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## **MEDITERRANEAN ACTION PLAN**

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**H2020 initiative MIRA project report on pollution related research**

# **REPORT ON THE MEDITERRANEAN SEA POLLUTION SITUATION ADDRESSED BY THE HORIZON 2020 PROGRAM OF THE ENPI, AND CHALLENGES IN THE RESEARCH DOMAIN**

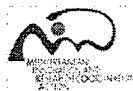
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**FP7 INCO.Net MIRA PROJECT WP 7**



**Report Coordinator:**  
**Prof. Rafael Rodríguez Clemente,**  
**IDAEA-CSIC, Barcelona, Spain**  
**raro@orgc.csic.es**

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# **MIRA PROJECT REPORT ON THE MEDITERRANEAN SEA POLLUTION SITUATION ADDRESSED BY THE Horizon 2020 PROGRAM OF THE ENPI, AND CHALLENGES IN THE RESEARCH DOMAIN**

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# **1. STATE OF THE ART OF THE LEGAL AND NORMATIVE, SOCIO-ECONOMIC AND TECHNICAL SITUATION IN THE MEDITERRANEAN RIPARIAN COUNTRIES (EXPERTS GROUPS INPUTS ON NATIONAL NORMATIVE, TECHNICAL AND SOCIAL FRAME).**

The analysis of the replies to the Questionnaire (see next two Hyperlink to the Questionnaire and an EXCEL file with the results of the Normative, Social and Technical questions replies of the different experts, related to the issues of the survey) shows a dispersion of situations in the riparian Mediterranean Countries.

## MIRA WP7 Questionnaire.doc

Normative and technical data Experts Group Meeting 05.04.12.xlsx

Formally, the Member States of the EU share the WFD as the general water policy and, similarly, the Emission Laws of these states are based in EU Directives dealing with this issue. The Water Management Agencies are based in the public property of water, but, in many cases, public-private or private companies participate in the management of water, especially in the urban areas. A similar situation happens with the management of waste water, but in this case, the percentage of private participation is steadily increasing in many countries. In the S and E side of the Mediterranean the situation is similar, but the treatment of waste waters is significantly assumed by private companies and in the case of the S under supervision of the governments. In all countries there is a Water Observatory providing information on water stocks, management and other issues. The panorama that comes out from the replies shows differences between the EU situation, ruled by the WFD and its daughter Directives, and the different normative rules in all the other Mediterranean Countries. A point for future activities will be a benchmarking exercise of the different Water Laws and Waste Water Laws across the Mediterranean, as well as a feasibility study of the applicability of the WFD principles in the whole Mediterranean area based on the previous studies of FP6 Project MELIA. Collecting and updating actual information about institutional regulatory framework of water



planning, with specific consideration on the treatment given to non-conventional water resources in the different countries is needed.

In most Mediterranean countries the main source of water for domestic use are surface waters, with the exception of Italy, Slovenia, Croatia, Syria, Jordan and Palestine. In the case of Palestine, it is because of its absence of control of surface waters, and Cyprus and Malta because of their insular character. In most countries the main use of water is for agricultural purposes, except in France, Slovenia, Croatia, and Palestine where urban and industrial use is dominant. A clear trend is the diversion of water uses from agriculture to industry and urban development. However, a mix of policies is needed to provide alternatives to the actual use of water for agricultural purposes, taking into account the demographic displacements to the Mediterranean shores, but also the enormous fraction of population dedicated to agriculture in many Mediterranean countries.

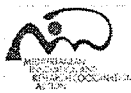
The waste water treatment situation is very uneven among countries and the related data corresponding to urban and industrial waste water production in most case has not been properly identified and differentiated. Waste water in France, Malta and Cyprus are treated to a tertiary level, while it is treated to a secondary level in the majority of Mediterranean countries. In several countries, such as Slovenia, Croatia, Albania, Morocco and Palestine, most of the waste waters receive no treatment. Except Slovenia, the level of waste water treatment has increased for the last ten years in most countries, but with varying percentages ranging from 100% in the case of Malta to 1% in the case of Croatia.

Only few Mediterranean countries have implemented wastewater reuse within their water plans, and farmers often irrigate with untreated or partially treated wastewater.

Regarding desalination, most of the countries are nowadays using this technology, although only a few of them have done it within a planned integrated framework, and none has a clear strategy for the management of the resulting brines.

Most of the countries have plans for Risk Assessment covering most of the surveyed fields, with the notorious exception of Montenegro, Palestine and Lebanon, where at least three fields have not Risk Assessment Plans (See Questionnaire and EXCEL File in the previous Hyperlinks). Moreover, there are 6 countries without "Severe Drought" contingency plans and 4 without "Floods" contingency plans. The "Assessment of Water Management" and the "Interconnection between water sources" are missing in 3 countries.

The public perception of the water management issues of the 21 countries examined is on average Medium out of three categories (Low, Medium and High), but with some indicative trends: the issue "water quality" and "water delivery" present the



highest interest (addition of Medium and High) around the Mediterranean, while "water saving", "reclaimed water", "water and energy" and "environmental protection" show lower interest (addition of Medium and Low). It is clear that more must be done on creating public awareness about the importance of these fundamental issues, especially on the social arguments about water saving, reclaimed water use and environmental protection. These results contrast with the high activity in most of the educational levels, particularly the primary and secondary levels, about the water issues. Perhaps, more basic and technical information about the scarcity of water and the needs for its reuse, as well as the protection of the water resources should be provided to the educational systems.

In most of the countries, the barriers for waste water use are the "Financial availability" and the "Health risks", with a significant presence of "Lack of trust" as another argument (See Questionnaire and EXCEL File). Perhaps, regarding these important social barriers for waste water use, it should be recommended to start with the building of trust about the reliability of the treatment techniques and the waste water operating responsible, and the alarming situation of water availability, which will support the mobilization of resources for the reclaiming of waters and the generalization of its use, especially for agriculture and gardening.

The initial interpretation of the results of the survey clearly shows a progressive change of the water culture of the Mediterranean riparian countries population from a rural perception to a more urban contextualized, which implies more consideration of all the complex processes associated to the water management and a focus on water delivery and water quality issues, typical of an urban culture. More participation of the public in the Water Management and decision making processes is needed in order to raise the citizens' awareness on this important subject. Participative mechanisms already existing should be analyzed and compared. This issue is particularly important when considering the progressive tendency to privatization of services related to water. The public awareness is a lever of social equity and the evolution of the normative frames.

The results of this survey provide arguments on the content of the socio-economic dimension of the Research Agenda in support of the H2020 Program of De-Contamination of the Mediterranean. Certainly, deeper studies are needed to understand the position of the entire Mediterranean Countries population about the risk associated to the scarcity of water resources against an increasing demand. It is clear that a benchmarking of the legal status of the different Mediterranean riparian countries is needed in order to find the points of convergence, which will support a common strategy and those where there are different points of view or legal constraints that could represent obstacles for the common endeavor.



The level of awareness on these important issues should mark the political agenda and the prioritization by the regulators and governments of the financial support needed to handle the water resources management. Similarly, the refusal of some sectors of the population to reuse waste water after treatment is rooted in the perception of health risks and the lack of trust on the technical solutions or their reliability. More work is needed to identify the concrete elements at the origin of this perception, and better presentations of the research work and the technical solutions at hand must be disseminated through the educational systems and the media. The Education System should incorporate more elements in the description of the water issues, the new risks associated to the demographic changes and the climatic global changes, as well as a better description of the water cycle incorporating the elements of water reuse and its domains of application and costs. More work is needed also in the domain of environmental protection.

Adopting the Water Strategy for the Mediterranean and a well-structured Action Plan will contribute not only to the harmonization of the Institutional regularity Frameworks but also in inviting coherent national policies and strategies in the various Mediterranean.

## 2. RESEARCH CAPACITIES RELATED TO H2020 OF THE MEDITERRANEAN RIPARIAN COUNTRIES IN TERMS OF NATIONAL RESEARCH PROGRAMMES AND RESEARCH TEAMS. FP5 AND FP6 RESEARCH EFFORTS ON THE SAME SUBJECTS

In this survey we considered a Research Program as a medium and long term life political and financial action addressing some issues of national interest, managed by a national authority and functioning through calls for submission of concrete Projects. This definition is ambiguous, but the objective is to have an idea of the continuous national efforts in the domain of research addressing the issues of Mediterranean contamination and related topics. The survey has identified a great number of research programmes addressing the issues of H2020, but some experts presented in some cases concrete Projects as important national actions without relating them to concrete national strategies or programmes, so leading to a certain confusion in the identification of the continued national programming. Nevertheless, the broad spectrum of Mediterranean initiatives with guarantees of sustainability within the National Research programs that appears from the survey is not highly affected by this confusion of Programmes and Projects. The next Hyperlink provides the **total list** with identification of the Programmes/Projects and Research Groups of the Mediterranean riparian countries, as identified by the members of the Working Group.



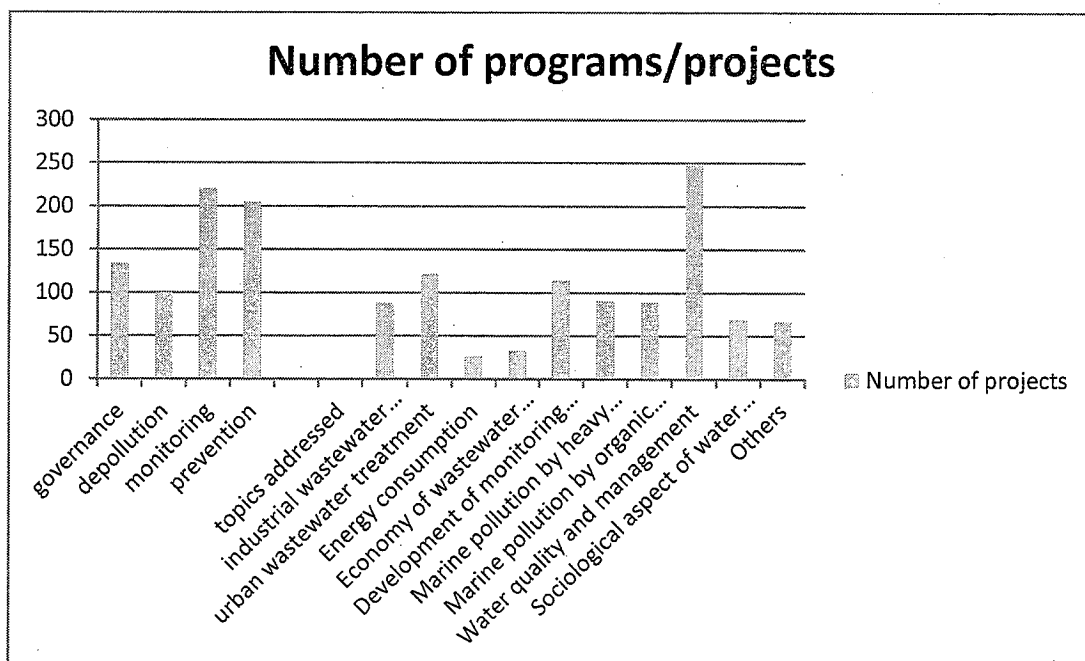
## D7.57 - Programs and Centers Synthetic document.docx

As mentioned previously, the survey has asked for the identification of research groups existing in research institutions such as Universities, Research Institutes, Environmental Agencies, etc., to make an initial estimation of the human and research capacities already existing in the Mediterranean riparian countries, able to cooperate in the frame of Mediterranean-wide research initiatives of common interest to address the issues related to sea contamination and the definition of de-contamination strategies and actions. The following Hyperlink presents a comprehensive survey of the numerical results of the survey highlighting the topics addressed by the Programmes/Projects:

### National Programmes and Projects.xlsx

Figs. 1 and 2 show the global distribution of Mediterranean Programmes/Projects object of interest, according to the views of the experts, with specific areas, such as Governance, De-Pollution, Monitoring and Pollution Prevention, and specific research topics also listed in the abscissa coordinate of the next two figures. It is clear that, globally, the areas of Monitoring and prevention receive more support, and the topics that receive more attention are the Water quality and management.

Fig. 1





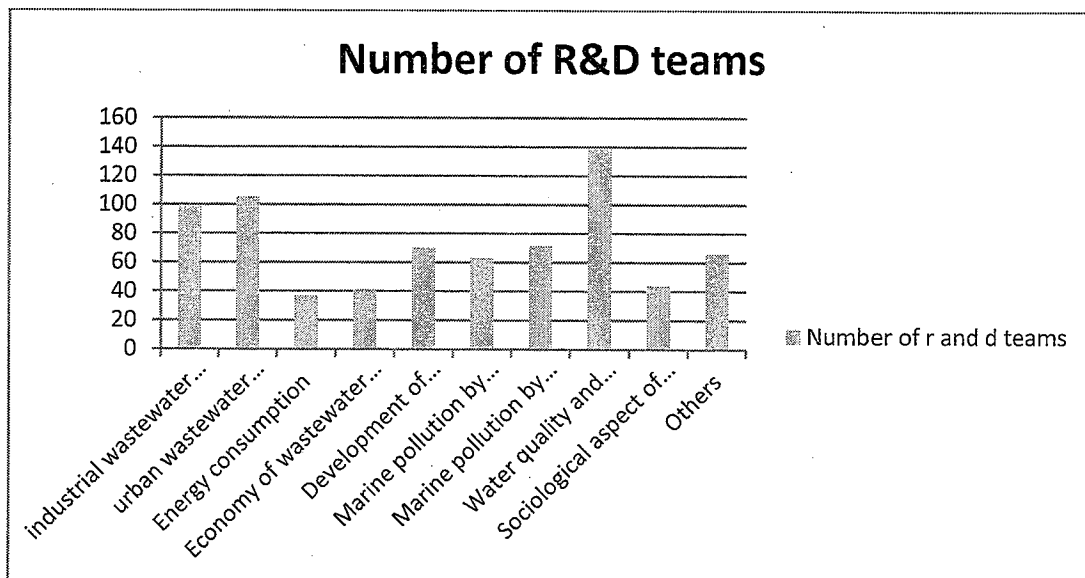


The survey shows that the number of Research Teams in different topics of the different countries is large enough to guarantee a sounded basis for international cooperation; next Hyperlink is a list of Research Groups of each country.

#### R&D Teams.xlsx

Here again, the issue of Water Quality, management and Monitoring is the more important topic addressed in most of the countries, but urban and industry waste water treatment are also very important attracting topics. This indicates the potential contribution of the programs/projects in the optimal management of restricted water resources in the arid Mediterranean region. The issues here are the strong differences in equipment and the standards used by each team, size of the teams and the relation between these teams and the national authorities in charge of monitoring the contamination and designing actions of mitigation. In any case the identification of these groups is a promising starting step for the promotion of a Mediterranean-wide area research agenda.

Fig. 2



The projects dealing with the topics covering the issues of interest of H2020 financed by Framework Programmes 5<sup>th</sup> and 6<sup>th</sup> as described in the CORDIS Data base, are listed in the next Hyperlink and summarized in figures 3 and 4, using the same topics as in the previous figures.

#### MIRA Final Report Global FP5 and FP6 projects (April2012).pdf

Fig. 3

### TOPICS ADDRESSED IN FP5 + FP6 AGAINST N° OF PROJECTS

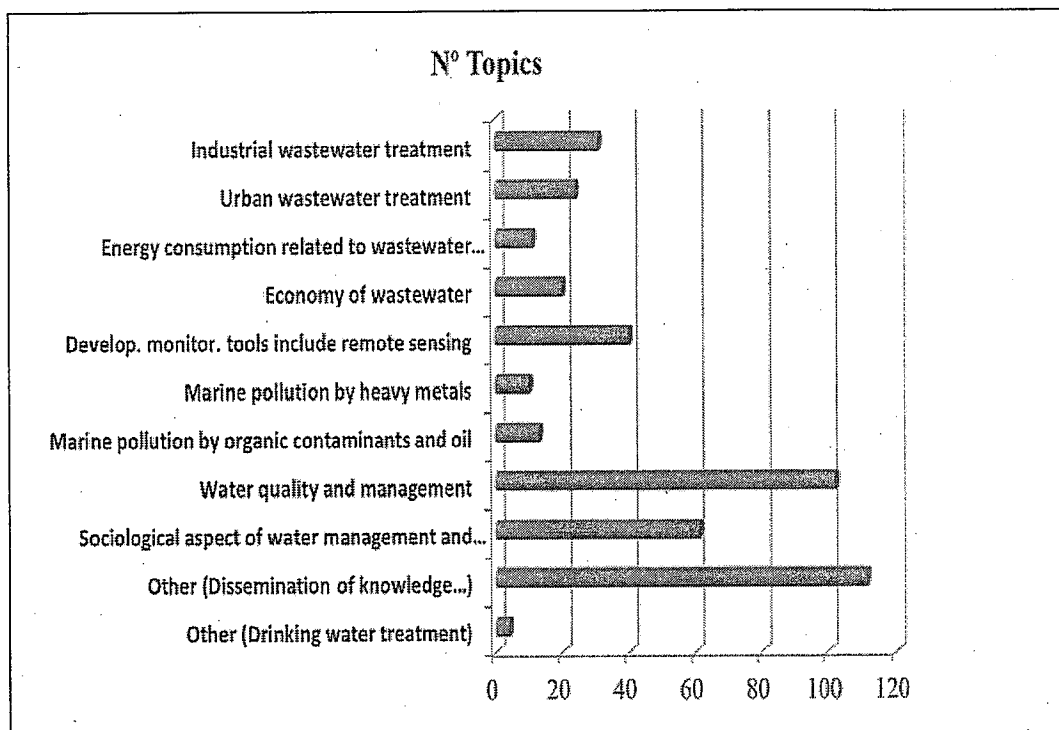
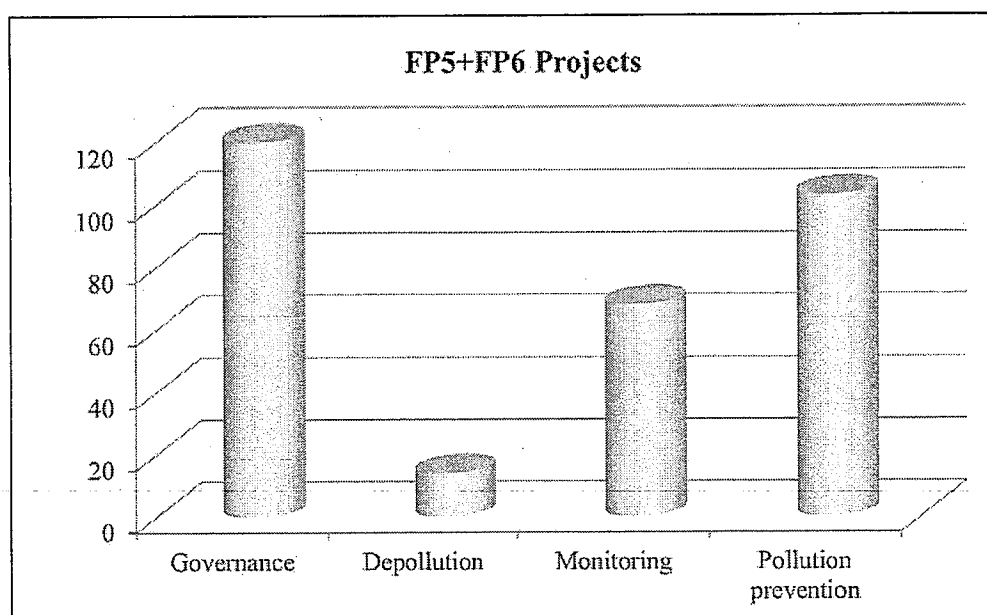


Fig. 4

### RELEVANCE TO THE OBJECTIVES OF THE HORIZON 2020



### 3. SWOT ANALYSIS OF THE SITUATION

Addressing the issue of the Research Agenda for De-Contamination of the Mediterranean is an ambitious but challenging objective, a SWOT analysis of this initiative allows us to identify key issues that frame the risks and benefits that could be obtained:

STRENGTHS	WEAKNESSES,
<ul style="list-style-type: none"> <li>➤ Common awareness of the problem</li> <li>➤ Regional Instruments such as ENPI and MAP.</li> <li>➤ Well-developed national monitoring facilities in most countries</li> <li>➤ Political support at Ministerial level (UfM)</li> <li>➤ Well qualified and connected scientific community</li> <li>➤ Observatories of contamination in all countries</li> <li>➤ Social and business support</li> <li>➤ Alignment with mainstream policy on resources efficiency, and environmental protection</li> <li>➤ The region is open to innovation: desalination, reuse of waters, better coastal management</li> </ul>	<ul style="list-style-type: none"> <li>➤ Lack of common laws results oriented, regulations and enforcement mechanisms related to the subject.</li> <li>➤ Lack of common standards and harmonized data base. Lack of accountability and transparency</li> <li>➤ Lack of regional drought and flood strategy</li> <li>➤ No integrated regional monitoring system</li> <li>➤ No common repository of knowledge sources</li> <li>➤ Insufficient area specific capacity building at scientific scale (human and material resources)</li> <li>➤ Public awareness is weak at national level</li> <li>➤ No effective incentives to engage in these actions</li> <li>➤ No clear overall approach from the catchment scale to the sea</li> <li>➤ Technology treatment is behind the state of the art of knowledge</li> <li>➤ Lack of awareness of the importance of coastal and marine waters on the economy of the region</li> <li>➤ Lack of long term strategy to increase water efficiency</li> <li>➤ Low level of uptake of research results</li> </ul>
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> <li>➤ Demands of water creates the need for integration of waste water in water management strategies, and allows for lowering sea contamination</li> <li>➤ Water scarcity as driver for innovation and sustainable water management (SWM)</li> <li>➤ De-contamination of the Mediterranean,</li> </ul>	<ul style="list-style-type: none"> <li>➤ Time is working, the problem dimension increases</li> <li>➤ Political blockage in agreeing common initiatives</li> <li>➤ Alteration and destruction of habitats, decline of fish stock and biodiversity</li> <li>➤ No early warning system</li> <li>➤ Unknown effects of sewage and chemical</li> </ul>



<p>is of common interest and a source for direct business activities impacting other sectors such as fisheries, tourism or transport. H2020 and SEIS, under development, will be reference actions and systems</p> <ul style="list-style-type: none"> <li>➤ Appropriate Technology co-development and Transfer in pollution prevention and Innovation Provisions =&gt; Incentives</li> <li>➤ Possible Joint Programming of riparian countries on De-Contamination and SWM issues</li> <li>➤ Networking of research laboratories, integrated consortia with participation of all countries to deal with the problem.</li> <li>➤ Search for harmonization of standards</li> <li>➤ Direct access to research programming</li> <li>➤ Development of the socio-economic dimension of research under a Mediterranean common interest</li> </ul>	<p>pollution, particularly of emerging pollutants</p> <ul style="list-style-type: none"> <li>➤ Implementation of policies, such as tourism development without incorporating the contamination prevention precautionary principle</li> <li>➤ Increasing coastal urban and industrial development</li> <li>➤ Increasing agricultural use of water without appropriate monitoring of diffuse contamination impact</li> <li>➤ Population migration to the coastal and water availability area</li> <li>➤ Water conflicts at regional level</li> </ul>
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#### 4. GOVERNANCE ISSUES AND COMMUNICATION STRATEGIES

### Current State of Governance

#### Main laws and regulations

There are several frameworks and agreements in the Med Basin that govern the preservation and pollution prevention of water resources and water bodies, especially the Med. Sea. The most important is the Barcelona Convention for the protection of the Sea, the ENPI Neighborhood Policy Program and other international agreements and tools of monitoring and data sharing on this issue (e.g. MEDPOL, SEIS, etc.).

Furthermore, in EU Member States, the Water Framework Directive (WFD, 2000) and daughter directives and the Marine Policy Directive are delineating the main principles for water management and protection within the European policy framework and setting specific objectives to ensure the safeguarding of the resources and water bodies, but still these desirable objectives are far from being attained. For instance, the WFD aims at achieving a good status of European water bodies by 2015, which, according with the available data, will probably not be achieved.

In the southern and eastern part of the Mediterranean Countries, national laws and regulations are the governing laws that ensure the preservation of water resources and water bodies. Some of these laws in some countries may be in line with some of the EU Directives, but no obligation as of yet to be in complete harmony



unlike the situation in the North where, all national laws and regulations shall be in complete harmony with the EU Directives.

### **Enforcement Mechanism**

Each member state in the northern part of the basin should comply with the EU Directive of meeting standards and enforce the regulations in their countries. Monitoring is secured through national or regional agencies in each member state and violations are contained and ratified more rapidly since the judicial system provides for implementing and enforcing any compliance with these Directives and prohibit and violations of them. However, even in the N there is huge discrepancy in law enforcement capacity. In the south the situations range from no enforcement to adequate enforcement. Moreover, the role and capacity of National agencies is weak in several areas and regular monitoring mechanism and capacity is not developed in many countries and often monitoring results are not taking into account to revise regulations. Violations take more time to be settled since the judicial system is not well developed to provide for enforcement.

### **Main institutions, their roles, communication means and data sharing**

The main institutions in the north are the Ministries and National Agencies, Basin Organizations, River Basin Districts and Authorities Regional Authorities, Local Authorities, Local management Structures, User Associations, etc. However, in some of the southern countries they are more centralized and represented by Ministries and Local Authorities.

The role of the institutions is far better defined in the north while there is more duplication and un-clarity in the role of certain institutions in charge of water and environment in the south. Often more than one institution is charged with same task. This also creates confusion and hinders cooperation, coordination and exchange of information among these institutions. Sometimes, in some countries even the information is hardly shared from one department to another in the same institution. The coordination and cooperation is more institutionalized in the north while it is less structured in the south.

### **Governance Provisions for Stakeholder Dialogue and Participation**

The provisions for multi-stakeholder participation and dialogue as well as public engagement are vague in the southern governance while it is better articulated in the northern governance. However, the challenge remains in the right practice of public to their role and in taking active and responsible actions to influence decisions.



Moreover, although there is good practice of public engagement in the south, the results of engagement process may not often influence change of policies or governance. Rather, it is practiced just to show that stakeholders are consulted and they are part of policy setting or change. The entire challenge of the proper implementation of the governance and of the proper stakeholders' participation is linked very much with how democratic, transparent and how accountable these systems are.

#### **Public awareness and responsibility, Public Engagement Barriers and level of knowledge**

The level of awareness varies from North to South, depending on the governance setup and level of democracy and public awareness toward citizenship. Public engagement is often informal in the south and the main barriers for their engagement are to some extent related to the laws which have no provision for such engagement. Other barriers related to the level of knowledge sharing and information availability as well as the large gap between public and governing structures in the south.

#### **Communication strategies. Involvement of population.**

An important step would be to build partnerships (dialogue) between authorities and public. Involvement of the public in planning has always been fundamental to successful development plans. However, from our perspective, a need to move beyond public consultation into public partnering is fundamental. Engagement allows a direct involvement/participation of the public in the development and implementation of solutions to the prevailing problems. The awareness of general public should be raised, whilst keeping in mind that appropriate education should be based on comprehensive analysis and scientific methodologies. This can be promoted also by introducing innovative and specialized education programs and training on water treatment technologies, considering the sociological aspects of technologies and their adaptation to the local context.

There should be a better transmission to the civil society of the benefits of wastewater reuse, and technological improvements especially in water scarce areas. In this case, the connection with the media should play an important role.

#### **Governance provisions for Appropriate Technology Sharing (adaptation), main barriers for such sharing and main provisions for innovation**

There are many cooperation programs and instruments that encourage exchange of experience between North and South. However, there are many cultural, social, economic and institutional barriers that hinder the sharing and adaptation of



such technology and laws are not well developed to support and encourage innovation especially in the south. For example, unless the same standards are used no good technological exchange can be successful. In the same logic, the technology providers must be aware of the local social and cultural circumstances. Finally, the mobility of experts for technological transfer is hindered by the Visa problems, with the consequences of discouraging the uptake of European Technology in the MPC.

### **Incentives and Financial Policy Instruments**

There are few incentives and financial policy instruments in some countries in the south for the impulsion of a water de-contamination strategy of water users (e.g. Ecological Tax, Water Abstraction Tax– Algeria). This approach is more advanced in the north. Incentives and financial instruments are generally not linked with the social and economic conditions of people and other end users. Specific schemes to encourage different types of waste water treatments in different contexts (urban, industrial, agricultural, tourism, etc.) must be promoted.

### **Challenges and Conclusions**

- Fragmentation of institutions / Role duplication
- Legislative frameworks in the South and North are top down, i.e., the participative processes are limited. The technical challenge in the north is aligning the national, regional and local regulations and legislation with the EU Directives. While in the South some legal benchmarking exercises would be necessary to check the effectiveness of the legal and regulations frameworks.
- Lack of enforcement mechanisms at some southern countries and mainly at basin and trans-basin levels.
- Lack of financial instruments and lack of incentive strategies to reduce pollution
- The provisions for multi-stakeholder participation and dialogue as well as public engagement are vague in the southern governance while it is better articulated in the north.
- Low accountability and transparency
- No clear provisions to support and encourage innovation, mainly in the southern part of the Basin.
- No clear link between, academia, stakeholders and industrial entities in the southern part of the Basin. Such interrelationships may support and encourage innovation approach.

### **Proposed Actions for Governance and Communication**



- According to the new EU ENPI Action plan, especially the part related to reform; developing a governance structure that allow and support public hearings and stakeholder engagement in policy making is needed.
- To develop more transparent and more accountable laws that supports the development of appropriate mechanisms of communicating science to public and society and builds shared knowledge and mutual trust as well as reduces socio-cultural barriers in water management and pollution prevention among various actors.
- Due to the need of addressing de-pollution of the Mediterranean Sea, a watershed-to-sea management prospect is needed. Moreover, building adequate governance at basin as well as trans-basin levels that is capable of dealing with multi-sectors and multi-disciplines at the various scales.
- Developing a governance system that delineates clear financial instruments and incentives to minimize pollution and encourage conservation as well as enforcing polluters pay principle, but with clear engagement for prevention actions.
- Innovation ways of governance based on public participation and involvement of stakeholders, urban managers, and scientists in decision making should be promoted by conducting Capacity Building activities.
- Develop favourable governance conditions to encourage innovation and appropriate technology sharing and settlements at local, basin and trans-basin levels with emphasis on area or even sector specific conditions.

## 5. DIMENSIONS OF THE RESEARCH AGENDA IN THE GLOBAL OBJECTIVES OF H2020

The H2020 Programme targets the following objectives:

- Identification of investment projects to reduce the most significant sources of pollution => Mediterranean Hot Spot Investment Programme – Project Preparation and Implementation Facility (MeHSIP)
- Harmonization of procedures and lab facilities among MPC and EU countries
- Identification of capacity-building measures to help neighboring countries create national environmental administrations that are able to develop and police environmental laws => Mediterranean Environmental Programme (MEP) => Capacity building in handling treatment plants
- Review, Monitoring and Research:
  - Develop indicators to monitor the progress/success of Horizon 2020 => Shared Environmental Information System (SEIS) => Open to participation of Neighboring Countries (South component of SEIS)
  - Use of the EC's research budget to develop greater knowledge of environmental issues relevant to the Mediterranean and ensure this is shared => RESEARCH AGENDA => mobilize results from 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> Framework Programme and identify research gaps needed through the MIRA Project.





The Working Group of MIRA has analyzed the state of the past and present research activities in the Mediterranean Countries and the FP of the EC. The results of the analysis points to the need of a strategy where the **research effort in the region should be situated inside a more general coherent Euro-Med Strategy of knowledge and human and material resources management**. In this sense, it is worth mentioning that the **scientific efforts in all countries and cases should be coordinated with the monitoring of both the impact of pollution and of the political-administrative interventions and major de-pollution or prevention actions of all the states and the international community**. In practical terms, this implies that the **research infrastructures, equipment, methodologies and standards** should be compatible or, even, shared among the monitoring institutions. This, in turn, implies that in many cases institutions and methods should be upgraded and certified. A strong link between both fields of intervention must be guarantee, particularly in the selection of **key indicators that reflects on the one hand the impact of the contaminants, and on the other of policies and their enforcement. Both need to be well characterized and quantified by the research community**. Similarly, the data used in monitoring and modeling of the contaminants should be better gathered, quality controlled, harmonized and evaluated at national and international levels to guarantee a Mediterranean wide cooperation of the research and monitoring communities.

Moreover, it is clear that **Capacity Building (CB) in the scientific environment** is needed in order to mobilize human resources at the technical and scientific levels to support policies and strategies, in a way similar to what has been done in the Capacity Building/MEP Program of H2020. However, CB in the scientific world has to involve from the beginning researchers to identify gaps at Mediterranean level to tackle specific R&D issues related to water and to build a CB programs. It has to be used to build R&D networking and programs as objective and should be closely linked to EU/MED research programs (H2020) for real impact. Connection with mobility and infrastructure creation programs will assure sustainable impact. Such mechanism will lead to powerful R&D CB. The ERAWIDE programme (supporting some excellent quality research centers in the MPC) dealing with water issues, is a good example of experience on CB in scientific environment. Capacity building should also target new approaches, technologies, innovative governance and financing mechanisms allowing water multi-use, water reuse, water efficiency increase and leading to sustainable Med sea de-pollution.

The **political and socio-economic dimensions** of the H2020 has not been fully addressed by the scientific community, while the consequences of the diversity of legal frameworks, public perception of the issues at stake, such as the long term consequences of pollution or the need of waste water reuse, the impact of littoral massive urbanization, to mention only a few issues, are not seen as urgent matters by the societies and governments. An intensive awareness campaign targeting the political levels, Parliaments, Governments and Local Administrations must be drafted and developed at Mediterranean level, eventually within the next face of H2020. **Similarly, the public awareness of the risks and consequences of sea contamination**



**must target all levels of education and the media.** It is necessary to collect reliable information/data from all available sources on chemical and biological contamination and marine litter to be used for the formulation and dissemination of the relevant information.

## 6. COMMON MONITORING AND RESEARCH ISSUES

Monitoring the long-term effects of the Mediterranean coastal water quality requires a large-scale, active network using standardized methodologies and indicator end-points carefully selected. The Mediterranean Contamination is usually described according to values and indicators referred to the following topics:

- Changes in the basin hydrological cycles provoked by man induced changes or extreme events
- Impact of urbanization in waste water and coastal erosion
- Fisheries and aquaculture activities
- Litter and other transport related pollutants
- Industrial and physical pollutants (Chemical. Biological.....)
- Climate change impact and monitoring
- Algal bloom, invasive species and adverse effects in coastal areas (anoxia, turbidity...)
- Early warning systems Monitoring and Assessment needs

It is worth mentioning the lack of agreed strategies to tackle the important issue of diffuse contamination produced by agricultural practices. This point will be treated later.

Monitoring in the H2020 Programme is the realm of the actions lead by the EEA, targeting the extension to the whole Mediterranean Area of the SHARED ENVIRONMENTAL INFORMATION SYSTEM (SEIS). The analyses of this program describes the situation in the Mediterranean sub region as exhibiting important gaps of knowledge regarding reliable data on levels and loads of pollutants, information on issues of trans boundary concern, inventories of specific ecosystems and hot spots and regional cooperation. Even though there are a number of Political Agreements on monitoring, such as MED-POL of the UNEP/MAP, the contracting parties have failed to comply with their responsibility in spite of the agreements. Information is collected from national diagnostic analysis reports, in most cases it comes from case studies and research programs rather than comprehensive national monitoring programs. Overall, the information about the environmental state, trends and pressures is rather poor in



the Mediterranean region as compared to the North and Baltic Seas. In particular, information for the South and East Mediterranean is generated through scattered, inconsistent and sometimes unreliable investigation programs. Therefore it is suggested to deploy effort to establish continuous monitoring programs on environmental status and pressures on the marine/coastal environment. More capacity building in these issues is needed as well as sound agreements on the selection of key parameters and indicators resulting from harmonized techniques and guaranteeing data quality.

Data on transfer of loads via air-sea interaction are not well addressed and when they are, the spatial coverage is very heterogeneous. For example, data on hazardous substances and nutrients in aerosols and rainwater exist for the North western Mediterranean since the late 1980s, as opposed to the South western Mediterranean where there is little information. Data on riverine discharges are very scarce. Most rivers, even though they are very important, are not adequately monitored for loads of organic and inorganic pollutants. This implies lack of long time-series data. As far as the urban-industrial discharges are concerned, the information so far collected is the result of an estimation programme based on emission factors in the framework of the preparation of the national diagnostic analysis reports of the impacts of land-based sources and the national baseline budget of releases from land-based point sources.. Nevertheless, the collection of input data from point sources is considered a breakthrough by the Mediterranean countries.

However, the continuous exploration carried out by the scientific community of the effects of old and new contaminants, is a key element in the evaluation of the pertinence and impact description of traditional indicators and the proposal of new indicators, and the obtention of related data, to measure the impact of contamination on the biota or the sea and coastal use. It is noteworthy to mention the use of mussels (*Mytilus spp.*) as a bio-indicator for monitoring chemical contaminants in the Mediterranean Sea.

Several research programmes substantially increase available information on the Mediterranean coastal environment. However, reliable field data remain sparse for wide coastal areas, especially along the southern and eastern shores. Nevertheless, the emergence of new threats and the evidence that those already well known may be more seriously and globally affecting the environment than formerly thought, stress the need to develop integrated strategies to protect both the environment and human health. Strategies and methodologies must be coordinated, the outcomes of such an operational network will

- provide End-Users (Mediterranean countries, EU, UNEP-MEDPOL) with an unique, integrated and standardised network equipped to assess long-term changes/improvements in the quality of the Mediterranean coastal environment,



- identify clearly the contribution of different sectors (urban, industry, tourism, agriculture) to Med sea pollution as basis for adapted sectorised strategies
- substantially improve the knowledge on the contamination of the coastal environment with reliable and inter-comparable data on key pollutants at the Basin-wide scale (key information for the assessment of temporal trends and for the decision on actions to be taken and legislation to be enforced),
- consolidate a reliable and sustainable related database,
- improve multi-lateral communications among Mediterranean countries,
- promote local, more fundamental, applied or prospective pollution-related research that can benefit from local enhanced expertise and/or equipment.

The evolution of chemical contaminants within the Mediterranean Sea must be approached by the construction of **complete biogeochemical models** in which scenarios based on various emissions and environmental changes could be implemented.

This requires increasing our knowledge on

- flux data at sources and sinks and their temporal variations,
- Understanding the processes of contaminants accumulation in marine biota (bio accumulation and bio-magnification in food webs) and emerging contaminants (new chemical compounds).
- bio-geochemical behavior models based on the specific properties of chemical contaminant and their integration within the biogeochemical cycles of major elements, including transfer processes at physical and biological interfaces (exchanges, bioaccumulation, etc.).

This comes with the coupling of biogeochemical, ecological, sedimentary, hydro dynamical and atmospheric models, and this philosophy should be in mind when building policies in term of monitoring and research at general and local scales.

Marine litter which is commonly associated to shipping but also to coastal urban waste management remains an issue for many Mediterranean areas. The Mediterranean Action Plan (MAP) of UNEP (United Nations Environmental Program) previously carried out in 2001 and more recently in 2011 assessed the status of marine litter in the Mediterranean. The study showed that the main sources of coastal litter in the region are river runoff, tourist activities and coastal cities whereas the presence of litter in the beaches, floating or on the sea bed indicated an inadequate management of coastal solid wastes.

The conclusions of the MAP/UNEP, 2011 assessment, which is based on the 2008 report UNEP/MAP, MIO-ECSDE, HELMERA and Clean-up Greece can be summarized as follows:

- Data on marine litter is available but it is inconsistent and mainly from North Mediterranean. It has also been observed a decrease in the number of items and weight of marine litter and a proliferation of lighter marine litter items (e.g. plastics, aluminum and smoking-related litter) as opposed to heavier items from dumping activities (e.g. construction materials, tires, etc).
- Standardized research data for statistical purposes concerning the problem of litter in the Mediterranean is a necessity. Data on the amounts and types of collected marine litter from literature, authorities, NGO's, etc. are difficult to compare because surveys are conducted with different criteria, e.g. litter types are classified differently; in some cases litter is measured in items while in others by weight; etc., while other important information is not given (e.g., type and length of coast cleaned, proximity of coast to sources of litter, etc.).
- The sources of most of the Mediterranean marine litter are largely from land-based sources rather than ships.
- Marine litter on beaches in the Mediterranean originates from shoreline and recreational activities due to tourism (which generate an average of 10-15% more waste than inhabitants) and the poor solid waste management in most Mediterranean countries. The main types of marine litter in the Mediterranean are plastics (bottles, bags, caps/lids etc.), aluminum (cans, pull tabs) and glass (bottles) (52%). Marine litter from smoking related activities accounts for 40% (collected items), sea and waterway activities account for 5%, dumping for 2% and medical/personal hygiene for 1%, respectively.
- In terms of marine litter floating on the surface of the Mediterranean sea in 2008 according to the Hellenic Marine Environment Protection Association, plastics account for about 83% (no. of items observed), textiles (6%), wood (6%), paper (3.8%) and metal (1.2%) as major categories observed from vessels.
- Only few countries have policies related specifically to marine litter although policy reforms covering from waste prevention practices to environmental waste disposal is being carried out in most of them. Local administration and municipalities are usually the ultimate responsible for the management of coastal litter in the region. It has not been reported any kind of collaboration on the issue of marine litter management among neighbor countries.
- The Integrated Coastal Zone Management (ICZM) Protocol signed in January 2008 by Algeria, Croatia, France, Greece, Israel, Italy, Malta, Monaco, Montenegro, Morocco, Slovenia, Spain, Syria and Tunisia, and the coming into effect in 2009 of the Mediterranean Sea as a *Special Area* (under Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL)), will reinforce marine litter management. Another important aspect widely unknown of marine litter is the impact of floating and sea bottom debris on marine life. As an example, the SEAS-ERA.Net EU-project focus its research recommendations, among other subjects, on assessing the impact of marine litter on benthic and pelagic organisms.

Marine litter has been targeted as a secondary source of trace metals in the Mediterranean Sea, but there are very few studies on the presence of emerging contaminants coming from river runoff or dumping (e.g. pharmaceuticals, per fluorinated compounds, etc) or having endocrine disrupting properties (e.g.



phthalates, nonylphenol, bisphenol A, etc.) in coastal water and/or organisms. Understanding the occurrence and fate of these substances and modeling their exchanges between marine compartments must be a research priority. Another focus of interests are the early detection of spills (e.g. heavy oils) or the study of processes of bioaccumulation and bio-magnification of chemical contaminants in marine food webs as stated by the Seas-ERA EU-project.

Marine Litter Monitoring programs (MLM) are currently carried out in many Mediterranean countries. It has been claimed the lack of statistics in most of the countries and also the lack of mechanisms for collecting information and monitoring trends in the areas of concern. As already mentioned, the problem in the former case is the lack of standardization and compatibility between methods used and results obtained in these monitoring programs. Thus, it is difficult to compare data from different areas and to make an overall assessment of the marine litter pollution situation for the entire Mediterranean region.

The Barcelona Convention for the Protection of the Mediterranean Sea against Pollution, adopted in 1976 by the Mediterranean countries, signed the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources (LBS Protocol, 1980). In 1996 the protocol was amended to cover the entire watershed area within the territories of the riparian states draining into it, the waters on the landward side of territorial boundaries, and communicating brackish waters, marshes, coastal lagoons and groundwater (UNEP/MAP, 2010).

However, the land-based activities mainly addressed in the LBS protocol and in its "executive arm", the Strategic Action Programme (SAP), are mainly related to urban environment (especially municipal wastewater and urban solid waste) and to industrial activities. Solid waste apart, sewage effluents and industrial discharges are the only pollution sources generally accounted for coastal pollution.

This may be mainly due to the fact that they are point-pollution sources and are thus easily identifiable and verifiable in terms of pollution potential.

Nevertheless, one should be aware that point-pollution sources represent only a fraction of the land-based sources of pollution affecting the sea water quality and environment. The widespread occurrence of non-point source (NPS) pollutants in surface (and groundwater) waters reaching the sea by rivers and groundwater flows has been well documented. In the wide world, NPS pollution is mainly associated with agriculture primarily because of the potential movement of materials from the land surface into rivers and streams via runoff and erosion, and into groundwater via leaching. The U.S. Environmental Protection Agency (USEPA; 1990) already identified in 1990 the non-point runoff of agricultural chemicals, nutrients, pathogens and sediments coming from inland agricultural and livestock farming activities to cause impairment of 55% of the surveyed river length.

In the Mediterranean also, agricultural practices are now recognized as the largest non-point source of pollution carrying phosphorus, nitrogen, pesticides, heavy metals, pathogens, salts and trace elements. Particularly, due to the large increase of pesticides application over the last twenty years, agricultural run-off through rivers has



become the most important non-point-source contributor of pesticides to the Mediterranean. (UNEP/MAP, 2010).

Mediterranean coastal water are especially sensitive to the issue of agricultural non-point source pollution as by 2025 countries on the southern and eastern edges of the basin are expected to show a five-fold increase in their agro-food activities (UNEP/MAP, 2010). These countries will therefore be the most vulnerable to increased pollution from the expansion of the agro-food activities.

Unfortunately, non-point source pollution is more difficult to be aware of than point source pollution. Releases of nutrients, mainly nitrogen and phosphorus compounds, into sea water are the major reason of eutrophication, especially in areas of limited water circulation, which may induce algal blossom and altered/decreased biodiversity. Also pesticides may be very dangerous, even if their behaviour in the marine environment requires deeper studies.

River fluxes are obviously the main pollutant conveyor of agricultural NPS to the Mediterranean Sea.

The discussion above just says that water quality issue cannot be restricted only to wastewater management, but it calls for interconnected land-sea strategies and policies. In other words, the issue of seawater pollution should be approached by viewing *the coastline and the river basins as an integrated physical and hydrographical unit*. Land-based NPS of pollution, especially from agriculture, should be considered at least as hazardous as the urban and industrial point-source of sea pollution. In this sense, suitable decision-making strategies for managing and protecting the marine environment would require a change in the public concern to the agricultural NPS of coastal water pollution.

Obviously, assessing the environmental impact of NPS pollutants at the scale of the Mediterranean coastal region is a complex task. Forecasting information from model simulations with the appropriate databases may thus be considered as powerful tools in decision strategies specifically designed to protect the coastal water resources.

In summary, efforts to improve coordination among the different actors involved in waste management; **lack of reliable statistical information** (need of a standardized data card); lack of technical tools, means and expertise at regional and national levels; need for further information on the impacts of marine litter, diffuse and emerging pollutants on humans and ecosystems; increase of awareness campaigns and educational programmes have been pointed out as priority actions to improve the situation of the marine pollution in the Mediterranean. Finally, it must be taken into account that there are not a concerted regional response to the problem of marine contamination in the Mediterranean through a harmonized regional coastal waste management scheme, taking into account national specificities, needs, opportunities and priorities (MAP/UNEP, 2011). It is noteworthy that a number of H2020 capacity building workshops were devoted to Marine Litter, based on relevant demand by South Mediterranean Countries.



## 7. THE WASTE WATER REUSE ISSUE

The Mediterranean basin is characterized in its southern regions by the water scarcity due to low rainfall and the consequent overexploitation of groundwater resources. However, the waste water reuse is still statistically insignificantly in comparison with conventional water resources. This is a common situation in most of the N and S countries, with the exception of some countries such as Israel or some Spanish regions as Murcia. The reasons vary from the application of strict precautionary principles in Italy, to the lack of appropriate waste water treatment plants and reuse techniques and strategies in many countries of the S Mediterranean.

The improvement of waste water uses should take into account a number of recommendations:

From a general point of view, recommendations that can lead to a significant and effective water reuse in the Mediterranean countries with water scarcity problems include:

- 1) Increase investments and research on the newest and most efficient wastewater treatment technologies, to reduce reclaimed water production costs.
- 2) Develop a flexible legislative or normative framework which establishes reclaimed water reuse rights and concessional system, quality standards according to the final uses, and procedures to bring closer this resource to water users.
- 3) Increase population's awareness and higher water-consumer sectors of the importance of making a rational and efficient use of water to ensure a sustainable development, and the benefits of reused wastewater to maintain clean water flows or groundwater reserves.
- 4) Water reuse must be primarily tackled in the industrial sector, where direct water recycle may be easily implemented through source segregation within the production cycle. This should lead to "zero discharge" of those industrial pollutants that, passing unaffected through the municipal wastewater treatment plant, may hinder treated water reuse.

In addition to the already planned actions, the Tunisia, Italian and Spanish reports recommend to build strategies based on customized approaches with reuse integration:

- Wastewater reuse (minimum 50%) should be considered as compulsory when developing any new WWTP project and treatment processes has to be sustainable and reliable to ensure a constant quality in TWW. Invest in existing reuse systems so as to suit the quality standards demanded by potential users.
- Reuse options can be related to agricultural, tourism or industry activities or indirect reuse with specific requirements. It should exist always a real





demand of purified treated wastewater in order to involve the different stakeholders (users, authorities, etc.) in the works funding.

- Encouragement of R&D, pilot studies, case studies, capacity building etc., to optimize the valorization of sludge to increase economical and energetic efficiency and decrease potential negative impacts. Facilitate the compliance with stringent standards and reducing productions costs, etc.
- Principles of water-saving and water efficiency improvements considering reuse/recycling in short and long term should include standardized requirements before supplying high water consumers for instance agriculture, tourism and industry (excluding human consumption and environment protection).
- Face the weaknesses in the management and operation of wastewater treatment systems, e.g. lack of funding, control, resources, and, in many cases, a lack of real users concerned or convinced to pay for reclaimed water, with an appropriate stimuli policy using taxation, prices and transparency in the information of the reclaimed waters quality and applicability.
- Monitor uncontrolled spills into municipal collectors that hinder the treatment of wastewater, and hence its regeneration to the quality standards prescribed by law.
- Update the water concession system to existing uses of regenerated water, and associate the handling of both resources
- Increase public and higher water consumer sectors awareness in the usefulness of reused wastewater in specific applications and uses, to release pressures on water bodies and thus protect the environment. To this end, the series of H2020 capacity building workshops carried out until now could be considered as very helpful. A regional strategy could be promoted to transmit good-practices and gathered experiences, taking into account cultural and specific geographical aspects.
- Increase investments and research on the adaptation of the newest and most efficient wastewater treatment technologies, with the aim of reducing wastewater treatment costs.
- Ensure principle of sustainability regarding water consumption for new urban developments, through a proper legislative framework and use of construction's good practices for an efficient water use.
- Develop a legislative or normative framework that ensures the optimal quality standards related to the intended uses, establishes water treatment and reuse rights, concessional systems, and procedures to bring closer this resource to water users (this should be applied at the national level, but regional guidelines should be promoted).

## 8. INNOVATION DIMENSION

Policy makers charged with environmental management are generally faced with a difficult task to start with because environmental interventions are not perceived as productive activities but as breaks in economic activity.

Each economic tool that will be designed for the treatment and prevention of pollution of the Mediterranean Sea from land based sources should be based on the market mechanism of pollution rights trading of emission/wastewater discharge. For implementation the tool, it is necessary to customize it for use in the Mediterranean basin, which has a large number of countries with different social – economic characteristics, and a large gap both in traditions and at the level of economic development and existing physical infrastructure.

To ensure a good application of the designed tool, it is necessary to assure the definition of the tested parameters, and create a preliminary process that will allow measurement and control of the processes taking place in countries participating in the array of trade. Furthermore, it is necessary to discuss aspects related to the required minimum standard level of sewage treatment, the establishment of recovery and treatment systems, ensuring transparency and creating clear and sustainable funding mechanisms.

A key factor which requires a solution in the design of the new policy is the subject of equity principles. Lack of attention to these principles will violate the balance between developed and developing countries, and in fact harm the chances of successful implementation of the economic policy tool.

In the long run, the prospects for using economic instruments in developing countries (as in developed and transitional economies) are virtually unlimited. They are the fastest and least costly (and possibly the only) vehicle to sustainable development. The source of the problem is under pricing and free riding. To the extent that economic instruments prove to be effective means of internalizing environmental and depletion costs and instituting full-cost pricing, they hold the key to environmental management and sustainable development for resources such as the Mediterranean Sea, considered a "Global Common" (earth's unowned natural resource).

Most of the countries in the Mediterranean are facing water shortages and are characterized by a severe water imbalance between water demand and supply, with problems peaking especially during the summer season. In addition, climate change effects will most likely exacerbate these imbalances and related conflicts. On the other hand, in the Mediterranean region water shortages have historically provided the incentive to promote water-related technologies and saving practices, and the Region has been since pre-history the origin of important 'technologies' for the storage, treatment and reuse of waters.

The main focus of action is currently shifting to the reuse of wastewater and unfortunately an analysis of the current status in this regard shows that a number of countries do not have sufficient systems for urban and industrial wastewater



treatment and some countries still dump raw sewage into the sea or use it for direct irrigation purposes without treatment endangering human health and the environment as a whole, when quality standards have not been previously set. In addition, industrial activity in the region is increasing and changing, introducing new pollution agents with their associated impacts.

In this regard, the mobilization of non-conventional water resources is increasingly being considered as one of the main options to alleviate water scarcity, imbalances and reduce environmental pressures. In fact, treating wastewater in the Mediterranean countries is not only important to reduce the contamination going to the sea but it is also increasingly being considered in regards to the provision of a new source of water which will provide an environmental, social and economic asset to complement the national and water budgets. The need for immediate action is thus paramount - as a reminder, according to the Barcelona Declaration the Mediterranean cities that do not belong to the EU and that have a population of more than 100,000 inhabitants must have installed adequate wastewater treatment systems by 2005, while those having a population of more than 50,000 inhabitants should have done so by 2010.

The following overarching recommendations for an Innovation Strategy in waste water treatment and reuse have been identified:

- A balance should be established between technological innovation, social/cultural issues and economic aspects in order to address supply and demand issues in particular through determining, and achieving the optimal level of water quality for different uses, thus ensuring maximum applicability. Depending on the particular use, considerations related to the net environmental impact of the reused water should be paramount.
- Current expectations indicate that industrial water demand shows an increasing trend. Governments should propose (and later-on impose) to industries the incorporation of water reuse systems in particular for their process water. To do so, public-private partnerships, incentives and other economic tools should be promoted.
- There is still a need to develop competitive research on water technologies to enhance innovation in the water sector (e.g. to increase water savings, precision irrigation, efficient water use, water treatment, irrigation performances or water productivity). Consequently, funding priorities should focus on the implementation and adaptation of results achieved in existing research in particular through related field demonstration.
- While progressing on innovative know-how research, existing knowledge and results of previous research projects should be explored and their results capitalised. It is of high importance, for instance, to gather good practices and pilot activities and make them available to the wider public. Moreover, it should be ensured that results from research networks reach politicians, policy makers and the industry (better marketability of findings is needed in order to



ensure that such research is able to influence the future direction of water policies and action programmes in the region).

- In addition, efforts should focus on developing the necessary know-how for improving the methodology required for reducing pollution at the source. This could be combined with the H2020-CP/RAC of UNEP/MAP efforts for promotion of clean technologies in industries. Such an approach will reduce the level of downstream treatment requirements, ensure a more affordable treated-product and thus achieve wider usability even in low economic return activities (e.g. preventing and planning measures).
- Innovative aspects are clearly linked to governance set-ups, as the latter should ensure technological transfer and exchange of experiences, and usually establish financial instruments to minimize pollution and encourage conservation. Thus, the links should be looked for and strengthened.
- Due to multi-sectored aspect of water, it is important that water issues are tackled in multi-disciplinary environment to consider interfaces and generate innovation
- To increase economical impact of R&D and know how transfer, all the components of water chain (from supply to reuse) has to be considered in integrated approach but in well defined local implementation.
- Innovation structures and mechanisms as well as clear national innovation system has to be supported (CB, infrastructure, management tools, risk consideration....) for implementation and efficient impact.
- Supporting Public-Private-Partnerships in water sector is important for innovation and R&D transfer specially when the public sector is the main actor
- Adopting a common Water Strategy for the Mediterranean and a well-structured Action Plan will contribute not only to the harmonization of the Institutional regularity Frameworks but also in asking Mediterranean countries formulate and implement coherent national policies and strategies.

### **Transfer of technology. Exchange of experiences**

- There is a need to promote appropriate treatment technologies and improve existing facilities for:
  - Highly populated touristic areas: plants and treatment systems should be efficient, manageable and adapted to seasonal wide population fluctuations.
  - Small scale and rural areas: facilities should be cost-effective, easy to manage and maintain and directed towards the production of an effluent, which can be safely re-used in the rural environment.



- Capitalization of the results from existing research and capacity building initiatives should be ensured to achieve a wide dissemination of the available knowledge on technologies, research results. This process should also promote connections among researchers' and other relevant networks (North-South, South-South, etc.).
- In addition, the transfer of know-how should be promoted through comprehensive contracts, the mobility of existing equipment (e.g. to areas in need) technology settlement, and the development of co-ownership of technological advances. In some cases the adaptability of transferred technology is not always ensured, and additional training and capacity building is needed.

### Socio-economic aspects

- Participative processes should be promoted in cost-benefit analyses to ensure the implementation and social acceptance of selected measures (and reduce conflicts risks).
- Surveys and studies should be developed to assess the social acceptance of the reuse aspects, and at the same time transmit information on the matter.
- Economic incentives for municipalities, industries and SMEs should be progressively implemented to reach "zero discharge".

### Access to data and data sharing

Important amounts of data exist, especially from previous research projects, as well as from pilot activities and best practices, but there is a lack of interconnection of databases at national and regional levels. Quality data is not always ensured (different systems sometimes provide different data for the same variables). Thus, innovative mechanisms should be used to ensure quality and reliance of data, and improve their easy access from the public. Further works should be developed on environmental indicators and data sharing processes. Existing information systems and repositories should be promoted to improve data share related to innovative practices. In addition, connections among these systems could be improved. For new and to-be-developed infrastructures using innovative aspects, sustainability assessments should be shared with the civil society.

### Emerging issues: dredging, ballast waters (exotic species), emergent pollutants (hormones, drugs), ...

Exotic species (from one Sea to another) are introduced through different ways as for instance, through ballast waters (waters released from ships to balance flotation). Although international agreements exist on this topic, a better



implementation of recommendations should be ensured to reduce related impacts. Furthermore, there should be an increase in training and update of professionals (improve and renovate technical guidelines).

Important sea pollution is related to dumping of dredged materials from ports. Innovative aspects should focus on improving sampling methods of pollutants, controlling the dredged material and implementing managing and treatment practices of materials (these can be reused in hydraulic or civil works, stored in retention ponds to reduce pollution risk...).

Technologies to remove emerging pollutants of industrial origin exist but are expensive. In addition, direct impacts of these pollutants in flora and fauna are still incomplete. Additional research should focus on determining the effects of these pollutants and more cost-effective technologies are required for their removal.

## 9. MIRA PROJECT PROPOSALS FOR ACTION

A Research Agenda for De-Contamination of the Mediterranean falls within the demands of several actions undertaken in recent year starting with the actions of the UNED-MAP(MED-POL, Plan Bleu, etc.) and several European initiatives such as the European Pollutant Release and Transfer Register (E-PRTR), the demands of EUROSTAT or the actions of GEOSS and the My-Ocean Program of DG Environment.

The SEAS-ERA.Net Project suggests some key strategic objectives for a healthy Mediterranean marine environment such as: "Improve our understanding of Mediterranean Sea functioning and evolution", "Support sustainable economic growth in the region", "Support knowledge-based policy making and management", "Develop new capacities and promote convergence between Mediterranean countries",

SEAS proposes a number of research priorities covering a full range of actions aimed at understanding the marine dynamic, the behavior of the biota, and several other aspect related to the use of resources and technological developments. In the case of the marine pollution it proposes the following research issues to be treated in the Mediterranean context:

- Hazardous and noxious substances contamination
- Marine litter and underwater noise
- Assessment of anthropogenic pressures
- Environmental Assessment Criteria (EACs) for key pollutants.
- 

This, essentially, has also been treated by the MIRA working group taking into consideration the important inputs of this Project.

In the frame of ERA-WIDE Programme, water priorities in S&T with the objective to address jointly the common key issues are target by several projects. As example, priorities identified by CB-WR-MED project (FP7-INCO-2010-6, ERA-WIDE, Area INCO, 2010-6.2 Workshop Organized by CERTE, Tunisia) underlined the need of capacity building in these priorities related to Med sea de-pollution:

- R&D for national water data base and indicators development: developing robust and flexible water systems, efficient monitoring systems, database construction or improvement/connection of existing ones (TN, MED, EU, etc.) with adapted indicators development.
- Tools to support proactive management of the risks of extreme event (floods, droughts) and scenarios development: Integrated responses to extreme events with consideration of different components (environment, climate, socioeconomic, water quantity, water demand, land protection, risk management, eco-system, etc.), development of alert systems and connections of existing ones (national and regional level).
- Efficient water use (including wastewater) at Agricultural level
- Sustainable approaches and technologies for water saving: Multiple use of water at urban and rural levels integrating end-users specificities and adapted management schemes
- Cleaner production and service to minimize water footprints, increase water efficiency and decrease environmental impact in sectors with high water consumption or high polluting impact.
- Impacts of climate change on natural resources: It is important to develop monitoring capacities (accurate field data) and adapted tools and models for climate projections.
- Water in the green economy: sustainable water management as driver to innovation and economical development
- Sustainable Desalination: decrease the negative impacts of desalination

The results of the MIRA Working Group on the Research Agenda for H2020 can be summarized in a number of domains of actions and concrete scientific research topics:

- Political and socio-economic domain. Innovation prospect
  - Collecting information about the institutional regulatory framework of water planning and waste water treatment in the different countries. Analysis and benchmarking of the legal and regulatory frames.
  - Analysis of the participative processes in water management and pollution abatement in the various Mediterranean countries.
  - Adopting the Water Strategy for the Mediterranean and a well-structured Action Plan will contribute not only to the harmonization of the Institutional regularity Frameworks but also in providing coherent national policies and strategies in the various Mediterranean. Feasibility study on a "Mediterranean Water Framework Directive" aiming at establishing a watershed-to-sea management prospect, based in basin units and



establishing proper incentives for the reduction of contamination and reuse of waste water. This prospect should result from an exercise of Mediterranean-wide discussion and being fully co-owned by all or most of the Mediterranean countries.

- Elaboration of guidelines to promote the sharing of water resources and contamination data and the opening of the national data base by all or most of the Mediterranean countries. Toward a common monitoring system.
- Proposals for shortening the intake of the scientific advice by the decision-making community (legislative bodies, administrations, etc.). Mechanisms to promote and use the scientific support to the governance of the Mediterranean contamination issues
- Support for the development of new technologies to tackle the reduction of pollutants (traditional and new) from the punctual and diffuse sources. New business opportunities in the handling of reclaimed waters.
- Market and Incentive packages schemes to encourage different types of waste water treatments.

➤ Social awareness

- Building trust between public and government/private agencies responsible for water and waste water treatment to be accepted for specific uses by the public.
- Creating an intellectual resources bank of science based arguments about water impact on society structure, the meaning of water scarcity, need of utilization of reclaimed waters and criteria for its use, to be used at different levels of education.
- Repository of updated information about water challenges in the Mediterranean accessible to the media

➤ Capacity building in the scientific environment

- Use the experience of the activities in Capacity Building (CB/MEP) H2020 Sub Group (MIO-ECSDE) for capacity building in scientific environment and develop adapted mechanisms and connections with other programmes for sustainable impact. Promote specific training for technicians and scientist on the De-contamination topics and technologies.
- Use the experience of ERAWIDE programs and the water priorities for S&T collaboration identified in the frame of related projects as starting point to build efficient CB in scientific environment
- Promote the systematic uptake of the Mediterranean ancestral water culture, and link the results of the past with present research effort (see HYDRIA project/MEdIES).





- Create a specific fund to support the upgrading of the research analytical infrastructures, with a perspective of sharing them with the monitoring institutions.
  - Create a specific fund to support the certification of the analytical infrastructures and procedures.
- Connectivity with the Monitoring initiatives. Standards and quality of data exploring fully the H2020/SEIS and UNEP/MAP projects
- Comprehensive revision of the different national systems already in place and standardize their different processes.
  - Setting a uniform data collection system with shared methodologies and quality standards.
  - Creation and maintenance of a Mediterranean-wide common data base for monitoring and scientific purposes, and to support an evidence-based political management.
  - Enhance regional cooperation as it concerns data for offshore waters and characteristics of sub-regions according to EU Marine Strategy Framework Directive (MSFD) and UNEP/MAP Ecosystem Approach.
  - New measurements should address emerging needs (e.g. climate change, species migration and intrusion of alien species).
  - Develop citizen science (involve public in environmental data acquisition).
- Scientific research areas to be addressed
- Drafting the targeted research programs and project with full development of the social, economic, cultural and scientific dimensions.
  - Impulse the shared elaboration of complete biogeochemical models in which scenarios based on various emissions of agricultural, industrial, physical (including sediments), chemical and biological pollutants (such as algal bloom or invasive species), and environmental changes (including climate changes) could be implemented, and serve as a reference for assessment the quality of waters.
  - Deepening the study of the impacts of emerging contaminants coming from river runoff or dumping (e.g. pharmaceuticals, per fluorinated compounds, etc.) or having endocrine disrupting properties (e.g. phthalates, nonylphenol, bisphenol A, etc.) in coastal water and/or organisms. Modeling of the nutritional web evolution provoked by these emerging contaminants.
  - Modeling the impact of coastal urbanization in waste water production and management, coastal erosion and marine litter impact.
  - Modeling of changes in the basin hydrological cycles provoked by man induced changes or extreme events, considering the coastal lines and the river basins as an integrated physical and hydrographical unit.



- Modeling the impact of punctual and diffuse (agricultural origin) contamination on the human health, fisheries and aquaculture activities.
- Developing of early warning monitoring systems strategies and assessment methodologies.
- Fostering innovation in water sector and know how transfer
- Supporting R&D project on Med sea protection including prevention actions “acting at the source” in the frame of sustainable development

## 10. POTENTIAL IMPLEMENTATION OF THE RESEARCH AGENDA

The Research Agenda proposed above tries to support a knowledge-base and societal appropriation of the actions of H2020. It propose activities of a wide range of domains, where the pure activities of research are framed by the socio-economic, political and innovations aspects. Therefore, the implementation of this Agenda should be carried out by a number of different actors and financing agencies, but taking care of guaranteeing the full interaction between the different domains. The final objective of this proposal is to build a Decision Support System for the shared objective of the EU and the MPC to De-Contaminate the Mediterranean in accordance with a number of international agreements. The Governance and Sustainability of this activity is of outmost importance because the common endeavor is a long term journey, and it is needed a stable structure that could guarantee the continuous flow of information and warning signals to the decision-making structures. Therefore, the stability of the proposed structure could only results from the setting of shared and co-owned cooperation structures between the EU and the Mediterranean Neighbors Countries, as a consequent development of the Barcelona Process or the Union for the Mediterranean Agenda and structures. A Governance structure will full co-ownership of all the participating partners must be established with full legal capacity, and respecting the national legislations.

Moreover, the financing, promotion and management of the proposed activities must also result for the perception of the mutual benefits, which are very clear, and the will of co-ownership of its structures and results. A mix of funding agencies resulting from the aggregation of national, regional, private and EU programmes should be set, in respect of the strategic objectives of each stakeholder and their fields of competences. For example, the pure research actions, as well as the fundamental mobility actions, could be covered by the National Research Programs and the EU-FP, and have a full political support to avoid the continuous Visa problems,



but the dissemination and education activities could be covered by a different fund, perhaps a private Foundation or an international program, and the capacity building and research and monitoring infrastructures could be financed by the ENPI.

## 11. WORKING GROUP MEMBERS

In alphabetical order by country:

- Ms. Tania Floqi, UTPolitecnic, Albania. Email: [tfloqi@yahoo.com](mailto:tfloqi@yahoo.com)
- Mr. Abdelkrim Sadi, CDER, Algeria. Email: [a\\_sadi@cder.dz](mailto:a_sadi@cder.dz)
- Ms. Sanda Midzic-Kurtagic, University of Sarajevo, Bosnia and Herzegovina. Email: [sanda.midzic@heis.com.ba](mailto:sanda.midzic@heis.com.ba)
- Mr. Jure Margeta, Faculty of Civil Engineering and Architecture, University of Split Matice, Croatia. Email: [margeta@gradst.hr](mailto:margeta@gradst.hr)
- Ms. Despo Fatta-Kasinos, University of Cyprus, Cyprus. Email: [dfatta@ucy.ac.cy](mailto:dfatta@ucy.ac.cy)
- Mr. Alaa El-Din Abdin, Strategic Research Unit, Egypt. Email: [alaa\\_ea\\_abdin@yahoo.com](mailto:alaa_ea_abdin@yahoo.com)
- Ms. Zeinab El-Sadr, MHESR, Egypt. Email: [zs@sti.sci.eg](mailto:zs@sti.sci.eg)
- Mr. Hamid El-Zoheiri, MHESR, Egypt. Email: [zoheiry@rdi.eg.net](mailto:zoheiry@rdi.eg.net)
- Ms. Rasha El-Ashry, MHESR, Egypt. Email: [relashry@rdi.eg.net](mailto:relashry@rdi.eg.net)
- Ms. Alia Mokbel, MEHSR, Egypt. Email: [amokbel@rdi.eg.net](mailto:amokbel@rdi.eg.net)
- Mr. Abd-Allah Gad, NARSS, Egypt. Email: [abdallagad@gmail.com](mailto:abdallagad@gmail.com)
- Ms. Suzan Kholeif, National Institute of Oceanography and Fisheries (NIOF), Egypt. Email: [suzankholeif@gmail.com](mailto:suzankholeif@gmail.com)
- Mr. Bruno Andral, IFREMER, France. Email: [Bruno.andral@ifremer.fr](mailto:Bruno.andral@ifremer.fr)
- Mr. Michael Papapetrou, WIP, Germany. Email: [michael.papapetrou@wip-munich.de](mailto:michael.papapetrou@wip-munich.de)
- Mr. Evangelos Papathanasiou, Hellenic Center for Marine Research, Greece. Email: [vpapath@ath.hcmr.gr](mailto:vpapath@ath.hcmr.gr)
- Ms. Catherine Tsangaris, Hellenic Center for Marine Research, Greece. Email: [ctsangar@hcmr.gr](mailto:ctsangar@hcmr.gr)
- Mr. Michael Scoullos, H2020 CB Group and MIO-ESCDE, Greece. Email: [scoullos@mio-ecsde.org](mailto:scoullos@mio-ecsde.org)
- Mr. Uri Mingelgrin, Inst. Soils, Water and Environmental Sci., Israel. Email: [uriming@volcani.agri.gov.il](mailto:uriming@volcani.agri.gov.il)
- Mr. Tomer Ash, Pareto Co., Israel. Email: [tomer@pareto.co.il](mailto:tomer@pareto.co.il)
- Mr. Antonio Coppola, CNR-CIHEAM, Italy. Email: [antonio.coppola@unibas.it](mailto:antonio.coppola@unibas.it)
- Mr. Pierfrancesco Moretti, CNR, Italy. Email: [pierfrancesco.moretti@cnr.it](mailto:pierfrancesco.moretti@cnr.it)



- Ms. Chiara Morini, CIHEAM, Italy. Email: [c.morini@iamb.it](mailto:c.morini@iamb.it)
- Mr. Nicola Lamaddalena, CIHEAM, Italy. Email: [lamaddalena@iamb.it](mailto:lamaddalena@iamb.it)
- Mr. Claudio Bogliotti, CIHEAM, Italy. Email: [bogliotti@iamb.it](mailto:bogliotti@iamb.it)
- Mr. Dario Marani, CNR, Italy. Email: [marani@irsa.cnr.it](mailto:marani@irsa.cnr.it)
- Mr. Muhammad Shatanawi, Jordan University, Jordan. Email: [shatanaw@ju.edu.jo](mailto:shatanaw@ju.edu.jo)
- Mr. Abdul Mouneimne, National Council for Scientific Research, Lebanon. Email: [abdul.mouneimne@gmail.com](mailto:abdul.mouneimne@gmail.com)
- Ms. Carine Abu Ghanem, National Council for Scientific Research, Lebanon. Email: [carine.abighanem@cnrs.edu.lb](mailto:carine.abighanem@cnrs.edu.lb)
- Ms. Elise Noujeim, National Council for Scientific Research, Lebanon. Email: [enjeim@cnrs.edu.lb](mailto:enjeim@cnrs.edu.lb)
- Mr. Manuel Sapiano, Malta Resources Authority, Malta. Email: [manuel.sapiano@mra.org.mt](mailto:manuel.sapiano@mra.org.mt)
- Ms. Laila Mandi, Université Cadi Ayyad, Morocco. Email: [mandi@ucam.ac.ma](mailto:mandi@ucam.ac.ma)
- Mr. Mustapha Ijjaali, Sidi Mohamed Ben Abdellah University (USMBA), Morocco. Email: [ijjaali@yahoo.com](mailto:ijjaali@yahoo.com)
- Mr. Alhame Begdouri, Sidi Mohamed Ben Abdellah University (USMBA), Morocco. Email: [abegdouri@gmail.com](mailto:abegdouri@gmail.com)
- Mr. Ayman Rabi, PHG Palestine. Email: [ayman@phg.org](mailto:ayman@phg.org)
- Mr. Hilmi Salem, Director General of the Technical and Applied Research Center (TARC) - Palestinian Tech. Univ, Palestina. Email: [hilmisalem@yahoo.com](mailto:hilmisalem@yahoo.com)
- Ms. Vesna Flander-Putrlje, National Institute of Biology, Marine Biology Station Piran, Slovenia. Email: [Vesna.FlanderPutrlje@mbss.org](mailto:Vesna.FlanderPutrlje@mbss.org)
- Mr. Vlado Malacic, National Institute of Biology, Marine Biology Station Piran, Slovenia. Email: [Vlado.Malacic@mbss.org](mailto:Vlado.Malacic@mbss.org)
- Ms. Elisa Vargas Amelin, Mediterranean Network of Basin Organisations (MENBO), Spain. Email: [evargas@evren.es](mailto:evargas@evren.es)
- Mr. Rafael Rodríguez, IDAEA - CSIC, Spain. Email: [raro@orgc.csic.es](mailto:raro@orgc.csic.es)
- Mr. Joan Grimalt, IDAEA - CSIC, Spain. Email: [joan.grimalt@idaea.csic.es](mailto:joan.grimalt@idaea.csic.es)
- Mr. Jordi Martínez, IDAEA - CSIC, Spain. Email: [jordi.martinez@idaea.csic.es](mailto:jordi.martinez@idaea.csic.es)
- Mr. Francesc Ventura, Consultant, Spain. Email: [francesc.ventura@idaea.csic.es](mailto:francesc.ventura@idaea.csic.es)
- Mr. Awadis Arslan, GCSAR, Syria. Email: [abarslan@scs-net.org](mailto:abarslan@scs-net.org)
- Ms. Latifa Bousselmi, CERTe, Tunisia. Email: [latifa.bousselmi@certe.rnrt.tn](mailto:latifa.bousselmi@certe.rnrt.tn)
- Ms. Seval Sözen, Istanbul Technical University, Environmental engineering department, Turkey. Email: [sozens@itu.edu.tr](mailto:sozens@itu.edu.tr)