDPs is relatively weak. However, in most studied countries, in order to meet aims of self-sufficiency and market, irrigated surfaces developed considerably these thirty last years. The countries more irrigating are Turkey, Spain, Egypt and Italy.

The pressure of the irrigation on the water resources depends on many factors:

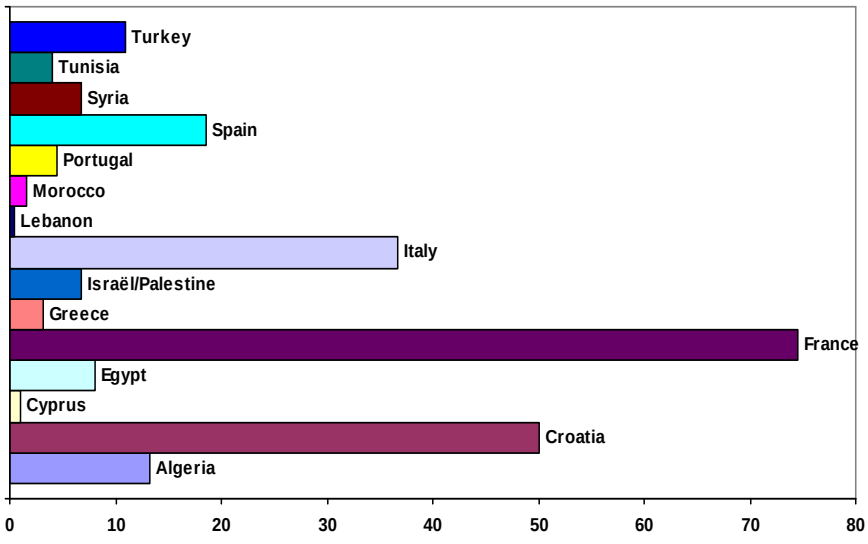
- concentration of surfaces,
- climate (in north, the irrigation is complementary to rain contributions, in the south it constitutes the principal contribution of water)
- soil,
- Type of farming (the choice as rice in Spain but especially in Egypt shows a bad taking into account of the Water value).

Then, demands for water are very varied, often higher than the needs.

Currently, the agricultural sector appears less and less priority in the distribution. This results, in particular, with the low economic profitability of the necessary investments and an increasing competition for the resources between the various uses as the, industry, tourism and household uses. The latter are thus favoured in Algeria which shows a serious delay concerning the drinking water supply and where the industrial sector is in full expansion (60% of the GDP)[6]. But the development strategies of the irrigation as well the infrastructures investments are not really challenged. In some areas, it seems that efforts are made to choose the crops and the techniques least consuming water. Moreover, the social weight (cultural and traditional) of the agricultural sector is far from being negligible in the countries of the South which put sometimes a brake on the policies of re-allocation of the resources. In Israel, although the Water Commission considers a reduction of the agricultural water allocation to the profit of drinking water, the lobby of the farmers prevents it by making pressures on the Minister for the Agriculture, on which depends the final decision.

However, if the Agricultural Water uses do not decrease in absolute value, their relative share in the whole of the uses has to decrease at least for demographic reasons.

2.3.3 Industrial Uses



graph 5: Water use for industry in %

Industries are supplied either by direct taking away or by connection on the public networks. However, the share of industries being not easily separable of that of the other users, the estimate of the quantities really used remains very approximate.

[6] This is also the case for small countries like Cyprus whose economy is especially based on tourism

According to graph 2, the demand for water of industries is weak in the majority of the countries, except France and Croatia (absence of a sector of irrigation?). They not very consuming clear. The recycling of water is practiced little.

In the demand for water, the energy sector is often regarded as an industrial use. What is explained the French peak. Two options of primary power production are present in the Mediterranean countries: hydroelectricity and thermoelectricity. With these two options correspond of very different water consumption.

The hydroelectricity exploits the hydraulic resource whose electric potential depends on the flows and the unevenness. The hydraulic potential of the Mediterranean basin is located at approximately 80% in Europe and Turkey. Hydroelectric installations directly do not consume water, the only true impact holds in the phenomena of evaporation of the reserves of accumulation. They are also compatible with other uses (irrigation, urban distribution, floods prevention).

The power stations primarily use water for cooling what involves only low consumption. In the Mediterranean basin, this sector is located at 99% in Europe including 50% in France.

2.3.4 Tourism

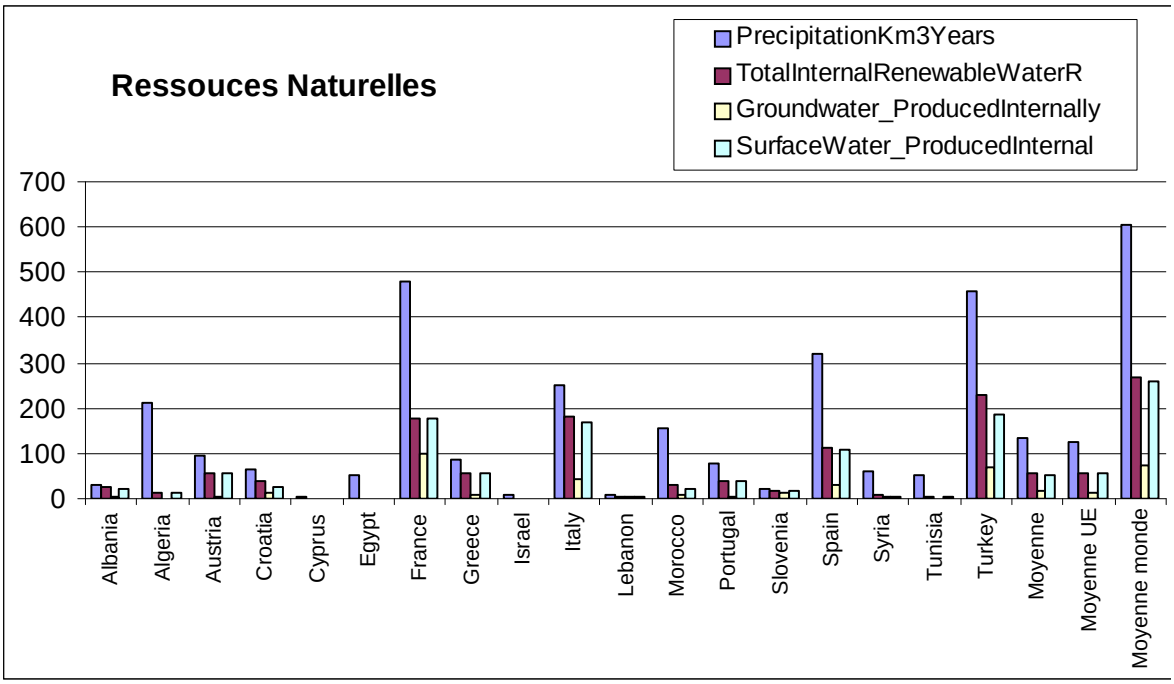
The Mediterranean countries attract each year on average 250 million national and international tourists (Blue Plan data - 2004) who induce activities of leisures and services strongly consuming water (golf's and thermal spas which multiply on the whole of the Mediterranean basin,).

However, the total demands for water remain relatively stable in each country. The peaks of consumption are very seasonal workers and relate to generally only the littoral. Thus, for example, the populations of 27 municipalities of Costa Brava in Spain as that of the area Provence-Alpes-Côte d'Azur in France have increased tenfold the summer. Equipment of production, distribution and wastewater operations is necessary to treat this brutal increase. It follows that the investments of infrastructures are oversize compared to those which would be normally necessary permanently.

In these areas the cost of water must be more important.

3 Economic instruments for Managing water Resources in the Mediterranean Countries

Mediterranean countries are faced with severe water scarcity problems. The "Plan Bleu" report (2004) points out that "nearly 60% of the world's water-poor population i.e. disposing less than 1,000 cu. M of average resources per capita, is concentrated in just the southern and eastern Mediterranean Countries". Indeed, as showed in Graph 6, natural water resources are badly allocated among Mediterranean countries with strong North/south imbalance. Note that Israel, Cyprus, Algeria, Syria and Tunisia are very poor in resource.



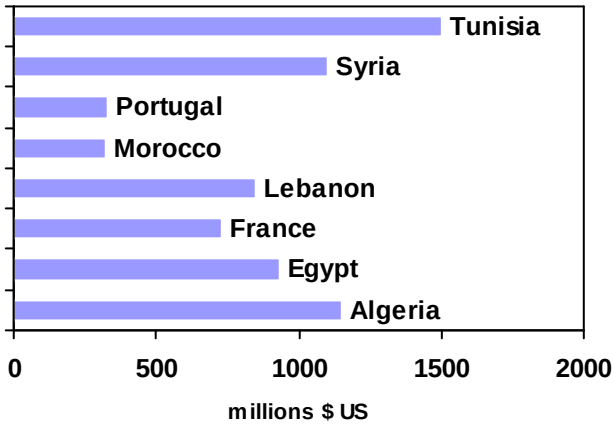
Graph 6 : Water Resources Allocation in Mediterranean Countries – FAO/Aquastat

Moreover, faced with increasing Demographic pressure with strong development of urban littoral area and irrigated agriculture needs[7] Water supply is ever more dependent to strengthened development (dams, reservoirs, canalization, desalination plants) and intensive resource exploitation which imply heavier investments. Countries which are going to see the biggest demand increases, are those where water resources are the lowest, the most costly to mobilise, to distribute and at least available per capita.

Country	Indicator Million $ US per year	Share of Public Investment	Share of Private Investment
Algeria	1150	NA	NA
Egypt	931	100%	0%
France	731,18	NA	NA
Lebanon	850	NA	NA
Morocco	324	100%	0%
Portugal	330,5	NA	NA
Syrian Arabic Republic	1 100	100%	0%
Tunisia	1 499	100%	0%
Turkey	98 billion $ US (Error?)	NA	NA

Table 2: investments needs in Infrastructure in some NOSTRUM Countries

[7] Agriculture is the main user (70% on average in the Mediterranean basin).



Graph 7: investments needs in million $ US

In rural areas especially but not only, access to safe water and also to sewerage system are faulty or inexistent (as in Lebanon). These phenomena end up by worsening the pressure on the pressure on the environment by drying up rivers, pollution and wetlands reduction. This is the case in Israel/Palestine where as a result of industrial discharge, municipal sewage or over pumping, most of rivers have either dried up or become sewage conduits.

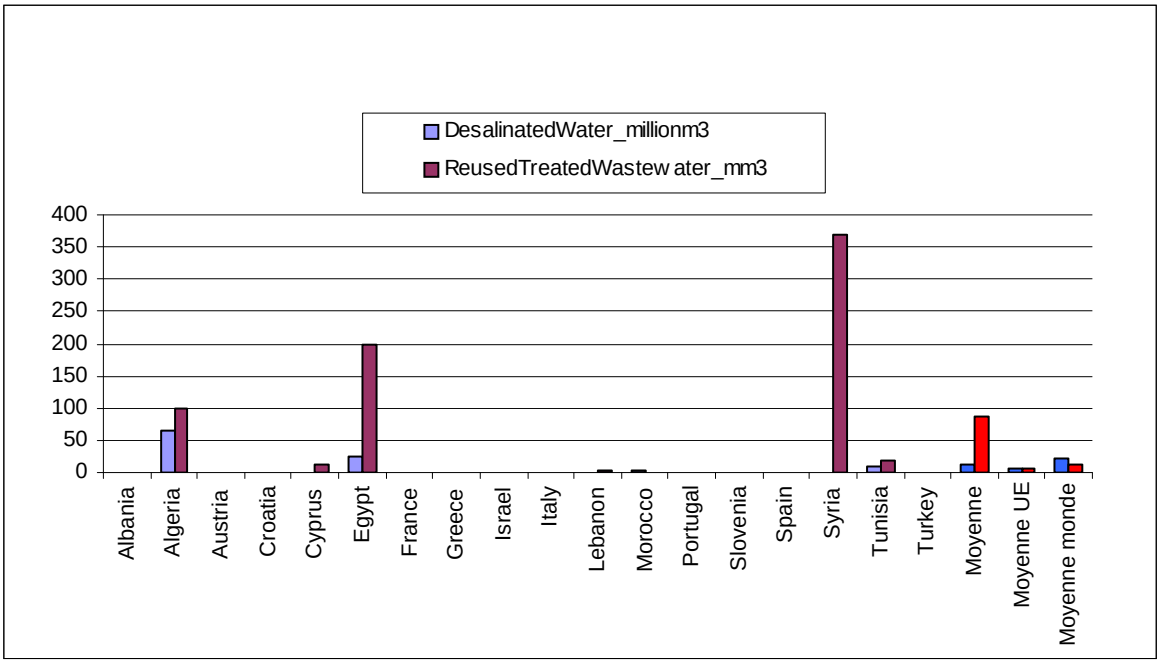
In response to these problems concerning water resources management, policies only based on a greater mobilisation of resources (supply approach) are very costly. These are, for example:

- Increased development and exploitation of renewable and even non renewable resources (while stocks last?)

- Water transfers between areas and/or water importation overland (France-Spain project) or by sea (Turkey-Israel project)

- Regeneration and re-use of wastewater (especially for irrigation) even drainage water,

- Desalinisation of brackish and salt water (see graph 8)



Graph 8 : allocation of desalinated and re-used water in Mediterranean countries – FAO/Aquastat

Part of the urban and rural populations of the countries of the South, is able to take part in the recovery of these costs only to a small extent.

Water policies are beginning to target better demand management (demand approach) i.e. revision of resource allocation, research into better irrigation efficiency in a context integrated water management.

"Integrated Water policies" is the whole set of decisions that the national and local authorities have to take and implement in order to solve the short or long term "water problems". Thus, the objectives of the Water policies may be expressed as the following ones:

- To ensure the security of water supply in quantity and qualities. That needs in particular to take into consideration increasingly restrictive standards, at acceptable cost for the users and without impacting on the resources and the environment;
- To prevent risks of shortage and rupture of balance between supply and demand;
- Managing the scarcity and arbitrating the conflicts of use;
- To ensure at the simultaneously the protection of water against pollutions and thus the health of the users.
- To introduce transparency and participative approaches
- To make users and institutional actors more responsible

The instruments to be implemented to meet these aims depend sometimes on physical, socio-economic, regulatory even geopolitical constraints. The scarcity of the resource and the increasing demographic pressure are data to be taken into account.

From a theoretical point of view, policy instruments aims at internalise the cost of resource degradation. In considering policy instruments a distinction is usually made between various form of direct regulations (also called "Command and Control" approach) versus what usually termed "Economic Instrument" (including Market Creation). The application of Economic Instrument implies that the Market mechanism is used to manage water resource (pollution, efficient allocation, depletion). Economic Instruments seems to be an interesting way to achieve

environmental goals and to reach specified quality (and quantity, also) standards. However, the choice of appropriate economic instruments may be complex.

Some examples of Policy Instrument are detailed in table 3 below.

ECONOMIC INSTRUMENTS	
Redefining property rights	Tradeable emission permits; liability insurance legislation.
Charge systems	Effluent charges, user charges, product charges and administrative charges. Product charges would be for instance charges on the content of pollutants in products or input factors, whereas effluent charges and user charges aim directly at charging the cost of resource use.
Subsidies	Financial aid in installing new technology; subsidies to environmental R&D expenditure (often in conflict with PPP).
Deposit-refund systems	Combines charges and subsidies so as to provide incentives to return pollutants for recycling. Particularly relevant to waste management.
Enforcement incentives	Non-compliance fees, performance bonds. Although enforcement incentives can be regarded as a type of economic instruments, they are inseparable from regulatory measures.
REGULATION	
Standards	Effluent standards, ambient standards, technology standards. Setting requirements to be met usually by a limited number of market agents such as certain industries or individual companies.
Resource use quotas	Emission quotas, harvesting quotas (e.g. fisheries); by allowing quotas to be traded among market agents, the quota system would be transformed to a system of tradeable permits.
Negotiation	Negotiating rules to be set up for a particular industry or company. The distinction between this form and other types of regulation is that enforcement is often left to the industry itself (subject to the threat of further measures in the future).

Source: OECD

Table 3: Instruments for Environmental Policies

3.1 Command and Control Approach

Regulation is often preferred to Economic Instruments. The barriers to Economic Instrument application are following:

- substantial costs of implementing economic instruments which seem to lower under regulation;
- greater certainty of the effects of regulation on environmental quality may be more acceptable to legislators and/or electorates,
- lack of monitoring capacity,
- environmental and growth conflicts,
- political constraints.

Standards are one general example of Water resources regulation. Governments restrict nature and amount of pollution or resource use for individual polluters or resource users. Compliance is monitored and sanctions made (fines, closure, and jail terms) for non compliance.

Another environmental regulation instruments are effluent or user taxes and quotas implementation. Government charges fee to individual polluters or resource users based on amount of pollution or resource use and nature of receiving medium. Fee is high enough to create incentive to reduce impacts. Charges and quotas are also considered as “weak” Economic Instruments on the divided line between Regulation and Economic Instruments.

However, regulatory regimes are likely to reduce incentives to search for clean technologies as administrative bodies have to prove that more stringent standards are technically feasible at low economic cost. Given the compliance cost and, therefore, low incentive for enterprises to cooperate on the one hand, and information being difficult to obtain on the part of the administration on the other hand the outcome of negotiations to change the regulatory status quo is likely to be sub-optimal.

Note that ambient standards and environmental sanctions will be pertinent to Economic Instrument enforcement.

3.2 Tradable Water Rights: an example of Economic Instruments

The basic principle of economic instrument is the “Polluter/user pays principle” that shifts the initial costs of natural resource uses from society as a whole to polluters and users changing therefore relative price of natural resources. The Principle is a “non subsidy principle” according to which the costs of pollution control (not necessarily the cost of pollution) should be paid by the polluter (or the user).

But instead of using prices and pollution levels to achieve quantitative environmental targets, regulators could introduce market-oriented mechanisms creating markets where agents (users) compete for quantitative rights (permits) to pollute or use.

The allocation of water rights has often been accomplished by a political process in which the division of these rights between different groups fails to achieve a high-welfare allocation. Often, for example, the agricultural sector has received rights that it values at a lower level than the urban or industrial water sectors. But this “inefficiency” is not scandalous considering that water value is different between activities sectors. For farming water in an important production factor that is not the case for most of the industrial users. Concerning domestic uses, the difficulty is not the same. Here there is a problem two major principles encountering in Mediterranean Countries : i) equity principle and ii) water access right for all.

The best way to ensure that water reaches its highest value users is to allow users to trade rights between them. (Thobani (1997)) Those who choose to trade water will typically be those who receive relatively modest direct benefits from the water, such as farmers with unproductive soils and uncertain water supplies. (Taylor (1995)) The purchasers of water rights may be others within the sector (intrasectoral trades from farmers with poor soil to farmers with good soil) or other sector’s users (such as intersectoral trades from farmers to urban water companies.) Five prerequisites must be met before trading can occur:

- *Rights attribution* : There are three primary schemes of apportioning rights to water: riparian, priority rights and proportionate rights. Under a riparian setting, water consumers who are immediately adjacent to a river have the right to extract water, as long as they return the water to its source. Water consumers who are not adjacent to a river have no rights to its supply. With priority rights, each new user is given a priority, with the last users receiving lowest priority to water. Thus in times of scarcity, the last to receive a grant of a water right within a water basin will have their right curtailed the most. In contrast, under a proportionate rights system, each user is given a right to a share of the available water in a basin for a given period of time. Thus, in times of water shortage, all users will lose an equivalent percentage of their “non-scarcity” water. The “quantity”, under an established right, will often be variable. The riparian legal doctrine of water

rights is not consistent with the free trade of water. The legal basis for water allocation has been altered in some cases where a riparian doctrine was the initial legal setting.

In defining the water right, the delivery point of the water will be specific to a given location. Current rights may include delivery to the farm. But tradable rights could include locations at the point of origin of the water or anywhere along its present path. Moreover, the rights include an obligation to make a payment to the water distribution authority and the future payment levels are unknown.

These prices paid to the water distribution authority may be subject to variation. Especially if water rights have been priced below cost in the past, the prices may rise in the future. In that instance, the value of the water right would fall dramatically. In order to ensure that investors and other purchasers are most willing to purchase water rights, it is important for government and regulators, at all levels from local to national, to clarify the expected path of charges over time as well as expected changes to regulatory regime.

The rights can either be short-term or long-term rights. Some urban water authorities are interested in making advance purchases of options to purchase water in times of scarcity rather than purchasing absolute free and clear ownership rights.

Rights enforceability : Rights must be enforceable, otherwise water theft or non-supply will prevent system equilibrium. Enforcement depends critically on two factors: reliable measurement of usage and prompt and appropriate penalties for non-permitted users.

Rights tradable : Even when rights are clearly defined and enforceable, they are not necessarily tradable. In Spain, for example, water use rights are clearly defined and are strongly connected to land use rights. As a result, water markets are not permitted because of the linkage between land and water rights. In countries with such systems, it is worth considering a change in the property legislation so that water rights become distinct and separable rights.

Market mechanism exist : A market mechanism must exist for trading to operate well. The mechanism will ideally allow a buyer to meet sellers in a low-cost environment and quickly and cheaply assure the legitimacy of transactions.[15] It is not necessarily the role of the government to set up the market mechanism, but the legal system will have to be sufficiently developed to provide the necessary support for potential disagreements within such a market.

Feasible transport: Feasible transport from the seller to the purchaser is a necessity for active trading. The complexities of organizing access to long-distance paths owned by a water company may mean that individual sellers, such as farmers, face only one buyer. More generally, when sellers and buyers are arrayed along a common water path, such as a canal, it is important that buyers be able to negotiate reasonable terms of access to the canal. When such transport mechanisms do not exist, the government can play an important role in making new facilities possible by aiding in the permit and land requisition process for building new water transport infrastructure.

When trading is introduced, substantial improvements in social welfare can occur. The most likely form of trading would be between agricultural and urban users in contexts with a limited supply. Often, agricultural users pay prices that are far below cost-recovery and thus even further below the “optimal” price. In contrast, urban users are increasingly paying prices the more closely approximate cost recovery. More importantly, urban users place a higher value on water than agricultural users, but they are not typically allowed to buy the rights of the agricultural users. Water sales by farmers would require part of a farmer’s land to go fallow, a crop change, or an improved irrigation method. Selling of water rights can offset the losses incurred from these changes in a farmer’s approach to water use. In the absence of trading, the costs of this misallocation are very substantial

Probably the most important economic problem that exists in the water sector is allocation of water under scarcity, both between different user groups and between different localities. For this purpose, the creation of tradable water rights and tradable water pollution rights may help to solve the problem of allocation between different user groups, different countries, and different localities. The creation of efficient, low-transaction-cost water markets is difficult and requires:

- Attributed rights
- Enforceable rights
- Tradable rights
- Market mechanism : i) Centralized trading location ii) Public information about agreed prices
- Feasible transport

Implementing water trading in basins that involve multiple countries is extremely difficult. Unless a method can be found to convince upstream countries to value the water and low pollution further down the river, water is likely to be wasted and over-polluted in upstream countries compared to the needs and values of downstream countries. Introducing tradable water rights with an international arbitrator that could ensure the terms of trade were respected would be one way to convince upstream countries and users in those countries to value water more appropriately and would allow a basic economic process to solve a complicated political problem.

3.3 Policy Instruments implanted in NOSTRUM countries

Table 4 summarizes information on the main policy instruments impl

	Choices of Policy Instruments			
Country	**legislation**	**Norms, taxes, fees**	**Polluters/users pay principle**	**Water rights**
Algeria	X			X Tradable ? Markets?
Croatia	X Precautionary Principle Preventive Principle		X	Not detailed
Cyprus		X		X Tradable ? Markets ?
Egypt	X			
France	X	X	X	
Greece	X	X	X	
Israël/Palestine				X Not tradable No markets[8]
Italy	X	X	X	
Lebanon	X Defectly implented[9]	X Concern farmers		
Morocco	X	X		
Portugal	X			
Spain	X		X	
Syrian Arabic Republic				X Concern most surface

[8] Licences are annually issued by Water commissioner who can revoke it when conditions are not fulfilled or water use endangers the water source

[9] Absence of enforcement mechanisms, lack of financial, human and technological resources.

				water available
Tunisia	X	X		
Turkey				X Tradable ? Markets?

Table 4: Policy Instruments in NOSTRUM Countries

4 Contribution to the DSS development

In most Countries, the DSS tools described in the national reports are either global general or very specific instruments. They are focused generally at the basin level. They could help in determining the population needs in all sectors or allow technical advices for a better irrigation management. Hence, if general tools (even universal) are lacking especially those dedicated to an "optimal" decision-making, the crossing of these various tools (basis data, simulators etc) could help to develop satisfactory socio-economic water policies and insuring a sustainable management of the resource.

4.1 Experiences with DSS in water management

ALGERIA

No real DSS process exists in the water domain. Recently some projects dealing with GIS and management have been conducted within the bilateral cooperation between Algeria and Germany (GTZ), concerning the Regional Water Plan (PRE). The main outputs are: multi-sources data collection and organization, GIS, management approaches.

During the period 2000-2003, a process concerned the basin agencies in Algeria. The main objective was to set up a regional management scheme for the western part of Algeria, taking into account the following issues:

− Conditions of evaluation and quantitative mobilization of the water resources.
− Existence of critical problems (protection of aquifers in dangers, overexploitation, pollution,
− fail management).
− Various strategies and policies of the economical development
− Various needs (urban, industrial, tourism, agriculture).
− Conditions of non-conventional use of water (desalination, wastewater)
− Absence of decision tools in order to meet the best conditions of sustainable development.

CROATIA

DSS for water management in Croatia has not been developed and used in operative terms. However, various elements of the system, such as hydrometeorological and water resource database and the information system are partially developed. Operative managing of key data/information is carried out in the State Meteorological Institute, hydrometereological data is collected, analysed and organized, as well as data on water level of watercourses and river flows in Croatia, and water level forecasts are made. The forecasts are regularly performed during flood flows and low water. However, data and information based on experience, not simulation models, are used in forecasts. Hrvatske Vode, water protection department, conducts fresh water quality monitoring and has a corresponding database, but not an operative information system, that is under preparation.

Monitoring of the sea quality is conducted by two institutes of marine sciences, within the integral monitoring programme "Jadran". Data bases are located in various institutes and an integral

information system has not been developed. Integral and organized monitoring of ground water, except the source, is not performed.

There is no operative model of the river basin, watercourse or groundwater system/basin. Up to now most attention has been paid to realization of simulation model of the Sava river. During the 80-ies one option of the Sava river model was in use over a short period of time. However the model didn't last, so that it hasn't been in use for 20 years.

Attention has been given to the preparation of DSS, but serious action has not begun. There is continuous attempt of creating the water information system. A new project of the integral Croatian water information system is under preparation. The project is expected to be finished in three years. Models of rivers or water entities are being made within scientific projects during preparation of various dissertations.

CYPRUS

The mechanisms in place to take decisions related to water policy developed during the last decades since the foundation of the Republic of Cyprus in 1960. This could be described as an evolutionary process where mechanisms are adapted continuously as available knowledge and data, but in particular the pattern of water use, changes. It should be emphasised that there has been no systematic endeavour at developing a Decision Support System (DSS) in Cyprus, hence no specific reference can be made to past successes and failures.

EGYPT

Several Decision Support Systems have been developed during the last twenty years to assist in proper water resources management on the national scale in Egypt. Three examples are briefly introduced herein.

EWRSES. The Egyptian National Water Research Center has developed a DSS entitled Egypt's Water Resources and Associated Socio-economic & Environmental Dynamic System (EWRSES). The model aims at capturing the complex network of relationships relevant to Egypt's development linked with water resources and land-use. Being a dynamic system model, it allows investigating whether the desired end-of-horizon state can be actually reached or not, and how the system will evolve. The model is designed to generate the relevant information for a broad Strategic Environmental Assessment addressing: i) the physical-technical performance of the system; ii) the quality of life of target groups of people; iii) the strategic decision making problem. The added value of the DSS implementing EWRSES is the systemic approach and the holistic view it provides together with the capability to jump from one level of analysis and evaluation to another by investigating the reasons underlying a given outcome, under explicit assumptions.

MODAT. Another example for DSS was developed at Cairo University to assist the decision maker in selecting among the various alternatives for the design of agricultural drainage systems and groundwater pollution with nitrates. Multi - Objective Decision Analysis Technique (MODAT) has been utilized. This system has been formulated in a user-friendly computer application named Drainage Ground Water Pollution with Nitrate (DGWPN). The system is initially tested in Zankalon Experimental Station (ZES) in Egypt. Furthermore, the system has been applied to test various alternatives for Irrigation and fertilizer applications for Rice Cultivations.

The Ministry of Water Resources and Irrigation has undertaken a pilot project named Decision

Support System for Water Resources Planning Based on Environmental Balance. The main objective is to develop a methodological approach to sustainable water resources planning. The project aims also at (i) assisting the MWRI and EEAA to draw sustainable policies by proposing a

methodology for the integration of environmental and socio-economic aspects in the analysis of water resources scenarios; (ii) developing an integrated, open architecture computer based tool

(DSS) to implement the above-mentioned methodology; (iii) developing a set of procedures, rules and relationships to facilitate exchange of information among different organizations; (iv) applying the methodology/DSS in a representative case study; and (v) contributing to capacity building of high level staff of NWRC, Planning Sector and EEAA.

FRANCE

The French Water Data Network was created in 1992 in order to collect, standardize and coordinate Water Data. At National Level, FNDN ensures the exploitation of Thematic Databases, HYDRO (hydrometry), PLUVIO (pluviometry), QUADRIGE (Coastal Water Quality). FNDN hosts the National Water Database (BNDE) who provides data processing required by users and spatial data (Geographical).

The SENEQUE Model elaborated within the Framework of the PIREN-Seine Program aims to achieve a global vision on a River Basin Scale on a time-scale frame. SENEQUE enable to calculate, under constraints, the main variables representative of water surface physico-chemical and microbiological quality for the overall River Basin. This Tool associates a hydrologic Unit (Hydrostrahler) to a bio-geochemical process Unit (RIVE). GIS Data Bases support the Model and are used to build the Constraints files needed to calculations of the model. The model calibrated will allow to show the impact of different pressures on the aquatic environment and their relative role, to estimate the effect of the socio-economic tendencies on the environment quality.

An Irrigation Water Demand Assessment tool (ADEAUMIS) was developed to contribute to Strategic Decisions of Water Resource sharing out between Users and Quotas Implementation and Revision. Its Efficiency has been showed reliable during the 2003 summer drought. This tool is based on coupling geographical database, simplified Corn Crop model and Irrigation Decision model. Irrigation strategies formalization, as decision rules, lead to the development of MODERATO, a model allowing Farmers Strategies Improvement and Optimal Strategies Search for given production criteria and Environmental Quality.

A Simulator for Water Management was developed with the main goal to provide Economic Argument Tools allowing balance between Resource Availabilities (Supply) and Users Needs (Demand). This approach combines hydraulic of simulation of River Basin Running model, crops allowing Farmers Irrigation Strategies calculation and Optimisation Crops allowing model, multiuses economic calculation. The expected result concerns the development of a simulator able to test scenarios of Agricultural and Water Policy assessing impacts and performances of them.

GREECE

DSS models for water management in Greece have been developed to serve the purposes of the Water Framework Directive and, consequently, are expected to play important role in the implementation of the WFD in the country and in influencing the relevant policy making. The DSS developed for EYDAP S.A. – the Athens Water Supply and Sewerage Company has been widely used by the company and the up to date results have been utilized to improve water management in Athens focusing on the interrelation of water resource use, efficiency, and economic viability.

A working example is the DSS for Integrated Water Resource Management in Crete. It was designed by the Planning and Development Department for Water Resource Management of the

Periphery of Crete with the objectives of:

− Developing an integrated/holistic approach for the effective, flexible and sustainable management of water resources in the island of Crete, aiming at (i) preserving the sustainable management of the island's water resources, (ii) covering current water demands and securing good quality water for any use, (iii) ensuring the qualitative and quantitative characteristics of the water resources and the water systems.

− Providing the capability for efficiency control of the proposed solutions (projects and actions). The acquisition of overall control of the water dynamic and of the management problems.

− Developing a decision support tool to be used in introducing policies for the implementation of certain water related projects and interventions to water resources management.

− The development of the framework for the implementation of the Framework Directive for the Water Resources (2000/60).

Basic criteria for the development of the DSS included the assessment of the quality and quantity of water resources, water demand and offer, the current conditions (favourable or not), and the time span of the project. After gathering and evaluating quantitative and qualitative data on water resources and studies applied in the island in relation to the hydrological and hydro geological conditions, as well as on the development of the relevant infrastructure, a hydrological and hydrogeological database was formed to be incorporated in a GIS and applied to the island of Crete. The results from the simulation of the hydrological and hydro-geological systems as well as from surface water and groundwater balance estimation were used in the development of the DSS. The DSS was tested for different scenarios of water management. Economic analysis of the scenario and training of the DSS model users also took place. This DSS provided the potential for future evaluation of projects and interventions in the water sector, enhanced design of the existing infrastructure for water supply, scenarios development, and sustainable planning for water resource management.

ISRAEL/ PALESTINE

No information is reported on use of DSS.

ITALY

Despite the wide and growing interest towards the development of tools and techniques for integrated planning and management of water resources at the catchments scale, relatively few of them have been actually and regularly applied over the last few years to real world decision making. Although several DSSs have been made available thanks to the efforts of the academic community and of specialized private companies, these tools still are not widespread in Italy. On the other side, an increasing number of regions and other territorial institutions, such as river basin authorities and ATOs, have been acquiring data base and information systems on meteorology, water and land resources as a tool to improve their monitoring, planning and management activities. Relevant progress has been made in the collection and storage of a great deal of land information thanks to the extensive use of the GIS techniques along with an increasing availability of simulation models of complex water resource systems.

Some of the most recent DSSs focus on the role of stakeholders' participation in decision-making and are designed to involve a wide range of actors and stakeholders. They include:

TwoLe. This is a DSS for planning and managing multi-purpose reservoir networks; it supports and improves participation to decision-making. By reproducing the structure of decision-making and using a particular class of models, Twole suggests how to extensively involve SHs and DMs at all stages of decision-making. TwoLe has been developed by a group of researchers from Milan Polytechnic and has been applied to three large projects.

Aquaroute. It is a DSS to help decision-makers to define sustainable water management policies. The tested alternative scenarios are different in terms of network layout and/or management options. Aquaroute adopts a multi-criteria approach (economic, environmental and social criteria) under the condition of uncertain information and several stakeholders. A team of researchers from the University of Basilicata has developed it.

Monidri. It can be considered one of the most complex efforts to build an Integrated Decision Support System (IDSS) for planning and managing different water uses -especially for agriculture at the river basin level. IDSS's main characteristics are: integration of different specialised monitoring/evaluation/simulation models (such as ground and surface water dynamics models, crop water requirement models, economic and environmental evaluation models etc.) and a participatory approach, consisting in the involvement of local actors in water use and management for the implementation of the IDSS. It is based on a GIS named SIGRIA (Information System on Water Resources Management in Agriculture) developed by INEA (National Institute of Agricultural Economics). Used by several Land Reclamation and Irrigation Consortia, SIGRIA is an important tool to implement a homogeneous information system on water irrigation schemes useful to support evaluation and decision-making, i.e. to calculate crop irrigation requirements. Financed by the Italian Ministries of Research and Agriculture, it has been carried out by a group of public research institutions and private enterprises. It has been tested in three river basins.

Mulino-Dss. This is an operational support system for the management of complex multi-sectoral problems of water resources and water quality at the catchment and river basin scale in Europe. It integrates the DPSIR conceptual framework – to describe and structure decision problems – a hydrological model, a multi-criteria evaluation procedure and a sensitivity analysis. The use of the

mDSS has been conceived as a part of a larger process of involvement of the different stakeholders that are requested to collaborate in collecting data, declaring their preferences for the alternative options, giving suggestions for decision criteria and their ranking, explaining the role, responsibilities and relationships between different stakeholders. It was carried out in the context of a European project – MULINO - by a group of partners from Romania, Portugal, United Kingdom, Belgium and Italy. Throughout the project the mDSS has been tested in six selected catchments that range in size, topography, climate, socio-economic and cultural context.

LEBANON

Several attempts have been made to apply DSS tools for the management of the water resources at the national and regional levels. Such projects have been primarily initiated by international agencies, mainly the United States Agency for International Development (USAID) and the European Commission (EC). Unfortunately, to date there is not a single successful experience of use of DSS in decision-making. Most tools were either left at the developmental stage or are currently under development. The main efforts in developing DSS tools for water resources management in Lebanon are: (i) the National Master Plan for Water Resources Management (2002-2003), (ii) the Investment Planning and Programming Project for the Water Sector (ongoing),

(a) Development of indicators

Since decisions cannot be derived from measured data alone, such as precipitation and stream flow, Basin Authorities rely on synthetic series of data. Observational records cannot not be directly used in most cases because the natural regime is strongly altered due to reservoirs, diversions and consumptive uses. Synthetic series for the natural regime are therefore computed with the Sacramento model.

This model reproduces stream flow from rainfall observations. The Sacramento model has been calibrated in the Tagus unaltered basin, and is used to generate runoff series for the 216 subbasins for the period 1940-41 to 2000-01.

The synthetic calibrated time series are then used to compute operational indicators that characterize the hydrological conditions of the basin. The indicators have the following characteristics:

− Discriminate to a reasonable degree between different levels of water scarcity intensity; and

− Be valid, the results being reasonable predictors of the results of more detailed studies.

In the Tagus basin the operational indicators are: stored volume and the Surface Water Supply Index (SWSI), that has the advantage of combining hydrological and climatological features in a single index and allows for the consideration of reservoir storage, very important in the Tagus basin. SWSI is computed for a hydrographic basin or for a water resources system by obtaining the probability of non-exceedance for the values of precipitation, runoff and stored water in the basin. Each component is assigned a weight depending on local conditions. These weighted components are summed to determine the global SWSI value for the entire basin. Threshold values of -2 and –3 of SWSI have been chosen, corresponding to moderate and severe drought respectively. (b) Contingency planning.

Once all the variables and indicators that concerning in the water resource systems are known from the physical and hydrological point of view, optimum management is reached, relying on mathematical models that reflect the system operation and are used to analyse the operational rules that lead to the best exploitation of the resources or to the justification of the requirements to create new elements -- such as reservoirs, conduction and capture, etc – that increase the availability of water resources. The mathematical operation for the physical operation of each system element is well developed and there are sufficient tools for the analysis of any type of problem that might arise.

SYRIA

The Coastal Water Resources Management Project (COWARM) was carried out by the General Directorate of the Coastal Basin (GDCB) and by a consortium of Dutch and Syrian consultants in order to optimally develop the costal basin area. Assessment was made of the stakeholders, the authorities and organisations that have interest in the water issues of the costal basin. The DSS of the pilot basin Asnober in the coast basin was developed at regional level, implementing the WEAP software, developed by the Stockholm Environment Institutes Boston centre (SEIB) at the Tellus Institute at basin scale. Scenario analysis was carried out to test and demonstrate the ability of the software to serve as corner stone of a Decision Support System.

The adaptation of DSS modules to water management was carried out through the following phases.

In the first phase (July 2003) included the completion of the following tasks: (i) Getting the project team and staff of General Direction of the Coastal Basin (GDCB) acquainted with the use as well as the advantages of modelling and simulation software, (ii) Identifying a suitable pilot basin to test and introduce the model, (iii) Starting data collection, identifying gaps in available data in the pilot basin, setting out the procedures to establish reliability of the data completeness, (iv) Formulating a schematic representation of the water resource system of the pilot basin, (v) Field trips of institutions and stakeholders in the pilot basin, (vi) formulation of the project follow-up activities and of a work plan, defining responsibilities for the follow-up. Additional data and information were collected between July and January 2004 to establish a sound baseline for the modelling and simulation exercises.

In the second phase the tasks as laid out in the work plan were carried out as follows: (i) Completing data collection and assessing the quality of available data, (ii) Installation of WEAP software and data entry, (iii) First simulation runs, model verification and calibration, (iv) Assessing

strength and weak points of the used software, (v) Creating and simulating future scenarios of development in the pilot basin, (vi) Visualisation of model results for the pilot basin.

DSS proved to be useful for taking decisions regarding water management for a number of issue, as the conceptual analysis of the existing surface water resources system, the evaluation and optimisation of the use of surface water resources, the evaluation of new water resources infrastructure.

TUNISIA

Water management in Tunisia benefits a particular attention by high authorities, with the objective to assure the durability of resources. Since the independence, relative substantial strong investments have been planning for water management:

− Mobilization of resources by a follow-up and sustained scheduling notably of 1990 to 2000 (21 dams for a total of 740 Mm3) with possibility of interconnection between some of them;

− Transfer of the water of the North to the Centre and the South (deficit).

− Rationalization of the water utilization (domestic use and agricultural use) by formation nand information of administrators and consumers.

Actually, one of the aims of water management strategy is to introduce new practices to administrators and users (agricultural users, consumers of drinking water) in order to manage water demand as well as water resources.

The concept of DSS is already known in Tunisia. However, even if it is extensively used in industrial and socio-economic studies, it remains of limited utilization in water management. However, some research projects are centred on the use DSS in water management. For the most, these projects for the most are achieved at regional and even local level. Very few projects can be extrapolated to the national level because results remain tightly related to specificities of the studied hydrosystem. In the same way, these projects remained to the stadium of research project, without being integrated in decisional strategies. This fact is due to the fact that decision-makers are rarely included as such in these projects but as technicians and supplier of data on waters.

Two examples of studies addressed to the introduction of DSS in water management are given by the “Economy of water in Bizerte region (North Tunisia)”, under the coordination of the “Institut Méditerranéen de l’Eau” (IME) in 1994-95, and “Water management in Mediterranean”, concerning the comparison of several studies achieved for several regions (Alexandria - Bizerte – Algiers Ramallah, High Sebou, Rabat, Fès, Tanger), carried out by the Institut Méditerranéen de l’Eau, within the framework of the program MEDWAN-METAP II, committed and financed by the World Bank.

Also, the Project MERGUSIE in collaboration with France and Tunisia, since 1996 concerned the basin of Merguellil (1540 km2) to understand the hydrological phenomena and to identify ways of improvement of water management. The second phase of this project is focused on the construction of tools to support decision making for the management of hydraulic planning in the basin. The understanding of interactions between water resources and water, via their formalisation is therefore one of the priorities of this research work. It must lead to the conceptualisation and the implementation of models achieving simulations in order to explore the evolution of the hydrosystem when submitted to different sources of variability, climatic or socioeconomic and their impact on the valorisation of water.

TURKEY

The development of DSS in Turkey is essentially an emerging issue, with a history of only a decade. Efforts towards DSS applications in water management have started in the early 90's, basically at academic levels through research carried out at universities and other research institutions. Major water resources agencies, which make the decisions, have been and are still pretty slow in adapting DSS tools in actual water management practices. Since cooperation between research institutions and these agencies is rather weak, it has not been possible to convey research results to practice. Only very recently there has been the recognition of the significance of DSS tools by decision makers and governmental water agencies.

Interestingly enough, within the last 2-3 years, these agencies have started to favour DSS tools; yet, they fail to use DSS effectively and sufficiently in decision-making since there is a strong need for capacity building and personnel training. Data availability is yet another factor that hinders proper use of DSS tools. Accordingly, practically no substantial application of DSS in decision-making in real world problems was made.

An example of applicable practice is given by the development of the nation-wide meteorological and hydrometric (stream flow, groundwater and water quality) monitoring networks. The meteorological network is run by the State Meteorological Agency (DMI) and has a sufficient spatial and temporal coverage. In the case of water quantity and quality, the major monitoring agencies are the State Hydraulic Works (DSI) and Electrical Works Authority (EIE). The monitoring practices of the two agencies extend to all Turkish river basins where stream flow is observed on a daily routine basis. Stream gauging was initiated in 1935 by EIE on Euphrates River and then extended to all other basins to meet the needs of water resources planning and development. DSI also monitors rainfall at selected sites in each of the 26 basins. The development of the network is quite rapid; yet, the basic questions of where, when and what to observe still remain unsettled. In selection of sites, the basic considerations are the locations of polluting sources, easiness of access to sampling sites, representative capacity of sites, presence of water quantity gauging stations, and availability of required facilities (laboratories, personnel, equipment, etc.). The sampling frequencies happen to be a more significant problem with respect to utilization of available data. The measurements are basically realized on a monthly basis with several gaps and missing values. Available data records are also pretty short (the longest being 7 to 8 years). In the selection of sampling frequencies, time periods are considered when significant variations in water quality are expected. These periods cover low flow time points during warm and dry seasons. Next, the problem of what variables to observe is simplified by specifying two groups. The first one includes variables that are to be monitored at every site; whereas the second group covers more specific variables depending on water use and sources of pollution at particular sites.

The monitoring agencies keep their data in digital formats; however, they have not yet developed them into national or institutional databases. Furthermore, all data are subject to significant charges when they are made available to users. Only academic users can access the data at reduced rates. On-line access to data is not yet possible. On the other hand, in recent years, activities started towards more refined means of monitoring hydrometric data. A protocol can be given as an example, which has been recently signed between DSI and the National Institute of Meteorology & Hydrology (NIMH) of Bulgaria.

4.2 Transfer of Know-how

Detailed analysis cannot yet been realized due to limited information concerning Economic Instrument. However, according to available data, an interesting case has to be more studied in order to discuss their transfer or application to other countries and the possibilities to reduce their disadvantages.
Some Southern Mediterranean Countries report deficit in applying efficient wastewater treatment. However in countries like France, bioengineering's systems, accessible are developed which would make it possible to preserve the environment while reprocessing water. However these techniques cannot treat all pollution. Moreover, if the concept is simple, the size of such a plant is

often very important. But an effort of research on these techniques could make it possible to reduce the costs of depollution considerably and to re-use water for example in the irrigation.

5 Conclusions and recommendations

5.1 Water Management

The responsibilities or intervene in the process of Water management. These institutions according to their interdepartmental or ministerial status respectively exert two functions which are:

1 – Infrastructures and Resources Development in operational ministries endowed with budgetary means and lawful capacities

2 - Consultation and coordination of the users and the conflicts arbitration (for example, the “Higher Council of Water and the Climate” in Morocco and the “Water Commission” in Israel)

However, the water resources distribution among the various uses is often assigned at institutions having at the same time a sectorial responsibility. In this case, these institutions can be considered both judge and judged. For example, in many countries, the ministries for agriculture are often responsible for the resource allocations between various uses. Thus, in Egypt, in Tunisia, in Syria, the ministry for agriculture and/or for irrigation is in charge of water management.

Among the ministerial departments, it is necessary to differentiate those which have an operational function of investment and those endowed with lawful capacities. The administrations responsible for the important investments are often those which have the most weight in the decisions. Generally, facing the “operational” ministries, the Department of the Environments, in load of the natural resource protection, ecosystems and the control of pollution in the Eastern and South Mediterranean countries are recent structures which lack competences and influence.

This scattering of institutional competences requires an adequate legislative framework for rational use of the resources and the environmental protection. In most of the countries, the water management is centralized. In Morocco or in Algeria regional institutions were created, such as the Agencies or the Hydrographical Basin Committees in order to support the participation of the actors concerned, to arbitrate the conflicts and to conclude the policies of development at the local level.

The institutions responsible for the deputy management of water in certain countries like Morocco, Turkey, the Territories Palestinian apply more and more the delegation of services (distribution of drinking water) and less frequently the concession of these services.

This tendency, encouraged by the World Bank[10] encounters political and administrative reactions (Turkey). These reactions are based on fears of job losses in the administrations or more generally on the incomprehension of the consistent concept which suppose to pay the operator deprived for services which were regarded as a free public utility. In addition, in certain countries, of the legislative constraints are opposed to the concession and the amendments require time.

5.2 Full Prices Recovery

One at least of the Economic instruments to manage water demand is used by most of Nostrum Countries. But the effectiveness of these instruments should be weak.

[10] who often makes of it a necessary condition for the attribution of infrastructures loans.

In most of the countries, prices for municipal water depend on the principle of progression by bands in order to encourage the water savings. Prices for waste water are done according to a percentage of the drinking water tariff. Their ceiling is often fixed at a maximum rate determined by the legislation (for example, 30% of the water tariff in Turkey, and 35% in Egypt). In Turkey, the administrations of water and waste water with autonomous budget, created after 1980 in the large cities, can apply stronger tariffs.

5.3 Demand Analyses

Although agriculture contributes relatively less to the national GDPs, however, it represents strategic priority for most studied countries in term of food security needs.
However, the increasing demographic pressure and the urban development of the coastal zones envisaged by 2020 will impose a deep modification of the policies of allowance of water between the various uses.

Industrial water constitutes the smallest percentage of the water demand. Nevertheless, the evaluation of this demand is rather difficult. Indeed, the data acquisition reliable on the share of industry in the water use poses many problems connected with the difficulties of identification of industrial consumption and with the heterogeneous character of the data. Thus, generally, the category “industrial use” includes the power production (France) but it is not always the case. However this distinction is essential because the power production takes large quantities of water with a very low rate of consumption. Moreover, it is important to make a distinction between the “use” and the “water consumption”. For example, the hydroelectric power plants and the cooling installations use large quantity of water for very low rate of consumption because water can be directly re-used. In Greece, the water used for the power production is consumed then for the irrigation. Thus, the industrial sector uses a great water quantity which is completely consumed by the agricultural sector (in this last case). Lastly, it appears quite difficult to define the share of industrial consumption coming from the public network of distribution. This case the part of industrial uses is included in category “urban Water”.

Moreover, industrial water use constitutes the greatest risk of pollution for the surface and underground resources. Généralement, les industries utilisent les eaux de surface et la rejettent sans traitement préalable. Generally, industries use water surface and reject it without preliminary treatment. In Egypt, the discharge of water used in the Nile is estimated at 550 million cubic meters a year without treatment. The lack of adapted water used reprocessing plants is very revealing. In Syria, but also in the majority of the studied countries, there is no tax of pollution based on the rejections to encourage the industrialists to treat water. In the middle term, this industrial pollution of water surfaces and underground could have an important effect on tourism, the agriculture and the respect of the international standard of drinking water quality.

Concerning the tourist demand for water, there still the data are relatively not very reliable. This sector is sometimes not indexed and it is associated the domestic request. However the presence of seasonal peak of consumption can give an outline of the weight of the tourism in the request but this is only a simple estimation. Equipment of production, distribution and wastewater operations is necessary to treat this brutal increase. It follows that the investments of infrastructures are oversize compared to those which would be normally necessary permanently.

5.4 Water Markets

Effective Water markets are dependent on some basic institutional arrangements such as tradable water rights or water use-rights. In many cases, institutional arrangements will also be needed to deal with third party effects that result from changes in return flow or economic activity decline for the region selling water. Adequate management and infrastructure will be needed for trades that are not local in nature. Provision of adequate information concerning water demand and supply is also needed.

In NOSTRUM countries, especially in the South, there are:

- a lack of Equipments,
- a legislation generally badly adapted but in progress of being modified ,
- a lack of information and communication,
- conflicts between different water actors,
- a multiplicity of actors and institutions (France) which lead to a rather vagueness organization

In this case, Water market creation could not be operational. But, as regard the different NR's, large efforts were made or are under study. The outline of a market of rights to water starts to appears especially in countries where the resource is limited (Algeria, Cyprus, Israel and Palestinian Territories). One can suppose that the evolution of the legislation will make it possible to develop the market of the water rights.

Most current legislations in the partner countries are enforcing financial and resource protection mechanisms such as "polluter pays", systems of progressive tariffs based on the actual use are positively progressing and Precaution Principle (in all European Countries and also in Croatia).

Recommendations :

1) Full cost recovery can not be used in the same in all the sectors especially in Industrial sector where a lot of data are missing. Its application often encounters important social pressures. Moreover, regarding the agricultural and industrial sector, the impact of the activities on the quality of the water resource of the agricultural sectors and industrialist is important and must be taken into account in the total costs (depollution costs). It is generally not the case.

4) The national policies of water in the Mediterranean basin also depend on the inter-relations with the bordering countries which have a major impact on the water allocation. An Standardized information reliable and available is needed, as well as combining data and judgement, modelling, and the building of applicable Decision Support Systems. DSS Tools should also take into account the various actors and the processes of negotiation. Some this type of models are under study in France but they fix only on the relations between the partners

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The overall conclusion of the Disciplinary Report should summarise the main findings of the investigation, and attempt to draw some policy recommendations to address the identified gaps and/or obstacles to water management across water using sectors, with respect to the discipline under exam, in order to ensure the sustainability of water use patterns.