INCO-CT-2004-509158

NOSTRUM-DSS

NETWORK ON GOVERNANCE, SCIENCE AND TECHNOLOGY

FOR SUSTAINABLE WATER RESOURCE MANAGEMENT IN THE MEDITERRANEAN.

THE ROLE OF DSS TOOLS

INSTRUMENT: Co-ordination Action

THEMATIC PRIORITY: INCO-MPC, Specific measures in support of international co-operation - Mediterranean Partner Countries (MPC)

Deliverable D2-2

Report on industrial water use in the Mediterranean Countries

DUE DATE OF THE DELIVERABLE: 31/09/2005	**ACTUAL SUBMISSION DATE: 14/11/2005**
START DATE OF PROJECT: 1st August 2004	**DURATION: 36 Months**
ORGANISATION NAME OF LEAD CONTRACTOR FOR THIS DELIVERABLE: INTERNATIONAL CENTRE FOR SCIENCE AND HIGH TECHNOLOGY	
	REVISION: APRIL 2006
PROJECT CO-FUNDED BY THE EUROPEAN COMMISSION WITHIN THE SIXTH FRAMEWORK PROGRAMME (2002-2006)	

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Executive Summary

This report focuses on the Industrial Use of Water in the partner countries of the Mediterranean involved in the project NOSTRUM. It is part of a series of studies dealing with different aspects of the water use (agricultural, industrial, urban-touristic) in form of analytical summary from the National Reports on the water resources provided by each of the 15 partner countries during Spring 2005. This report represents a first survey on the proposed themes, and is intended as a preliminary version of the project deliverable D2.2, since it addresses themes and questions that will require better definition in the course of the project.

In almost all countries the weight of industry is consistent, accounting between 20% and 30% of the national GDP, with the exception of Algeria, where this weight is at about 60%, mainly imputable to the great development of oil extraction and energy sector.

The analysis of the industrial water consumption reveals the difficulty of making an organic assessment based on the high fragmentation and lack of data, reflected from both the international sources and the respective national services, resulting often into the absence of data surveys on specific parameters and sectoral studies, and also on different ways to classify the industrial categories. In some cases, water is reported to be not a limiting factor where the weight of industry is not so relevant with regard to the water availability (Croatia, Cyprus). In other cases, the trend for increasing need of water is clear, especially in the Mediterranean Developing Countries where industry had great impact on the economy in the last decades. For examples, Lebanon estimates the water need about to double from 1994 to 2015; in Tunisia the yearly water demand is increasing of about 1.9% in the last years following the increase of enterprises.

Almost all countries identify the most critical areas of industrial water use with water pollution. Most of pollution threatens consist of oil residuals from extraction and refinery, heavy metals, heat and by-products. The major concern in this case seems to be the absence or scarcity of treatment plants, especially in the Mediterranean Southern and Mid-East area, where the industrial development had big impact in the last years. The situation is forecasted to get worse if no measures will be taken accordingly. In some cases, recent regulations are reported to have positive effects (France, Croatia, Portugal and Egypt). In general, lack of organic studies is complained (Greece and Lebanon) whereas some countries do not provide any data or information at all.

All the countries reported comprehensive and exhaustive information on the national policies related to the water management at national level. In most cases, the analysis reveals the trend to elaborate complex normative with the aim of covering the water management issues in integrated way, this particularly in view of receiving and applying the Water Framework Directive EU 60/2000 to each national legislation.

Few elements are presented on the current technologies for water management in industry. The overall emerging picture is that the existing technologies for water management are not applied with sufficient or satisfactory extents, especially in the Southern Mediterranean Countries, mainly due to high cost of installation and maintenance.

Most countries indicate ongoing activities in DSS or DSS-related for water management. Not all countries have specific experience of DSS, or indicate fragmented experience or progress under development. Many countries report the development of other instruments as databases or similar information systems, models and GIS that are not DSS *per se,* but are components of decision tools, which can constitute the baseline for further DSS development. The countries having more experience indicate that the level of development and the most outstanding examples of DSS come from the academic community or from national / international research projects, and that the link with and the follow-up to the stakeholders, namely land and water administrators, is broadly to be enforced. In no case a specific example of DSS for industrial water management exists. Most of DSS applications are addressed to the integrated water management at basin and regional level, involving multi-use planning of water use and demand. In particular, this involves the agricultural use of water and sustainable irrigation. This should be not surprising, considering that in the

Mediterranean water is limiting for shortage and that agriculture is traditionally the main economical activity.

The main findings of the report could be then summarised in the following issues.

1. Industry has great relevance in the socio-economic structure of the Mediterranean countries; this weight is expected to be greater in the next years. Industry is expected to greatly impact the economies of the Mediterranean Developing Countries, where the process is already ongoing. The investment in industrial activities is strongly increasing in these countries, attracting external capitals. Of course, the industrial growth is in order to bring heavy impact on the water quality, having potentially harmful follow –up on the human health and posing severe social concerns. The impact could be enhanced by the overlapping effects of industry, urbanisation and tourism, which will put more pressure on the Coastal Zones and on the main water streams. The request of efficient measures for conserving and treating water resources is already felt as urgent.
2. The analysis of water use in industry is not exhaustive, because of the difficulties to draw a satisfactory picture from data and information largely missing or incompletely collected. It could be pointed out that (i) the water use for industry in the Southern Mediterranean Countries is prospected to strongly increase in the next future; (ii) even if not comparable with the Northern Mediterranean Countries, the amount of water consumption will bring problems in areas where the water shortage is common; (iii) the industrial water pollution is reaching levels of non sustainability in the Southern Mediterranean; (iv) under this view, the need of modern and efficient technologies for treating and recycling water will be of fundamental importance; (v) the introduction of financial mechanisms as “polluter pays” and a system of progressive tariffs based on the actual use and on the type and amount of products could be helpful.
3. Managing water is a priority in all Mediterranean countries. In almost all cases, the management of industrial water is part of an organic process aiming at considering all the aspects of water use in the same framework. The concept of integrated water management is having more importance and has room in most of the Mediterranean countries legislation, with the development of Integrated Water Plans at regional or basin level or the promulgation of comprehensive laws. In this view, there is great potential for the research and the development of Decision Support Systems. Most countries put in evidence the ongoing work and application of databases, hydraulic models, GIS. In some cases, DSS are planned and developed at the scale of territorial integrated water management. Although no specific example exists of DSS for industrial water use, the trend is promising in this sense. For resulting into good practice instruments of policy applications, some aspects should be enforced: (i) to better organise and make available the collection of basic data on the industrial use of water as well as of the ecological and climatic components at regional level, that up to now are scarce and do not allow making detailed studies and analysis; (ii) to fill the gap between the DSS developers (mainly the academic community) and the stakeholders(authorities, land and water administrators, etc.), giving them a consistent follow-up, both at national and Mediterranean level, for example proposing permanent working groups of multi-disciplinary experts; and (iii) to better explore the application of DSS to IWRM under three interconnected perspectives, that is the Landscape Hierarchical Approach and Strategic Environmental Assessment which are essential to define the water needs and the strategies to find the water resources and the water allocation; the Industrial Ecology which offers the conceptual tools to reduce the ecological foot print of industrial development; and the Ecological Budgeting that is a very useful tool for controlling and verifying the suitability of the decisions taken under the first two perspectives.

1 Introduction

1.1 Context

This report focuses on the Industrial Use of Water in the partner countries of the Mediterranean involved in the project NOSTRUM. It is part of a series of studies dealing with different aspects of the water use (agricultural, industrial, urban-touristic) in form of analytical summary from the National Reports on the water resources provided by each of the 15 partner countries during Spring 2005. This report represents a first survey on the proposed themes, and is intended as a preliminary version of the project deliverable D2.2, since it addresses themes and questions that will require better definition in the course of the project. The report aims at describing the industrial use of water detailed in the following issues:

- Relevance of the industry on the socio-economical structure of each country;
- Assessment of water use and needs of the industrial sector in each country;
- Assessment of the critical areas of the industrial use of water, with particular emphasis on water pollution and related measures;
- Evaluation of the legislation and of the policies related to the water management in the industrial sector in each country;
- Analysis of the technological issues related to the industrial water management, with particular relevance to the development of Decision Support Systems (DSS) specifically addressed to this sector;
- Assessment of the sustainability issues (economical, social and environmental) linked to the industrial use of water;
- Conclusion and final remarks.

1.2 Methodology

1.2.1 Methodology used

The methodology used for preparing this report is essentially a disaggregation of the information contained in the 15 National Reports for producing a synthesis re-aggregating the data and information in a general context, selecting from different parts of the NRs the data concerning the specific theme of the industrial use of water.

Each chapter has a preliminary section, in which a short evaluation is tempted by means of a cross-comparison of the main findings, where possible, elaborating graphics or tables. This is followed by an overview of the analysed issue in form of a summary for each country, where all local aspects are presented with more details.

A series of parameters on the industrial use of water has been chosen in the first stages of the survey and proposed to the partners. The data and information come essentially from the National Statistical Services, or from administrative sources, or from thematic studies and projects. Wherever possible, the information have been integrated with the available statistics from the

international databases (i.e. Eurostat, FAO-Aquastat, World Bank WDI Database, UN Statistic Division – International Labour Office).

1.2.2 Problems and shortcomings of methodology

It is to remark that the report actually shows some uncompleted areas due to missing information in the national reports that prevented from applying fully the proposed methodology. This is due to a number of causes, the most important of which are:

- Remarkable lack and fragmentation of the available data, especially in the international databases. It is to note that in most cases the databases of the international organisations lie on the voluntary input from the member states, which of course can be non regular in providing data and uncontrolled;
- Heterogeneity of data, e.g. the same parameters are often expressed in different units, pending on the different proposed organisation;
- Discrepancy between different sources (international organisations, national services) on the values of the same parameter, maybe for different coverage / methodology / period of survey;
- Difficulty to obtain data from the national services, e.g. many data sets are not available to the public and are reserved or achievable on payment;
- In some cases, the issues under analysis are neglected or are not object of study in certain countries.

The assessment of the reports will detect the weak points in this analytical process and will aim at establishing the necessary actions among the project partners for finding the necessary solutions to solve the lack of data and information, wherever possible.

2 Relevance of the Industry

2.1 Objective relevance of the Industry

The overall relevance of the industry in each Mediterranean partner country is estimated by the % of industry on national GDP in Fig.1. The data are expressed as average over the period 2000-2004. It is to remark that in almost all countries the weight of industry accounts between 20% and 30% of the national economy, and there is no great difference between European and Non-European Mediterranean countries. The most outstanding case is Algeria, where the weight of industry on national GDP is about 60%, mainly imputable to the great development of oil extraction and energy sector. Some information is reported below on the main characteristics of the industrial sector country by country.

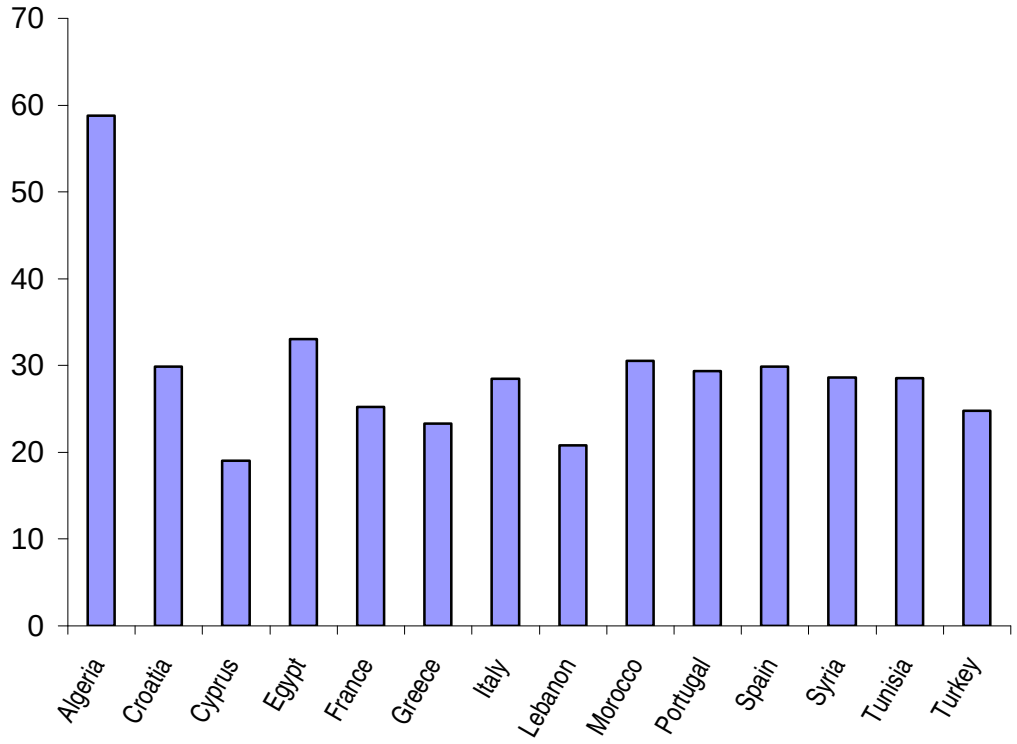

Fig. 1 – Relevance of the industrial sector in each country as average % on national GDP in the period 2000-2004. No data are available for Israel/ Palestine. *(Source: World Bank)*

ALGERIA

During years following the independence of 1962, Algeria chose an economic model of development based on a centralized planning and ambitious program of industrial development, supported by the recovery of the prices of oil in the years 1973-1974. Funded by significant public investments during years 1970, this model allowed the emergence of an industrial base. The development was based on the intensification of the exploitation of the natural resources and confirmed the importance of the public sector. The hydrocarbons participate for nearly 35% in GDP, 70% in the public revenue and 98% in the export.

CROATIA

The industry currently represents about 30% of Croatia's Gross Domestic Product, which is getting closer to European Union levels. The value of the industry's production level is estimated to be around 93 billion HRK (approx. 13.0 billion USD) for 1999 with an employment level of 293,000, which represents 27 % of Croatia's total workforce. Industrial goods account for 97% of Croatia's total exports. Main industrial centre is Zagreb, then Rijeka, Split, Sisak and Osijek. Processing industry, especially food industry, is most developed in the continental part of the country based on local raw material. There is also oil and gas related industry, refineries (two) and big fertiliser production. Metal and machinery industry is mostly related to shipyard activities and ship construction. In the last year development of construction industry was very high. In coastal areas tourism is most important industry.

EGYPT

About 350 industries are located along the Nile which may cause environmental risks of pollution to the Nile Water. Strong efforts have been successful in preventing almost all industries from directly disposing industrial wastewater into the Nile. There are about 1250 industrial plants located in Alexandria (about 60% of them may contribute to marine pollution of the Mediterranean coast of Alexandria) that discharges their wastewater into the sea via Lake Marriott. By the beginning of fifties, heavy industries were born in Egypt along the Nile Delta and in Cairo and Alexandria metropolitan areas. Chemicals, food, metal products, and textiles are the most prominent branches in Egypt. Industrial releases to surface or groundwater may pose a major threat to the agricultural land. In Egypt, food industry uses the largest volumes of water. Several studies revealed that untreated industrial wastes of more than 350 factories used to be discharged directly into waterways and bodies, some of which may include hazardous chemicals such as detergents, heavy metals and pesticides (RNPD, 1989). Waterways used to receive about 85% of the industrial water withdrawals back. These disposals to the Nile have almost stopped. In Shoubra El Khaima (north of Cairo) untreated industrial wastewater are discharged daily into agricultural drains. Textile industries, representing 48.3% of the total number of industrial plants, are the main contributors (almost 52%) of the organic load. The metropolitan area of Alexandria accommodates a multitude of industries in the vicinity of surface waters, e.g., in Amiria at the Lake Marriott, near the Mahmoudia Canal, etc. Out of 1243 industrial plants, 57 were identified as major sources of marine pollution either directly or indirectly via Lake Marriott. Paper, textile and food industries contribute 79% of the total organic load. As it might be expected, the mid-stream conditions of the Nile are still, on an average, at a fairly clean level owing to dilution and degradation of the pollutants discharged. The riverbanks at the further downstream end, however, are more at a pollution risk.

FRANCE

By its gross domestic product (GDP), France is the fourth world economic power. Its assets are varied: transport, telecommunications, food industries, pharmaceutical products, but also the banking environment, the insurance, tourism, without forgetting the traditional products of luxury (leather working, loan-with-to carry, perfumes, alcohols...). France, whose commercial surplus raised to 14,03 billion euros in 2000, is the fourth exporter of goods (mainly goods of equipment) in the world and the second concerning the services and agriculture (in particular cereals and agro-alimentary). France remains the first producer and European agricultural exporter. In addition, France carries out 63 % of its trade with its partners of the European Union (50 % with the zone euro). France is located at the fourth world rank of the host country of the direct investments coming from abroad. Indeed, the investors assess the quality of French labour, the high level of research, the control of the leading-edge technologies, the stability of the currency and a good control of the production costs. Herewith the most important industrial sectors are summarized with their relevant figures.

Tab. 1 – Economical relevance of the different industrial sectors, France

Sector	Sales turnover (billion Euro/yr)	Manpower
Construction	93.15	n/a
Food	111.9	398 000 (4 200 companies)
Chemistry	70.126	236 500
Mode / luxury	31.4	222 000
Pharmaceutical	28.4	94 500
Car	95.22	271 920
Transformation of raw material	42.79	n/a
Telecommunications and IT	67.23	n/a
Aircraft and space	19.85	95 300

ITALY

The model of “industrial districts”, very typical of Italian industrial pattern of development, is widely diffused in the North as well as in Central and increasingly in Southern Italy. It is characterized by high concentrations of quite specialized industrial activities, located in particular areas, often independently from “central” urban poles and networks. This pattern of development explains the very dispersed model of urban settlement and the low level of polarization of industrial activities (urban sprawl), causing evident difficulties to infrastructure network planning, and sewerage networks among others. In fact the whole Po lowlands and most important side valleys can be considered as a single, large semi-urbanized area. Much the same happens along rivers such as Arno, Tevere and along the coast.

LEBANON

After the war, the industrial sector has expanded, whereby; the number of industrial establishments increased. However, there are discrepancies in the data provided regarding the exact number of industrial establishments in Lebanon. The Ministry of Interior (2001) reported a total of industrial establishments of 22,026 for the year 1999. On the other hand, the Central Administration for Statistics (CAS) reported a total number of industrial establishments of 29,282. This can be attributed to the fact the data reported by the Ministry of Interior (MOI) is based on industrial certificates. However, based on the MOI records, the number of industries increased from 10,080 in 1990 to 21,692 in 1998. Most of these establishments are located in Mount Lebanon. In Lebanon, light industrial activities prevail. 89% of these activities relate to food and beverages, fabricated metal products, non-metallic mineral products, furniture, clothes and dying furs, wood products, leather products, and textiles. Around 114,000 people are permanent workers and 40,000 are seasonal workers. The average number of employees has dropped from 6.4 in 1994 to 5.2 in 1998. This can be attributed to the economic regression in the country.

MOROCCO

The industrial activity contributes to almost 30% of GDP, employing 12 % of total population. The principal industries of Morocco are food products, tobacco, chemicals, mechanicals, metal, electricity electronics, construction material, leather and textiles. Its fabrics industry has a special importance in the economy for it substitutes locally made, quality Moroccan fabrics for imports, and it stimulates Morocco's rapid growing export economy. In 2004, Moroccan Economy Growth is 3.0%, Morocco’s industry sector is dynamic with 4%in 2004 against 2.9% in 2000. The industrial production showed a higher rate of increase in the year 2004 than the previous year (+4% against +1.8%). In the same time, in the agricultural/food product sector, the index climbed in average by 4.9 % between 2000 and 2002. The index for the production of the mechanical, metallurgical and

electrical industries advanced by only 4.5% in the year 2002 against 5.3 % in 2000. The industrial activity is concentrated in the north west of the country. Casablanca shelters 49% of the industrial units. However, the water intake in the industrial sector by Wlaya and province shows that, the units of valorisation of phosphates established in the cities of Safi and El Jadida are most consuming water with respectively 48% and 47% of total volume. The companies of Wilaya of Casablanca come in second position with 1,65% only.

TUNISIA

The Tunisian economy strongly depends on industrial sector that procures an important contribution to economic and social indicators. During the last three decades, manufacturing industries were the most dynamic component of productive sector. Their contribution to GDP evolved of 6% during the years 1961-1963 to close to 28,8% in 2002. The production value manufacturing industries reached, in 2001, 21,2 billions of Dinars. The added value represented, in 2001, 31% of this value. These evolutions of the indicators of industrial sector show the development of important amount of investment. Indeed, these investments evolved from 513 Million Dinars in 1992 to 1064 Million Dinars in 2001. The importance of the industry in the promotion of the exports was about 3 billions Dinars in 1992 and reaches 8,5 billions in 2001, with an increasing rate of 13%. In 2001, the contribution of manufacturing industries was 89% of total exports of goods. On the social plan, the industry is employing 23% of labour force.

TURKEY

Throughout the five-year development plan periods implemented since 1963, "industry based growth" has been one of the main objectives in Turkey. However, the industrialisation strategies adopted and economic policies followed have shown great differences before and after 1980. An import substitution policy had been implemented until 1980. However, after 1980, significant progress has been made towards establishing the principles and fundamentals of a market economy through the introduction of export-oriented industrialisation. These reforms made significant contribution to the dynamism of the private sector and improved the adaptability of Turkish economy to internal and external impacts. Therefore, the source of industrial growth in recent years has been investments and the dynamism of the private sector. As a result, industry has shown a great performance, except the years in which economic crises occurred. Considerable increases were recorded in industrial value added, in the volume of exports and share of manufacturing industry in exports. As a result of economic growth, the volume of imports especially for investment and intermediate goods has also increased. Following a severe contraction in industry in the year 2001, as a result of the recent economic crises, signs of recovery were observed, starting from the first quarter of 2002 and continued at a higher rate with positive developments in the Turkish economy. Due to recovery in domestic demand and sustained export performance, there has been a considerable increase in production and capacity utilization in the manufacturing industry since then. Turkish industry mainly depends on the private sector activities. The share of the public sector in the manufacturing industry has been decreased through privatisation activities in recent years. Currently, more than 80 % of production and about 95 % of gross fixed investment in the manufacturing industry is realized by the private sector. The main objective for the improvement of industrial sectors emphasized in the Eighth Five Year Development Plan is to increase competitiveness and productivity of the industry, and to promote and maintain sustainable growth within an outward oriented structure, in the face of increased global competition. This objective will be achieved within the framework of market principles and in compliance with international agreements.

Cyprus, Greece, Israel / Palestine, Portugal, Spain, Syria did not provide relevant information on this issue.

2.2 Subjective relevance of the Industry / Patterns of development

Few indications were provided by the NRs on this issue. The main outlines on possible patterns of development are indicated for some countries in the section below.

ALGERIA

The industrial development model allowed certainly improvements without precedent in the quality of life of the Algerian citizens, but producing considerable ecological imbalances which appear very early in form of constraints burdening the future development. The economic logic of the industrial development was to select easy sites, close to the tanks of labour forces. Considering the priority given to industry and the systematic absence of impact studies, some industrial plants were built on arable lands and required overexploitation of the water resources. In addition, a significant part of the industries was not equipped with antipollution equipment.

CROATIA

The Croatian industrial sector is intensively changing and the effects of the full scale and strategically thought out restructuring of this sector are evident in many areas. Namely, this ranges from privatisation to the strengthening of exports to western markets, development of new products and innovations to existing products and manufacturing processes, to increasing the level and standardisation of quality, satisfying environmental protection conditions, reaching cost effectiveness, etc.

TURKEY

Turkish industry is prospected to: (i) use, as much as possible, domestic resources, (ii) produce in compliance with environmental norms, (iii) consider consumer health and preferences, (iv) employ well-qualified labour, (v) apply strategic management techniques, (vi) give importance to R&D, (vii) generate technology, and (viii) create original designs and trademarks, thus taking its proper place in international markets.
In order to reach those targets, it is of vital importance that private sector gives emphasis to investments, which aim at creating high value added, enhancing competitiveness, increasing employment, productivity and exports and enabling development and/or transfer of appropriate technologies. Foreign direct investments will certainly play an important role in that process. Information and technology intensive industries such as defence and aviation, machinery, chemicals, electronics, software and biotechnology will be promoted; the use of advanced technologies in industry will be increased and the competitiveness of traditional industries will be enhanced.

3 Water Needs Assessment

3.1 Industrial Water consumption

The analysis of the industrial water consumption reveals the difficulty of making an organic assessment based on the high fragmentation and lack of data, as mentioned above in paragraph 1.2.2. This is reflected from both the international sources and the respective national services, resulting often into the absence of data surveys on specific parameters and sectoral studies, and also on different ways to classify the industrial categories. An attempt of summarising the different components of industrial water consumption in the Mediterranean countries is made taking into account data from by various sources where available.

The total gross water abstraction (Fig.2) is indicated (according to Eurostat) ranging from 30,000 to 40,000 million m^3/year in the most industrialised countries (France, Italy, Spain and Turkey) and around 10,000 million m^3/year in Greece and Portugal, whereas no data are available for the Southern Mediterranean countries. Only a part ranging about from 5% to 20% (except Portugal, about 50%) of this water is abstracted for industrial use, whereas water for cooling purpose is relevant in Spain and Italy (6-7,000 million m^3/year) and especially in France (more than 18,000 million m^3/year).

The comparison on industrial withdrawal, produced and treated wastewater according to (FAO-Aquastat) indicates how the differences are great from country to country, but also as the fragmentation and often the inconsistency of data coming from different international sources is relevant (Fig.3). France, Italy, Spain, Turkey and Egypt are reported to be the greatest water consumers for industry, but the statistic is missing of the produced and treated wastewater for many countries; more, the comparison between the sources of Fig.2 and Fig.3 is of difficult interpretation.

The proportion of water use for industry (source FAO-Aquastat) puts in evidence great differences between countries (Fig.4), ranging from the highest value of France (74%) to the lowest of Lebanon (0.5%). However, the difference is relevant between the European (including Croatia) and the Non-European Mediterranean countries, based on the mean values of proportion of industrial water use (26.9% versus 6.5%). It is anyway to notice the big variation among the European countries, between great users of industrial water (France, Italy, Croatia) and the others.

In the section below more details are presented on a country-by-country basis.

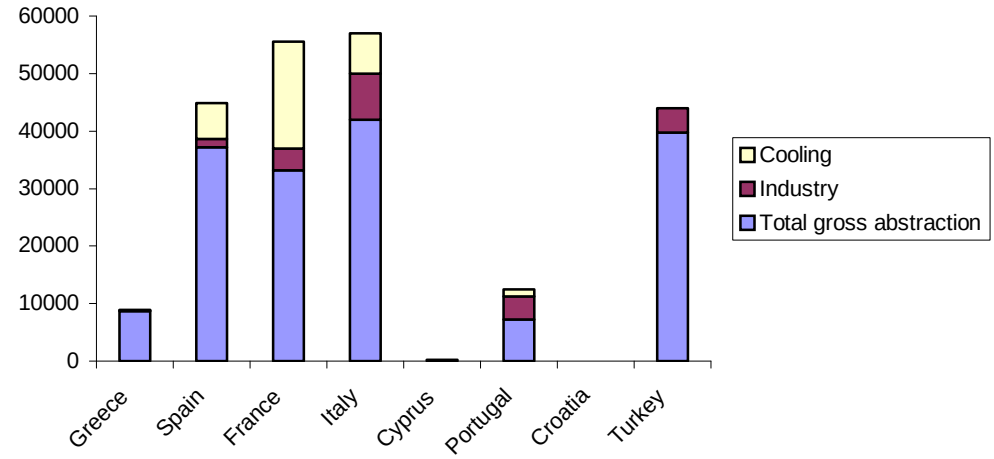

Fig.2 - Water abstraction in some Mediterranean countries (million m^3/year) *(Source: EUROSTAT)*

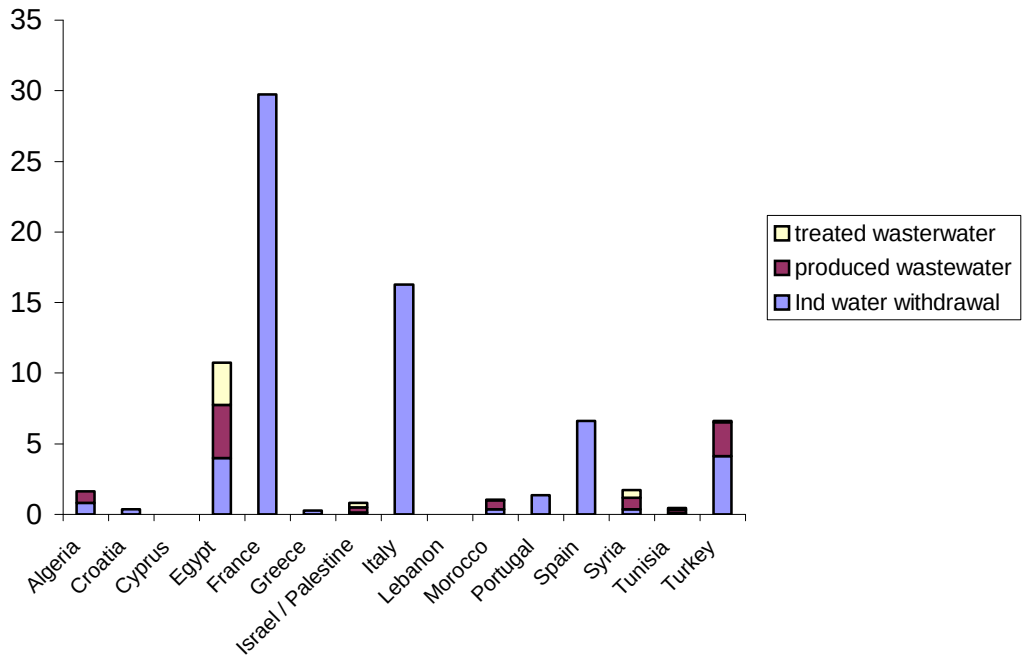

Fig. 3 – Comparison between industrial water withdrawal, produced and treated wastewater, million $m^{3/}$year (*Source: FAO-Aquastat*)

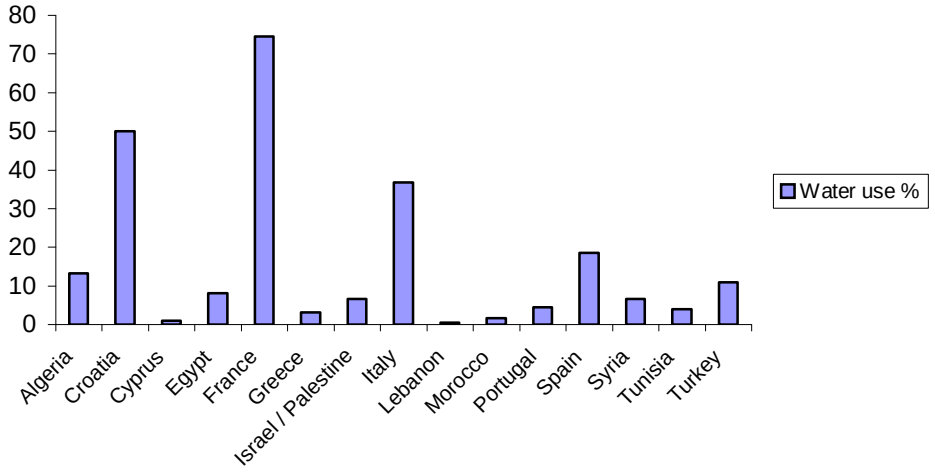

Fig.4 – Industrial water use as % on total water use *(Source: FAO-Aquastat)*

ALGERIA

In 1991, the volume distributed to the entry of the networks for industrial consumption was 115 million m3.

CROATIA

Today water is not limiting factor for industry development in many areas in Croatia, especially not in the continental part of the country.

CYPRUS

Industry is not a major water user and uses much less water than other sectors. The industrial water demand for the whole of Cyprus was estimated at 3.5 million m3 per year by Savvides et al.(2002), with 1.5 million m3 of this demand being in the Limassol region. Another figure is available from the Environmental Expenditure Questionnaire survey carried out by the Statistical Service of the Republic of Cyprus (CYSTAT). According to this survey, industrial freshwater intake was 5.9 million m3 in 2002. If intake of seawater for cooling purposes is included, the total water intake in 2002 becomes about 9.05 million m3.

EGYPT

There are no accurate records about exact water use and wastewater discharge classified by industrial sector. The indicators are based on questionnaires collected from public sector industries in 1990 (330 large factories). These factories were considered the main large industries in the country at that time.

FRANCE

In France, electric energy produced with water provides 18,5% of the total energy. This has required the construction of numerous dams and hydropower facilities (pressure pipes...) on the various watercourses of the territory. These facilities were built before 1940, and are managed today by "Electricity of France" (EDF). Almost all of them were designed for the single purpose of

energy production. Constructions, today, whether new or recently rehabilitated, must be multi-purpose such as: energy production, sedimentation control, guaranteed optimal low flow rate for the river, supply of raw water for irrigation, industry and municipal drinking water, environmental protection while respecting fauna in particular, by creating fish passes, and preserving wetlands.

ISRAEL / PALESTINE

Water use by industry in Israel is around 15-20% of the total water budget. Industry offers the best source for the adoption of water demand policies where these policies can be shown not to harm profitability. Industrial and institutional reform in the country can allow for the adoption of water demand management, as water conservation and pollution abatement components must be seen as an integrated activity in overall water management. Re-use of waste-water within industries or within an industrial zone, re-use of treated municipal wastes for irrigation of fields and parks, and industrial cooling are just examples of key elements that reconcile pollution abatement with water demand management. Water efficient processes match energy conservation and reduction of total pollution in many of the rehabilitated industries in the western countries including that of Israel. They contribute to improved industrial management and its profitability and need not obstruct industrial economic viability. It is a common myth in many developing countries that industrial environmental management undermines the economic basis of the industry.

ITALY

For the energy sector the estimated requirement is 4 km3 per year, considering only the thermoelectric plants that use water for cooling purposes. The hydroelectric plants are not considered in this estimate, as they do not really consume water. The estimates for the Italian industrial sector are approx. 8 km3; these estimates are based on the average consumption coefficient available for each sub- sector. The majority of plants use surface and underground water.

LEBANON

No studies, relating to variables of industrial water consumption, exist. Still, it was estimated that the industrial sector consumed around 130 million m3 of water in 1994, and was projected to increase to 240 million m3 by the year 2015.

MOROCCO

The industrial sector water consumption was evaluated to 1,088 billion m3 in 1996 of which 81% come from sea water, 14% of surface waters, 4% of drinking waters and 1% of subsoil waters. The sector of chemicals and Para chemical is using 1.1 million m3, almost 96.6% of total water used in industry. It uses mainly the sea water (more than 80%) then surface water 14%. The majority of domestic and industrial wastewater of the urban and rural centres are rejected into the natural environment, without preliminary treatment. The rivers receive directly approximately 30% of rejected total pollution. The ground and the under-ground receive approximately 27% from them.

TUNISIA

In Tunisia, the industry sector is a big consumer of water resources. It uses less water than agriculture (0,07 km3 in 2000) but its need in water increases as the number of enterprises increases. Numbers of industrial subscribers increases every year. It was of 11543 in 2002 (INS) and it passed to 11762 subscribers in 2003, it evolves to an increasing rate of 1,9%. The subscribers of industrial sector represent 0,7% of the total of the subscribers. In a general manner, it is necessary to note that small and mid-size firms often use water with good quality (drinking water of the public network) because it satisfies to all practices. On the other hand, the size and the situation of big industries drive them to use less expensive water resources, even seawater.

The increasing importance of the quantitative needs proves to be very various from an industrial activity to other, but also within a same activity according to the input technologies.

No additional remarks are reported by Greece, Portugal, Spain, Syria and Turkey.

3.2 Water needs assessments

The fragmentation of information on this issue does not allow making an overall assessment; however some elements can be drafted by the previous section.

In some cases, water is reported to be not a limiting factor, as for Croatia and Cyprus, where the weight of industry is not so relevant with regard to the water availability.

Israel / Palestine reports a weight of industrial water of about 15-20% on total water budget, emphasizing the need of major efficiency as key element in water re-use, with the purpose of improving the pollution level and the water demand.

In some cases, the trend for increasing need of water is clearly indicated, especially in the Mediterranean Developing Countries where industry had great impact on the economy in the last decades. For examples, Lebanon estimates the water need about to double from 1994 to 2015; in Tunisia the yearly water demand is increasing of about 1.9% in the last years following the increase of enterprises.

3.3 Critical areas for Industrial water uses

Dealing with the industrial use of water, almost all countries identify the most critical areas with water pollution. Most of pollution threatens consist of oil residuals from extraction and refinery, heavy metals, heat and by-products.

The major concern in this case seems to be the absence or scarcity of treatment plants, especially in the Mediterranean Southern and Mid-East area, where the industrial development had big impact in the last years, namely Algeria, Tunisia, Turkey, and Lebanon. The situation is forecasted to get worse if no measures will be taken accordingly.

In some cases, recent regulations are reported to have positive effects as in France, Croatia, Portugal and Egypt.

A general lack of organic studies is reported, as in Greece and Lebanon, whereas some countries do not provide any data or information, as Italy, Spain, and Syria.

Fig. 5 indicates the importance of the main industrial sector on water pollution, expressed as % on total BOD. Even if quantitative data are not available, it is to note as food and beverage industry causes the highest rate of pollution, ranging from 34% (Tunisia) to 70% (Syria). The textile sector is also relevant, especially in some Non-European countries (Tunisia 44%, Morocco 27%, Egypt 19%), followed by paper and pulp industry, more developed in the European Mediterranean countries (France 21%, Spain 20%, Italy 17%). The primary metal industry has the peak of pollution in Algeria (23%), followed by Turkey (14%), Egypt and France (both 12%).

The comparison between European and Non-European countries on average water pollution by industrial sector (Tab.2) indicates as the impact is quite heavier in the Non-European countries for

the food and beverage (54% versus 45.2%) and textile sectors (18.6% vs. 12.7%), while the opposite occurs in the paper and pulp (16.2% vs. 7%) and in the chemical sectors (8.2% vs. 6.5%).

More details by country are explained in the section below.

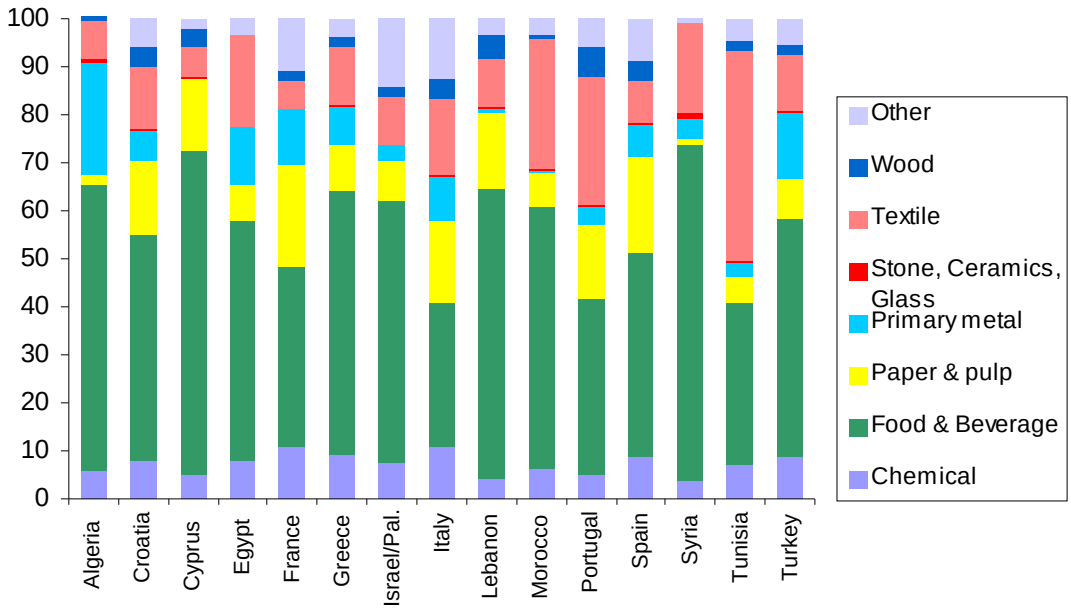

Fig. 5 – Contribution on water pollution of different industrial sectors (% of total BOD) *(Source: World Bank)*

Tab.2 - Average water pollution as % on total BOD in the European and Non-European countries by industrial sector *(Source: World Bank)*

	European	Non-European
Chemical	8.2	6.5
Food & Beverage	45.2	54.0
Paper & pulp	16.2	7.0
Primary metal	6.5	7.6
Stone, Ceramics, Glass	0.3	0.5
Textile	12.7	18.6
Wood	3.7	1.6
Other	7.2	4.3

ALGERIA

Water resources in Algeria are polluted both by the not controlled discharges of municipal worn water and the untreated industrial effluents. For example, the water resources in the area of Annaba are extremely polluted by industrial wastes conveying heavy oils, metals, radioactive substances, etc. Analyses of the quality of water often exhibit levels of pollution well above the limiting values of the World Organization of Health (WHO) for drinking water. In the town of Algiers,

the concentrations in trihalomethanes of drinking water have values definitely higher than the normal value of 100 ug/1. For the effluents of industrial origin, it is necessary to add other often underestimated sources of pollution: solid waste of industrial origin, accidental pollution and pollution due to not controlled operations of sand extraction. The situation is complicated by the absence of treatment of the industrial effluents. Only 14 production facilities obtained recently stations of treatment of wastewater. The National Report on Environment (1999) indicates that approximately 200 million m^3 of untreated industrial effluents are rejected every year.

The industrial companies generate, in a theoretical way, approximately per year:
- 220 000 000 m3 of wastewater,
- 55 000 tons of DBO5,
- 134 000 tons of suspended matter,
- 8 000 tons of nitrogen matters (expressed out of nitrogen N).

Approximately 66% of the volume of industrial wastewater is generated by three industrial parks, i.e. Annaba (50%), Skikda (10%) and Tlemcen (6%). This pollution already had negative impacts on health, agriculture and water resources in Algeria. The industrial effluents contribute significantly to pollution of the rivers and the dams, as the case of dams Beni Bahdel, Bakhada, Lekhal or Hamam Grouz, and the rivers Tafna, Seybouse, Soumam, Cheliff and Mekerra.

CROATIA

Industrial pollution and wastewater discharges can be a significant environmental problem. However, this is not the case of Croatia due to low industrial development and proper wastewater management. Most of the industrial wastewater is properly managed/treated before discharged into water resources. Strict legal enforcement is implemented and industry is properly charged if not treated wastewater in accordance with established needs by discharged permit. That's why most of the industry found interest to clean their waster water instead to pay high pollution charges.

EGYPT

There are three main regulations governing the discharge of industrial wastewater to the receiving environment. The first is Law 93/1962 (modified in year 2000), which governs the discharge of industrial effluents to sewerage network. The second is Law 48/1982, which sets parameters thresholds for effluent discharged to the Nile, irrigation canals and drains, and groundwater reservoirs. The third is Law 4/1994, the environment law, which sets the standards for discharging industrial effluents to the marine environment. Monitoring and enforcement of these laws have been more active, especially after the issue of the environment law in 1994.

FRANCE

Some of the rivers in France are polluted by sewage, industrial waste, and agricultural run-off. Major efforts to improve water quality include building more treatment plants and imposing pollution charges. Air pollution, caused by vehicle exhaust and combustion of fossil fuels, is a significant environmental problem in the major cities. France derives 76 per cent of its electricity from 58 operating nuclear power plants (1998) and the remainder from coal, oil, and hydroelectric power. The country has one of the lowest levels of carbon dioxide emissions among industrialized countries because of its heavy reliance on nuclear energy.

For three years, the investments in the field of water have increased, reaching 340 million euros in 2001. The energy sectors, of agri-food as well as chemistry, rubber and plastics concentrate the essence of these investments. The water pollution abatement had been declared priority a few years ago. The investments of the industrialists in this field had reached in 1993 a top of more than 2,2 billion francs, that is to say approximately 340 million euros. Consequently, undoubtedly by effect of undertow after the efforts authorized for several years, the investments of the industrialists to protect water have dropped. They were stabilized in 1997 and 1998, before beginning again

since 1999. The new framework directive on water and its French transposition to come encourages probably the industrialists to invest more in this field.

ISRAEL/ PALESTINE

Israel's industrial sector is clustered on the northern coastal plain and overlies sensitive aquifers and is located near to streams that are vulnerable to pollution from untreated industrial effluent and wastewater discharges.
According to the Ministry of Environment, industrial water consumption constitutes 5% of Israel's total water consumption, but this sector emits about 19% of the country's total wastewater. The wastewater discharged from a small metal finishing plant can pollute the drinking water of a medium size city. The organic pollutants discharged by a large food plant may equal the pollutants discharged from a city populated by 100,000 residents. A single textile plant may be responsible for a 10%-20% increase in the salinity of municipal wastewater and for the organic pollution emitted by a city populated by 200,000 residents.
Industrial effluents present a substantial risk to the environment. Numerous studies have been made to increase knowledge of these pollution sources and to formulate policies and regulations for effluent reduction and treatment.
In order to assess and identify the quantities of heavy metals and mineral oils discharged from the industrial and domestic sector, the Ministry of the Environment initiated surveys in wastewater treatment plants throughout the country. The first survey was targeted at the Dan Region Wastewater Reclamation Project, which serves some 1.5 million residents in the Tel Aviv metropolitan area (about 220 km^2) and treats about a third of the total quantity of waste produced in Israel today.
Following are the relevant findings:
Some 130,000 kilograms of heavy metals are discharged into the treatment plant annually, of which 22,500 are highly toxic;
Compliance with the regulations would bring about the following results:
- 83% reduction in the discharge of highly toxic pollutants which constitute 18,500 kg/year;
- 37% reduction in the discharge of less toxic pollutants (zinc, copper and manganese) which constitute 38,000 kg/year;
- Reduction of 56,500 kg/year out of a total quantity of 130,000 kg/year of pollutants.
Assuming that regulations will be enforced, most of the pollution from low toxicity heavy metals (zinc, copper and manganese) will derive from the domestic sector. In this case, the contribution of industrial pollution would decrease from 50% to 2.5% of total pollution.
The concentration of zinc in the wastewater sludge which originates in the domestic sector alone is half the concentration permitted in the sludge of wastewater treatment plants (according to draft regulations prepared by the Ministry of the Environment).
The existing concentration of nickel in the sludge would exceed the maximum concentration specified in the draft regulations, assuming that the sludge is stabilized as required for land treatment; The quantity of heavy metal pollution emitted from the domestic sector in Israel is smaller than that emitted by other developed countries.
During the course of a year, nearly 0,75 million kg of mineral oil are discharged to the sewage systems of the Tel Aviv metropolitan region. Compliance with the regulations would reduce this quantity to 16,000 kg. Today's surplus level reaches 4,700%.
The threshold concentration for mercury in the sludge discharged into the sea, in accordance with permit requirements; from the treatment plant is not enforceable since a large portion of the mercury sources is not industrial. It is estimated that more than half the pollution originates from the domestic sector and from dental clinics.
Dental clinics are major sources of mercury in wastewater. It is estimated that some 12 kg/year of mercury are emitted from dental clinics into the sewage system in the Tel Aviv metropolitan region;
A trend of continued decrease in heavy metal pollution was noted in 2001.

LEBANON

Few initiatives have been conducted to determine the levels of industrial pollutants. However, a national database of these pollutants has not been yet developed. Elevated levels of heavy metals (Arsenic, Lead, Zinc, and Chromium) were detected in seawater, as was shown by the study conducted by the American University of Beirut Water Resources Centre in 2000. Seven samples, near industrial sites located along the coastal line (ranging from power plants to chemical plants to cement plants to pipes industries), were collected. The levels of these pollutants were as follows:
- Arsenic: 7.7-51 µg/l (background level 5.1 µg/l)
- Lead: 2-17 µg/l (background level 2 µg/l)
- Zinc: 9.6-32 µg/l (background level 3.8 µg/l)
- Chromium: 23-100 µg/l (background level 2 µg/l)

In addition, thermal pollution was also detected in these sites. The temperature ranged between 28.7℃ to 31.3℃ when compared to the background te mperature of 28.80C (SOER, 2001). Unfortunately, general data on water pollution by type of industry is not available in Lebanon.

MOROCCO

The industrial liquid rejections convey an important organic and toxic pollution. It acts of various waste coming from various industries which are mainly installed on the level of the shore at the same time to get rid of waste directly and to make cool their machines (agriculture/food industry, leather and textile, chemical Industry, petrochemical Industry). In 1993, they were evaluated to 964 million m3, i.e. 89% of the total volume of wastewater.
98% of these rejections are poured at sea (944,7 million m3) and the remainder in the hydrographic network or directly on the ground.
The polluting matters conveyed by these rejections are evaluated as:

- 72 000 tons of oxydable matters (37% rejected into the hydrographic network or directly on the ground);
- 300 tons of nitrogen (84% rejected into the hydrographic network or directly on the ground);
- 200 tons of phosphorus (30% rejected into the hydrographic network or directly on the ground);
- 110 tons of chromium (64% rejected into the hydrographic network or directly on the ground);
- Urban pollution (domestic and industrial) has important consequences on the receiving mediums:
- The littoral which shelters only 10% of the urban centres (in 1994) receives wastewater of almost 48% of the urban population (6,45 million people);
- The perennial rivers receive wastewater of 212 centres, i.e. 29% of the urban population;
- The non-perennial rivers relate to 19 % of the urban centres and receive wastewater of 6% of the urban population;
- The ground and the under-ground constitute the receiving medium of 100 urban centres which add up a population of 2,21 million, that is to say 16% of the urban population.

In Morocco, if no measurement of reduction of polluting flows will be taken, the pollution conveyed by the liquid industrial rejections is estimated to broadly triple in 2020.

PORTUGAL

The efforts of the national industry to comply with the first generation of environmental norms are starting to have a positive result on the environment. The next decade will be more demanding, however, regarding the prevention of pollution and technological risks in the substitution of techniques and products, which are harmful to health and the environment. In this context, enterprises will need to have true environmental strategies with two lines of action: the adaptation to cleaner technologies and the introduction of Eco-management and Auditing Systems.

TUNISIA

Tunisian industry knew an important prosperity because it achieved a growth in the GDP and in the added value. However, this fast development exercises some pressures on the environment. As in all over the world today, it appears as the main responsible of the pollution of water, air and soil and be characterized constantly by an excessive consumption of energy and a increasing production of garbage. Actually, most processes generate polluted wastewaters that contain all by-products and raw losses materials that cannot be recovered or recycled. The nature and the composition of these wastewater are very various from an industry to another. According to an investigation done in 1996 by the ONAS, on 10 000 enterprises, 3333 have been identified as polluting enterprises in different sectors. We can notice the importance of industries identified as polluting, 33% of the total number of investigated enterprises and we also notice that most of them are exporters enterprises that have important contribution to the GDP.
In the same way, we notice that among these industries there are those that are greatly consumers of water resources, as the industry of leather, chemistry and especially agro-food industries that represent the most important number (1188 enterprises). The agro-alimentary industries has a meaningful contribution to industrial water pollution in Tunisia estimated to close to 47% in terms of oxygen biologic demand of oxygen (DBO) with a weight of 5555,8 tons. Its part in suspended materials is less important and is close to 2,19%. The industry of woods, furniture and paper comes in second place with a part in the pollution of 39,45% of oxygen biologic demand and 22,33% of suspended materials. The most important contribution to suspended materials is rejected by metallic and metallurgic industries, it represents more that the fifty: 52,33%.

TURKEY

75% of Turkey's industrial wastewater is discharged without any treatment, primarily into seas and rivers, 20% receives adequate treatment, and 5% receives only primary treatment. Further, approximately half of the 190,000 industrial enterprises in Turkey work in pollution-creating industries (Turkey Country Report 2003: http://www.worldwatercouncil.org).

4 Management policies

All the NOSTRUM partners involved in the data collection presented comprehensive and exhaustive information on the national policies related to the water management in their respective countries. In most cases, the analysis reveals the trend to elaborate complex normative with the aim of covering the water management issues in integrated way, this particularly in view of receiving and applying the Water Framework Directive EU 60/2000 to each national legislation.

Because the national legislative frameworks include many aspects correlated to the different use of water (agricultural, industrial, civil) in the next section an overview of the main normative is presented by country as a whole, trying to put in evidence, where possible, the specific regulations or article more closely dealing with the industrial use of water.

4.1 Demand and Supply side policies

ALGERIA

From the independence of 1962, a lot of legislative tools were adopted (laws, decrees, etc.). Due to the great institutional instability, these laws were partially cancelled or modified. The present juridical scheme is mainly based on legislative laws dealing with the domains of water resources, health, environment, regional and local administration, and finance.

- Law N°83-03 (05-02-1983): environmental protection
- Finance Law (1992): introducing a new tax on pollution
- Finance Law (1996): introducing new taxes on water economy and quality
- Decree n° 92-10 (3-3-1992): juridical transformation of the institutions dealing with production, distribution and management of water resources
- Decree n°93-160 (10-07-1993): rules for liquid industrial rejections
- Decree n° 93-163 (10-07-1993): introducing an inventory of the level of surface water pollution
- Decree n°98-156 (16-05-1998): tariffs modalities for the different uses (urban, agriculture, industrial)

CROATIA

Law is generally well enforced especially in relation to collection of the water, wastewater charges and control of water use. However, there are several areas where law is not enforced. Planning of water resources management is the one area, which is not implemented at all in accordance with The Water Law.

Croatia does not have strategic or any other type of Plan at the level of the State or River Basin as required by law. Normally, such situation does not guarantee that decisions related water resources management is good. Without a comprehensive and integrated water resources plans is not possible to achieve sustainable water resources management and resolve conflict situation at satisfactory level. The problem is very bad since Croatia never had any type of the water resource plan.

Second example of bad enforcement of the law is National Water Protection Master Plan. This is a basic Law, which set up framework for the implementation measures, which will protect water resources against pollution. This law and the proposed measures can not be very effective since is not harmonized with Water Resource Plan which do not exist. It is questionable that is possible to protect water resources without consideration of all other issues related to water resources management. The measures set up by this law (building of treatment plant and sewerage system) are not implemented in accordance with law. Degree of implementation is less than 20 % in accordance with Water resources study 2001. Population connected to the sewerage system is about 40 %, while population connected to the treatment plants is about 5 %. Such situation jeopardizes all needs related to protection of water resources against pollution.

Main regulation

- Law on water/Water Act (NN 107/1995): basic law that regulates water management,
- Law on water management financing (NN 107/1995. 19/1996; 88/98): defining the water charges,
- Directive on water classification (NN 77/1998): classifying water for different purposes and uses,
- Directive on dangerous substance in the water (NN 78/98): fixing the maximum concentration of toxic chemicals in waters,
- Regulations on limiting values of parameters, of dangerous nd other substances in wastewater (N.N. 40/99; amendments NN 6/01):regulating the industrial wastewater and effluent water quality in order to reduce pollution of industrial origin,
- National Water Protection Master Plan (NN 8/1999): establishing a regulatory framework for managing wastewater,
- Directive on establishment of sanitary protecting zones of water supply sources (NN 55/2002): preventing pollution of groundwater for human supply.

CYPRUS

The existing legislation is rather complex and is covered by numerous laws some of which existing since the colonial administration of Cyprus by UK (1878-1960). Often the proposed authorities execute overlapping jurisdictions, leading to conflicting resolutions that do not always contribute to the efficient and integrated management of water. The reason for which conflicting resolutions arise is due to the fact that there is no overarching " National Water Authority" yet in Cyprus that will resolve disputes arising among
Government Departments.
As regards the harmonization with EU legislation there are some concerns that the Directives could just be translated into Greek legislation and applied to Cyprus law without a real harmonization, i.e. a real adjustment to the already existing legal framework and local conditions does not take place. In this case problems could arise in implementation and enforcement and again overlapping jurisdictions could not be overcome. It is expected that the National Water Authority under formation will accelerate the thorough implementation of EU Directives.

- Government Waterworks Law (Cap. 341 as amended): regulating all the permissions for surface, ground and wastewater,
- Water Supply (Special Measures) Law of 1964: regulating the limitation/prohibition of well construction in areas of groundwater deterioration (quantity and quality),
- Mines and Quarries Law (Cap 270): Renders an offence the pollution of any water. Water used for mining operations must not leave the mining area if it contains substances detrimental life.
- Water Pollution Control Law (L.106(I)/02): harmonizing Cyprus legislation with several EU Directives, e.g. the Directive on Integrated Pollution Prevention Control (IPPC, Directive 96/61/EC), the Nitrates Directive (Directive 91/676/EC), etc.

EGYPT

Law 4 of the year 1994 entitled “Promulgating the law on the Environment” and its Executive Regulations, set forth the overall framework for protection of the environment. Under the law, installations or establishments that are subject to the provisions on evaluation of the environmental impact assessments are determined according to the type of the establishment’s activity; the extent of the establishment’s exhaustion of natural resources, especially waters, agricultural lands, and mineral wealth; the site of the establishment.
Law No. 4/94 requires the preparation of an environmental impact assessment with the application for license for a project. The owner of the establishment must enclose to the application a statement describing the project, comprising the data included in the form to be prepared by the environmental affairs agency. In addition the owner shall monitor and record the impact of the project’s activity on the environment. Law No. 4/94 established an agency for the protection and development of the environment which is called, “Egyptian Environmental Affairs Agency” (EEAA).

- Presidential Decree No. 93/1962 Concerning drainage of liquid wastes
- Decree No. 57/1978 On eliminating pools and swamps and prevention of digging works
- Law No. 48/1982: Protection of the River Nile and waterways from pollution
- Ministerial Decree No. 08/1983 The executive regulations of Law No.48/1982

In addition to the above regulations, the National Organisation for Potable Water and Sanitary Drainage (NOPWASD), through the Water and Wastewater Institutional Support project (WWISP) proposed the water and wastewater standards.

FRANCE

Industry is responsible for half of the organic pollutant emissions and the quasi totality of the toxic rejections (persistent organic metals heavy and Polluting). Thus, the attention was focused a long time on this type of pollution, with the detriment of another type of pollution related to many

changes in husbandries. The principal sources of pollution are due to suspended matter rejections, organic matter, N or P products, toxic products, mainly coming from the food industry, paper industries, the chemical industries, industries of leathers and skins, mining.
Main regulation.
The Law n°76-663 of July 19, 1976 redefined the fra mework and the methods of installations of the companies having greatest risks of pollution or harmful effects for water and the ecosystems waters. These installations (whose list is published in the Official Journal), are subjected to authorization under the authority the Prefect. Other installations, of average importance and having less risks are subjected to declaration that must comply with the general technical specifications notified to them and corresponding to the practiced activity. The prefect delivers a receipt of declaration.
Many industrial companies are equipped with stations of wastewater purification allowing a preliminary physico-chemical treatment before the rejection of organic effluents. They control their rejections by means of regular analyses. This self-monitoring allows to know if the regulations are strictly respected. The results are communicated to the inspectors of the Classified Installations and transmitted to approved laboratories to check the quality of the rejections. The Agencies of Water, of Environment and of Control of Energy can bring financial assistances for contributing to actions of reductions of industrial pollution. In zones of strong industrial density, the Permanent Secretariat for Industrial Pollution joins the local stakeholders having common interest for the questions of industrial environment, to discuss and validate the strategies allowing reducing pollution.

GREECE

In describing the Greek water resources management context, the most pressing issue seems to be that there are many government departments dealing with water problems, but their activities are not well coordinated. Also, the water law system is old-fashioned and widely scattered, thus permitting overlapping functions, multiple advisory bodies and insufficiently decentralized management responsibilities through regional organizations.
The law tends to be also deficient in case of pollution issues, where quality standards for water bodies and/or effluent have not been clearly established. Furthermore, the sporadic consideration of water quality from a policy point of view and the absence of systematic, uniform and enforceable pollution charges have compounded problems of integrated water management. Finally, an important problem relates to the fact that Greece shares water with neighboring countries. Greece is in most cases the downstream country, hence having additional constraints for the development and management of such water resources. Agreements are still pending with regard to various water uses, as well as water discharges and water quality levels for the watercourses crossing the Greek frontiers.
All of the above imply that in Greece there are not only continuous conflicts at all levels (individual, local, national, and transnational), but that incongruence and conflicts will further increase as demands change and the social structure of the country transforms. Such observations are reinforced by increasing demands, misuses and abuses of water arising from rapid urbanization, industrialization, uncontrolled agricultural practices and the overall economic pressures from rising standards of living. Thus, present and potential future conflicts become the driving reasons for a comprehensive framework of integrated planning and management of water resources and for developing an institutional framework in order of properly implementing conceived and articulated resource policies.

- Law 3199/2003: dealing with water protection and sustainable management of water resources, transposes the EU Water Framework Directive (EU 60/2000) into the Greek legislation.
- Ministerial Decree 55648/2210/1991: concerning measures and restraints for the protection of the water environment and setting of limits for hazardous substances in wastewater, in compliance with the Directive 88/347/EEC.

- Ministerial Decree 26857/883/88: concerning measures and restraints for the protection of ground water from the disposal of specific hazardous substances, in compliance with the Directive 80/68/EEC
- Ministerial Decree 15782/1849/2001: establishing the plan for the reduction of water pollution in the lakes Vergotida and Petron, and in the river Soulou, from disposal of hazardous substances
- Ministerial Decree 15784/1864/2001: establishing the plan for the reduction of water pollution in Pagassitikos Gulf from disposal of hazardous substances.

ISRAEL / PALESTINE

Both Israel and Palestine have national legislation dealing with the management of water resources. Both countries have laws dealing with water quality control, pollution prevention, water use and allocation and water pricing. The legislative system in both countries is extremely centralized with little room for direct stakeholder input. In Israel there is now a move to some form of decentralization with the privatisation of some municipal water services in the form of water utilities. In Palestine in the past, local control of water use existed in certain villages and localities although today this is rare and the Palestinian Water Authority (PWA) makes most water-related decisions.

In Israel the Water Law was legislated in 1959 and amended in 1971. The framework codified the administrative breakdown of authorities within Israel for management of water resources. A water commission, headed by a water commissioner was established overseen by the Minister of Agriculture. In 1996 oversight was transferred to the Minister of Infrastructure. The Water Commissioner is responsible for allocation of resources, development of new water sources and water policy in general, with a Water Council serving a marginal role as “advisor”/ Since 1989, Israel’s Ministry of Environment has been empowered to promulgate secondary legislation pursuant to the law and in practice has initiated dozens of criminal prosecutions of violators. The Ministry of Health oversees drinking water standards, as well as sewage treatment and wastewater reuse standards. In addition, sewage treatment itself is the responsibility of local authorities that are overseen and largely funded by the Interior Ministry. A recent law seeks to privatise the treatment via municipal overseen corporations. In Israel, citizens who suffer violations of the water law or a list of leading NGOs are empowered to file criminal and civil actions against violators.

- Water Law, 1959: establishing the General Management and framework for protection of resources, empowering of institutions, establishing standards and sanctions.
- Local Authorities (Sewage) Law, 1962: fixing the responsibility for sewage treatment and taxing to support it.

In Palestine the water related laws in Palestine date back to the Ottoman Empire period, followed by the British, Jordan/Egypt, Israel and now the Palestinian Authority. During the occupation of the West Bank and Gaza (1967-1994) Israel introduced Military Order Law No. 2 of 1967 deeming all water resources in the Occupied Palestinian Territories (OPT) as state property and hence under purview of the state with regards management, quality, allocation and supply and distribution. In 1994 as an outcome of the Oslo Accords the Palestinian Authority was created and in 1995 the Palestinian Water Authority (PWA) was established by Presidential decree. The PWA possesses the mandate to manage the water sector, water resources, prepare and execute a national water policy, supervise and monitor water projects and ensure cooperation among stakeholders. The PWA prepared a comprehensive water law in 2000/2001. The law aims to develop and manage water resources, increase capacity, improve quality and preserve and protect against pollution and depletion. In 2000 the PWA established the National Water Plan with a planning horizon until 2020. The plan provides for a measure of decentralization by shifting the functions of the PWA to the regional utilities in terms of operations, maintenance, repairs, wastewater collection and treatment, bulk water supply, water reuse and water allocation. The PWA will set tariffs and will license and monitor well drilling, abstraction and discharge. A complicating factor in the functioning of the PWA

is the issue of sovereignty over water resources. This issue has still not been successfully dealt with between Israel and Palestine.

- Presidential Decree No. 5, April 26, 1995: Establishing the Palestinian Water Authority (PWA), Responsible for the water sector in the OPT.
- Palestine Water Law No. 3, July 17, 2002: Instituting the framework of each level in the water sector, setting-up guidelines for efficient management and development of water resources in a sustainable way.

ITALY

Until recently, the legislation on water in Italy has been highly fragmented in many laws and legislative acts addressing the issues of water exploitation, civil protection, environmental and water quality; only over the last few years some efforts have been made to integrate different objectives, strategies and responsibilities in a coherent framework that takes into account a higher degree of complexity and decentralisation.
Main regulations. Current legal background is essentially based on three major pieces of water legislation

- Law n.183/89: dealing with the protection of watersheds and water resources, the safeguard of the water heritage and the uses and management of water. It introduces the division of the Italian territory into 29 River Basins with the creation of the Basin Authorities. The use and safeguard of water resources are considered jointly, and the different uses of water (for industry and agriculture) have to be coherent with the guarantee of not compromising the water minimum constant vital flow.
- Law n.36/94 (better known as the “Galli” Law): dealing with the consolidation of water services (both supply and wastewater treatment) into larger management units and authorising regions and municipalities to set user charges and raise finance. This law clarifies the public ownership of all water resources and declares the priorities of human consumption among the various uses of water. It promotes a more sustainable use of land and water resources through both the application of economic criteria and instruments in the water management (i.e. principle of “full cost recovery”) and the implementation of water saving strategies such as: (i) the diffusion of water-saving techniques and methods in the agricultural, domestic and industrial sectors; (ii) the restoration of the leakage-exposed water distribution systems; (iii) the installation of dual distribution networks in new urban and industrial settlements of relevant dimensions, etc. The law introduces the concept of Integrated Water Service, including extraction, conveyance and distribution services for water supply, sewerage and purification and requires the definition of the Optimal Territorial Areas for the management of Integrated Water Services.
- Legislative Decree n.152/1999: dealing with the dispositions on water protection from pollution, it aims at the integration of environmental, health, economic and productive policies towards a global policy of water resources management. This decree complies with the EU Directives 91/271/CEE on the urban wastewater treatment and 91/676/CEE on the protection of water against pollution caused by nitrates from agricultural sources, anticipated the content of the EU Framework Directive on Water and amended all previous laws regarding water quality of surface and groundwater, drinking water, effluents and other water-related environmental issues. It introduced environmental quality objectives, which should be assessed for all surface waters from ecological, chemical and environmental point of view and for all groundwater from only chemical point of view. According to this law, the Regions are obliged to arrange a Water Defence Plan indicating the actual quality of the existing water bodies, the definition of the quality standards to attain and the planned measures and actions for their achievement, including the regulation on effluents.

LEBANON

The Lebanese law governing the water sector dates back to the Ottoman and the French regimes. The archaic law, coupled with the “political instability” in Lebanon between the years 1975 and 1989, brought about many tribulations associated with the mismanagement of the water sector. However, recognizing the significance of sustaining the water resources prompted the decision makers to develop new set of laws.

- Law No. 221, (2000): dealing with the management of the water sector which aimed at inducing institutional changes and assigning the responsibilities to the bodies governing the water sector (mainly the MEW and the water and wastewater establishments). The law was not based on a sound study to take into consideration the current political-legal, socio-economic, and environmental situation in Lebanon. This resulted in several drawbacks such as: (i) the modification of many laws, decrees, and decisions, which are often contradictory between them, and (ii) the generation of conflicting rather than complementary roles among the institutions.
- Law No. 444 (2002): dealing with environmental protection, which emphasized the role of the Ministry of Environment (MOE) in promoting the sustainable utilization of the natural resources, the prevention of environmental pollution and degradation, and the promotion of a safe life characterized with a stable environment. The lack of enforcement decrees and mechanisms for this law results in its defective implementation.
- Decree No. 8018 (2002) indicating the required distances of the industrial zones from the surface and groundwater bodies.
- Decision 8/1 of 2001: involving the criteria and standards of wastewater and air pollutants that should be discharged or emitted from a wastewater treatment plant for the protection of the water resources and the environment.
- Decision No. 75/1 of 2000: emphasizes (a) the rationalization of water use along the industrial production course, and b) water reuse.
- Decisions No. 3/1of 2000, No. 5/1 of 2000, No. 16/1 of 2001, No. 29/1 of 2001, No. 61/1 of 2001: indicate the water conservation methods to limit water consumption in production and cleaning in industrial settings.
- Decree No. 14438 of 1970: indicating the annual rates of the total amount of water licensed for irrigation and industrial activities. This may also include the cost of damage of the property.

MOROCCO

The first fragmented water laws in Morocco dated back to 1914. However, the real acknowledgment of the need to legislation of water and its unification in only one law, was promulgated in 1995.Morocco has committed to a program to rationalize and optimize water management that follows the international consensus on water management articulated at Dublin and adopted numerous international organizations.

Main regulations.

- Water Law (n°10-95): introducing the legislative, economic and organizational instruments necessary to the institution of a decentralized and participative water resources management and use program. To face water shortage, Morocco has integrated all the different resources into a sustainable system in which the management of water must be examined at all levels (national, regional, local) between the services of the administration and the users. The most important components of the law 10-95 are: (i) water resources are considered public properties, (ii) the creation of River Basin Agencies in individual or a group of catchments, (iii) the clarification of functions, responsibilities and mandates of each institution involved in water management, (iv) the elaboration of national and river basin master plans, (v) the establishment of a mechanism for recovery of costs through charges for water abstraction, (vi) the creation of a water pollution tax based on the principle "user-

pays" and "polluter-pays", and (vii) the protection of water quality, a new decision in Morocco.

PORTUGAL

Water resources management in Portugal can be now characterised by a multiplicity of organisational forms and management structure of the services, along with an insufficient level of provision of water and of collect and treatment of sewage.
The 1974 Portuguese revolution opens the door to the reinforcement of the weight of the State in the economy. Based on the presented framework, the water industry specificities in Portugal claim now for different schemes of regulation or, at least, for different emphasis to the several vectors of regulation. There are some similar roles, between various regulatory agencies, in terms of economic regulation. In the sequence of an increase of the demand for water, the strategy was the use of technical engineering solutions, answering with an increase of the supply. Today it has been accepted, by environmental and scarcity of the raw water resource reasons, that the answer must also focus on the demand side of the industry. The limited competencies given to the regulator enables it to lead the water policy in that way.
Main regulations.

- Law 46/77, known as Delimitation Sectors Law (DSL): defining the activities reserved to the public sector, prohibiting private economic initiative in domains such as water abstraction, treatment and distribution of water and collect of wastewater, sewage treatment and rejection of effluents, using networks. It was partially revoked in 1993 and the involvement of private capital was possible in water utilities at municipal level, through the mechanism of concessions. The presence of private capital was also allowed in the concessions of utilities that involve more than one municipality but, in these cases, the public part must be the major one.
- Decree-Law 379/93**:** defining the municipal and the multi-municipal utilities and creating the first multi-municipal systems. Since then, multi-municipal systems are those who serve at least two municipalities, that need investments from the State due to reasons such as national interest and that interacts “on the rise”, considering as municipal system all the other ones, in terms of number one of this Decree-Law.
- Decree-Law 319/94: providing a new framework for private participation in the provision for water services. In 1995, concerns with the quality of public service of the activities mentioned before, granted in an exclusiveness ground, lead to the creation of the National Observatory of both municipal and multi-municipal systems of water abstraction, treatment and distribution; of collect, treatment and rejection of effluents and of collect and treatment of solid residues. One of its responsibilities was to protect consumers, avoiding market abuses. It also included securing and controlling the quality of those public services as well as to supervise and to control the prices, due to the fact that these activities are developed by natural monopolies.
- Water National Plan (WNP, 2001): concerning the national hydrographical resources. Based on the diagnosis of the situation, a plan was made in order to improve the management of these resources. One of the challenges of the WNP, by imposition of WFD, is to change this state of things and conduct the State strategy, as the regulator, to a rational and efficient use of water or either to a management of demand. So, one of the domains of the actuation of the regulator must be the definition of adequate tariff schemes in order to discriminate prices as a function of the use of the resource and to conduct to a rational use of water. Currently the project of a new Water Law is in process of elaboration, which will transpose the Water Framework Directive to internal law.

SPAIN

Two instrumental laws are identified as the main precursors of water management. The Water Law and the Law of the National Hydrological Plan.

- Waters Law 29/1985 (modified by law 46/1999). It is a modern and comprehensive water code, covering all issues and aspects related to water policies, organization, procedures, finance, civil works, planning, and public participation. For planning purposes, users or right holders are ordered according to priorities explicitly established in each Basin Hydrological Plan. In case of a non-defined order of priorities, the priorities are: (1) urban (2) irrigation; (3) industry for power generation; (4) other industries; (5) aquaculture; (6) recreation; (7) navigation; and (8) others. Works and projects needed to solve emergent scarcity problems are considered works that promote the general interest (Article 46), and as such, their approval procedures and financing enjoy preferential treatment. Basin Authorities can create Water Exchanging Centres, through which right holders can offer or demand use rights in periods of droughts or severe water scarcity situations. This initiative must be proposed by the Ministry of Environment and be approved by the Ministerial Cabinet.
- Law of the National Hydrological Plan Law 10/2001. This Law consolidates all Planning decrees for the different interregional basins, and lays down the basic principles of the Water Planning at the national level. The Environment Ministry will establish a system of hydrological indicators to support the formal declaration of alert situation and droughts by Basin Authorities. All public administrations that are responsible of supplying urban water services to cities with more than 20,000 inhabitants must develop an Emergency Plan. The relevant Basin Authority must approve this Plan.

SYRIA

All the water resources in Syria belong to the Ministry of Irrigation, and to the bylaws of the Ministry of Irrigation, unless special laws regulate the water supply for domestic or other uses. The level of devolution in the water sector focuses on the Irrigation Ministry for specific regulations on the optimisation the water use.

- Presidential Decree 2145/ 1971: establishing the agency for preventing the public water from pollution and for keeping the water quality as it is naturally. The Syrian authorities adopted the WHO guidelines as reference for domestic water and the FAO guidelines as standard for agrarian laws. The water use specification for industry and tourism follow the USA or the European standards. This law fixed the principle of “polluter pays”, and that damage must be recovered by removing the pollution source within one week. On the contrary, the government removes the pollution sources by closing the farms or the factories, and establishing penalties as prison, or money penalties, or both. The Syrian laws are compulsory for constructing treatment plants for any farm or factory in order to remove the pollution.
- Law No. 144/ 1925 (establishing the ownership of water as public property) and law No. 165/1958 (establishing the terms of water management as right of the government) define the modalities and use of water abstraction, with modifications by which drinking water is considered be the first priority, industry and tourism the second and agriculture the third.
- Presidential Decree 10 / 1972: dealing with the protection of seawater, establishes the terms of the wastewater discharges into the sea.

TUNISIA

Since the independence (1956), the Tunisian public administration plays a major role in all domains and notably the hydraulic domain. In Tunisia, the domain of water is a prerogative of the state. The “Code des Eaux”, promulgated in 1975, constitutes the legislative basis text that governs all interventions in the water sector. The responsibility of the application of the laws on water, the scheduling, the realization of the big hydro-agricultural amenities, the development of management strategies is confided to the Ministry of agriculture, environment and Hydraulic Resources. The hold of decisions in the domain of water is defined in the “Code des eaux” that consider water as Hydraulic Public Domain as a natural resource whose utilization must respect rules of rational management of the national natural heritage. It has been completed by national Agenda 21 elaborated in 1995 that defines the following objectives for rational management and

utilization rational and lasting of water resources of the country: (i) Enhanced and integrated water resources management, (ii) Assessment of water resources, (iii) Protection of water resources, of water quality and aquatic ecosystems, (iv) Supply drinking water and purification, (v) Guaranteed of resource in sufficient quality and quantity, for the purpose of food lasting production, (vi) Adaptation to extreme situations, droughts, flooding and climatic changes.
All strategies of water management in Tunisia are elaborated to the national ladder and remain a prerogative of the state. Stakeholders' contribution is only introduced at the level of the application of these strategies and is considered as a tool to improve the management of water demand.
Referring to the water allocation issues of industrial use the "Code de Eaux" states what follows:

- Article 94 establishes that industrial users of water must justify in their demand of facilities that the foreseen arrangements are those that permit to save in maximum the quality of water used, to preserve the quality of it and to limit to the maximum pollution.
- Article 95 establishes that industrial users of water must proceed for their needs to the recycling of water used, all times that this is possible.

TURKEY

The major systematic aspect of water related activities in Turkey is central planning. At the national level, Five Year Development Plans (FYDP) are aimed at ensuring the optimum distribution of all kinds of resources among various sectors of the economy. Every five years, the State Planning Agency (DPT), with experts from all sectors prepares the Development Plan. Under the eighth FYDP (2001-2005), the most important policy was to increase the ratio of population in terms of accessibility to the basic infrastructure facilities in accordance with sustainable development together with regional development goals. Once again, an integrated planning approach and harmonization among involved institutions have been strongly emphasized during the construction of municipal water, sewerage, and treatment facilities. Other relevant policies are stated as follows: (i) encourage effective use of natural resources; (ii) establish an effective operation and management system for infrastructure services; (iii) encourage private sector involvement; (iv) enable the participation of the public and private actors in the decision making process; (v) prevent water loss; (vi) emphasize the reuse of wastewater for agricultural and industrial purposes; (vii) encourage the privatisation of the water and sewage authorities or bodies at the municipalities; and (viii) adopt the EU standards for water, wastewater, and solid waste management in Turkey.

- The Bank of Provinces Law, 1945. The Bank of Provinces was established with a mandate to assist all municipalities, irrespective of size, in the financing and construction of their infrastructure works including water supply (drinking water) and sewerage, under the Ministry of Public Works and Resettlement.
- Establishment of the General Directorate of State Hydraulic Works (DSI), 1954. The law defines duties and authorities of DSI and determines its organizations. Water resources management and nation-wide responsibility for water sector planning is centralized within DSI, under the Ministry of Energy. DSI acts to some extent as a means of water sector integration, although this is not systematically established in the legislation.
- Groundwater Law, 1960. According to this law, groundwater is the sole property of the State, and DSI is the only legal authority responsible for the investigation, use, and allocation of ground waters.
- Rural Area Water Supply Law, 1960. Responsibility for supplying drinking water to villages was originally assigned to DSI, but later was transferred to GDRS (General Directorate of Rural Services).
- Drinking Water Supply Law, 1968. This law authorized DSI to provide drinking water to cities having a population of more than 100,000 provided that the government authorizes DSI and the concerned city council approves.
- The Law of Environment (No.2872), 1983. Based on the principle of "polluter pays," this law deals with the issue of environment in a very broad scope. The aim of the law, which considers the environment as a whole, is not only to prevent and eliminate environmental

pollution, but also to allow for the management of natural and historical values and land in such a way as to utilize and preserve such richness with concern for future generations as well. Although there are separate enactments dealing respectively with matters such as rural and urban water supply, groundwater, irrigation and hydropower, DSI coordinates water use at the national level. Any agency with either need for a potential development project or is itself investing in a water-sector related activity has to cooperate with DSI and must obtain prior approval from DSI concerning the source and volume of water to be used for each project. Though DSI is the main executive agency for the government for overall water resources planning, execution, and operation, at the user level, distribution of drinking water supply and distribution of hydropower through inter-connected systems are undertaken by municipal water administrations and TEDAS, respectively.

4.2 Implementation: Successes and failures

From the overview of Section 4.1 the general impression is that most Mediterranean countries are endowed of a detailed legislation on water management, whose main traits is the reception of the concepts of integrated water management. In some case the legislation looks modern and updated, often introducing the principles of “polluter pays” and in other cases integrating the normative on water management within a more comprehensive legislative framework on environmental conservation.

On the other side, negative aspects emerge in more or less each country, that are mainly summarised in the following issues:

- the legislation is scarcely or unsatisfactorily implemented, because of various factors, among which the most common are the lack of enforcement measures in order to guarantee the correct law application, the insufficient level of resources (human, structural, financial), the inefficiency or slowness of application procedures;

- in some countries there are many agencies or administrations whose jurisdiction overlaps on the same issues, sometimes resulting into scarce or no coordination and conflicting decisions. This hampers the right knowledge of the management questions and strongly affect the application of law and the realisation of measures, for example in case of pollution;

- in some cases high centralisation of decision is complained, together with scarce involvement of the stakeholders in the decision-making process;

- in some cases, unsolved questions of territorial sovereignty of water resources emerge, as for Israel and Palestine, or other similar questions, as in the case of Greece, whose territory is downstream with respect of the neighbouring countries, giving problems of management of water resources.

5 Technological innovation, know-how and use of DSS in Industry

5.1 Technologies for water management in Industry

Few elements are presented by the National Reports on the current technologies for water management in industry. The overall emerging picture is that the existing technologies for water management are not applied with sufficient or satisfactory extents, especially in the Southern Mediterranean Countries, mainly due to high cost of installation and maintenance.

As example, in Algeria only 30 to 50% of industries have wastewater treatment plants, and the water purification is clearly insufficient, most of plants being out of order or malfunctioning. In Egypt, the government adopted in the last decade with some success international programs for improving treatment and cleaner production. In Lebanon, the normative for applying technologies for rationalization and recycling are not supported by proper enforcement mechanisms, so most of water is discharged with no treatment. In Morocco, no impact studies are made for waste disposal, and only 20% of industrial waste (mainly solid) is recycled. In Turkey, the lack of application seems not to depend on the technological level of offer, but on the high costs.

No indications are provided on this issue by the Northern Mediterranean Countries (France, Greece, Italy, Portugal, Spain), whereas only Croatia indicates no problems on recycling wastewater, mainly due to general low impact of industry and high availability of water.

The following section outlines some more details by country.

ALGERIA

According to a report on the evaluation of dangerous waste (BC Berlin, 1995), approximately 30 to 50 percent only of the industrial companies Algerian have installations of wastewater treatment. The state of these installations of treatment and their output are often unknown by the companies themselves. Other information indicates prolonged breaks of the installations caused by lack of financial resources for the purchase of spare parts. According to an investigation of a national engineering and design department (EEC, 1996), the total capacity of the anti-pollution installations was 85 649 m3 / day (Tab.3).

Tab. 3 – Depuration plants of industrial wastewater, Algeria

Situation of the stations	Number	Installed or projected capacity (m3/day)	Rate(%)
In function	41	57,600	66.25
Out of service	15	16,040	18.75
En cours	9	4,565	5.33
Planned	19	7,420	8.67
Total	85	85,649	100

Thus, it arises clearly that the deficit of purification of worn water is significant. With some exceptions, the majority of the purifying plants are either out of service, or in bad operating condition. An effective and controlled use, from this resource will require a total control of the processes of purification.
The capacities of purification of the industrial effluents represent approximately 20 year/m3 million, that is to say some 10% of the volume of generated wastewater. The two great "hot points" are Annaba (SIDER steel company) and Mostaganem (GIPEC paper paste company). A project of the World Bank was set up for company SIDER. A decree prohibiting the discharge of the effluents liquidate industrial in the natural environment was promulgated in 1993 (executive Decrees 93-160 and 93-161), but it does not seem to have had the expected effect. The Code of water (amended in 1996) envisages financial incentives to encourage the industries to install systems of purification. Incentives are also planned for measurements of economy of water. Another source of pollution,

often underestimated, it is the bad management of solid waste in particular the wild practices of discharges resulting in not controlled rejections of the lixiviates affecting surface waters.

CROATIA

Recycling of treated wastewater in the industry still is not of significance. Reason is relatively cheap fresh water supply and easy available water resources. Only thermal electrical plants reused cooling waters.

EGYPT

The government has introduced programs, in collaboration with international organisation, for enhancing adoption of cleaner production and industrial wastewater treatment, which have been active in the past decade. The World Bank and the German KfW have supported the establishment of industrial wastewater treatment plants in about 20 large industries. Parallel to this cleaner production programmes have been initiated by the UK DFID, DANIDA and UNIDO which have helped about 200 different scale industries in reducing their wastewater discharge.

LEBANON

Several ministerial decisions have been developed by the Ministry of Environment [Environmental Criteria to Permit the Construction and the Use of farms, dairy processing plants, plastic industries, and fruit processing plants (Decision No. 3/1of 2000, (article 3, paragraphs 1&3), Decision No. 5/1 of 2000, (article 3, paragraph 1&3). Decision No. 16/1 of 2001, (article 3, paragraphs 1&3), Decision No. 29/1 of 2001, (article 3, paragraphs 1&3) Decision No. 61/1 of 2001, (article 3, paragraph 1&3)]. These decisions emphasized the use of water rationalization and water recycling technologies. However, such decisions have not been yet implemented due to the lack of enforcement mechanisms (ELARD, 2004). Ultimately, most of the industrial wastewater is being discharged in the environment without prior treatment.

MOROCCO

Solid waste contributes to the degradation of the surface but especially ground water resources. The choice of the sites of refuse tips is not generally subject of an impact study as a preliminary.
Each day some 10 800 tons of domestic waste are currently produced in urban environment and 800,000 tons per annum for the industrialists. On the 85% of collected domestic waste, 2% only either are recycled, or put in controlled discharge. The remainder is discharged in a wild way in nature, which strongly contributes to the pollution of the water resources by percolation and drainage of the leaching waters or quite simply by haulage and drive of waste in rainy period.
Only 20% of the industrial waste is recycled, the remainder being stored in a wild way in the refuse tips or near the production facilities. The quantity of produced industrial solid waste will reach nearly 2 400 000 tons in 2020. The risks of contamination of the water resources will increase, if no measurement is taken.

TURKEY

Existing technologies offer physical, chemical and biological treatment facilities, depending on the nature and the amount of wastewater. The problem with wastewater treatment is that the operation of treatment plants often is not realized effectively due to high operating costs.

5.2 Experiences with DSS in water management for Industry

Most partner countries of NOSTRUM indicate ongoing activities in DSS or DSS-related for water management. The main findings could be summarised as follows:

- In no case a specific example of DSS for industrial water management exists. Most of the analysed DSS are addressed to the integrated water management at basin and regional level, involving multi-use planning of water use and demand. In particular, this involves the agricultural use of water and sustainable irrigation. This should be not surprising, considering that in the Mediterranean water is limiting for shortage and that agriculture is traditionally the main economical activity.

- Not all countries have specific experience of DSS, or indicate fragmented experience or progress under development.

- Many countries report the development of other instruments as databases or similar information systems, models and GIS that are not DSS *per se,* but are components of decision tools which can constitute the baseline for further DSS development.

- The countries having more experience indicate that the level of development and the most outstanding examples of DSS come from the academic community or from national / international research projects, and that the link with and the follow-up to the stakeholders, namely land and water administrators, is broadly to be enforced.

Because no example of DSS for industrial water management is available, an overview of each country experience is not possible, and discussion cannot be made on this issue to understand the different degree of evolution of this methodology and the possibility of future applications in this field.

5.3 Transfer of Technology and Know-how

The information provided by the National Reports is not enough to discuss a comprehensive transfer of technology and know-how for industrial water management. While it is clear that some Southern Mediterranean Countries report deficit in applying efficient wastewater treatment, there is no indication by the Northern Mediterranean Countries on which technologies are the best to be used and how to transfer them. The matter is then question of deeper studies.

5.4 Knowledge gap and further research works

There is lack of knowledge on specific DSS for managing the industrial use of water, but in each country much activity is ongoing and many instruments have been developed in form of DSS basic components, such as databases, numerical models and GIS applications. The field has great potential for amelioration and further research, the tendency being in many cases to develop DSS addressed to the integrated management of water, i.e. including all the aspects of water use at wider territorial scale (region, basin).

Integrated Water Resource Management deals with a given geographical area defined on the basis of some criteria (administrative, geomorphologic, cultural, etc.). The application of Decision Support System (DSS) to develop plans for IWRM has to be organised in a clear framework

offering a conceptual and knowledge reference system to decision and policy makers and to various stakeholders. The IWRM has to be seen under the main perspective of sustainable development. Since in the Mediterranean countries and especially in the South, one parameter that has to be taken always into consideration is the *uncertainty of water availability*, the adoption of a DSS has to be based mainly to the aim of assuring a sufficient amount of water during all the year limiting the possible conflicts in the use. To assure a sufficient amount of water is a fundamental question that has to be answered according to a dynamic perspective related to the socio-economic development of the area. The amount of water that was sufficient 10 years ago can be ridiculous for the today situation. For this reason it is important to promote a way for the application of DSS based on a clear conceptual framework. This can be given by the *Landscape Hierarchical Approach (LHA)* and in Strategic Environmental Assessment (SEA) that offer respectively the basic knowledge of the "carrying capacity" of a given area and the possible impacts of different development scenarios; by the *Industrial Ecology* that offers conceptual tools to reduce the ecological foot print of the industrial development and by the concept of *Ecological Budgeting (EB)*, that offers a way to verify the effectiveness of the decisions taken by the application of DSS. Actually DSS has to be applied within all the three perspectives.

Landscape Hierarchical Approach and SEA

The water demand depends on the economic activities (indirect drivers) the policy (decision) makers are supporting. In this the hierarchic analysis is very important to apply DSS since local decision-makers can directly influence the choice of technology, changes in land use, and external inputs but have little control over prices and markets, property rights, technology development, or the local climate. National or regional decision-makers have more control over many indirect drivers, such as macroeconomic policy, technology development, property rights, trade barriers, prices, and markets. When population and the global economy are growing, there are major advances in information technology and biotechnology, and the world is becoming more interconnected. Changes in these drivers are projected to increase the demand for food, fibre, clean water, and energy, which will in turn affect what we cam call "direct drivers". The direct drivers are primarily physical, geo-physical, chemical, and biological. The geomorphology and water availability have strong influence on the human settlements and activities and therefore on land use and land cover changes. These have a strong feed back on water "circulation".

A hierarchical approach is very important since decision making is always fitting the hierarchical processes adopted in environmental planning. This can be done at different hierarchical scales both administrative (national, regional, local) and geomorphologic (watershed level, eco-regions etc.). The landscape can be always decomposed in a hierarchical way and for any kind of activities proposed for the socio-economic development the SDSS (Spatial Decision Support System) can be used to find suitability maps for each activity. In Strategic Environmental Assessment (SEA) different scenarios can be set up to describe a number of situations in which decisions have to be taken. In each scenario it is essential to define the hierarchies. These are not fixed since different hierarchies can be generated depending on the importance we give to the components of the area of interest (Landscape). Examples of hierarchies can be found when we describe the sectors of water use (e.g. irrigation) and the sub-sectors (irrigation of olive plantation, irrigation of orchards, irrigation of herbaceous crops, etc.) or we consider the industry and the different sectors (metallurgic, textile, food etc.). The generation of scenarios and the definition of the impacts produce the matrix of water allocation and the matrix of water quality transformation (transition matrices). The data regarding water have to be related with the data concerning land uses and socio-economic aspects, it is necessary for this reason to collect data and information on:

1) a detailed description of the water supply system with specification of:
- the criteria adopted for current management;
- the adopted criteria and techniques for estimating stream-flows series at system's nodes and for evaluating water demands;
2) the data availability;
3) the users;
4) models of the water supply system in its present configuration;

5) conflicts in water uses in order to know the relationships between municipal, irrigation and industrial water supply; it is necessary always to answer the question on which decisions need to be made;
6) estimation of water resources availability (surface and groundwater, including reservoirs, intakes, inter-basins water transfers, pumping wells as well as with use of unconventional waters, such as treated wastewaters and desalinated water from the sea) for input in the model of water supply and identification of the periods of risk of shortage of water.

The use of GIS can provide hydrological maps that can be used to calculate the suitability maps for crop development, industrial development and urban development with Multi-criteria Analysis.
Since a key issue in water management in Mediterranean areas is the *uncertainty*, long climatic time series of data for characterizing suitability maps are necessary. Models that can predict the risk of shortage of water availability corresponding to the different suitability areas have to be applied and linked with the DSS. Very important is the application of a SDSS (Spatial Decision Support System) for allocation of reservoirs, dams and canals to store water and to facilitate its flow in critical periods
It is always necessary that the administrators and planners would work with an information system capable to manage Automated Data Collection, Real-time Digital Data, web Dissemination tools, Spatial mapping based on integration between ground data with remotely sensed data.

Industrial ecology
Industrial ecology is the discipline that opens a well-defined perspective of looking at the biosphere, it focuses on the industrial production and therefore it offers a clear framework of interactions between industry, economy and the basic environmental variables (in particular what we call resources) of the environmental systems. The water management in industry is depending on the choice of the type of industrial development. Water has to be considered one important parameter for calculating the suitability maps for industrial areas and industrial parks.
The hierarchical approach in water management and DSS application in industrial development is clear: DSS can be used to choice or rank the industrial alternatives suitable for the socio-economic development of one area. Once choices are done SDSS is applied to establish where the industries are settled, once the industries are settled DSS has to be applied to reduce the ecological foot print of the industries by establishing programs of cleaner production and water saving. Sources of information on water efficiency are available through EPA's web site (http://www.epa.gov/OWM/genwave.htm), and numerous other sources, some of which may be accessed through the EPA web site, or through WaterWiser, The Water Efficiency Clearinghouse (http://www.waterwiser.org).
For reducing the ecological foot print of industry and to apply efficiently the concepts of industrial ecology it is very important to activate the programs suggested by the discipline, namely the *use of process simulation to save water and to limit water pollution at the source*, establishing the Life cycle assessment of the products and the industrial plants, Eco Audit (application of EMAS and ISO 14001 etc.) and ecological budgeting (EB) at the level of single industrial plants to industrial areas and industrial parks.

Ecological budgeting (EB)
Over the last twenty years, many important elements of financial budgeting have been transferred to the area of environmental management instruments both at the level of single enterprise and at the level of administrative units at different hierarchical level namely: Auditing, reporting, controlling, account management, balancing and planning. There are important similarities between financial budgeting principles and the objectives of environmental management. Environmental budgeting tries to assess the total environmental spending during the budget period. The principle of economic efficiency is directly comparable with ecological efficiency. Yet the crucial component of financial management, the budget, has not been fully transferred to the field of environmental protection and resource management. This because the intrinsic difficulty to determine the value of environmental resources. However even if it is difficult to place a monetary

value on the environment, an environmental budget based on the most important environmental indicators such as air and water quality can be assessed.

EB takes into account not only the pollution of the local environment, but also the community's impact on the global environment. The available data are placed into one framework. This provides a clear overview, which makes it possible to track and compare developments and forecast future spending. Environmental budgeting converts data into information. Beyond the presentation of environmental information, the objective is to develop a way of presentation that provides a quick and compact overview of the current environmental spending situation.

Although financial budgeting systems differ from country to country, most of them share some basic characteristics. The main characteristic, which can be found, is the annual or bi-annual budget cycle. The budget cycle starts with a pre-report set up by the financial unit or department. Then the estimates are totalled up by the financial department, normally finding that they exceed the resources available. The adopted budget sets priorities, for this a DSS can be applied. At the end of the budget year a budget balance is set up. Cost-benefit-analyses can be provided. The environmental budgeting cycle is based on an environmental management system that confirms that the targets in the budget can be met or reveals the need for action, should there be considerable deviation from the budget value. Even if ecological overspending can not be avoided, it would have to be accounted for. Each annual (or bi-annual) budget cycle consists of the following steps:

1) An environmental budget is drawn up. The ecological spending framework for the coming budget year according to maximum rates of consumption and according to environmental targets is delineated.
2) Passing the environmental budget by the suitable actors.
3) Implementation of the environmental budget; during the budget year, the implementation of and adherence to the environmental budget is supervised through environmental monitoring and controlling.
4) Environmental Budget Balance, which includes (i) the balance of environmental accounts; at the end of the budget period, the budget balance, including a balance for each account, is prepared. Furthermore there can be informative elements like spatial and sector summaries, which combine the information included in the single accounts, (ii) a statement of environmental assets should be set up to describe the natural assets available and make long-term developments apparent - be they positive or negative, (iii) environmental benefit analysis shows the relationship between environmental spending and the social benefits achieved. At the end of the budget year a statement of environmental accounts is set up to compare the planned values with the achieved results through the budget year. The actual table therefore looks very similar to the budget. Additional information can be provided by a *distance-to-target index* – that is, how much of the planned improvement, from the starting point to the long term target, has already been achieved.

6 Sustainability issues

The information provided in the National Reports does not allow making clear separation between economical and social issues, thus a general discussion is made gathering all the available information.

6.1 Social - Economical issues of water management in Industry

In most cases, the information contained in the NRs refers to water management in the respective countries as a whole, and it is difficult to extract specific indications on the industrial use. However, some general questions can be put in evidence, concerning difficulties of water management policy that reflects also to the industry sector. Especially in the Southern Mediterranean Countries, they are related to:

- Excessive reliance on supply management,
- Lack of economic pricing,
- Lack of criteria of efficiency for cross-sectoral allocation,
- Lack of proper tariff system and cost recovery policy,
- Weak institutional capacity for planning, monitoring, assessment; or in some cases, general management water plans that are under preparation;
- Value of water that is not sufficiently studied or is difficult to evaluate;
- Limited water availability, which implies plans for maximum water conservation, optimal management and correct water allocation.

The need of water saving, leads to policies for the application of a tariffs system instead of a mobilisation of resources. Analysing specifically the industrial use of water, in Tunisia the tariffs are fixed on the volume of used water and on the quality of wastewater. In Israel, tariff rates are fixed for industrial plants exceeding 5,000 m^3/ year of water use, based on the quantity of water consumption according to the category and the scope of products.

Dealing with the tariff system in the industrial sector, the overall picture is not simple to define. There is lack of information and the costs are not indicated with the same currency, so a comparison is not reliable (Tab.4). It is to note that subsidies exist in some countries for some 50% of the water price (Algeria, Turkey), whereas in other situations (Egypt, Syria) the charges are greater than the cost of water.

Tab. 4 - Industrial water cost, charge and subsidy in the Mediterranean countries per m^3 of consumed water (* costs expressed in local currency units)

	Cost	Charges	Subsidies
Algeria*	48	23.4	24.6
Croatia*	7	5 - 12	0
Cyprus	n/a	n/a	n/a
Egypt	0.09	0.17	
France	0.9		
Greece	n/a	n/a	n/a
Israel / Palestine*	1.33		
Italy	n/a	n/a	n/a
Lebanon	n/a	n/a	n/a
Morocco*	5.55		
Portugal	1.07		
Spain	n/a	n/a	n/a
Syria	0.28	0.43	
Tunisia*	0.796		
Turkey	1	0.5	0.5

6.2 Environmental issues in Industry

Section 3.3 above discusses the environmental aspects and impacts of industry on water in the Mediterranean countries. As explained, each country identifies the main critical issues of industrial use of water in pollution.

The main finding is that water pollution from industry affects remarkably almost all countries, but the impact is going to be severe in those Southern Mediterranean countries that had a consistent industrial growth during the last decades (Algeria, Tunisia, Egypt, Lebanon, Turkey) and look less ready to front this question. All complain generally the scarcity of measures and treatment plants to purify and reuse wastewater; the consequences are huge considering that the industrial estates tend to concentrate near the coasts or along the main water streams, overlapping with the problems of increasing urbanisation.

The question is essentially a problem of high costs, because improved and cleaner technologies guaranteeing a sustainable quality of wastewater are expensive. This is true also for the industrialised countries of Northern Mediterranean. For example, in France the water pollution has been declared a priority since some years ago, the investment in this field rising up to 340 million Euros in 1993. A similar trend is becoming positive for continental Europe in the last 20-30 years thanks to great investments and closer application of laws, yet much progress has to be achieved.

7 Conclusions and recommendations

The conclusions of this Thematic Report are indicative and require major effort for knowledge and analysis. The questions linked to the industrial use of water involve many correlated socio-economical and environmental aspects that need to be deeply explained and interpreted by national and international, multi-disciplinary teams of experts. Actually there is no room for giving recommendations, but it is possible to outline some findings that could be of help for developing integrated solutions for industrial water management.

7.1 The socio-economic importance of Industry: concluding comments

Industry has great relevance in the socio-economic structure of the Mediterranean countries; this weight is expected to be greater in the next years. The importance of industry ranges from 20% to 30% of the national GDP in all countries, reaching 60% in Algeria, where the industry of oil extraction broadly grew in the last decades. Industry is expected to greatly impact the economies of the Mediterranean Developing Countries, where the process is already ongoing. The investment in industrial activities is strongly increasing in these countries, attracting external capitals. Of course, the industrial growth is in order to bring heavy impact on the water quality, having potentially harmful follow –up on the human health and posing severe social concerns. The impact could be enhanced by the overlapping effects of industry, urbanisation and tourism, which will put more pressure on the Coastal Zones and on the main water streams. The request of efficient measures for conserving and treating water resources is already felt as urgent.

7.2 Water use in Industry: concluding comments

The analysis of water use in industry is not exhaustive, because of the difficulties to draw a satisfactory picture from data and information largely missing or incompletely collected. The main findings can be outlined as follows:

- the water use for industry in the Southern Mediterranean Countries is prospected to strongly increase in the next future;

- even if not comparable with the Northern Mediterranean Countries, the amount of water consumption will bring problems in areas where the water shortage is common;

- the industrial water pollution is reaching levels of non sustainability in the Southern Mediterranean

- under this view, the need of modern and efficient technologies for treating and recycling water will be of fundamental importance;

- the introduction of financial mechanisms as “polluter pays” and a system of progressive tariffs based on the actual use and on the type and amount of products could be helpful.

7.3 Managing water for Industry: concluding comments

Managing water is a priority in all Mediterranean countries. In almost all cases, the management of industrial water is part of an organic process aiming at considering all the aspects of water use in the same framework. The concept of integrated water resources management (IWRM) is having more importance and has room in most of the Mediterranean countries legislation, with the development of Integrated Water Plans at regional or basin level or the promulgation of comprehensive laws. In this view, there is great potential for the research and the development of Decision Support Systems. Most countries put in evidence the ongoing work and application of databases, hydraulic models, GIS. In some cases, DSS are planned and developed at the scale of territorial integrated water management. Although no specific example exists of DSS for industrial water use, the trend is promising in this sense. For resulting into good practice instruments of policy applications, some aspects should be enforced:

- to better organise and make available the collection of basic data on the industrial use of water as well as of the ecological and climatic components at regional level, that up to now are scarce and do not allow making detailed studies and analysis;

- to fill the gap between the DSS developers (mainly the academic community) and the stakeholders(authorities, land and water administrators, etc.), giving them a consistent follow-up, both at national and Mediterranean level, for example proposing permanent working groups of multi-disciplinary experts;

- to better explore the application of DSS to IWRM under three interconnected perspectives, that is the Landscape Hierarchical Approach (LHA) and SEA (Strategic Environmental Assessment) which are essential to define the water needs and the strategies to find the water resources and the water allocation; the Industrial Ecology (IE) which offers the conceptual tools to reduce the ecological foot print of industrial development; and the Ecological Budgeting (EB) that is a very useful tool for controlling and verifying the suitability of the decisions taken under the first two perspectives.