EXPERT GROUP MEETING ON CUMULATIVE ENVIRONMENTAL IMPACTS OF DESALINATION ON THE MEDITERRANEAN

SWIM-SM Activity 1.3.2.2

In coordination with UNEP-MAP

Brussels, Belgium

23 - 24 June 2014

Contents

List of Abbreviations & Acronyms

CC	**Climate Change**
CDG	**Core Desalination Group**
CSP	**Concentrating Solar Power**
EC	**European Commission**
EDS	**European Desalination Society**
EIA	**Environmental Impact Assessment**
EU	**European Union**
FPs	**Focal Points**
GHG	**Green House Gases**
LBS	**Land Based Sources**
LO	**Liaison Officer**
MAP	**Mediterranean Action Plan**
MED	**Multi-Effect Distillation**
MED-POL	**Programme for the Assessment and Control of Marine Pollution in the Mediterranean Region**
MEDRC	**Middle East Desalination Research Centre**
MSF	**Multi-Stage Flash**
NRW	**Non-Revenue Water**
PCs	**Partner Countries**
PPP	**Public Private Partnership**
PV	**Photovoltaic cells**
RE	**Renewable Energy**
RO	**Reverse Osmosis**
ROWA	**Regional Office for Western Asia**
SEA	**Strategic Environment Assessment**
SMC	**Southern Mediterranean Countries**

SWIM-SM	**Sustainable Water Integrated Management - Support Mechanism**
TL	**Team Leader**
UN	**United Nations**
UNEP	**United Nations Environment Programme**
WP	**Working Package**

1 ORIENTATION/BACKGROUND NOTE FOR THE EGM

In most South Mediterranean countries, there is growing concern that the available water resources are now facing or will soon encounter severe chronic shortages of freshwater that might make life impossible. This situation is likely to deteriorate further in view of the increased population, fluctuating economic growth, economic reliance on irrigated agriculture and the unpredictable impacts of climate change (CC).

Fortunately, advances in desalination technology have made it an economically viable alternative source of fresh water in the region. Consequently, in response to shortages of naturally renewable water supplies, many Mediterranean countries are bound to construct and operate large desalination facilities.

Starting from 1970 to the year 2013, over 1532 seawater desalination plants had been installed around the Mediterranean Sea. As of 2013, these plants have a total cumulative installed capacity of some 12 Million m^3/day. In the last 13 years (2000 to 2013), the reported installed capacity has dramatically increased by an astounding 560 %.

In principle, desalination as a nonconventional water supply should be considered as a last resort after exhausting all water saving and demand management options.

Within the scope of Work Package 3 (WP3) – "Application of Water Management Plans" Activity 3.1, the EU-funded SWIM-SM Project is performing several tasks with the aim to develop mechanisms and procedures to facilitate regional dialogue, consultations and exchange of experience among the most water intensive sectors such as agriculture, tourism and urban development. This is served within the four SWIM-SM Thematic Pillars including the one on Non-Conventional Water Resources Management.

To this effect, SWIM-SM project implemented a sequence of cumulative activities during 2012& 2013. The 2014 activities were intended to ensure continuity by taking stock from results and recommendations emanating from first two years program implementation and through synergy with partners dealing with the issue to guarantee complementarities.

As a part of the 2012 activities and in order to ensure the inclusion of state-of-the-art knowledge, and following recommendation by the European Commission (EC), an Advisory Core Desalination Group (CDG) was formed within SWIM-SM. It brings together internationally renowned experts to review and discuss the outcomes of the range of desalination material (assessments, studies, reports, etc) and related activities to be undertaken by SWIM-SM. Such advice assist SWIM-SM to service its PCs on policy orientations, to provide articulated suggestions to EU technical, political and financing institutions on related aspects, and to convey messages to the wider stakeholder community in the region towards more sustainable desalination practices.

In 2013 SWIM assessed the potential cumulative environmental impacts of desalination plants conglomerating around the Mediterranean in synergy with UNEP/MAP MED-POL Program. The main objectives of the assessment of potential cumulative environmental impacts of desalination plants conglomerating around the Mediterranean was to identify the current installed capacity and prospects of desalination in the SWIM-SM region; and to conceptually investigate the cumulative environmental impacts of mega desalination plants conglomerating around the shores lines of the Mediterranean. In order to give a more comprehensive and realistic image of the environmental impacts of desalination on the

Mediterranean sea, the scope of the assessment was expanded to encompass all Mediterranean countries rather than SWIM-SM PCs only.

The report aimed at providing decision makers in SWIM-SM Partner Countries (PCs) with a close-up look on current cumulative desalination capacity and resulting emissions to near-shore marine environment and the atmosphere. It also projected the prospects of desalination in the region with an estimation of volume of future discharges up to the year2030. The report has provided a conceptual account and analysis of the potential fate, transport, bio-accumulation and bio-magnification of various pollutants to the marine environment. The report also concluded by developing a framework to assess the cumulative environmental impacts of seawater desalination plants.

Within such a framework, SWIM-SM held an Expert Group Meeting (EGM) with the participation of the CDG in Brussels from 23 to 24 June 2014. The EGM was devoted to (1) reviewing the outcomes of the assessment of the potential cumulative environmental impacts of seawater desalination conglomerating around the Mediterranean Sea undertaken by SWIM-SM during 2013, and (2) discussing and suggesting a draft policy options note for desalination in the Mediterranean region. The sessions were attended by experts from countries of the SWIM-SM region, SWIM-SM project Focal points (FPs), H2020 Liaison Officers (LOs), the EC, UNEP-MAP MEDPOL focal points or their representatives, in addition to experts from selected non-SWIM-SM European countries (Spain, Germany and Cyprus). The EGM aimed at establishing a dialogue between SWIM-SM KEs, the EC, UNEP/MAP MEDPOL focal points, high-ranking water and environment officials from SWIM countries and selected national desalination experts on the regional assessment report. Within such a context and in light of the confirmed environmental impacts of seawater desalination, a draft regional strategic policy note on prospects of the industry in the Med region was formulated.

2 OBJECTIVES, APPROACH AND RESULTS

2.1 OBJECTIVES

The main objective of the EGM (23 & 24 June 2014) was (1) to review, discuss and validate the findings of the SWIM-SM project assessment of cumulative environmental impacts of desalination in the Mediterranean region report; and (2) to discuss a draft policy options note for desalination in the Mediterranean region.

2.2 APPROACH TO MEET THE OBJECTIVES OF THE MEETING

In order to achieve the objectives of the meeting, a highly dynamic, interactive and participatory approach was adopted, according to the following:

During the first day of the EGM, the SWIM-SM TL provided briefings from the main outcomes of the SWIM-SM regional assessment of cumulative environmental impacts of desalination in the Mediterranean region and on factors for opting for desalination. Each presentation was followed by discussions, in plenary, involving national experts designated by the PCs and the CDG. Presentations on policies and strategies related to desalination in 4 PCs (Egypt, Israel, Lebanon and Libya) followed on the first day. The second day of the EGM, started with a presentation on RE and desalination. The rest of the morning session was devoted to representatives from 3 SWIM PCs (Morocco, Palestine, Tunisia) and 2 European

countries (Spain and Cyprus) to provide a brief account on their countries policies and strategies for desalination. The second half of the second day of the EGM was devoted to discussing a draft policy brief for the Mediterranean region. Preliminary comments were given on the brief and it was agreed that additional comments would be provided to SWIM-SM over email within a period of 10 days from receiving an amended policy options brief from the project.

The presentations on the SWIM-SM assessment report, the country policies and strategies, and other presentations and discussions served to inform and shape the policy options note for seawater desalination on the Mediterranean Sea.

2.3 OUTPUTS

- An amended pre-final version, of the assessment regional report on the potential cumulative environmental impacts of seawater desalination conglomerating around the Mediterranean Sea. The final report shall be reflecting the relevant inputs and views of the CDG, regional experts and collaborating agencies and organizations.
- A draft desalination policy options brief that is amended as per the relevant comments of the participants during the meeting and to be finalized later taking into consideration comments received by email from the participants.

2.4 RESULTS AND MAIN RECOMMENDATIONS OF THE MEETING

The results of the meeting, conclusions and recommendations are presented below as derived from the contributions and discussions during both days.

The meeting results were the following:

1. Preliminary comments (awaiting final comments by email) on the policy options brief on desalination in the Mediterranean
2. An overview of desalination policies and strategies in the SWIM PCs and 2 European Countries.
3. Recommendations for actions, based on the discussions during the event, related to desalination in the Mediterranean region
4. An overall understanding that desalination through renewables in the Mediterranean is an unavoidable solution, especially for the more water-scarce countries, provided that environmental factors/impacts are taken into account

The main recommendations and conclusions were the following:

1. Soften the tone of the text of the policy note to make it more generic suiting, non-interfering in and non-binding to the countries and allowing flexibility and potential adaptability based on national contexts and conditions
2. Avoid any mention of specific technologies or processes or concepts that might possibly cause conflicts such as “virtual water”
3. Reduce redundancy in the text.

   As relates in general to desalination in the Mediterranean Sea (details in next sections)

4. Desalination should be approached from a sustainable development point of view.
5. Further research and monitoring (especially Mediterranean Sea salinity levels) are needed to better understand the environmental impact (point-source and cumulative) of desalination around the Mediterranean.
6. A new paradigm shift in desalination technology is needed with a view of reducing its environmental and other related impacts on health and its energy requirements.
7. Environmental Impact Assessment (EIA) and Strategic Environmental Assessments (SEA) studies should be undertaken prior to the design of desalination plants and for national desalination programs.
8. New guidelines for locating and designing inflows and outflows and for the discharges of desalination plants should be developed based, when applicable, on the Barcelona Convention and the LBS protocol.
9. Desalination should be considered, either after exhausting all possible water demand management and water conservation options or as an interim solution in parallel to the implementation of these options.
10. Renewable energy options should be considered, when feasible and applicable, to power desalination plants and reduce GHG emissions and their impact on climate change.
11. PCs should be empowered to operate desalination plants and manufacture required equipment and parts especially RO membranes.

3 PROFILE OF PARTICIPANTS

1. High level officials form Ministries/Agencies/councils dealing with Water and Environment including some of the SWIM-SM FPs and LOs as well as MED POL focal points
2. Members of the SWIM-SM Core Desalination Group
3. Experts in desalination and in renewable energy for desalination who are not members of the CDG
4. Representatives from Regional Organizations

4 OVERVIEW OF THE WORKSHOP AGENDA

The workshop was held over two days (June 23rd & 24th, 2014) as per the detailed Agenda in **Section 6** of this report.

The agenda during **Day 1** consisted of:

1) Presentations of the current status, prospects, environmental aspects and impacts of desalination in the Mediterranean based on the assessment prepared by SWIM-SM.
2) Presentation of factors for opting for desalination
3) Review through presentations of the national desalination policies and strategies to bridge the demand-supply gap in four SWIM-SM countries (Egypt, Israel, Lebanon

and Libya. Algeria did not present) with a focus on associated environmental aspects.

All the above was followed by discussions between the participants and the experts.

Day 2: Included:

1) Introduction on the use of renewable energy in desalination
2) Review through presentations and discussions of the national desalination policies and strategies to bridge the demand-supply gap in three SWIM PCs (Morocco, Palestine, Tunisia) and 2 European countries (Spain and Cyprus) with a focus on associated environmental aspects.
3) Presentation and discussion of the policy brief on cumulative environmental impact of desalination.

5 PRESENTATIONS AND DISCUSSIONS

5.1 THE ASSESSMENT REPORT ON POTENTIAL CUMULATIVE ENVIRONMENTAL IMPACTS OF SEAWATER DESALINATION CONGLOMERATING AROUND THE MEDITERRANEAN SEA

5.1.1 Presentations and discussions

The SWIM-SM team leader started with presentation of excerpts from the report on the "Assessment of Potential Cumulative Environmental Impacts of Desalination Plants Around the Mediterranean Sea".

The presentations covered:

1. The current status of desalination in the Mediterranean Sea in parallel with the state of water in the region and the biodiversity of the Mediterranean.
2. The prospects of desalination in the Mediterranean Sea
3. The environmental aspects on desalination in the Mediterranean Sea.
4. The potential environmental impacts, fate and transport of brine reject from desalination plants in the Mediterranean Sea.

Presentation 1: The current status of desalination in the Mediterranean Sea

The main points of the presentation were the following:

- Duration of the water cycle in the Mediterranean is 80 to 100 years and evaporation is greater than the inflow
- Water scarcity is increasing in the SWIM PCs where 180 million inhabitants live on less than 1000 m^3/ca. year and 80 million live below 500 m3/ca. year. The Mediterranean Sea is suffering from increasing salinity and pollution. It is home to very sensitive and highly diverse fauna and flora especially Posidonia prairies that are likely to be affected by desalination in the mixing zones.
- Over 1532 desalination plants of all scales were constructed around the Med from 1970 to 2013, producing some 12 million m^3/day with RO being the most used technology.

- Desalination is playing a more important role to bridge the gap of water supply but its impact on an environmentally sensitive and biodiversity rich Mediterranean Sea, needs to be understood.

The main points derived from the discussions following the presentation are:

- Desalination is a tool to mitigate the effect of water scarcity in a sustainable development context either after exhausting options for water conservation or in parallel to the implementation of these options. Conservation measures might take a long time to be implemented and yield results. Consequently, desalination can become an interim option giving time for countries to apply and reap the results of conservation measures.
- It might have negative consequences on surface and groundwater availability to wait until all water conservation options are exhausted in order to start implementing desalination projects. Desalination can be a tool for mitigating the environmental impacts of over-abstraction of water from ground and surface water and the possible salinization of coastal wells.
- A holistic approach to desalination should include the review of options to water and wastewater treatment.
- Close monitoring of the salinity of the Med Sea should be undertaken. Current observations do not show any changes in water volumes of the Med Sea.
- EIA studies should be undertaken prior to the implementation of any desalination project.
- Water as a human right influences the decision on desalination projects.
- There is a need to study the influence of current and future (potentially increasing) prices of oil on desalination and to raise the issue to high national decision levels.
- n very water-scarce countries like Algeria, desalination might be the main option.

Presentation 2: The prospects of desalination in the Mediterranean Sea

The main points of the presentation were the following:

- An incremental increase in desalination projects up to 1 million m^3 per year is projected until 2016 to multiply up to four fold in 2030
- Most countries around the Mediterranean Sea have plans to increase their desalination capacity.
- RO has become the technology of choice due to its low energy requirement and relatively low environmental impact.
- RE is still an expensive option in desalination but future improvements in technology and increased demand and fossil fuel prices might lower the cost.

The main points derived from the discussions following the presentation are:

- Reliance on RE in desalination in oil producing countries saves the oil and reduces the environmental impact of desalination in the process caused by the emissions of GHG.

- Manufacturers and contractors of desalination plants should be engaged by the public authorities in order to initiate a dialogue based on the commitment of the countries to invest and the need to find technological solutions with a view to reduce prices and impact.
- The accelerated urbanization of coastlines in the Mediterranean as well as transboundary water issues are driving forces towards more desalination of seawater due to increased demand.
- Capital cost is the main obstacle slowing down reliance on RE in desalination projects especially when these projects are developed as PPP where reduced costs are a major factor influencing the projects. On the other hand, there is a huge solar power potential in the south Mediterranean region, and the capital cost might be high but the maintenance for the 30-40 years of operations are quite minor.
- Algeria has specified that it completed its desalination plans except for one plant.
- The impact of desalination plants should be separated into the impact of brine and the impact of energy related emissions.
- The assimilation capacity of the Mediterranean Sea should be investigated and used to determine its desalination carrying capacity.

Presentation 3: The environmental aspects on desalination in the Mediterranean Sea.

The main points of the presentation were the following:

- 37.4 million m^3/day of feed seawater are withdrawn from the Mediterranean Sea for desalination purpose.
- By 2030 the annual withdrawal of feed water would be between 35-45 billion m^3/year
- Desalination produces CO_2 emissions with RO technology being the lowest emitter and an estimated total emissions of around 30 million metric tons/year by 2030.
- Total brine discharged to the Med Sea during 2013 is = 25.3 Million m^3/day
- Different types of chemicals are discharged from desalination plants in different amounts during the desalination and cleaning processes. These chemicals end up in the sea with still unclear environmental impacts.

The main points derived from the discussions following the presentation are:

- Effluent standards for discharge are almost non-existent in SWIM PCs except for Israel. Egypt needs to modify existing standards for discharge in order to suit desalination processes.
- There is a need for general guidelines on discharge and the location of outflows and intakes based, as applicable, on the Barcelona convention and related protocols.
- Beach wells or similar, when feasible, can reduce the impact of the inflows to the stations.
- Dispersion models can be used to find the location outflow pipes with the least environmental impact.
- A list of references on different topics related to desalination plants has been requested by the audience and its provision approved by SWIM-SM, among which

the presentation by Israel which contains a table on environmental standards, the book by Latteman, UNEP ROWA, MEDRC and Juan Canovas. These books were provided in soft copies to all participants.

Presentation 4: The potential environmental impacts, fate and transport of brine reject from desalination plants in the Mediterranean Sea.

The main points of the presentation were the following:

- Some of the pollutants discharged from desalination plants are subject to several degradation mechanisms.
- Sea water intakes have the highest environmental impact on the sea due to entrainment and impingement of marine fauna and flora
- Thermal pollution might cause stress on fauna and flora and changes in community structure and characteristics of the individual species in the mixing zone.
- Increased salinity in and near the mixing zone can lead to the eradication of *Posidonia* prairies and dependent marine biota.
- The adversity of the impact on salinity varies with the depth of seawater and shore morphology (open or enclosed).
- The extremely large carbonate buffering capacity of seawater will minimize the impact of acids on the environment and renders them negligible
- The impact of salinity levels in brine is insignificant compared to seasonal changes in salt concentrations due to natural evaporation.
- After many years of practice, desalination officials deduced that discharged levels of polymer anti-scalants are way below the concentration levels that might cause any acute or chronic toxicity to marine organisms.
- Despite their low concentrations, heavy metals releases should be taken into consideration due to their accumulative effects.
- Chlorine has a negative impact on marine organisms even in very low concentrations.
- Bromoforms as the dominant trihalomethane do not have a cumulative effect.
- Dispersion and dilution of pollutants discharged in reject brine of desalination plants can be achieved through carefully designed diffusers extending several hundred of meters away from the shorelines. More technical and design details on this issue were provided in the MEDRC manual distributed to the participants.

The main points derived from the discussions following the presentation are:

- Reference was given to a MEDRC publication for the impact of diffusers in the mixing zones as mitigation not being part of the study undertaken by SWIM-SM. SWIM provided soft copies of the MEDRC report.
- Circulation/simulation models for an EIA in Israel to identify impacts around an outfall have led to an agreement with other authorities to have the outfall at not less than 15 m depth. In Cyprus, the minimum set outflow levels is 4m below surface and 4m above sea floor with a reduced velocity of 3 m/s and less without diffusers

due to the presence of currents. Finally in Spain, outflows are set at 35 m depth to avoid beds of Posidonia and no impact on Posidonia has been recorded.

- Discharge on the shore is possible when there is dilution.
- There is a need for discharge limits related to impacts on *Posidonia-oceanica*
- The environmental impact of intakes is stronger than that of outflows and water velocity at intake should be minimized
- There is a need for more research on the impacts on environment of desalination.
- Alternative sites for desalination plants need to be researched in order to avoid damage to the environment. A "no project" option should even be considered
- A strong debate on the impact of salt in brine was engaged with suggestions on the dilutive impact of sea level rise and the dilution effect of mixing with the Atlantic ocean and the Red Sea and a final resolution to monitor salinity in the Mediterranean and request by Palestine for support by SWIM or other EU mechanisms in clearing still vague issues on environmental impacts.
- A re-emphasis was made on the need for EIA studies prior to the undertaking of desalination projects
- Expectations that technology will respond to the need for reduced negative impact and energy requirements.

5.2 FACTORS FOR OPTING TO DESALINATION IN SWIM-SM COUNTRIES.

The main points of the presentation were the following:

- Desalination should be considered only after less expensive technical efficiency (demand management interventions) & allocative efficiency (efficiency with which society allocates its water resources among sectors for sustainable socio-economic development) are exhausted. Options such as water conservation, reallocation among sectors, water transportation, changing crop patterns, innovative irrigation techniques, reduction of NRW, etc. should be considered first.
- Opportunity cost analysis, including the socio-economic & environmental externalities, should be used as an analytical tool to select among different alternatives.
- In case desalination is decided, it has to be subject to EIA study according to the national policies & guided by the internationally recognized criteria & procedures.

The main points derived from the discussions following the presentation are:

- Desalination projects can be initiated in parallel with measures to reduce consumption not only when water resources conservations measures are exhausted.
- Economic considerations are the main factors affecting the expansion of desalination projects.
- The government should be the regulator not the operator of desalination projects. The private sector should be the operator guaranteeing that the standard operating procedures are followed

- Subsidies should be considered carefully for the water sector as they might lead to project failure. Considering the real value of water is important when pricing water
- Water allocation among different sectors should be based on economic return from the water.
- Virtual water is a complex concept should not be forced on the countries. Its consideration should be in parallel with the amount economic value produced by a volume of water.
- Desalination policies, strategies and programs should be subjected to an SEA study.
- The cost of producing desalinated water should include environmental and other externalities.
- A regulatory framework needs to be developed for SMCs to regulate all environmental aspects associated with desalination of seawater using different technologies.

5.3 REVIEW NATIONAL DESALINATION POLICIES AND STRATEGIES TO BRIDGE THE DEMAND-SUPPLY GAP IN SWIM-SM COUNTRIES WITH A FOCUS ON ASSOCIATED ENVIRONMENTAL ASPECTS.

7 SWIM PC representatives and 2 representatives from EU countries presented overviews of the status of water and desalination and related policies and strategies in their respective countries.

The main and synthesized findings are as follows:

- Desalination is an option used to close a gap in water availability in all countries with the added use for aquifer recovery in Palestine. Water availability is affected by its natural availability and variability, population growth, economic development and climate change. 20% additional redundancy in advised by Israel to ensure constant availability.
- Most countries have exhausted possible water conservation options before attempting desalination projects. Some countries claim they were late in starting desalination, which has led to heavy stress on water resources.
- Desalinated water is mainly used for domestic consumption with the exception in Morocco where some of the water is used in high value off-season agriculture for export and in Egypt where most desalination provides water to touristic sites.
- Most countries have taken different measures and use different tools to protect the environment from the potential negative impacts of desalination through the undertaking of EIAs prior to decisions on building desalination plants and/or the setting of environmental protection standards and or legal guidelines to be followed by the promoters of desalination projects.
- Most countries have plans to expand, at different rates, their desalination capacity. Development of desalination projects responds to identified need for water that cannot be supplied by existing sources.
- Most countries are using RO as the main technology for desalination due to its low power requirements and low environmental impact.

- All countries use fossil fuel for powering desalination plants except for one new project in Tunisia that uses photovoltaic cells. Most countries, however, tend to contemplate the use of RE but cost is still prohibitive especially when oil prices are heavily subsidized such as in Egypt.
- Few countries have monitoring plans for the impact of desalination. Figures from Israel show no impact from salinity beyond 3 kms from the outfall. Monitoring data from Spain and Cyprus show no observable impacts on fauna and flora
- Israel has a strategic plan on the increase of desalinated water capacity and the state imposes complete EIA studies to the operators for big desalination plants.
- In Palestine the Gaza Strip desalination plant is a must and the only viable solution, as the aquifer risks of being depleted/unusable by 2016 and only 5 to 10% of the available water is drinkable.
- In Spain, all desalination plants producing more than 3,000 m3 of water require a complete EIA.
- Land size and availability is a factor that is taken into consideration in siting and selecting desalination plants because in small countries there is a general lack of land space and in large countries there is a need to site desalination in overly urbanized coastal areas.
- Cost reduction options are applied as much as possible by some of the countries.
- Egypt plans to support local industry in order to enable it to produce spare parts, membranes and equipment for the desalination plants and thus reduce the cost of desalination.
- Lebanon has no desalination plants and does not plan, mainly due to its reliance on dams and the very high energy cost
- In Cyprus, marine environmental programs have been applied to all desalination plants and there was no major impact recorded
- New approaches and technologies for desalination need to be investigated and researched in order to reduce costs and negative environmental, public health and agricultural impacts of boron levels in desalinated water. A Mediterranean network for information exchange need to be established to support exchange of information and building capacity with a proposal for cooperation by EDS.
- Recurrent recommendation for the strong need for more detailed research on the impacts on the environment of desalination in the Mediterranean. Establishment of a network for desalination in the region and development of a regional research program to assess the environmental aspects of desalination on the Mediterranean Sea were proposed.

5.4 THE IMPACT OF SALT LEVELS CAUSED BY DESALINATION

A one slide, off the agenda, intervention to settle the issue of the impact of salt in brine on the Mediterranean see was undertaken by the SWIM-SM TL. Calculations showed that total amounts of discharged salt (2013 total) from desalination plants are insignificant compared to the total quantity of salt of the Med Sea and to changes in this quantity caused by natural evaporation.

Reactions from the participants were as follows:

- Discharge and evaporation figures should be adjusted to 2030 desalination capacity to account for future desalination plans and expected increased evaporation due to CC.
- The long cycle of water in the Mediterranean (80-100 years) has strong bearing on salinity levels.
- Global warming is conceptually result into the dilution of seawater due to the melting of the Polar Seas.
- The impact of desalination should be studied at the level of the ecosystem as a whole with the impacts of all pollutants, such as industrial and municipal waste, etc, combined together.
- Additional research is needed to understand the point of no return for ecosystems in terms of pollution carrying capacity.
- Figures from Israel have shown that there is no increase in salinity beyond 3 km from the outfall.
- The dilutive impact of water transfers from the Atlantic to the Mediterranean through Gibraltar in an estimated amount 1 M m^3/s
- In the debate on the need for desalination in the Mediterranean there is a need to factor in the basic human right for water.

5.5 RENEWABLE ENERGY AND DESALINATION

A presentation by Mr Massimo Mozer on desalination and RE was added to the agenda of the second day due to the importance of the topic and the debates that surrounded it in the workshop.

The main points of the presentations were the following:

- Desalination is needed in the SWIM PCs to close the demand gap after potential water conservation measured have been or going to be applied
- There is a huge potential for the use of solar energy in desalination in most of the SWIM PCs especially in North Africa.
- The selection of RE technology (wind, PV, or CSP) depends on the size of the plant where wind and PV are used for small plants and CSP is used for large plants. The possibilities of power source mixes should be looked into.
- The advantage of CSP is its consistency of supply and the availability of energy storage for continuous supply of electricity to desalination plants when the sun is not available and water is needed.
- CSP can provide electric power only to the desalination plants like RO with a lot of flexibility in locating the CSP plant or it can provide both electric power and heat for thermal plants such as MED with the need to restrict the location on only the coast of the CSP and MED plants.
- The cost of water produced by RO plants is lower than that produced by MED plants due to differences in energy requirements and the cost of metals and fossil energy.

- The difference in cost between using fossil fuel for desalination or RE is that RE has a high initial capital cost but low and almost constant operating cost while fossil fuels have a low capital cost but longer and fluctuating operating cost.

The main questions and comments were the following:

- Solar energy has a high capital cost compared to conventional and other RE. The solution being the use of a mix of RE technologies to minimize cost of supply and the starting with the replacement of high cost fossil energy systems, such as natural gas, with cheaper REs.
- The cost of fossil fuels should include the cost of environmental externalities. If externalities are taken into consideration than the cost of REs becomes competitive with fossil fuel energy.
- Energy subsidy prevents RE to penetrate the market. The solution is the long-term guarantee of RE costs through financing models covered by international insurance to cover possible failure of repayment to investor.
- To reduce costs of solar and RE, a solution might be to produce, in the SWIM PCs and under license from the manufacturer, some parts (membranes) and equipment of RE and desalination plants.
- RE technology is mature with the parabolic trough being most mature. The solar tower has the potential to reduce cost due to higher efficiency. The linear Fresnel has the lowest land footprint and has accordingly least land cost; the solar tower has the highest land footprint and accordingly land cost.

5.6 MODIFIED POLICY NOTE

A presentation, paragraph by paragraph, on only the suggested policy options and measures section of the policy note was undertaken by the SWIM-SM TL after agreeing with the participants that comments on the introductory sections will be sent by email to SWIM-SM.

The main suggestion for changes on the last section of the policy note were the following:

- Suggestion to adopt a generic, suggestive, non-binding language avoiding strong statements and redundancies in the note.
- Request to make the text simple and non-technical so as to make it accessible to lay people, the case of most high-level decision makers in SWIM PCs. Provide definitions for technical terms.
- Requests to remove any mention of specific technologies, RO and CSP in this case, and the need to use RE from the policy note as this will be considered as interference in the choices of the countries and as a limitation to the development of other industries such as MED and MSF. Just describe list the requirements for adopted technologies.
- Suggestions to add the notion of using desalination in parallel with the implementation of water conservation measures and not only after exhaustion of “all” possible measures.
- Suggestion to add the conservation of good environmental status of the Mediterranean Sea and the protection of coastal aquifers in the requirements of desalination projects

- Suggestion to remove the reference for the link to job creation and poverty eradication in the assessment of the need for desalination projects.
- Request to remove reference or use the word "can" instead of "should" regarding the use of "virtual water" as a tool and allocative and technical efficiencies in the assessment of needs for desalination
- Suggestion to remove any pre-labelling of desalination with a negative environmental impact from the text awaiting further research on the topic.
- Suggestion to add the need for a mandatory public consultation prior to the decision on building a desalination project.
- Reduce redundancy in the text such as descriptions of impact to avoid on the environment with just a mention of the need to undertake an EIA for projects.
- Suggestion to add operating costs to capital costs in the text of the note with a final suggestion to remove capital and keep the mention of costs only.
- Suggestion to add the need for monitoring salinity levels in the Mediterranean Sea.
- Mentioned potential subsidies covering the poor should not discriminate between social classes and related decisions should be left to the countries. Replace the mention of subsidies with the decisions of the UN resolution on water as a human right.
- Suggestion to involve financial institutions and the private sector to provide financing for desalination and reducing its costs with the countries providing adequate legal and institutional frameworks for investments.

Additional comments that will be sent by the participants by email to SWIM-SM will used to the extent possible to develop the final draft of the note.

6. THE GENERAL COMMENTS ON THE EVALUATION FORMS

General comments

- The workshop would have benefited from the presence of additional experts in different fields of desalination
- Selection of the chair persons to be prior to workshop
- Need to listen more to the thoughts of the countries
- Plan transport from and to the airport
- Involve manufacturers of desalination plants
- Find radical solutions for the environmental impacts
- The Francophones are always "lésés", i.e. they feel they are ignored because the presentations are delivered in English

Issues Appreciated

- The SWIM Team in charge of the workshop
- The country presentations
- The level of experts

- The final discussions on the policy brief
- Prof. Khordagui and Balaban
- Exchange of knowledge between countries
- Session on RE
- The subjects of the workshop and the discussions
- The presentations of Spain , Morocco and Tunisia
- Technical and professional handling of subjects
- Organization and topics of workshop
- High quality presentations

The needs to be improved

- More focus on cost related issues
- Management and governance aspects
- There should be more in depth analysis and emphasis on RE
- Final policy note should be rephrased

Descriptive Statistics of evaluation grading:

At the end of the meeting the participants filled an evaluation form to express their opinion and feelings about the efficiency, effectiveness and soundness of both the organization and delivery of the meeting. The forms were thereafter analysed to extract lessons and recommendations for future events. Below is a summary of the evaluation findings and main feedback from the participants. The form has been divided in 2 parts (A and B) and the questions made are summarized in the table below:

Table 1. Questions asked in the evaluation form

A1	Good handling of invitations, visas and event information
A2	Smooth flow of the programme
A3	Efficient logistics
A4	Planning of the event
A5	Efficient and effective follow up of preparation and progress towards the event
A6	Clarity, coverage and sufficiency of concepts
A7	Procedural issues. Design of methodology Programme Agenda and work rules
A8	Presentations correspond to planned objectives
B1	Efficient and effective performance and interaction by participants
B2	Efficient and effective facilitation

B3	Efficient and effective Cooperation and team spirit
B4	Acceptable level of achievement of planned objectives
B5	Length of the event
B6	Positive general impression

A scoring scale from 1 to 5, with 1= ''Strongly disagree'' or the lowest, most negative impression and 5=''strongly agree'', or the highest, most positive impression. As it can be noticed the average of all questions concerning the organization and administration of the EGM ranged from 3.85 to 4.42 points indicating an overall positive evaluation for all the subject criteria. On the other hand, the score for the execution of the EGM ranged from 3.8 to 4.4. The general impression about the meeting (B6) was 4.12. Figure 1 illustrates the evaluation of the participants for the organization and administration of the EGM. Figure 2 represents the scoring of the execution of the meeting.

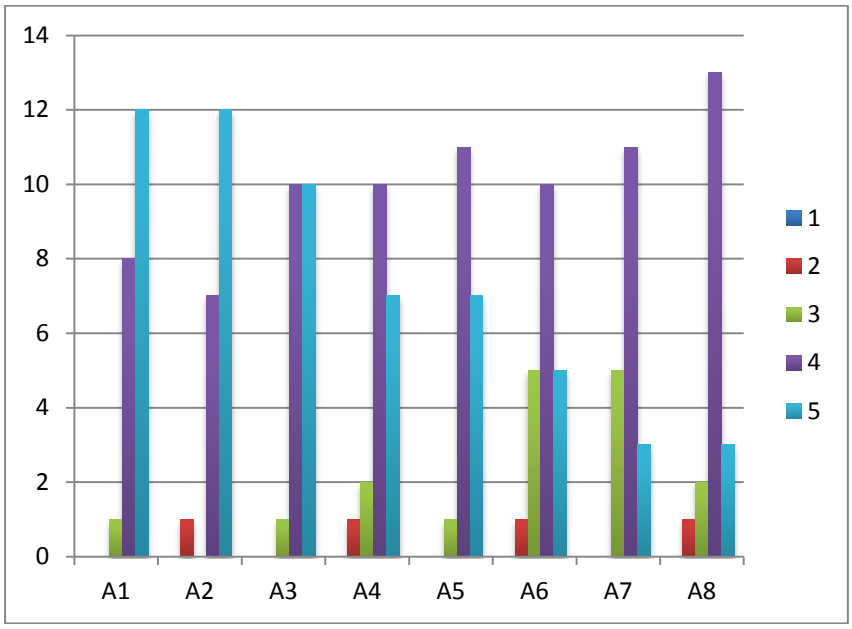

Figure 1. Average number of points obtained per evaluation criteria for organization and administration of the EGM

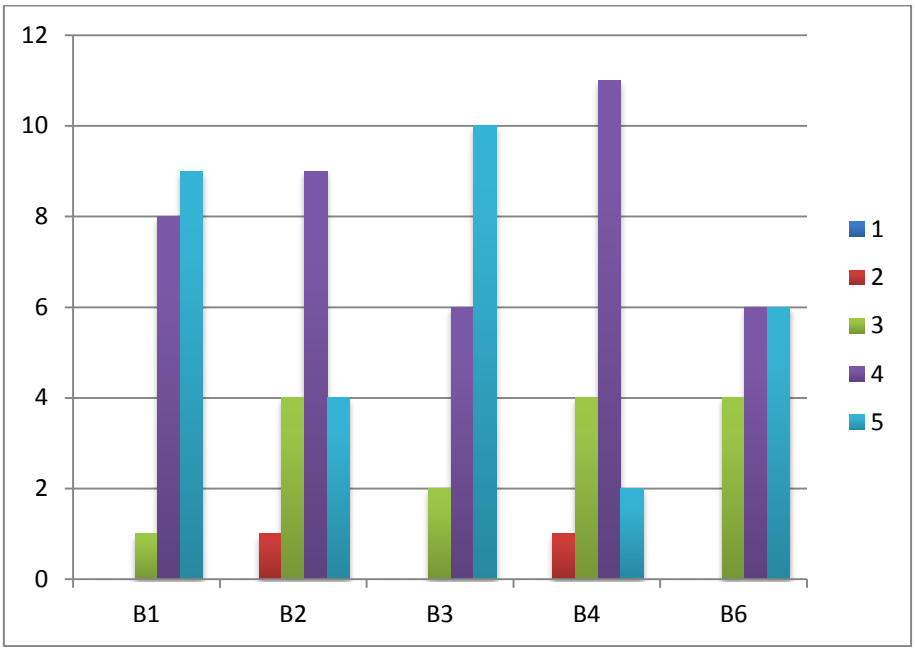

Figure 2. Results of the evaluation of the execution of the EGM

7. DETAILED WORKSHOP AGENDA

Day 1:

a. Validation of SWIM-SM assessment report on potential cumulative environmental impacts of seawater desalination conglomerating around the Mediterranean Sea.

b. Review national desalination vision, policies and strategies to bridge the demand-supply gap with special emphasis on environmental impacts in SWIM-SM countries.

9:00-9:30 Session 1: Workshop Opening

- Opening remarks (EC SWIM project Coordinator and SWIM-SM Project Director)
- Opening remarks by representative of UNEP-MAP
- Introduction and orientation (Team Leader – SWIM-SM)
- Tour de table

9:30-11:00 Session II: Reflections and Comments on assessment report on potential cumulative environmental impacts of seawater desalination conglomerating around the Mediterranean Sea:

- Presentation on current status of desalination in the Mediterranean Sea, (15 minutes). This presentation will address the current seawater desalination production capacities of SWIM-SM countries and other major European producers, the technology in use, cumulative production capacity, uses of desalinated water in the Med region, etc.
- Round table discussion of the findings (30 minutes)

- Presentation on prospects of desalination in the Mediterranean Sea, (15 minutes). This presentation will project the cumulative production capacity of seawater desalination in the Med Region until the year 2030. This will entail the technology to be used, the distribution by major producers, the prospect and factors that might influence the future of desalination in the future in the region.
- Round table discussion of the findings (30 minutes)

11:00-11:30 Coffee Break (30 minutes)

11:30-13:30 Session III: Reflections and Comments on assessment report on potential cumulative environmental impacts of seawater desalination conglomerating around the Mediterranean Sea:

- Presentation on environmental aspects on desalination in the Mediterranean Sea. (20 minutes). This presentation will address all environmental aspects associated with production of desalinated water including masses of pollutants discharged on a daily and yearly basis in the brine reject to the near-shores of the Mediterranean and volume of CO2 currently discharged and the projected emissions by the year 2030.
- Round table discussion of the findings (40 minutes)
- Presentation on potential environmental impacts, fate and transport of brine reject from desalination plants in the Mediterranean Sea, (20 minutes). This presentation will address the impacts, fate, transport, transformation, bioaccumulation and biomagnification of various pollutants in the nears-shore marine environment of the Mediterranean.
- Round table discussion of the findings (40 minutes)

13:30 – 14:30 Lunch Break (60 minutes)

14:30-15:30 Session III: Factors for opting to desalination in SWIM-SM countries.

- Modality for assessing country needs (15 minutes). This presentation will address the recommended measures and recommended policies for communities to undertake before opting on seawater desalination.
- Round table discussion of the findings (45 minutes)

15:30-17:30 Session IV: Review national desalination policies and strategies to bridge the demand-supply gap in SWIM-SM countries with a focus on associated environmental aspects. (Part 1) (Coffee to be served during session)

- Egypt: National desalination policies and strategy (15 minutes)
- Israel: National desalination policies and strategy (15 minutes)
- Lebanon: National desalination policies and strategy (15 minutes)
- Libya: National desalination policies and strategy (15 minutes)

Discussion and comments (45 minutes)

Day 2:

a. Review national desalination vision, policies and strategies to bridge the demand-supply gap in SWIM-SM countries with focus on associated environmental impacts. (Part 2)

b. Discussion and finalization of draft regional strategic policy brief on desalination in the Mediterranean region.

09:00-9:30: Introduced session: Combined electricity and water production based on solar and wind energy. Massimo Mozer. DLR

09:30-11:00: Session V-1: Review national desalination policies and strategies to bridge the demand-supply gap in SWIM-SM countries.

- Morocco: National desalination policies and strategy (15 minutes)
- Palestine: National desalination policies and strategy (15 minutes)
- Tunisia: National desalination policies and strategy (15 minutes)
- Discussion and comments (45 minutes)

11:00-11:30 Coffee Break

11:30-13:00: Session V-2: Review national desalination policies and strategies to bridge the demand-supply gap in selected MED-POL countries (Spain, Cyprus and Malta)

- Spain: National desalination policies and strategy (15 minutes)
- Cyprus: National desalination policies and strategy (15 minutes)
- Discussions and comments (45 Minutes)

13:00-14:00 Lunch Break

14:00-16:30: Session VI: Discussion and adoption of strategic policy note for the Mediterranean region. (Coffee served during session)

- Presentation of draft policy brief on cumulative environmental impacts of desalination in the Mediterranean Region (20 minutes)
- Moderated discussion:
    - Policy options and measures for sustainable seawater desalination in the Med Region (60 minutes)
- Concluding remarks (30 minutes).

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