
WATER
AROUND
THE
MEDITERRANEAN
REVOLVE

Foreword

Sustainability is not an abstract concept in my home of Jordan. According to NASA, we in the eastern Mediterranean are facing possibly the worst drought in 900 years. Increases in the cost of water are affecting farming and hampering industrial development. Acidification of rain is polluting water resources, while the Dead Sea is divided in two and slowly disappearing as its level decreases.

HRH Princess Sumaya bint El Hassan
President, Royal Scientific Society, Jordan

As my father, HRH Prince El-Hassan bin Talal, has long said, solving our regional problems requires catalytic change at multiple levels across inter-related sectors. Academia, media, civil society, business and government must come together to address the great sustainability challenges of our times to achieve equal and fair access to water and sanitation for all, as stipulated in SDG #6.

What do we mean by catalytic change? The Oxford English Dictionary defines a catalyst as a substance that increases a chemical reaction without itself underdoing any permanent chemical change, or a person or thing that precipitates an event. I believe that we have reason for hope. For, we have proof that catalysts exist in the West Asia and North Africa (WANA) region, and that they can bring about positive change.

The WANA region is rich in scientific knowledge. We have over 136,000 registered engineers in Jordan alone, equivalent to a city bigger than Aqaba. Imagine what could be achieved if these individuals could unlock their potential. The energy, entrepreneurial spirit and resilience of the people of the WANA region are astounding. If we could connect this spirt with the right knowledge and know-how, then we may well meet the challenges of our time.

We made great progress in identifying catalysts that connect environmental sustainability and social entrepreneurship at the first edition of AMWAJ, hosted by the Royal Scientific Society (RSS) with Revolve and PepsiCo in Amman in November 2016. We were delighted to further address these issues at the World Science Forum 2017, which was hosted by RSS at the Dead Sea in November 2017. This great event brought together key influencers and actors from around the world to address and advance the theme of Science for Peace.

In Jordan, we aspire to be a sustainable, just and equitable society. Sustainability, in the environmental sense, requires catalysts that propel scientific and technological advancement, which is the key to long-term durable economic development. Awareness and education are crucial to this, and publications such as Water Around the Mediterranean contribute to a vital knowledge base.

We believe that important advancements can be made with well-targeted research and development applications that support science and technology. This is a vital contribution to positive change in the Arab world.

I believe that forums such as AMWAJ can help to pave the way for greater cooperation between all stakeholders in our society, from both the public and private sectors, academia, civil society, industry and the media. The cross-fertilization of ideas engendered by collaboration is our greatest hope.

In this age of globalization, forging cooperative alliances with like-minded individuals, associations and companies from around the world is essential. New synergies and unexpected opportunities emerge with the sharing of knowledge, experience and aspirations for a better, cleaner and safer world.

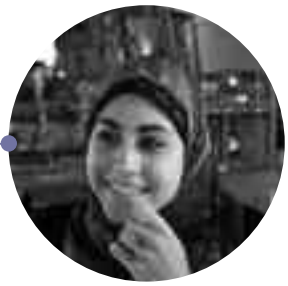
Within this context, the transmission of knowledge is vital to balance progress and to counter the forces that hope to foster fear in our world. This is the primary process of building cultures of sustainability, where science and innovation are revered above bias and ideology.

We must grasp the opportunity to reach an unprecedented consensus through which we can forge a path towards long-term sustainability that is science-based, resilient and universally applicable.

Life on our planet was forged through a melding of water and energy. Inspired by the efforts of others around the world, and being mindful of the great and unrealized potential for prosperity and sustainability in our societies, I wholeheartedly support any efforts to create a water and energy community for the WANA region, based on shared access to and informed management of our precious natural resources for the benefit of all our people.

Image: Tripoli, Lebanon. Source: Nick Hannes ©

Contributors



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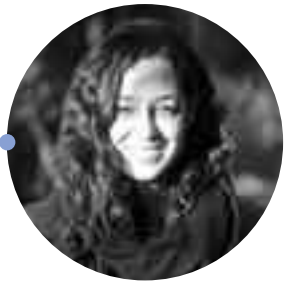

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Image: Cruise. Source: Nick Hannes ©

A Sustainable Water Policy for the Mediterranean

The Mediterranean has often been at the centre of world affairs. It's the cradle of our civilisation, the birthplace of democracy and the midwife to some of the world's major religions.

Karmenu Vella
European Commissioner (2014-2019) of the Environment, Maritime Affairs and Fisheries

Today, as much as anywhere else in the world, it concentrates the problems we face. It brings us face to face with the realities of water scarcity, urbanization and our growing energy needs. On its southern shores, an enduring economic crisis is bringing ongoing socio-political instability, conflict and large-scale migratory movements.

And one thing is increasingly clear. Most of these challenges have some connection to water.

We are nothing without water. It underpins all societies, all commerce, all life on earth. And world leaders are explicitly committed to its protection: UN Sustainable Development Goal (SDG) 13 is an explicit requirement to combat climate change. SDG 14 is an obligation to conserve the oceans and ensure their use is sustainable. And SDG 6 demands the sustainable management of water for all.

Policymakers are tasked with ensuring that these impressive-sounding commitments are translated into action on the ground. With ensuring that governments, private companies and civil society all work together to deliver on these existing commitments and raise the level of ambition.

The challenges are all too clear: all around the Mediterranean, fresh water resources have been profoundly affected by climate change; warming oceans, sea level rise and acidification are already here and their knock-on effects will be difficult to manage.

And yet our future depends on how we rise to these challenges.

Europe is determined to act. The EU and the European Commission are long-time supporters of sustainable water management in the region. The Sustainable Water Integrated Management (SWIM) programme launched by the European Commission contributes to the extensive dissemination and effective implementation of sustainable water management policies and practices in the southern Mediterranean region.

Last October, the European Union hosted the Our Ocean Conference in my home country, Malta. I am proud of the results we achieved and the determination it revealed to address climate change and to help communities work with nature, not against it. An unprecedented € 7 billion ($ 8.25 billion) was pledged to this fight, in a host of different areas, from fighting marine pollution and climate change to ensuring a sustainable blue economy.

And as members of the Union for the Mediterranean, we pledged to address these challenges. We are already working on numerous initiatives focusing on delivering our commitments for the 2030 Agenda for Sustainable Development, including on water and inter-linked sectors.

When water ministers gathered in Malta for the April meeting of the Union for the Mediterranean, the meeting was something of a breakthrough. We delivered a new regional framework for long-term cooperation in the water sector.

While still attentive to the regional priorities of the region, this ambitious declaration targets broader, global policy agendas. One of these global commitments is the development of green growth and the circular economy, a concept that will be vital for the sustainable development of the Mediterranean region.

Because water is a tremendous driver of innovation. By encouraging industry to innovate and find solutions, we make it more competitive at the global level. The challenges the region faces are very real, but they are also opportunities – drivers of economic benefits, bringing jobs, growth and better quality of life.

We can share that satisfaction, because as the Union for the Mediterranean constantly proves, water doesn't have to divide us. We can also use it to bring us closer together.

Image: Benidorm, Spain. Source: Nick Hannes ©

Under the Patronage of **H.H. General Sheikh Mohammed bin Zayed Al Nahyan**, Crown Prince of Abu Dhabi and Deputy Supreme Commander of the U.A.E. Armed Forces

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Contents

Chapter 1

Water Scarcity & Security

The Mediterranean region holds only **3%** of global water resources but hosts over **50%** of the world's water poor populations, around 180 million people. (7)

There is a clear connection between water scarcity, food insecurity and social instability, which in turn can trigger and intensify migration patterns. (2)

Water must be managed better in an integrated fashion, if poverty, migration and the potential for conflict are to be reduced and social stability ensured. (3)

Natural water scarcity in the Mediterranean region is compounded by new threats of population growth, growing food and energy demands, pollution, transboundary competition and weather extremes. (1)

In the Middle East and North Africa region, **60%** of the population live in areas of high or very high water-stress, compared to the global average of **35%.** (1)

Sources: FAO (7), Miletto, M., Caretta, M. A., Burchi, F. M. and Zanlucchi, G. (3), World Bank Water Group (1), World Water Assessment Programme (2)
Image: Tsar Touroug, Morocco. A Berber Moroccan man fills water containers at a well in the remote desert between El Jory and Tsar Touroug, Morocco in the morning. Source: Joesboy

Water Scarcity and Security in the Mediterranean

Writers: Cosimo Lacirignola, Nicola Lamaddalena and Roula Khadra

Current patterns of water management and development in the southern Mediterranean region are often not sustainable. The region is facing severe water scarcity with freshwater availability per capita among the lowest in the world, representing a serious constraint for socio-economic development and a potential cause for water-related conflicts.

Modernized pumping station in Egypt

Summary

The lessons learned from past and current research and cooperative or development programmes in managing Mediterranean water resources could be resumed as:

- The scientific community, institutions and relevant stakeholders must be prepared to handle complexity, thus to agree on an explicit frame of goals and priorities to assess the successful achievement of sustainability through adequate water management.

- The positive impact of research projects and programmes on society depends on our ability to design and implement adequate national and regional integration plans and on our ability to reach out effectively to politicians, users and citizens.

The technical framework

Water management has been shifting from a supply-oriented approach to one based on demand. This is particularly true for the agricultural sector that accounts for more than 80% of the withdrawals of water in southern and eastern Mediterranean countries. However, these strategies are still restricted to pilot actions; they are sector-oriented and not fully embedded in integrated water management. As a result, there is no equitable access to water and there is no controlled use of groundwater. Moreover, limited consideration is given to water quality and little attention to water-related natural hazards, mainly droughts.

Although the concept of water saving is extended also to the civil and industrial sectors, in the Mediterranean context the management of limited water resources is strictly related to agriculture, the latter being the major cause of pressure on natural waters (Gleik, 1993; Bonnis and Steenblik,1998; Hamdy and Lacirignola, 1999). Therefore, it is important to address the assessment and development of specific "saving" aspects of agricultural water management such as: water use efficiency and water productivity; irrigation system performance; non-conventional water use and participatory methods of management (Jensen, 1980; Hoffman et al., 1990; Tanji, 1990; Hamdy 1993; Choukr-Allah et al., 1995; Steduto, 1996; Asano, 1998; Hamdy, 1999; Lamaddalena and Sagardoy, 2000; Lieth and Lohmann, 2000; Hatfield et al., 2001; Howell, 2001; Pereira et al., 2003; Khadra et al., 2017).

Current literature lacks a consistent overview of the results of water saving techniques across Mediterranean countries and lacks the means to assess results and impacts which could be achieved by comparing, integrating and up-scaling the above components of water saving, accounting also for public participation and community involvement. Significant challenges still remain in the areas of technological, managerial and policy innovation and adaptation, human resources development, technology transfer and dissemination.

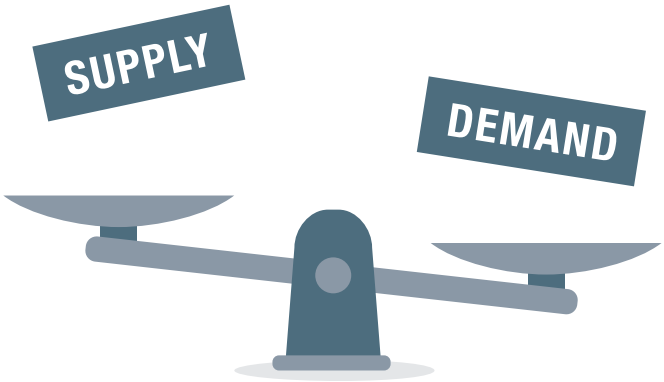
Regarding agricultural water, management constraints are mainly of two kinds. First, farmer level projects are scattered and fragmented and often different standards are used in different Mediterranean countries, therefore results cannot be easily compared. Secondly, water saving actions are difficult to standardise throughout the Mediterranean, particularly at basin level, that has a particular meaning in the region since water use is strongly linked to withdrawal from groundwater aquifers and only a limited number of important permanent water courses exist.

In addition, existing literature (IWMI, 2000; Pereira et al., 2002) and statements of international organisations (FAO, 1989, IHE-UNDP, 1991) have also proved that Comprehensive Water Resources Management is needed, based on the decentralised management of water resources with the active participation of users. The participation of key stakeholders, appropriate incentives or income generating water saving options constitute important means to ensure the sustainability of regional water management. Several research activities and trials on water saving have been carried out locally in Mediterranean countries, but not enough regional water saving research or coordinated trials have been carried out on a Mediterranean-wide scale. This is basically because established regional networking is not a consolidated practice in the region.

After 2030, available water supplies will fall below demand.

The political framework

The long-term peace and prosperity of Europe and the Mediterranean region is recognized as being inevitably linked. A strong and stable Mediterranean benefits everybody north and south of this major world sea basin. Conscious of the importance of water issues in achieving the objectives set in the historic Barcelona Process (1995-2000), the EU – as one of the co-chairs of the Union for the Mediterranean created by the Paris declaration of 2008 – provides its support to the development of UfM Water agenda (see pages 40-41) also in the field of water management. The view of a more consistent cooperation between the EU and the southern and eastern Mediterranean countries, together with the implementation of the Water Framework Directive, create new demand and new opportunities for EU water-related research and technological development. The EU Water Initiative aims at widening the adoption and practice of integrated river basin approaches based on knowledge and innovation. It will also try to promote and mobilise partnerships between science, public, non-governmental and private actors in Europe and neighbouring countries and regions in other parts of the world with a view to achieve the water-related objectives of the United Nations Sustainable Development Goals (SDGs).



The main problem in Mediterranean countries: How to balance water demand and water supply

Pumping irrigation water from the Khabur River, Syria. Source: Bertramz

The EU is aware that water scarcity could become an important threat for stability and peace, since there is a risk for national and transboundary water conflicts. Water scarcity also induces abandoning land or reducing productivity that could affect the socio-economic stability of countries, provoking undesirable migrations and threatening the sustainable development of the Euro-Mediterranean region. The pressure on water resources, arising mainly from agriculture and increasingly from growing urban areas and emerging tourism and industry, results in high variability of water yields due to climate change. It is expected that after 2030, available water supplies will fall below demand. It is therefore necessary to find ways of increasing supply while limiting demand so that water does not become an intractable problem for countries of the region.

Modernized on-farm irrigation system in Syria: an example of a gated-pipe.

The CIHEAM-Bari Commitment

Pursuing and improving water saving management should constitute a valuable and indisputable contribution to sustainable development. The following points are the main sustainability targets and concerns of water saving and water management in the Mediterranean that CIHEAM-Bari is committed to address through its International Research and Cooperation Programmes:

▶ EU HORIZON 2020 "MADFORWATER" DevelopMent AnD application of integrated technological and management solutions FOR waste WATER treatment and efficient reuse in agriculture tailored to the needs of Mediterranean African Countries: www.madforwater.eu

▶ Assistance to Egypt and Tunisia in the modernization of their Irrigation Systems and Schemes.

Social concerns

▶ Improve equity through water saving by developing criteria and approaches that could facilitate the integration of gender and marginal farmer communities in water management.

▶ Incentivize and motivate farmers to save water and adopt innovative technologies and options enhancing a higher rate of employment.

▶ Develop approaches to optimise balance between water saving benefits and social costs.

▶ Improve recognition of and explore indigenous knowledge for potential opportunities for water savings technology.

Economic concerns

▶ Develop water strategies enhancing an adequate regulation of water rights and land tenure to facilitate the access of farmers to water resources.

▶ Develop comprehensive and dynamic economic approaches to sustain competitive water savings; approaches should consider closely the sustainability of water tariffs, the dynamics of tangible and non-tangible value of water, energy cost and strategic policy of water management.

▶ Develop indicators to assess low-cost technology and increase awareness and capacity to implement effective low-cost water saving technology programmes; the development of energy-saving technologies should be coupled with water saving low-cost technologies.

▶ Develop policies for subsidies in water saving.

Environmental concerns

▶ Improve knowledge between quantitative aspects of water saving and real natural water body enrichment. This calls for the need to understand saving effects on water bodies accounting for the scaling effects from farm-to-catchment levels, to consider also climate change scenarios.

▶ Improve the assessment of salinity risks due to saving practices, particularly

Storage tank from which treated effluent is pumped for irrigation at Haran Al-Awamied, Syria. Source: SuSanA Secretariat

regarding deficit irrigation and non-conventional water use.

▶ Increase the focus on nitrates and the traceability of pollutants in water saving conditions.

▶ Improve health risk zoning and relationships with agronomic practices of water saving.

▶ Improve risk management under climatic variability and uncertainties, including drought.

▶ Unravel ecosystem water requirements to support saved water re-allocation for environmental purposes.

▶ Mitigate groundwater stress by deepening criteria for water-well maximum capacity to regulate groundwater withdrawal for agriculture purposes and other uses.

Institutional concerns

▶ Improve the governance of water management by strengthening the participatory approach. A special focus is needed for: **1)** better identification of stakeholders through adequate and accurate analysis; **2)** methodologies and mechanisms for participation, which are not well developed and standardised (there is a need to regionalise the participatory approach to allow scaling of different levels in the processes from local to basin levels); **3)**adaptation of existing participatory methodologies to specific cases; **4)** improve means of knowledge transfer; **5)** training to facilitate involvement in participatory water management; and **6)** improve collective planning to enhance water risk management and preparedness to external perturbations.

▶ Strengthen dissemination on water saving beyond research, towards politics and institutions.

▶ Improve agricultural water governance accounting for the real empowerment of women in water management and decision process.

▶ Improve and develop water saving strategies embraced by a comprehensive framework of institutions for a better harmonisation of water saving in relation to:

- Conjunctive resources use.
- Hydrological dimension of water basin to support decision-making and tackling scaling processes.
- Responses to extreme events, particularly drought.

▶ Improve stakeholder management and institutional capacity-building.

▶ Improve decision-making: **1)** training stakeholders and users to improve involvement in co-decision making; **2)** linking participatory approaches and defining variables and indicators to calibrate user-friendly DSS; and **3)** simplify management routines to deal with complex decisions.

▶ Deepen relationships and efficient inter-linkages between centralized and decentralized management accounting for the IWRM.

▶ Develop multi-level assisted tools for multi-level participation.

Perspectives on technology and innovation

▶ Deficit and supplementary irrigation (field crops, irrigation scheduling, earth observation, system modernisation).

▶ DSS supported by databases and GIS:

- Develop different tools for different users and levels.
- Incentives for tools adoption.
- Financial analysis for the sustainability of databases.
- integrate participatory approaches and results in DSS through the development of mental models and algorithms.

▶ Regionalisation and making demonstration systems available and understandable by users to enhance innovation of water saving technologies.

▶ Development of new devices and integration of simple and indigenous technologies in quality-quantity control.

▶ Integration of rain-fed agriculture in innovation and technology (water harvesting, range-lands, etc).

Prompting researchers on priority actions

To pursue the priorities above and to achieve the minimum level of targets, the following types of actions emerge for an immediate road map:

▶ Make national and international funds available for technology and equipment to improve labour productivity and irrigation scheduling efficiency.

▶ Water monitoring, reduce cost of control and operation and improve labour productivity and irrigation scheduling efficiency.

▶ Start specific projects on "water saving technology demonstrators" at all levels, to improve acceptance of farmers and decision-makers and to increase the levels of innovation and transferability.

▶ Fund focused research on methodologies to assist the participatory process and develop transferable guidelines.

▶ Fund focused projects on the development of holistic models and multi-dimensional indicators to assess real contributions to water saving for sustainability, considering the simultaneous social, economic and environmental benefits.

▶ Coordinate actions and networks to bring about regional guidelines for good irrigation practices including the linking of local initiatives on participatory processes and case studies.

▶ Consolidate local and regional networks to embed gender equality in agricultural water management.

CIHEAM

Founded in 1962, the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM) is a Mediterranean intergovernmental organization devoted to the sustainable development of agriculture and fisheries, food and nutrition security and rural and coastal areas. It is composed of 13 Member States (Albania, Algeria, Egypt, France, Greece, Italy, Lebanon, Malta, Morocco, Portugal, Spain, Tunisia and Turkey) and operates through its 4 Institutes based in Bari (Italy), Chania (Greece), Montpellier (France) and Zaragoza (Spain) and the Headquarters based in Paris.

The CIHEAM works at the service of its members to promote multilateral cooperation in the Mediterranean in the fields of agriculture, food, fisheries and rural territories in order to meet their needs. The CIHEAM implements this cooperation mission, through its main fields of action including education and training, research, networks and open knowledge platforms, projects and technical assistance, scientific diplomacy and political partnership.

The agricultural sector accounts for more than 80% of groundwater withdrawals in southern and eastern Mediterranean countries.

On Water Security in the MENA Region

Anders Jägerskog, PhD, Senior Water Resources Management Specialist,
World Bank Water Group

Water in the Middle East and North Africa is a crisis waiting to happen. Four insights into the challenges and solutions to counter water-related challenges across the Middle East and North Africa (MENA) with a leading global water specialist.

1. Are the region's water resources being managed sustainably and efficiently?

The MENA region is a global hotspot of unsustainable water use. Using water unsustainably is equivalent to living beyond one's means – withdrawing money from a bank account faster than it is being deposited. While each country has its specific challenges, groundwater is generally overused in the absence of alternative sources, or as a buffer against drought and it may not be apparent beforehand when this crucial resource might fail. Water quality in the region is degraded by unsustainable water consumption, brine discharge from desalination, pollution and untreated wastewater. About 55% of the wastewater collected across MENA is returned to the environment untreated, resulting in both health hazards and wasted water resources. And the region has some of the world's highest losses of freshwater resources in its food supply chain on a per capita basis. A major part of the MENA water challenge lies in managing demands and putting the right incentives in place to save water. This management is essential to improving water services delivery and water resources productivity.

2. Are water services being delivered reliably and affordably?

All countries should try to design affordable, equitable and sustainable water service fees and subsidy policies, which could help strengthen the social compact between governments and citizens. Improving the quality of water services will require improving data collection and monitoring. For example, monitoring the targets of the new SDGs (in particular SDG 6 on water) provides a tremendous opportunity to build a more evidence-based and comprehensive picture of the status of water services.

The Middle East and North Africa is the most water-scarce region in the world.

In most MENA countries, average service costs exceed average service charges, indicating a lack of cost recovery which is essential to ensuring the long-term sustainability of water services provision. The region relies heavily on government subsidies to compensate the difference and usually wealthier areas benefit more from subsidized water than poorer neighborhoods. Overall, MENA has the highest proportion of GDP (2%) spent on public water subsidies and the world's lowest water tariffs; this combination leads to excessive use of extremely scarce water resources. The MENA region has made

This Q&A highlights the main points of the Overview document summarizing the World Bank Group MENA Development Report "Beyond Scarcity, Water Security in the Middle East and North Africa" (2017).

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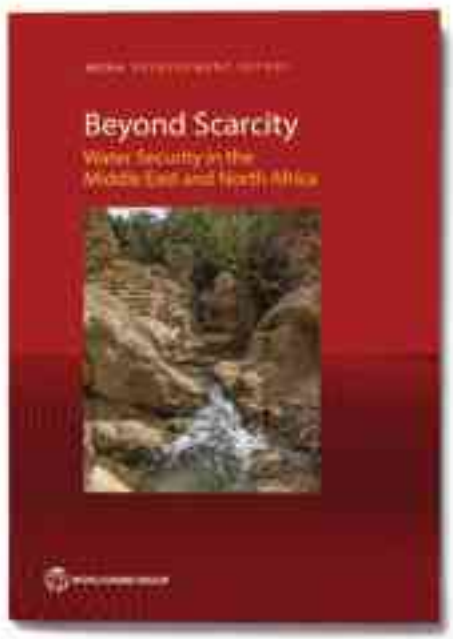

major improvements and is among the best performers globally in terms of increasing access to improved drinking water supply and sanitation since 1990, yet in many areas conflict and violence have reversed this hard-won progress.

3. Are water-related risks being appropriately recognized and mitigated?

Growing water stress is the largest challenge with which MENA countries and citizens will be confronted. The tandem of climate change and population/economy growth will only increase the water stress of MENA cities and societies. Climate change increases the risk of floods and droughts that will most likely harm the poor disproportionately. Climate change-related sea-level rise also leads to the salination of deltas and aquifers in coastal areas causing disturbances in agricultural yields and drinking water. The subsequent inter-relations between the water-food-energy sectors pose difficult trade-offs that can result in unintended consequences.

The League of Arab States has responded by recognizing, in its Strategic Framework for Sustainable Development (2014), the importance of multi-sectoral nexus approaches to solving complex water resource management problems. Geopolitically, since most surface and groundwater resources are shared and transboundary, there are many risks related to water security that require concerted action and constructive relationships among countries in the region to be mitigated. Fragility and conflict in the region thwart water security and water security in turn can compound systemic state fragility.

4. What are the opportunities and solutions for water security?

Some of the most notable water management innovations in the world are being implemented in the MENA region. Innovations include highly successful efforts to increase water use efficiency. Smart metering, for example, is being deployed to improve accuracy in billing, evaluate consumption and increase users' awareness of their own consumption. Mobile-based systems also ensure improved customer service by allowing for real-time monitoring of water infrastructure. Mobile water payment options also can improve collection efficiency and increase utilities' revenues, providing financial strength to extend services to the underserved.

Public-private partnerships have also been implemented in the MENA region to tackle the operational constraints of water utilities. As-Samra wastewater treatment plant in Jordan is the largest and most successful in the region (for more details see 2016 Water Around the Mediterranean report). And innovations in Integrated Urban Water Management can contribute to improving the quality, reliability and sustainability of urban and agricultural water services. New approaches will encourage cities to create strong synergies within or outside the water basin – for example, through the development of wastewater recycling for agriculture or shared desalination within industries (for more details see the Water Scarce Cities initiative: www.worldbank.org/en/news/feature/2017/05/15/water-scarce-cities-initiative).

The most important lesson from global and regional experience is that technology, policy and institutional management must evolve together to achieve water security.

Some 60% of surface water resources in the region are transboundary and all countries share at least one aquifer.

Chapter 2

Water Access & Availability

UfM Member States are investing **€430m** in water and environment projects to improve access to water, contribute to the depollution of the sea, while preventing new pollution and reinforcing the capacities of civil society. (5)

The Middle East region has one of the best records for improving access to safe drinking water and sanitation since 1990, but this is not achieved evenly and conflict and migration have reversed progress in some countries. (1)

The poorer sectors of population benefit the least from public supply subsidies, often because they are not connected to the infrastructure grid. (1)

The growth of infrastructure and the use of new technologies is not keeping pace with the growing demands of population and economic growth. (1)

There is great potential to reuse wastewater in the Mediterranean region as currently only around **1%** of it is recycled. (5)

Sources: UfM (5), World Bank Water Group (1)
Image: Fountain in the Casbah of Algiers, Algeria. Source: Jean-Marie Pirard

Towards Equitable Access to Water and Sanitation

The UNECE - WHO Regional Office for Europe Protocol on Water and Health is advancing national, regional and global commitments to achieve equitable access to water and sanitation for all. Everyone has the right to water and sanitation!

Writer: Chantal Demilecamps

Co-secretariat of the Protocol on Water and Health, UNECE

The recognition of access to water and to sanitation as human rights, derived from the right to an adequate standard of living, by the United Nations General Assembly and the Human Rights Council in 2010, confirmed the obligation of governments to ensure that water and sanitation services are available, physically accessible, of good quality and safe, acceptable in terms of dignity and privacy and affordable for all without discrimination. Governments therefore have to take concrete steps towards ensuring access to safe water and sanitation for all. Some components of the right to water and sanitation are deemed subject to progressive realization, but obligations such as that of non-discrimination are of immediate effect.

Equity considerations are very strong in the 2030 Agenda for Sustainable Development. In particular, the Sustainable Development Goal 6 (SDG6) on water and sanitation sets ambitious targets in this respect:

- **Target 6.1.** By 2030, achieve universal and equitable access to safe and affordable drinking water for all.

- **Target 6.2.** By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.

> Governments have to take concrete steps towards ensuring access to safe water and sanitation for all.

Countries from the Mediterranean region reaffirmed, in the 2017 Ministerial Declaration of the Union for the Mediterranean (UfM) Water Ministers on the UfM Water Agenda, their "willingness to undertake the necessary efforts ensuring access to safe drinking water as a fundamental human right, particularly for the most vulnerable." (see UfM Water Agenda pages 40-41.)

In the pan-European region, the Parties to the United Nations Economic Commission for Europe (UNECE) – World Health Organization Regional Office for Europe (WHO Regional Office for Europe) Proto-

Rural view, Armenia.

col on Water and Health have committed to ensure equitable access to safe drinking water and adequate sanitation through accession to or ratification of the Protocol. Indeed, the Protocol requires its Parties to ensure access to water and sanitation for everyone and specifically to promote equitable access to water and sanitation "for all members of the population, especially those who suffer a disadvantage or social exclusion."

The UNECE - WHO Regional Office for Europe Protocol on Water and Health

As a powerful tool to promote and operationalize equitable access to water and sanitation in the pan-European region, the Protocol provides a sound framework for the translation of these commitments into practice, particularly with the obligation to set targets and target dates, through the participatory approach called for and thanks to the monitoring systems and compliance review procedures established under its framework.

Since 2011, the Protocol has developed several important tools and supported a number of activities to provide support to countries to improve equitable access to water and sanitation. The publication **No One Left Behind: Good practices to ensure equitable access to water and sanitation in the pan-European region** presents good practices and lessons learned from the pan-European region on the policies and measures to be enacted to provide equitable access.

An analytic tool, the **Equitable Access Score-card** supports governments and other stakeholders to establish a baseline measure of the equity of access through a self-assessment process, identify priorities and discuss further actions to be taken to address equity gaps. It has already been applied in nine countries of the pan-European region (Armenia, Azerbaijan, France – Paris Greater Area, Hungary, Republic of Moldova, the former Yugoslav Republic of Macedonia – 3 regions, Portugal, Spain – Municipality of Castelló and Ukraine) and is currently being applied in Bulgaria and Serbia.

The **Guidance Note on the Development of Action Plans to Ensure Equitable Access to Water and Sanitation**, so far used in two countries (Armenia and the former Yugoslav Republic of

Macedonia) helps governments to take a structured approach to the identification and implementation of actions to ensure equitable access to water and sanitation.

Ensuring Equitable Access to Water and Sanitation

The outcomes of equitable access assessments carried out in the nine countries have highlighted four main challenges of ensuring equitable access.

The degradation of the quality of water resources means that many towns and villages that rely on local water sources do not have access to safe water, while water scarcity can deprive some towns and villages of access altogether. For example in Ukraine, improper water quality remains one of the key issues faced, specifically in rural areas.

Rural areas in the pan-European region have significantly lower levels of access to water and sanitation services than urban areas and may face higher tariffs. For example in Armenia, the assessment showed that 579 rural communities were not serviced by water companies and were not provided with centralized water supply services.

People belonging to vulnerable or marginalized groups do not enjoy the same levels of access to water and sanitation as the rest of society. The situation differs across groups, such as persons with specific physical needs, those who rely on public facilities, users of institutional facilities, or those living in unsanitary housing. For example in the former Yugoslav Republic of Macedonia, the assessment pointed out the challenges faced by the Roma population living in the capital Skopje: only 26% have access to water and only 16% have toilets and a bathroom at their living place, while most of them have to use toilets outside of their homes.

Vulnerable or marginalized groups do not enjoy the same levels of access to water and sanitation as the rest of society.

Affordability is a growing concern for all countries. For the poorest countries, either a large part of the population already devotes an important share of their income to pay for water and sanitation services, or they will likely be facing this situation soon as tariffs increase to ensure financial sustainability. In European Union countries, more stringent water quality objectives and progress towards full cost recovery also means that paying for water and sanitation services has become a real concern for lower income families. For example in the Republic of Moldova, the water and sanitation access gap difference between the richest and the poorest quintile of the populationcontinue to increase with years.

Different assessments show that current water governance frameworks are often "equity blind". The roles and responsibilities of different stakeholders and institutions in ensuring equitable access to water and sanitation are often not clearly identified and allocated. For example, water operators need to be more responsive to delivering equitable access and local government and civil society organizations need to play a greater role. The identification of different vulnerable and marginalized groups is a challenge, data on their access to services is often missing and the participation of members of these groups in decision-making processes constitutes a real challenge.

Addressing the Water and Sanitation Equity Gap

Such assessments have helped countries to get a clearer understanding of the gaps in access to water and sanitation and this helped them in turn to translate the pri-

Informal settlement without access to services, Serbia.

Wealthy neighborhood, Chisinau, Republic of Moldova.

School toilets in Mojance, Macedonia.

Drawing water from the well, Armenia.

orities identified into actions to address the equity gaps and in financing the necessary measures to advance towards universal access.

Based on the outcomes of such assessments, as well as in line with the countries obligations to guarantee the human rights to water and sanitation, several countries have taken concrete measures to improve the equity of access. Types of measures vary from the analysis and evaluation of existing plans, policies and programmes, legal and institutional reforms, targeted investments, capacity-building initiatives to enhance the understanding of the importance of equitable access by staff in relevant ministries, agencies and utilities.

For example, in the former Yugoslav Republic of Macedonia, Regional Health Centres coordinated by the National Health Centre, with the support of local and national civil society organizations have promoted the findings of the assessment, contributing to awareness with local people and decision-makers about the main access gaps faced and creating a "mood for change". Local action plans have been prepared through participatory processes in three municipalities. Concrete improvements, such as the renovation of toilets in schools and the construction of public toilets, have started.

In Portugal, the assessment has contributed to filling information gaps. The main findings have been considered in the revision of the strategic plan for water supply and sanitation of the national regulator (ERSAR). ERSAR has also carried more work on affordibility, introducing a set of Indicators including an "affordability indicator" for each operator in their annual report for the water, sanitation and waste services. It has also contributed to improvements of laws and legislation, with regulations being prepared to establish conditions for the social tariffs.

In Armenia, following the official adoption of a National Equitable Access Action Plan by order of the State Committee on Water Economy, several actions have been carried out: an in-depth evaluation provided detailed information on the problems faced by the 579 rural communities not serviced by the centralized water companies. On that basis, water operators are currently addressing this issue.

Experience shows that countries face difficulties in apprehending the actual situation of access to water and sanitation in terms of equity. Collecting information through assessments can help countries to get a clear understanding of the gaps in equitable access to water and sanitation and therefore to define and finance measures to advance towards universal access. Countries working under the framework of the Protocol have shown concrete progress in progressively improving equitable access. While this process requires time and continuous efforts, it is key to sustainable and inclusive development.

More information at: www.unece.org/env/water/pwh_work/equitable_access.html

UNECE

The United Nations Economic Commission for Europe (UNECE) is one of five regional commissions of the United Nations. Its major aim is to promote pan-European economic integration. As a multilateral platform, UNECE facilitates greater economic integration and cooperation among its member countries and promotes sustainable development and economic prosperity.

More information at:
www.unece.org/env/water

WHO is the authority responsible for public health within the United Nations system. The WHO Regional Office for Europe is one of WHO's six regional offices around the world.

More information at:
www.euro.who.int/en/health-topics/environment-and-health/water-and-sanitation

The views expressed in the article are those of the author and do not necessarily represent the views of the United Nations or its Member States.

Water Sharing in the Southern and Eastern Mediterranean

Writers: Hagar ElDidi and Yumna Kassim

How does community-based irrigation water management impact water access in the southern and eastern Mediterranean?

In the arid and semi-arid climate of the southern and eastern Mediterranean (SEMED) region, the management and access to scarce water resources is one of the strongest factors affecting agriculture, food security and the livelihoods of farming communities. Climate change will exacerbate these factors and even less water is expected to be available for agriculture. More frequent and intense droughts affecting soils may leave the region vulnerable to pollution and overuse of water and desertification, while experiencing hotter summers, less rainfall, population growth and a surge

Farming in Dayet Ifrah, Morocco.
Source: SuSanA Secretariat

Traditional knowledge, practices and the adaptive capacity of farming communities are pivotal to improving water management and sustaining water resources.

of climate migrants. Rising sea levels also threaten coastal areas while transboundary water management presents a further challenge in the region where major river basins straddle sensitive frontiers. Technical and policy solutions alone cannot provide a firm and sustainable water management plan. Improved on-farm practices, including the reduction of water losses from evaporation or leaks during distribution and altering cropping patterns and irrigation techniques, are only part of the water management system and its implementation process. Given rising demand, intensifying competition over water and the resulting potential for conflict, these corrective actions require strong participatory support from the main agricultural water users – farmers.

Irrigation water scarcity in the SEMED region is both a natural and anthropogenic phenomenon that has led to tensions between farmers demands and government attempts to respond effectively. Governments have provided structured scheduling for irrigation allocation periods: farmers are given time slots to use water, which is itself a good practice to avoid overuse but the schedules often cannot meet the needs of farmers. Whether due to inefficiencies or lack of water, a vicious circle ensues whereby farmers accuse governments of inefficient and unequal water management, while public water officials blame farmers for inefficient and illegal water use. Whoever is to blame, small farmers are too often left with limited, irregular and unequal access to water. Undoubtedly, competition for water has led to access inequalities among farming communities, but there are examples where communal cooperation in water

management, sharing and reciprocity practices have provided creative ways for enhancing water governance, equity and access for all. Community dynamics, common interest, social capital and cohesion, moral norms and the state all play an essential role.

Physical and Constructed Scarcity

Different access mechanisms to water and alternative water sources allow farming communities to adapt with varying results to water scarcity. For example, diesel pumps, groundwater wells and boreholes have a positive effect on poverty alleviation and agricultural productivity. However, they also lead to the over-exploitation of groundwater, unequal access and less willingness to engage in collective action for managing, allocating and sustaining water resources. Here are some SEMED cases to help illustrate these dynamics of community water management:

In Zaouiet Jdidi, northern Tunisia, farmers using irrigation schemes previously received water through pipes fed from an aquifer managed by the government and whose allocation was based on schedules where only two farmers could irrigate during each allocation period. In 1998, the irrigation management of small delivery pipes was transferred to the community level, which led to a deterioration in water provision services and increased salinity. Though the amount of water allocated to the system remained unchanged, the rules went unenforced and farmers irrigated simultaneously. With increased pressure, more wealthy farmers sought individual strategies to secure water by drilling private wells (often illegally) and over-exploiting the deep aquifer. This exacerbated inequalities

Individualistic actions to meet growing demand have aggravated the deterioration of access to water for all, and are an obstacle to the effective community management of irrigation systems.

and left small farmers vulnerable to prolonged irrigation turns with low quality water. Similarly, in the Oued Merguellil river basin in central Tunisia, resorting to private wells became common practice among farmers dissatisfied with the unreliable irrigation water schedules, which have led to a sharp decline in the water table.

In some circumstances, farmers rely on irrigation water from government-managed canals. While the government strives to meet demand, the scheduling and provision of water can be erratic often leaving canals dry for prolonged periods, which makes planning difficult for farmers and increases the feeling of scarcity. As a result, individual farmers tap into the canals simultaneously with their water pumps, causing irrigation water shortages downstream and unequal water allocations within the community.

While government scheduling has been effective in many instances, in parallel there are many documented cases of such unregulated private irrigation in SEMED countries that have led to over-exploitation and eventually a decrease in cultivated land areas. Individualistic actions to meet growing demand have aggravated the depleting access to water for all and are an obstacle to the effective community management of irrigation systems.

Collective Adaptive Capacity

Interestingly, in some parts of the region, farmers who drill private wells provide the water for free to all other farmers in goodwill, while incurring drilling costs. This is common charity in this context. The intricate social and family ties, as well as cultural norms of water charity foster a form of social cohesion within the community. These arrangements provide farmers with water entitlements and ultimately improve water access and security for farmers, counter-balancing the existing scarcity and inequality issues to an extent. The case of Tadla, Morocco also exemplifies how farmers may even resort to informal or illegal mechanisms to achieve this, with an estimated 20% of farmers benefitting from these informal arrangements.

In north-west Morocco's Khrichfa Canal in the Ain Bititt irrigation system, villages have adapted to variable spring discharge, insufficient scheduled releases and tension and competition over water rights along the water course. The rotational irrigation schedule, based on a 14-day cycle, prevented farmers from being able to grow

onions. Farmers developed an internal system to exchange and divide their water allocation periods to be able to grow and irrigate onions every seven days. Eventually, once the local Water User Association (WUA) came to take a more active and effective role, the official system switched to a shorter rotational schedule resulting in a more equitable water distribution for each farmer, thus preventing conflicts.

This case suggests that the "adaptive capacity" of communities to devise ad-hoc adjustments to deal with situations of water scarcity temporarily improves water security for farmers. The different ways farmers collectively adapt to enhance water access for all represents a valuable lesson for setting policies and improving government regulations to the benefit of farmers and ultimately food production and security. However, this system was made possible once the state intervened to provide improved infrastructure and technology by way of rehabilitating irrigation canals and installing gateways for famers to manage their irrigation allocation periods and to direct the water to separate fields.

Traditional knowledge, practices and the adaptive capacity of farming communities are pivotal in improving water management and sustaining water resources. If internalized into policy decisions, they can lead to better management outcomes. The south of Tunisia, for example, is an arid rainfed area but with highly irregular annual rainfall, ranging from 100 to 250 mm. Traditionally, farmers have been collectively engaging in rainwater harvesting. Through community trial-and-error, accumulated knowledge and adaptive capacity, communities have constructed the now widely-adopted Jessour (terraces) system of cultivation, which is both sustainable and resilient, being effective at storing water in the root-zone for the dry season and providing a shield from soil erosion and flash floods.

Findings from empirical research on collective action consistently show that users tend to manage their locally-shared resources in a more sustainable way when they cooperate to devise and enforce their own governance rules, compared to when rules are externally imposed. This is especially true with the presence of strong traditions and

local leadership. Individual actions by farmers each wanting to secure water for themselves creates inequity in these systems. Practicing simultaneous irrigation and some farmers' actions of secretly enlarging their irrigation canals to receive more water than their share in the case of Khrichfa, Morocco, caused water shortages for farmers downstream. In both cases, however, when working together, the farmer communities' collective actions helped correct some of the inequities in water access.

When facing scarcity, holistic and fundamental reform of agricultural policy is vital, but it is only part of the solution. Of equal importance is the thorough understanding and recognition of the behaviour of people, with the most challenging part of policy implementation being initiating and maintaining a change in people's behaviour. Community-based water management, equipped with adaptive capacity, social capital and cohesion, can be well-suited to respond to water competition. Public policy can benefit more from understanding local community governance systems of water management. The state still has a role in reinforcing the delicate balance between providing technical assistance and larger infrastructure, transferring management to communities, while boosting the sustainability and equitability of community-based management practices.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
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Visit: www.ifpri.org


MEDITERRANEO

Chapter 3

Governance & Diplomacy

Once access is achieved, good governance takes over as the critical factor to maintain a reliable, safe and sufficient water supply. (1)

With good governance, a water scarce country can be water secure, while with bad governance, a water abundant country can be water insecure. (1)

In the MENA region, water supply governance is not keeping up with the pace of growing pressures from population and economic growth. (1)

The political importance of water determines its scope for promoting diplomatic efforts towards transboundary cooperation and equitable sharing of water resources. (6)

The greater the conflict potential from water, the greater the potential for water to influence diplomacy. (6)

Sources: WANA Institute (6), World Bank Water Group (1)
Image: The beginning of the Mediterranean Sea at Punta de Tarifa, Spain. Source: Cjmolinagil

Strengthening Transboundary Water Cooperation

As water demand continues to grow and water quality continues to diminish, the importance of transboundary water cooperation is becoming primordial to ensuring safe and clean access to water.

Writer: Diane Guerrier

Secretariat of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, UNECE

Transboundary lake and river basins cover nearly half of the Earth's land surface and account for an estimated 60% of global freshwater flow. Transboundary groundwaters provide drinking and domestic water for about two billion people across the world, support their income and livelihood and play a crucial role in conserving ecosystems. While demands for water continue to increase, availability and quality is dwindling. As a result, water resources sustainability is endangered.

Around the Mediterranean, water is an increasingly scarce resource unevenly distributed in time and space, and heavily exploited. Mediterranean countries are highly dependent on shared water resources, both surface and groundwaters, and therefore water management poses a major challenge. To achieve an integrated sustainable management of these shared waters, Mediterranean countries have to cope with conflicting water uses, different political priorities and strategic interests; and diverse legal and institutional frameworks. In some cases, unequal levels of overall development are some of the obstacles inhibiting cooperation between countries and turbulent political relations can impede coordination efforts. Mediterranean countries have realized how hard managing transboundary waters can be when done alone. Significant progress has been made across the countries to improve the joint management of shared waters to make it beneficial for everyone.

At the global level, the importance of transboundary water cooperation is recognized in the Sustainable Development Goal #6 (clean water and sanitation) where target 6.5 requests all countries to implement integrated water resources management

(IWRM) at all levels, including through transboundary cooperation. At the trans-regional level, commitments such as the 2017 Ministerial Declaration of the Union for the Mediterranean (UfM) Water Ministers on the UfM Water Agenda (see pages 40-41) and the 2015 Water Strategy in the Western Mediterranean of the 5+5 Dialogue (see pages 38-39) recognize the need for transboundary water cooperation.

Transboundary water cooperation is indeed crucial to prevent conflicts between riparian countries, to optimize the use of resources and to ensure sustainability, therefore contributing to stability, peace and prosperity in a region facing many environmental, socio-economic and political disparities.

Introducing the Water Convention

International water law can provide a common language and a starting point for the discussion, adoption and further elaboration of normative and institutional frameworks for transboundary water resources management. By protecting the rights of all riparian countries and at the same time defining obligations to ensure sustainability and prevent harm, international water law has a key role in preventing conflicts on transboundary water resources. In recent years, a significant development in international water law took place with both the entry into force of the 1997 Convention on the Law of the Non-navigational Uses of International Watercourses (UN Watercourses Convention) in 2014 and the opening of the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992 Helsinki Water Convention or Water Convention) to all UN Member States in 2016.

3 Key Principles to the Water Convention

- to prevent, control and reduce transboundary impacts.
- to ensure reasonable and equitable use of shared waters.
- to cooperate through bilateral or multilateral agreements and joint bodies.

The Water Convention, whose secretariat is hosted by the United Nations Economic Commission for Europe (UNECE), is an international legal and institutional framework that helps strengthen transboundary cooperation. The Water Convention aims to protect and ensure the quantity, quality and sustainable use of transboundary water resources by facilitating and promoting cooperation between riparian countries.

Initially negotiated by UNECE Member States as a regional Convention for the pan-European region, the Convention was adopted in Helsinki, Finland, in 1992 and entered into force in 1996. In 2016, the Water Convention became a global multilateral framework for transboundary water cooperation as a result of an amendment process. Currently, 40 countries and the European Union are Parties to the Convention.

Over the past 20 years, the Convention has proven its effectiveness and has made a real difference on the ground; fostering the development of agreements, the establishment of joint institutions and the strengthening and broadening of cooperation at both political and technical levels in the pan-European region. When becoming Parties to the Convention, countries commit to the implementation of the three central obligations of the Convention which are 1) to prevent, control and reduce transboundary impacts, 2) to ensure reasonable and equitable use, and 3) to cooperate through agreements and joint bodies. These principles are based on the level of basins for water management to achieve successful IWRM.

Thanks to its institutional framework that is organized around a Meeting of the Parties, a Bureau, an implementation committee, working groups and task forces as well as a secretariat, the Convention provides a platform for the continuous development and advancement of transboundary cooperation. Through the many activities in its programme of work, the Convention supports Parties and non-Parties in implementation, promotes the sharing of experience between countries and basins, the development of guidance, fosters mutual assistance and adapts its activities to emerging

Lake Ohrid, Drin River Basin.

needs. For example, in the framework of the Convention, guidance documents have been elaborated on climate change adaptation in transboundary basins, transboundary groundwater cooperation and identifying, assessing and communicating the benefits of transboundary cooperation.

The Water Convention aims to protect and ensure the quantity, quality and sustainable use of transboundary water resources by facilitating and promoting cooperation between riparian countries.

Implementing the Water Convention

In the Mediterranean region, Parties to the Water Convention – Albania, Bosnia and Herzegovina, Croatia, France, Greece, Italy, Montenegro, Slovenia, and Spain – have been guided by the Water Convention to strengthen their water cooperation by entering into agreements and establishing joint bodies as well as by implementing concrete actions and projects on the ground.

The Drin River Basin shared by five riparian countries: Albania, Greece, Kosovo (UNMIK, Security Council resolution 1244), Montenegro and The Former Yugoslav Republic of Macedonia has benefited from transboundary cooperation mechanisms to improve its management. To respond to the numerous transboundary environmental challenges faced by the basin, the riparian countries signed a memorandum of understanding in 2011 and committed to a Shared Strategic Vision for the Sustainable Management of the Drin River basin. This engagement was a first step to implement an institutional frame for cooperation. Several cooperation projects were set up to improve the joint analysis and understanding of transboundary issues. The Water Convention represented an interesting tool for these riparian countries to create a common language for discussion and understand key legal obligations under international water law.

The Water Convention is now a unique intergovernmental framework also available for countries from the southern part of the Mediterranean and can provide a solid cooperation framework platform to help countries from the region to elaborate bespoke measures in their shared water basins. The Water Convention assists those countries interested in the Convention to support them in analyzing their transboundary water issues and facilitating national processes to study the benefits of possible accession to the Water Convention and of the implementation of its provisions.

Since 2011, specific work has been developed in partnership with the Global Water Partnership – Mediterranean (GWP-Med) in the southern Mediterranean region to promote the Convention and explore the needs and challenges of the different regional transboundary basins. For instance, the workshop organized in Rome in 2012 entitled **"International Roundtable on Transboundary Water Resources Management in the Southern Mediterranean"** was an opportunity to initiate these reflexions. Several Mediterranean countries in the Middle East and North Africa (MENA) region, including Lebanon, Jordan and Tunisia, have also expressed their interests in joining the Convention. UNECE and GWP-Med organized national workshops in these countries to discuss key aspects and opportunities provided by the Water Convention to strengthen transboundary water cooperation in their basins. Tunisia has also shown encouraging efforts to create the enabling environment for access to the Convention. This was made possible notably through collaboration between UNECE and the Tunisian Ministry of Agriculture, Hydraulic Resources and Fisheries.

Joining the Water Convention

As a flexible international tool, the Convention can be applied in very different settings and conditions. In the Mediterranean region, countries have different levels of water stress and of economic development, so the level of ambition for implementation measures should be proportionate to the capacity and means of the respective

country. The Convention is based on equality and reciprocity and it defends the rights of both upstream and downstream countries.

Joining the Water Convention offers multiple advantages. A country gains recognition from the international community and shows its willingness to cooperate on implementing the Convention. This can be a way for a country to place the transboundary water issue in the main political priorities, launch a dynamic discussion and set the example to its riparian countries in the regional basin. Being Party to the Water Convention also enables countries to take part actively in the institutional structure of the Convention and to participate in the development of its regime during the meeting of its governing bodies. Parties benefit from existing experience under the Convention including guidance documents and projects on the ground. For instance, a basin struggling with the allocation of water for irrigation and energy production can benefit from the Convention's activities on the water-food-energy-ecosystems nexus. In addition, the Convention is a collective platform where a Party may bring its needs and expectations to others. Potential concerns between riparian countries can be shared and discussed at the Meeting of Parties, for example.

Implementing the Convention obligations improves IWRM at the national level through the application of specific standards decided by countries themselves based on their capacities. While the Convention obliges its Parties to have bilateral and multilateral agreements for specific basins and established joint bodies, it provides support to establish such agreements and bodies, or in strengthening existing ones. In this context, the secretariat of the Convention's role is to guide and advise Parties as well as non-Parties interested in the Convention, taking into account their governance and political mechanisms. Parties may also benefit from the Convention's trust fund (based on voluntary contributions) for technical support in the effective implantation of the Convention through organization of training activities or pilot projects.

The Water Convention provides the framework for evolving and long-term transboundary water cooperation agreements to integrate environmental, cultural, social and economic implications of water use. In the Mediterranean region, the Convention is an appropriate tool to improve political and technical collaboration both between riparian countries as well as between northern and southern Mediterranean countries. Indeed, since the opening of the Convention, there are interesting opportunities for exchange between southern Mediterranean and northern Mediterranean countries on their experiences in transboundary water cooperation and best practices.

Supporting the improvement of water management and enhancing trust between countries, the Water Convention offers different technical instruments and a multilateral platform for the Mediterranean region. These can help turn potential conflicts into mutual benefits, boosting regional development and contributing to global peace and security.

For more info on the Water Convention, visit: www.unece.org/env/water

UNECE

The United Nations Economic Commission for Europe (UNECE) is one of five regional commissions of the United Nations. Its major aim is to promote pan-European economic integration. As a multilateral platform, UNECE facilitates greater economic integration and cooperation among its member countries and promotes sustainable development and economic prosperity.

The Convention is based on equality, reciprocity and no-harm and it defends the rights of both upstream and downstream countries.

The Douro River, Iberian Peninsula.

What is the 5+5 Dialogue?

Q&A with Mr. Eduardo Orteu, Chairman of the 5+5 Water Working Group, from the Directorate-General of Water at the Spanish Ministry of Agriculture, Food and Environment

What is the 5+5 Dialogue?

The Western Mediterranean Forum, commonly referred to as 5+5 Dialogue, was officially launched in Rome in 1990 as an informal sub-regional forum of countries geographically situated on the western rim of the Euro-Mediterranean littoral comprising Algeria, France, Italy, Libya, Mauritania, Morocco, Portugal, Spain and Tunisia. Malta became a member in 1991. As a trans-Mediterranean security initiative, the rationale of the 5+5 Dialogue is to secure closer cooperation between these five EU Member States and the five Arab Maghreb countries through political dialogue and economic cooperation and by encouraging the more efficient management of resources as a means of enhancing regional interdependence and development.

How is 5+5 linked to the UfM Framework?

The importance of achieving a closer and action-oriented cooperation among the Mediterranean riparian states is reflected in the development and implementation of several regional processes including in the efforts of consolidating the Union for the Mediterranean (UfM). Water and Environment form one of the six priority work areas of the UFM Secretariat. The UfM aims at making substantial contributions to depolluting the Mediterranean Sea, promoting environmental sustainability. Water within this framework represents an essential resource to protect and manage.

In that context, the Euro-Mediterranean Ministerial Conference on Water (Dead Sea, Jordan, 22 December 2008) agreed to prepare a shared and long-term Strategy for Water in the Mediterranean and approved guidelines for its elaboration. Despite the fact that there was general consensus from all the countries and experts involved on the technical contents, the references to the main geographical conflicts in the region made it impossible to adopt the Strategy. Spain and Algeria consider that the adoption of a water strategy for the Western Mediterranean basin is a necessary step to promote a common policy that could help prevent conflict, foster development and contribute to the respect of the human right to water and sanitation. With this context, the 5+5 sub-regional platform has contributed to supporting the UfM framework to revitalize the Water Political process by achieving the new water ministerial declaration on water on 27 April 2017 in Malta during their European Council Presidency.

Why can these 10 countries work efficiently together?

Most of the countries within the 5+5 dialogue share Mediterranean coast lines which have very similar characteristics. These countries are generally mountainous, sensitive to erosion, with highly-populated coastal areas which demand more and more water and discharging all kinds of residue (whether treated or not) into the same sea – the Mediterranean. Moreover, they are under the total or partial climatic influence of these shared waters. The Mediterranean climate, characterized by warm and dry summers and mild, humid winters have helped create a unique bio-climatic space that favours the intense development of its agriculture. These issues should inspire a common strategy.

What are the common regional priorities and how do they contribute to the global agenda?

Following recent episodes of water stress due to natural and anthropogenic causes, three thematic blocks have been defined, starting with the cross-cutting subjects and widely accepted basic orientations on water management. The second dimension describes the regional interest issues adapted to the specific context of the Western Mediterranean. The third aspect focuses on more technical objectives, according to the specificities proposed by the 10 countries to improve water management.

These three thematic blocks are aimed at 1) enhancing the convergence of western Mediterranean country policies towards the general principles of a sustainable water policy; 2) fostering cooperation on regional interest matters; and 3) promoting the improvement of water management. These three themes are integral part of the UfM water ministerial agenda (see pages 40-41) as well as the 2030 UN Sustainable Development Goals.

El Atazar Dam is on the Lozoya River, close to where the Lozoya joins the Jarama, near Madrid, Spain. The reservoir capacity is 424,000,000 m^3. Source: Carlos Delgado

Understanding the UfM Water Agenda

At the end of April 2017, ministers in charge of water from the 43 UfM member countries came together in Valetta, Malta, for a meeting hosted by the Maltese Government, **where they agreed to develop a UfM Water Agenda to enhance regional cooperation on water.** The UfM Water agenda is expected to lead to a consensual regional water policy framework that offers a means for substantial and measurable positive impact towards sustainable livelihoods in the Mediterranean region. It will also contribute to meet the UN Sustainable Development Goals and targets, in particular SDG 6 on water and sanitation, as well as address the adverse effects of climate change, notably the growing problem of water stress and scarcity.

Writer: Peter Easton, based on contributions from Miguel Garcia-Herraiz and Almotaz Abadi

This declaration is a natural progression of the 15 international and Mediterranean region environmental and social agreements and initiatives, from the Rio Earth Summit in 1992 to the UN Resolution on Water as a Basic Human Right (2010), and the Declaration and Mediterranean Strategy on Education for Sustainable Development (2014). The declaration restates 25 key statements and observations regarding the value of water to humanity and the region, and the critical need for its protection, some examples of which are:

- As a limited resource, water requires policies and regulations to ensure availability, quality and sustainable management.
- The Mediterranean region faces water-related stresses and challenges and is among the world's most water-scarce, particularly its southern and eastern countries.
- Regional socio-economic trends and environmental impacts are interlinked with water inadequacy, which can contribute to social and political instability.
- Regional cooperation adds distinctive value and complements national efforts, by facilitating and supporting experience sharing, promoting common approaches, joining pilot projects, enhancing existing knowledge, communicating innovative practices, and enhancing investment opportunities and access to sustainable financing.
- Welcoming the engagement by a large number of donors and international financing institutions that provide substantial support for materializing the water agenda of the Mediterranean countries and for promoting regional cooperation on water-related issues.

The ministerial declaration adopted in Malta also established the Strategic Guidance for a Water Agenda of the UfM, stating that:

"We, the Ministers, aim to support the Water Agenda of the UfM leading to a consensual regional water policy framework for substantial and measurable positive impacts towards achieving sustainable livelihood; and the UN Sustainable Development Goals (SGDs), in particular SDG 6 on Clean Water and Sanitation, and to prosperity, stability and peace in the region. […]

We anticipate that the UfM Water Agenda process will substantially enable the implementation of a range of key regional policies including:

Developing the circular economy and enabling green growth.

Meeting the obligations of Parties to the Barcelona Convention and other Multilateral Environmental Agreements to which UfM members are the Parties, as well as the objectives of the Mediterranean Strategy for Sustainable Development The implementation would require the contribution of regional institutions and stakeholders of the UfM region and their involvement where appropriate."

The UfM Water Agenda will be accompanied by a financial strategy designed to support its implementation in consultation with financial actors, the private sector and relevant stakeholders. The UfM Water Agenda will provide a suite of recommendations, proposals and initiatives to help UfM members achieve to achieve their goals with the participation of stakeholders. The UfM Water Agenda establishes and mandates a Water Expert Group (WEG) to implement this work in coordination with regional institutions, donors and non-governmental actors.

Key tools for achieving regional objectives include good governance regarding water supply planning, access to safe drinking water and sanitation, pollution control and de-pollution projects, sustainable water use of surface and groundwater resources, transboundary cooperation, sustainable financing, public private partnerships, reliable data and information, research and innovation and technology transfer, as well as education and awareness and capacity building.

EU Commissioner Karmenu Vella said: "Water scarcity is a growing problem around the Mediterranean. To improve the situation, cooperation between countries is essential. That is why I am so pleased to help the Union for the Mediterranean agree this Declaration on water. It provides a vision for a regional work programme on integrated water resources management. I am confident that improved access to clean, sustainable and efficient use of water will be the result."

NOTE TO READER:

This is a summary of the key components of the 6-page UfM Water Agenda. For the complete declaration, visit:

ufmsecretariat.org

Union for the Mediterranean
Union pour la Méditerranée
الإتحاد من أجل المتوسط

The Union for the Mediterranean (UfM) is an intergovernmental organisation bringing together the 28 European Union Member States and 15 countries from the southern and eastern shores of the Mediterranean, providing a unique forum to enhance regional cooperation and dialogue in the Euro-Mediterranean region.

Based in Barcelona and the first permanent structure dedicated to the intergovernmental Mediterranean partnership, the Secretariat of the Union for the Mediterranean is the operational institution that empowers this regional dialogue between the UfM Member States and stakeholders, fostering synergies and promoting cooperation projects and initiatives with a direct impact on the lives of people.

Promoting Water Cooperation in the WANA Region

Water is clearly recognised as a scarce resource in many parts of the WANA (West Asia and North Africa) region, and becoming more so with increasing population, wealth and environmental pressures. Will water be the cause of the next wars or a source of regional cooperation? According to the 2016 WANA Institute report, **Promoting Water Cooperation in the WANA Region: widening the base for water diplomacy**, with support of the Swiss Agency for Development and Cooperation (SDC), water can play a key role in mitigating or inciting conflict, but is not yet the main cause of war.

Writer: Peter Easton

Globally, there are 276 transboundary lake and river systems, and approximately 300 transboundary aquifer systems, with 40% of the world's population living in a basin shared by two or more countries. Starting with the Helsinki Rules on the Uses of International Rivers (1966), there has been a succession of policy guides and agreements aimed at establishing an internationally-applicable approach, most recently the UN Watercourses Convention of 2014. However, with ratification by only 36 countries to date, the reality is that most water sharing agreements are bilateral, and sometimes tri- or multilateral.

Regionally, around the Mediterranean, there is great potential for cooperation amongst countries despite the many challenges presented by transboundary rivers and bodies of water. Such challenges include exploitation, ownership, management, agricultural demands, hydropower supply, and other linkages to provide fresh water and clean energy to people living in coastal areas. Water diplomacy helps advance and ensure the positive outcome of mutually-beneficial cooperation between neighbours and regional partners for sharing this precious natural resource.

What defines whether water diplomacy is relevant?

A key paradoxical point the WANA report makes is that the greater the conflict potential from water, the greater the potential for water to influence diplomacy. Conversely, if water is not a subject for dispute, then there is limited incentive for mutual cooperation over its management.

The notion of water diplomacy relies on two key assumptions: 1) in the context of increasing scarcity, competition for water resources can drive conflict between states; and 2) water cooperation can give rise to mutually beneficial solutions. Water diplomacy is particularly attractive to the WANA region where water scarcity is high and diplomatic relations often complicated. Many transboundary agreements exist, but as the Nile example shows, these often favour the more powerful country, and they have generally under-delivered on their expectations of solving disputes and improving socio-economic conditions. There is also the argument that water diplomacy cannot yet demonstrate success in achieving peace. Examples are the ongoing Israeli-Palestinian tensions in a context where water resources are critical, and ongoing tensions between India and Pakistan despite their need to share the Indus River waters.

Water is often insufficiently important to drive conflict or diplomacy because, at least in part, the pressure on water demand is offset in time by a combination of technologies, such as desalination and wastewater recycling, and by imports of virtual water, whereby the import of agricultural products means much of the water use is in other global regions. Thus, many parts of the West Asia and North Africa region do not suffer the water scarcity challenges that might incite conflict between states, while water stress does rise domestically.

Beyond transboundary water scarcity

Water-related conflict may not always be about transboundary water scarcity. The Shatt al-Arab waterway was a driver for the Iran-Iraq war of the 1980s, but the conflict was over access to a critical shipping route, not water supply. And this occurred between two neighbouring countries with respective water scarcity concerns.

Transboundary water bodies are not the only conditions for water-related conflict. It can also be driven by inequalities within a sate. Inadequate or unreliable water supplies for parts of the population, especially the poor, can be a driver for civil unrest. Until inequalities in water, food and energy provision are compressively addressed, they are likely to fuel local-level conflict for years to come.

Conclusions

The political importance of water determines its scope in diplomatic efforts. However, regardless of the role of water cooperation in leading to peace, it remains important in the context of political and social stability, human welfare and the natural environment of the region. The West Asia and North Africa continues to face many water-related challenges, some of which are worsening, such as the over-extraction of water sources, seawater intrusion, growing demand and climate-related threats like droughts and floods. Policies must take into account future generations. This is especially important for non-renewable resources such as aquifers with very low or negligible rates of recharge (where the water is often referred to as fossil water).

Developing a more enabling environment for the advancement of water science and technology within the region will be primordial for addressing the great water challenge of our times. Arab states, to date, under-perform in the areas of peer-reviewed science publications, patents and R&D spending. Better laboratories and science education are not enough. There needs to be a political will to integrate science and research into the wider economy. There are, however, some positive signs of change. Saudi Arabia, Kuwait and Qatar are taking a lead in science and R&D investments. Also welcome is Jordan's hosting of the World Science Forum in November 2017. Science can play a more explicit role in making the link between water science, water preservation and water cooperation.

More information at:
www.worldscienceforum.org
wanainstitute.org

WANA INSTITUTE

The West Asia - North Africa (WANA) Institute is a non-profit policy think-tank based in Amman, Jordan.

Operating under the chairmanship of His Royal Highness Prince El-Hassan bin Talal, WANA works to promote a transition to evidence-based policy and programming to combat the development and humanitarian challenges facing West Asia and North Africa.

The WANA Institute aspires to be a trusted source of knowledge, evidence and opinion, and to provide a forum for open debate for leading researchers and policy-makers in the region.

We undertake research, host conferences and conduct training workshops in the areas of social justice, sustainable development and human security. We believe these three areas represent both the most pressing issues facing our region and the greatest opportunity for our work to create vital impact.

Chapter 4

Food & Agriculture

The MENA region has some of the **world's lowest water service fees** for irrigation, enabling famers to grow water intensive crops and to reduce incentives for efficient irrigation technologies. (1)

Arable land is being whittled away by advancing urbanization, erosion and salinization of soils, and desertification, much of it stemming from **unsustainable agricultural practices.** (7)

In **agriculture** – the MENA region's **biggest water user** – large volumes are lost due to inappropriate techniques or outdated infrastructure. (7)

The rush to increase home-grown **agriculture**, often with an aspiration of self-sufficiency, puts the **highest pressure on water availability.** (1)

If existing rates of **land degradation** continue, by 2020 another **8.3 million hectares** of agriculture land may be lost, versus 1960. (7)

Sources: World Bank Water Group (1), FAO (7)

Image: Since the 1980s, Almeria has developed the largest concentration of greenhouses in the world, covering close to 30,000 hectares. Half of Europe's demand for fruits and vegetables are grown under these plastic shades. Source: Nick Hannes ©

Two pathways out of a regional water crisis

Writer: Javier Mateo-Sagasta and Alvar Closas

Re-using wastewater and solar-powered irrigation can address and assuage the growing water crisis across North Africa and the Middle East.

Water scarcity has worsened substantially over the last 30 years as a direct result of population growth, urbanization and the intensification of agricultural activities. Average water availability in the Middle East and North Africa (MENA) now stands at only 1,200 cubic metres per year – about six times less than the world average of 7,000 cubic metres. Water scarcity on this scale has major implications for economies around the region that is already witnessing a series of droughts, adding to the societal stresses created by armed conflict and the resulting displacement of millions of people. The civil war in Syria particularly, by greatly increasing the numbers of refugees in neighbouring countries, has put tremendous pressure on land and water resources as well as on infrastructure, with serious long-term consequences that will likely be further aggravated by climate change.

Governments across MENA are seeking ways to increase water security, including initiatives to manage water more efficiently, to narrow the gaps between supply and demand and to prevent the degradation of water quality. Such efforts to alleviate the region's water crisis, if successful, will contribute to prosperity and stability, thus mitigating the mass migration of 'water refugees' out of the region. Two innovative technologies are emerging as useful solutions for providing clean water for agriculture and urban usage:

Average water availability in the Middle East and North Africa (MENA) now stands at only 1,200 cubic meters per year – about six times less than the world average of 7,000 cubic meters.

Wastewater reuse: Emerging success stories

As populations and water use grows, wastewater is the only water resource that increases in the equation. Fortunately, a wide range of technologies and approaches are now available that can treat and reuse wastewater for many purposes, such as forestry, agriculture, landscaping and aquifer recharge. Taken together, these options represent a powerful means to combat water scarcity and pollution at the same time.

MENA countries generate 18.4 cubic kilometres of municipal wastewater per year, according to estimates from the Food and Agriculture Organization (FAO) of the United Nations and the International Water Management Institute (IWMI). With appropriate treatment, this wastewater and its nutrients have the potential to provide irrigation and fertilizer for more than two million hectares of agricultural land. The freshwater conserved could instead be made available for domestic use and a wide variety of productive purposes. Treated wastewater can be used to create green belts, generate energy, produce fodder for livestock and irrigate fruit trees or other cash crops, all with due consideration for local or national safety regulations.

Despite the fact that MENA is among the most arid and water-scarce regions in the world, its uptake of managed wastewater reuse has been slow and uneven. Some countries, like Jordan and Tunisia, promote wastewater treatment and reuse as an integral part of their water management strategies, while others, like Lebanon, make only limited use of this approach. According to the FAO and IWMI, only about 45% of the total volume of municipal wastewater generated in the region receives treatment and most of this is in the Arabian Gulf countries. Of all the treated water (amounting to about 8.3 cubic kilometres per year), only 3.1 cubic kilometres are reused, with most of this (about 2.0 cubic kilometres) going specifically to agriculture. There is considerable space to increase the treatment and reuse of wastewater throughout the Middle East and North Africa.

To tap this potential, countries need to address four challenges

- **1.** cultural barriers and distrust regarding health and environmental safety limit public demand for treated wastewater.
- **2.** institutional divisions jeopardize the design and implementation of effective policies for wastewater reuse.
- **3.** stringent regulatory frameworks constrain viable options for reuse.
- **4.** the lack of appropriate tariffs, economic incentives and financial models undermine the sustainability of reuse projects by making it difficult for them to recover the costs of wastewater treatment.

Overcoming these challenges is critical if the region is to meet target number 3 of the UN Sustainable Development Goal (SDG) #6 - ensuring availability and sustainable management of water and sanitation for all:

> **6.3.** By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Emerging success stories on the reuse of wastewater – at various scales within and beyond the region – provide grounds for optimism. These successes create opportunities for countries to learn from one another in the search for solutions to common regional challenges. Among the key success factors are active stakeholder participation, sound economic and financial models, flexible plans for ensuring safe reuse of wastewater, conducive policies, inclusive partnerships, innovative technologies and cost-effective investments.

One particularly instructive case is the wastewater treatment plant at as-Samra, Jordan, that serves Greater Amman and Zarqa areas, by sending electricity to the capital and treated water to the agricultural lands of the Jordan Valley.

See the 2017 edition of this report for more details on As-Samra

www.revolve-water.com

Solar-powered irrigation: Perils and payoffs

In pursuit of the SDGs, governments across the Middle East and North Africa are strongly promoting the use of renewable energy, particularly solar energy, to power irrigation. Their efforts have the triple aim of strengthening water, energy and food security. Governments also expect that solar technology will help reduce oil-based carbon emissions.

To these ends, Morocco, for example, expects to install more than 100,000 solar pumps by 2020. Other countries in the region are undertaking similar ventures, prompted by oil price instability leading to high diesel costs and intent on taking advantage of the region's high solar radiation. The trend towards a reduction in traditional fuel subsidies provides a further incentive for shifting to the use of solar and other renewable energy sources.

Solar-powered irrigation offers a way for farming communities to leapfrog from chronic vulnerability toward resilient and sustainable intensification of production. The technology overcomes water and energy constraints, while also strengthening food security. It also has a downside, however, which is our inadequate understanding of groundwater and the related tendency to overestimate its quality and quantity. This together with poor regulation and enforcement of rules have made it exceedingly difficult to control the over-use of groundwater. Further incentives to freely abstract groundwater via solar-powered irrigation would presumably make the situation even worse.

Further challenges derive from the generally close link between solar-powered irrigation pumps and the use of drip irrigation systems (for example, in Egypt, Jordan and Morocco). These systems offer well-known advantages in terms of water-use efficiency, but they also have practical limitations resulting from poor installation, cheap materials and inadequate training in operation and maintenance. Moreover, the expected reduction in water requirements may be offset by an increase in the irrigated area and by more intensive

cultivation, leading to greater evapotranspiration and depletion of aquifers.

The roll-out of solar-powered irrigation poses financial and societal challenges as well. Volatile currency rates (in Egypt, for example) can undermine the capacity of countries to import this technology and make it available at competitive prices. Given the heavy upfront capital requirements, there is also a risk of excluding marginalized groups (particularly smallholders, women and youth), especially if they have only limited access to credit and competitive markets for their agricultural produce.

To diminish these challenges, it is vital for countries to develop solar-powered irrigation through an integrated and informed approach that adequately addresses the water-energy-food nexus. This approach must incorporate close monitoring of groundwater use and focus on improving our knowledge and control of this vital but "hidden" water resource. The use of innovative technologies, such as smart meters, together with new institutional arrangements (like the solar cooperatives that IWMI has piloted in Gujarat, India) could contribute to sustainable spread of this technology in the region. Failure to do so could give rise to a perfect storm that will only aggravate water stress in MENA and make the region's water and food security challenges more daunting than ever.

Learning from success and failure

Solutions to the region's looming water crisis are within reach. But to implement them successfully, governments must closely analyze previous investments in wastewater reuse and solar-powered groundwater pumping and learn critical lessons from both successes and failures. On this basis, governments can then devise strategic plans and roadmaps to scale out solutions that address water scarcity successfully.

In support of such analysis and planning, the region needs to have a mechanism for enabling countries to learn from each other. This could take the form of a dynamic knowledge platform that links stakeholders and helps them share information about the factors responsible for success and failure in wastewater reuse and groundwater use within and beyond the region. Such stock-taking would help us build a shared understanding of what works, what does not and of what challenges we must address.

At the same time, national governments need to re-examine policies and align them with the SDGs. Countries across the region are at different stages in planning how to deliver on these. One requirement is to ensure stakeholder participation in this process, which should result in wider and more equitable uptake of sustainable solutions.

Another key step is to mobilize a wide range of experts for an assessment of the current state of water resources, in terms of their availability and use in countries throughout the region. This will make it possible to create baseline scenarios and a shared vision for future progress towards SDG 6. Each country can chart its own transitional path towards this goal, building on current plans and programmes. The roadmaps could include recommendations for institutional reforms, investment priorities, capacity development plans and new or revised water policies that can facilitate the adoption of the most promising models.

It is particularly vital for local water projects to be based on lessons learned regionally and internationally. Such projects tend to be more effective and sustainable when they result from participatory selection of technology, based on an analysis of its technical, economic and social feasibility. This analysis will bring to the forefront any concerns about the sustainability of resource use, the mechanisms and rules for their allocation and the possible impacts on vulnerable communities.

How well the water sector addresses the formidable challenges it faces in the Middle East and North Africa depends ultimately on new knowledge, capacity development, financial resources, appropriate technologies, political will and strong partnerships with active stakeholder engagement. To be effective and sustainable, water management solutions must be ambitious but realistic, drawing on lessons learned from previous efforts.

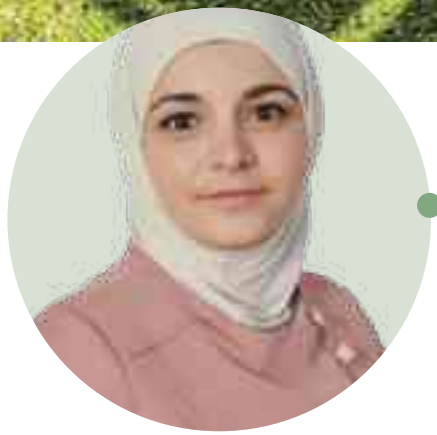
> MENA countries generate 18.4 cubic kilometres of municipal wastewater per year, that – if treated appropriately – could provide irrigation and fertilizer for more than 2 million hectares of agricultural land.

IWMI International Water Management Institute

The International Water Management Institute (IWMI) is a non-profit, scientific research organization focusing on the sustainable use of water and land resources in developing countries. IWMI works in partnership with governments, civil society and the private sector to develop scalable agricultural water management solutions that have a real impact on poverty reduction, food security and ecosystem health.

Introducing Lina Energy

LE green roof happy photovoltaic



Lina Al-Kurdi is a renewable energy professional. She holds a M.Sc. in Renewable Energy (2016) from the University of Jordan and established her own renewable energy and energy efficiency company. She received her Renewable Energy Professional Certificate from the Association of Energy Engineers in 2016. She founded Lina Energy (LE) in 2017 and strives to increase building efficiency, in particular to improve external wall thermal insulation and to restore green spaces in Jordan through the LE Green Roof technology.

Lina Energy (LE) is a Jordanian start-up founded by Engineer Lina Al-Kurdi in early 2017 to support growing development needs in Jordan. The expanding number and size of construction projects is increasing the demand for cooling and heating energy, but also has a negative impact on the availability of green open space in this arid country. This is where LE's sophisticated green roof technology addresses two main challenges in Jordan: energy demand and environmental sustainability.

LE's Green Roof provides developers and building owners with the opportunity to compensate for green spaces lost to construction projects and to reduce cooling-heating energy consumption. LE Green Roof increases the value and attractiveness of a property and provides many benefits for its inhabitants. LE Green Roof has a range of designs. It can be solely dedicated to energy efficiency, but can also be designed to provide open spaces that are recreational, relaxing or educational, or for other consumer purposes. Different applications include rainwater harvesting and restoring ecological habitats and biodiversity.

LE Green Roof has a positive social impact by enhancing the local micro-climate, cooling and filtering air, restoring a more natural green environment and helping to mitigate greenhouse gas emissions. LE Green Roof can offer greater benefits when implemented on a larger scale in cities. It helps reduce the urban heat island affect, by reducing roof temperatures from 60 degrees Celsius down to 25 degrees Celsius, thus reducing the stored and reflected heat of the building, and helping to cool surrounding micro-climates.

LE Green Roof consists of several layers, the main layer being vegetation, maintained with a water efficient irrigation system. Drought-tolerant vegetation is always recommended. Despite its sophistication, LE Green Roof is very flexible with many applications and uses. It is recommended to be installed with a photovoltaic system which increases efficiency by 3%, extends its life and reduces maintenance. The system also provides a protective layer against harsh weather conditions.

The LE team studies the project location and characteristics and makes sure the final design allows for access to all roof equipment requiring regular maintenance. The building owner does not have to choose between different rooftop options as the LE Green Roof is compatible with most standard designs.

LE green roof simple city

LE green roof industrial look

For new buildings, the LE Green Roof replaces the conventional insulation layer. For existing buildings, it enhances the building's thermal performance through increasing its envelope efficiency to lower the cooling/heating energy demand, and the severity of heat flux which can damage the roof condition.

LE Green Roof performs more effectively than conventional roof-surface insulation systems due to it being of living material. This enables it to react to weather changes to achieve improved thermal performance and to maintain a greater comfort level for inhabitants inside the building.

LE provides after sales support to its clients and has a dedicated team to ensure optimal performance of the LE Green Roof. The design is tailored to the client's needs. LE makes sure the owner's maintenance staff understand the system and how to maintain it. Alternatively, LE can provide scheduled care and maintenance.

More information at: www.lina-energy.com

Who are the Switchers?

The Switchers is a community of inspiring green entrepreneurs and change-makers in the Mediterranean region. Switchers are individuals, enterprises or civil society organizations implementing innovative and ecological solutions that contribute to sustainable and fair consumption and production models. They are active in a variety of fields, such as organic farming, green tourism, renewable energy or waste management. The platform **www.theswitchers.eu** tells their stories of sustainable transformation and change.

The Switchers platform has been developed by the Regional Activity Centre for Sustainable Consumption and Production (SCP/RAC) in the framework of the SwitchMed initiative. SwitchMed is an initiative that supports and connects stakeholders to scale up eco and social innovations in the Mediterranean; our aim is to provide them with tools and connections to supporting partners for their eco and social innovations, to achieve productive, circular and sharing economies in the Mediterranean. SwitchMed is a regional programme funded by the European Union (EU) and collaboratively coordinated by the EU, United Nations Industrial Development Organization (UNIDO), United Nations Environment Programme Mediterranean Action Plan (UNEP/MAP), Regional Activity Centre for Sustainable Consumption and Production (SCP/RAC), and and the UNEP's Division of Technology, Industry and Economics (UNEP/DTIE).

switchmed

UNIDO

UN environment
United Nations Environment Programme

Mediterranean Action Plan
Barcelona Convention

Regional Activity Centre for Sustainable Consumption and Production

SwitchMed programme is funded by the European Union

Chapter 5

Pollution & Protected Areas

The Mediterranean Sea contains more than **670 marine protection areas (MPAs),** of national or international status, including **five** Biosphere Reserves, but only **two** UNESCO World Heritage sites. (8)

Water quality problems in the south and east Mediterranean arise from **desalination plant discharge (brine),** industrial and agricultural pollution and untreated wastewater. (1)

The Mediterranean Sea represents less than **1%** of the global **ocean surface,** yet hosts almost **20%** of global marine **biodiversity.** (8)

Today, **52%** of **fish** stocks are being **exploited** at unsustainable levels. (7)

MPAs cover **4.6%** of the Mediterranean Sea area. (8)

Sources: FAO (7), MedPAN (8), World Bank Water Group (1)
Image: Beach polluted with plastic garbage due to sea currents, Korcula island, Croatia. Source: Don Mammoser

Protecting the Mediterranean and its biodiversity

Writer: Peter Easton (based on information from MedPAN website and reports)

What is MedPAN?

MedPAN is a network of managers of Marine Protected Areas (MPAs) in the Mediterranean, first created in 1990, and since 2010 run by the MedPAN Organisation, gathering over 100 institutions and NGOs that either have direct responsibility for managing MPAs or are involved in the development of MPAs in the Mediterranean.

Also under this umbrella are 'Other effective area-based conservation measures' (OECMs). The network incorporates over 100 MPAs and over 1,200 protected areas when including OECMs.

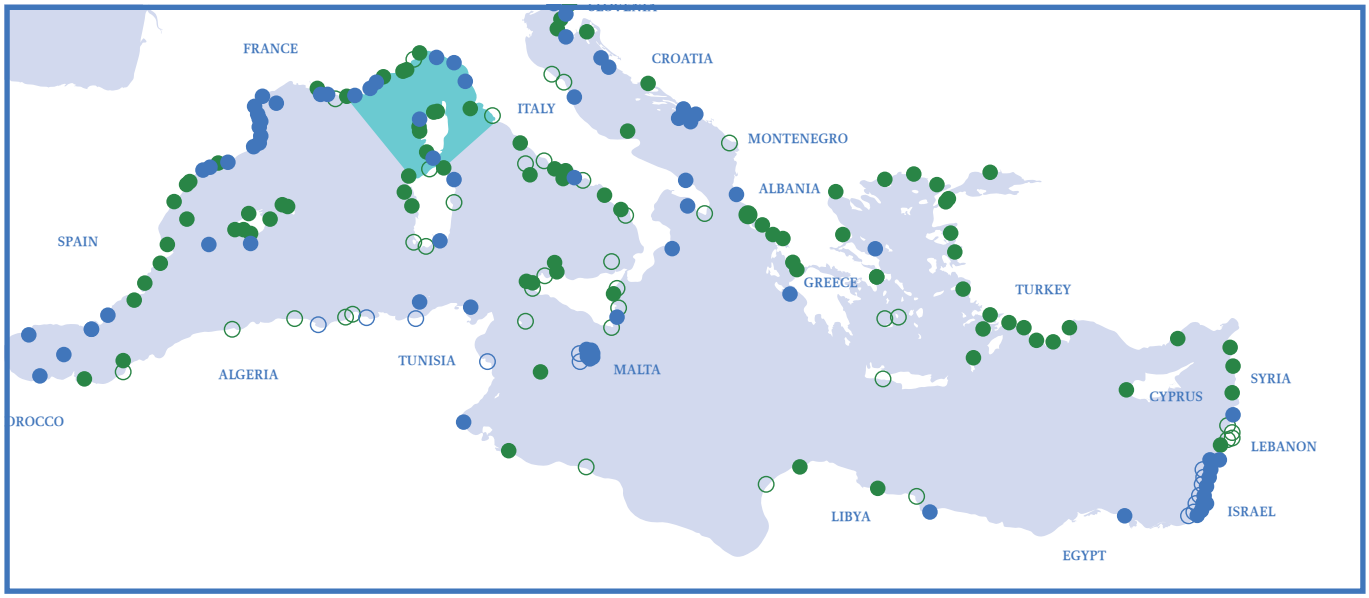
Participating organizations originate from 18 coastal countries: Albania, Algeria, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Lebanon, Malta, Morocco, Monaco, Montenegro, Slovenia, Spain, Tunisia and Turkey.

Key partner organizations and influencers include:

- UN Environment Programme through the RAC/SPA (Regional Activity Centre for Special Protection Areas)
- WWF

The MedPAN network: more than 80 MPAs in 18 countries in April 2013

Source : MAPAMED, the database of Marine Protected Areas in the Mediterranean, MedPAN, RAC/SPA, 2012. Note: only some Natura 2000 at sea sites are present on this map



- The Conservatoire du Littoral (a coastal conservation organisation of France)
- IUCN Mediterranean
- The French Agency for Marine Protected Areas
- ACCOBAMS (Agreement on the Conservation of Cetaceans in the Black Sea
- Mediterranean Sea and contiguous Atlantic area. Cetaceans are aquatic mammals such as whales, dolphins and porpoises)
- GFCM (General Fisheries Commission for the Mediterranean)

The global importance of the Mediterranean Sea

The Mediterranean is a semi-enclosed sea whose waters lap the coasts of 21 countries of a region that has been the cradle of civilisations for centuries. Its geological and human history has given the region its richness in terms of biodiversity, but also in terms of social, cultural and political diversity.

As one of the planet's key areas for marine biodiversity, the Mediterranean Sea hosts habitats, species and ecosystems of particular importance. Its richness and quality contribute to the well-being of its human populations and to the development of coastal areas.

Mediterranean marine ecosystems are under significant pressure. The risks are linked to the intrinsic value of ecosystems, but also to the loss of biodiversity and natural habitats, which play a major role in human health, lifestyle, food production and availability of natural resources for the economic development and the well-being of coastal populations.

The Mediterranean Sea is subjected to anthropogenic disturbances especially along the coasts and new potential or actual pressures are emerging in the open sea. It is also faced by a transformation of its environmental characteristics due to global changes, with climate change projected to have a negative impact on the region.

The impacts of coastal development such as agricultural, industrial, transport, tourism, … and urbanisation are among its main threats and these have intensified over the last few years. 450 million people live in the Mediterranean basin, 40% of whom live along the coast. This coastal demographic growth contributes to degraded landscapes, soil erosion, increased waste discharges into the sea, loss and fragmentation of natural habitats as well as a deterioration of the state of vulnerable or endangered species. The development of activities in coastal areas has created economic opportunities, but can also have a negative impact on standards of living and well-being.

The Mediterranean region is one of the world's most important tourism destinations, attracting about 30% of international tourism. While generating benefits to the countries' economy, this popularity generates significant negative impacts on the marine environment through uncontrolled coastal zone development and the increased use of water resources and the production of solid wastes and sewage.

Maritime transport is another important economic activity for the region: it represents about 30% of the international shipping trade and 25% of maritime oil transport. The associated risks of accidental or deliberate pollution, transport of exotic species are still poorly controlled.

Fishing is also an important activity in the Mediterranean in terms of employment, income and food security. Recreational fishing is an important sector for certain territories. Its continual development is poorly controlled. The uncontrolled rise in fishing efforts registered over the last decades in a number of Mediterranean countries has led to the decline of many fish stocks. According to recent evaluations made within the framework of the General Fisheries Commission for the Mediterranean (GFCM), 90% of the assessed fish stocks were over-exploited.

Aquaculture puts a localised and relatively strong pressure depending on the site and its development, which is backed by many public policies, raises questions in terms of its impact especially on the environment, fisheries and the associated stocks of raw material required to feed the fish.

Ongoing changes in the availability of resources and the cost of energy has led to a growing variety of pressures and makes spatial planning more difficult for stakeholders interested in the area such as desalination, wind/tidal turbines or in the deep-sea resources (aggregates, oil, gas, rare minerals, biotechnology). This reduces the surface area available for MPAs or traditional stakeholders (artisanal fishing) and affects the required connectivity or representativity of the network of MPAs.

The work of MedPAN

The MedPAN network has been guided by its 2013-2017 strategy, based on the Statutes of the MedPAN organisation, the expectations of its members and partners, as well as the challenges faced by Mediterranean MPAs. This strategy was approved by the General Assembly of the MedPAN organisation in November 2012, but is now due for renewal.

The 2013-2017 strategy is broken down into three big strategic components and the five major transversal interventions areas of the MedPAN network.

The three strategic components:

- **1.** Be a network for knowledge, information, anticipation and synthesis.
- **2.** Develop the life of the network, the exchanges between its members and their capacity to effectively manage their MPAs in connection with the other players in their territories.
- **3.** Reinforce the sustainability, prominence, governance and resources of the MedPAN network.

The five major transversal interventions:

- **1.** Scientific strategy
- **1.** Capacity building
- **3.** Communications strategy
- **4.** New funding mechanisms dynamic
- **5.** Consolidation of the Secretariat and the governance of the MedPAN network

The programme organises regular workshops on management issues common to all marine protected areas, such as management planning, management of fisheries and tourism, habitat management or financing of marine protected areas. It also funds studies and the production of methodological tools and communication tools to assist managers in their daily work and to establish the first global database of marine protected areas in the Mediterranean. **Known as MAPAMED, this database is a core component of the programme.** The MedPAN website provides valuable links to reports and studies on ocean environments from around the world. For example, a stunning 300-page publication **"The Ocean Revealed" (Euzen et al, 2017)** on the health and sustainability of oceans around the world.

MedPAN also publishes its own reports on the status and progress of its work and the condition of the sea. Its most recent is "'The 2016 Status of Marine Protected Areas in the Mediterranean" which provides a number of statistics and key findings:

- The total surface of the Mediterranean Sea is 2.5 million km2
- There are 7,231 protected areas, consisting of more than 100 MPAs, and the rest OECMS
- The total of protected areas is about 180,000 km2, equivalent to twice the size of Portugal
- But this represents just 7.1% of the sea area; the long-term target is to achieve at least 30% coverage
- The protected areas include 'no-go', 'no-take' and 'no-fishing' areas, although these currently represent only 0.04% of the sea area

- The Mediterranean Sea is globally important for marine biodiversity, representing just 0.7% of world ocean area, but about 8% of marine biodiversity

- An important priority is to support the UN Sustainable Development Goal (SDG) 14 to "conserve and sustainably use the oceans, seas and marine resources for sustainable development".

- The Mediterranean carries 1/3 of global marine traffic

- It is the world's primary tourist destination, with 350 million visitors a year, contributing to the pressures on pollution and use of resources, including food and water

- 85% of fish stocks are over-fished

- The majority of protected areas are in the north, with 90% in territorial waters of the European Union

Regarding progress in achieving its aims, it recognises that progress is not as fast or effective as it really needs to be. MedPAN concludes that major limitations on effective management of protected areas are poor governance and insufficient funding and staffing. Thus, the pressure on governments to take greater responsibility for the critical health of the Mediterranean Sea needs to be kept up and the progress in nurturing closer cooperation between all interested parties and organisations needs to be maintained.

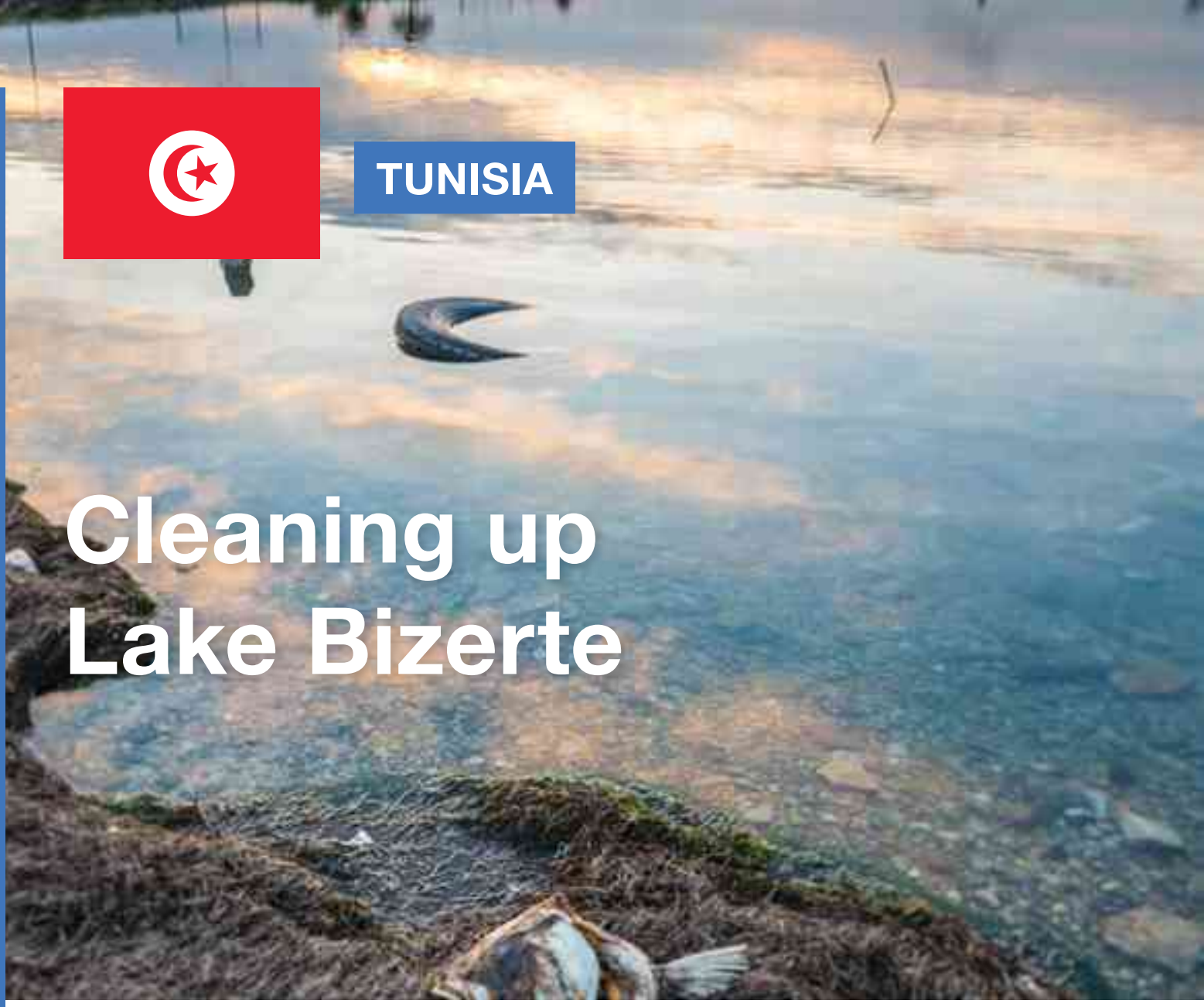
About MedPAN

Since 1990, MedPAN has brought together the managers of Mediterranean Marine Protected Areas (MPAs) and has supported them in their management activities. Becoming an independent organisation since 2008, MedPAN aims to promote the establishment, the operation and sustainability of the network of MPAs contributing to the Convention on Biological Diversity, to the Barcelona Convention and to different European policies on marine issues.

The MedPAN network gathers to date more than 65 members, primarily MPA managing institutions from the whole Mediterranean basin, and 45 partners willing to contribute to the creation and strengthening of MPAs. These actors manage more than 110 MPAs in 18 Mediterranean countries.

The MedPAN network contributes to improve MPA managers capacities with good practices exchanges, training, tools; the network also improves communication on MPAs and dialogue between decision-makers, managers, scientists and socio-economic actors in the Mediterranean. The network represents MPA managers in European, Mediterranean and International decision-making fora.

More details at: medpan.org



TUNISIA

Cleaning up Lake Bizerte

After decades of urban and industrial pollution, Lake Bizerte will have fresher waters again, with additional benefits.

Writer: Peter Easton, based on contributions from Dhekra Gharbi and Almotaz Abadi

Bizerte is the northern most city in Africa – further north than Malaga, Malta, Crete and Cyprus. The city, with a population of 143,000, rising to 400,000 in the nearby region, lies between the Mediterranean Sea to the north and Lake Bizerte to the south. The lake is in fact a tidal lake or lagoon, meaning that its waters are brackish, connected to the sea via a 7 km-long canal, which serves as the entrance to the city's commercial port.

Over recent decades, the lake has become continuously more polluted through urban and industrial pollution, causing damage to the natural condition of the lake, its fisheries and creating risks to human health.

The Union for the Mediterranean has helped to promote and coordinate an integrated programme to clean and protect the lake and its catchment, which includes the surrounding drainage basin and Lake Ichkeul – a freshwater lake providing most of the inflow to Lake Bizerte.

The project aims to rehabilitate the environment and water quality of Lake Bizerte, through a clean-up and removal of pollution sources, and to improve conditions for aquatic life and living conditions for the surrounding populations. The results will also have a positive impact on the development of tourism and aquaculture.

A range of positive impacts are expected. There will be improved sanitary and environmental conditions for an estimated 400,000 inhabitants in urban and surrounding rural areas. There will be improved conditions for sustainable industrial production (state-owned and private companies) and a boost to local employment opportunities in the fields of sewage, waste management, fisheries and agriculture.

The project will focus on four priority areas of investment:

- **1. Industrial pollution:** address and manage industrial or atmospheric pollution of water and air in the steel, cement and oil sectors to be in compliance with Tunisian standards.
- **2. Urban wastewater:** extensive rehabilitation works will bring wastewater collection and treatment up to Tunisian standards.
- **3. Solid waste:** remediation of landfills, securing storage areas and creating treatment plants and transfer centres in rural areas.
- **4. Coastal zone management:** cleaning and landscaping the lakeshore and extending fishing harbours.

The investment component will be complemented by specific decentralised cooperation actions between local authorities for the detailed conception of complementary work in the fields of environmental follow-up, governance, communication and awareness-raising.

This project is an excellent example of a coordinated multi-stakeholder approach to reversing the pollution impacts of decades of urbanization and industrialization in a sensitive environment.

Union for the Mediterranean
Union pour la Méditerranée
الإتحاد من أجل المتوسط

Lead promoter:
Tunisian Ministry of Environment and Sustainable Development with support from UfM

Project partners:
International financing institutions, such as the European Investment Bank (EIB) and the European Commission (supporting the feasibility studies) as well as the European Bank for Reconstruction and Development (EBRD)

€90 million total funding, including:

- Tunisian government: €16 million
- EIB: €40 million
- EBRD: €20 million
- EU: €15 million

Duration:
2016-2022

Source: Union for the Mediterranean

Chapter 6

Technology & Solutions

Non-Conventional Water Resources, including rainwater capture, greywater re-use and recycled wastewater, are means to make a **valuable resource from waste products,** and can be cost effective methods of increasing local water availability and climate resilience in water scarce Mediterranean islands. (9)

Technology can help the transition to a more sustainable approach to the increasing demand for water, through **improved efficiency, re-use and recycling** in place of the more traditional approach of simply increasing the supply. (1)

The use of **treated wastewater for irrigation** is growing, in part due to incremental social acceptance. (1)

Improving technology is **reducing the costs** of desalinated water treatment. (1)

The MENA region holds **47% of global desalination** capacity. (1)

Sources: GWP-Med (9), World Bank Water Group (1)
Image: A view across a reverse osmosis desalination plant. Source: James Grellier

How to remove nitrates from water

Nitrate contamination of groundwater is a global issue that is alarming in Asia, Europe and the United States. Nitrate levels are increasing in drinking water supplies, regularly exceeding the health-based guidelines for drinking water set by the World Health Organization (WHO). The biggest health risk associated with nitrates (NO3) or nitrites (NO2) in drinking water is methaemoglobinaemia, known as a 'blue-baby syndrome' due to cyanosis or reduced oxygen levels in the blood, which presents a risk to bottle-fed infants, and potentially causing asphyxia in the most extreme cases. Here is how to remove nitrates from water:

Writers: Alexandra Martí (CWP), Sara Gabarrón (CWP) and Joaquim Comas (ICRA – UdG)

Nitrate contamination of groundwater is mainly caused by the wide use of nitrogen-based fertilizers and livestock manure, especially from pigs. Other factors that increase the potential for nitrate contamination of groundwater are land use practices, soil type and water well depth.

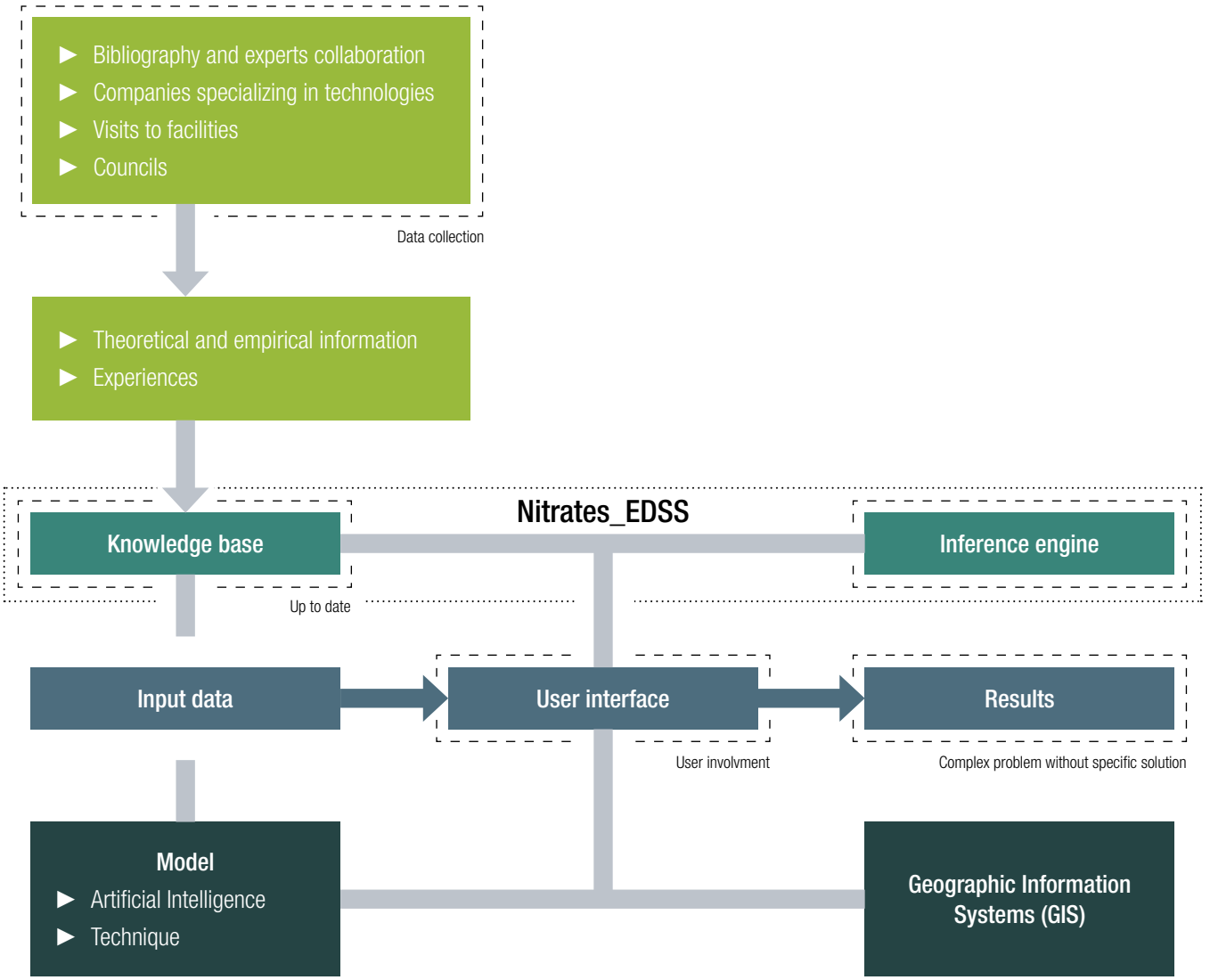
As a western Mediterranean example, the Catalan Water Agency established in 2016 that almost 41% of its groundwater bodies exceed the value of 50 mg/L (WHO safe level) for nitrates. This leads to the need to implement solutions for the treatment of groundwater across the land, especially in water supply systems for small populations without access to other drinking water sources.

To guarantee reliability over time, technology treatment specifications for removing nitrates are important, as are the groundwater characteristics and the users' requirements, such as seasonal demand, and priorities, such as cost efficiency. Several technologies are already available on the market with some successful experiences from full scale systems, while others are just being developed and implemented for the first time. The identification of the most adequate technology for treating each specific polluted groundwater source is not so straightforward and requires an assessment of multiple technological, economic and environmental parameters.

EDSS for Nitrates Removal

An Environmental Decision Support System (EDSS) for the identification of the most adequate treatment technology for nitrates removal from groundwater is being developed, called the Nitrates_EDSS tool. An EDSS is an intelligent information system that reduces the time in which decisions are made within an environmental domain and improves the consistency and quality of these decisions. EDSSs use a combination of models, analytical techniques, and information retrieval methods to help develop and evaluate appropriate alternatives; such

Figure 1. Scheme of EDSS nitratres adapted from Poch, M., et al. (2012).



systems focus on strategic decisions and not operational ones (Figure 1). EDSS tools have emerged as successful support tools for 'Industry 4.0' to facilitate and improve decision-making when dealing with complex problems. More specifically, an EDSS should contribute to the reduction of the uncertainty faced by managers when they need to take decisions regarding future options.

The Nitrates_EDSS tool is being developed following a standard methodology for developing such smart tools including five essential steps: 1) the analysis of the problem, 2) data collection and knowledge acquisition, 3) model selection, 4) knowledge implementation and integration, and 5) validation. The data collection and knowledge acquisition step is essential to develop a comprehensive knowledge base, which is to be the core of the EDSS, able to generate some recommendations according to data provided.

The Catalan Water Partnership (CWP) has created a working group comprising universities, research centres, technology providers, engineering companies and other water suppliers to gain, share and structure the knowledge about nitrates removal technologies. Together with the CWP, the universities of Girona (UdG) and Barcelona (UB) are leading this study. Data has been collected through experts interviews and with an extensive literature review complemented by the aggregated experience of nine Catalan municipalities, where some of the treatment technologies have already been implemented.

Spreading the Knowledge

There are different types of technologies to treat groundwater contaminated by nitrates. The first classification is based on whether the technologies are applied in situ or after abstraction from the aquifer. The systems

TREATMENT	MECHANISM		TECHNOLOGY
EX SITU	PHYSICAL		Reverse osmosis
			Electrodialysis
	CHEMICAL		Ion exchange
			Catalytic hydrogenation
			Electrochemical systems
	BIOLOGICAL	HETEROTROPHIC DENITRIFICATION	Biofilters, mobile biofilm reactors, etc
		AUTOTROPHIC DENITRIFICATION	Bioelectrochemical systems
IN SITU	PHYSICAL		Permeable reactive barriers
	CHEMICAL		
	BIOLOGICAL	HETEROTROPHIC DENITRIFICATION	Biostimulation Bioaugmentation Permeable reactive barriers

Table 1. Classification of mechanisms involved in the removal of nitrates.

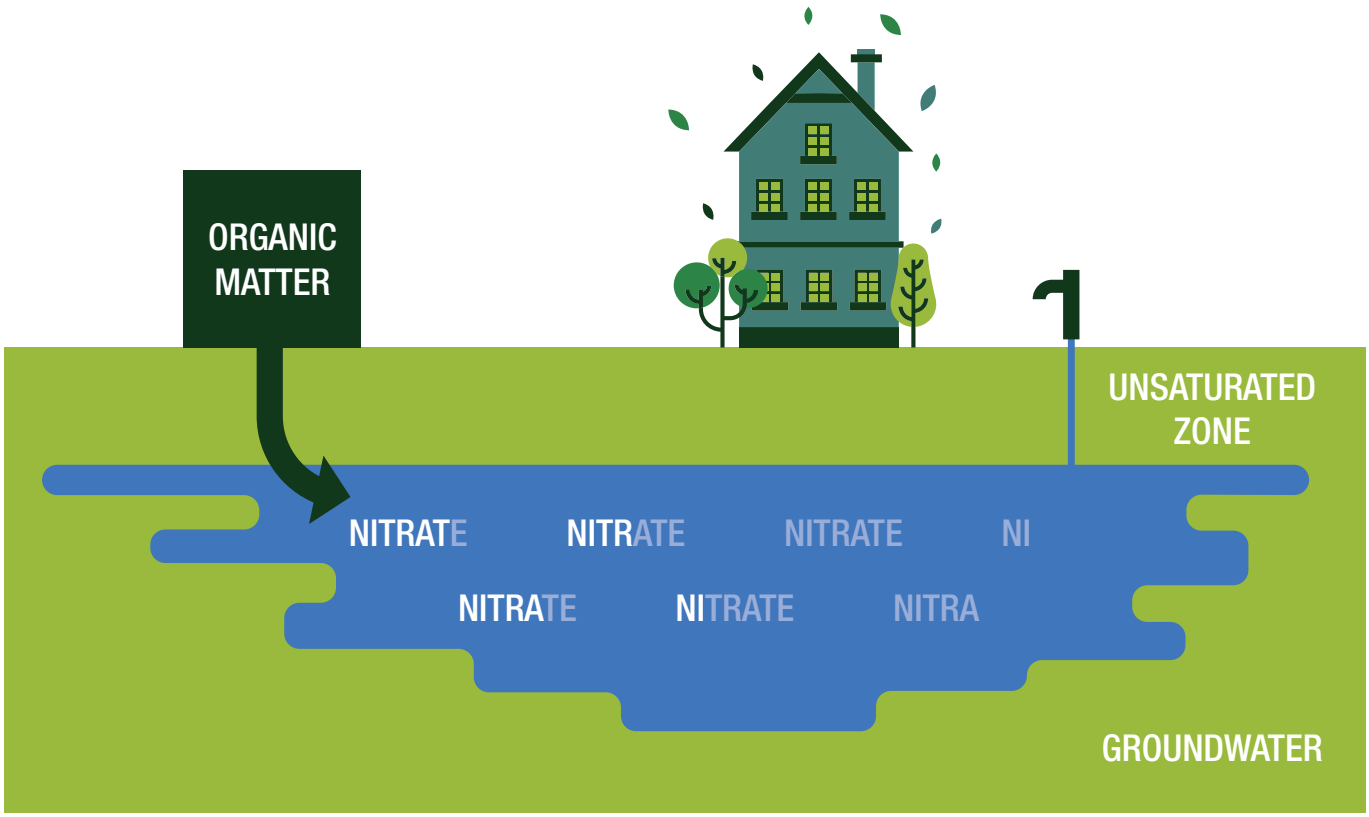


Figure 2. Scheme of in situ bioremediation (Insitrate). Graphics from Freepik.

that focus on treating groundwater that is pumped to the surface, outside the aquifer, are defined as **ex situ treatments** while **in situ treatments** refer to technologies that directly treat groundwater inside the contaminated aquifer.

The mechanisms involved in the removal of nitrates led to the identification of three technology types: physical, chemical and biological, which are defined below and summarized in Table 1 that shows the general classification of all technologies available for nitrates removal.

Physical technologies refer to technologies that involve a physical barrier to retain pollutants, such as reverse osmosis, or to transport pollutants through the barrier to separate them from the water, for example electrodialysis. These technologies do not really eliminate nitrates but a concentrated reject is generated that will require a subsequent treatment. Currently, the management of this concentrated waste entails its discharge to the sea, surface waters or wastewater collectors, its use in agricultural fields, its injection into deep wells, or its evaporation to eliminate the liquid part. Although waste is generated, physical methods allow the separation of multiple pollutants and are therefore not specific for nitrates.

Chemical technologies eliminate, separate or transform pollutants through a chemical reaction to form safer molecules.

Biological technologies eliminate or transform contaminants due to the metabolic activity of micro-organisms. These technologies involve multi-specific microbial communities, which make it difficult to study and optimise these technologies as a simple, unique and invariant process. Generally, these biological technologies are associated with wastewater treatment. However, there are more and more systems that are based on biological activity to eliminate drinking water contaminants without generating hazardous waste.

Focusing on **in-situ technologies**, the INSITRATE project demonstrated the feasibility of in situ bioremediation of nitrate-polluted groundwater at pilot scale in Catalonia (for more details, visit: **www.insitrate.ctm.com.es/en**). The main innovation of this technology is the design of the bioremediation strategy based on modelling and simulation. The technology is based on the injection of organic matter into the aquifer around the extraction well to create a reactive area in which the autochthonous denitrifying bacteria is stimulated (Figure 2). The technology was implemented at pilot scale and was run for two years (Figure 3). Project results demonstrated its feasibility from the technical, economic and environ-

Figure 3. Pilot plant (Insitrate).

mental perspectives. Nitrate was reduced by up to 70-100% with very low organic matter consumption, low energy demand and low cost.

On the other hand, there is a great diversity of **ex situ technologies** particularly with the following technologies (see Figure 4):

- **Reverse osmosis.** Commonly used for seawater desalination, this technology involves high pressure applied to the water flow via a semipermeable membrane, which allows the passage of water but not the dissolved ions. Therefore, nitrates and other ionic elements will remain on the feed side of the membrane while 'sweet' clean water will go through the permeate side of the membrane.

- **Electrodialysis.** A technology with selective semi-permeable membranes of cations and anions. Membranes are alternated, and, with the application of electrodes, an electrical current is generated, which causes the migration of cations (positive ions) towards the negative electrode and the migration of the anions (negative ions) towards the positive electrode, leading to cells with a high concentration of salts and other more diluted cells.

- **Ion exchange.** In anions exchange columns the nitrate anion is exchanged for the chloride or bicarbonate anions of the resin. Nitrate is removed from the water, and replaced by chloride and bicarbonate at harmless levels.

- **Catalytic hydrogenation.** Technology based on the chemical oxidation and reduction reactions produced by the direct attraction of hydrogen in the presence of a catalyst that favours the reduction of nitrate to nitrogen gas, which leaves the water.

- **Electrochemical systems.** Specific electrochemical technology for the removal of nitrates that converts nitrate to nitrogen gas by the use of an oxidation anode and a reduction cathode, which causes the flux of anions and cations necessary for the reaction. The reduction of nitrate to nitrogen gas occurs in the cathode.

- **Heterotrophic denitrification.** Conversion of nitrates to nitrogen gas through the metabolic activity of heterotrophic micro-organisms, which oxidize organic substrates using nitrate or nitrite as an acceptor of electrons instead of oxygen, due to its absence, since it is carried out under anoxic conditions.

- **Bio-electrochemical systems.** Oxidation and reduction reactions produced between two electrodes where, at least in one of them, the driver of the reaction is the metabolism of certain microorganisms.

Figure 4a. Heterotrophic denitrification. UFBAF, KING DIAMOND.

Figure 4b. Electrochemical system. HYDROKEMOS.

Figure 4b. Electrochemical system. HYDROKEMOS.

In autotrophic denitrification, hydrogen or reduced sulphur compounds are used as a substrate, and carbon dioxide or bicarbonate are used as a contribution of carbon to cellular growth.

Reasoning process of the Nitrates_ EDSS tool

Once all acquired data and knowledge are analyzed, the reasoning procedure to identify the most suitable treatment must be codified using the most adequate knowledge representation technique. The selected reasoning model for the Nitrates_ EDSS tool is an artificial intelligence technique based on heuristic 'if-then' rules which facilitates the representation of the reasoning procedure as a decision tree, a visual graphic easy to understand and modifiable by experts. The current knowledge of technologies will be organized in the form of a decision tree which, once verified by experts, can be simply converted into a collection of 'if-then' rules. Finally, the knowledge base, combined with the collection of 'if-then' rules extracted from the decision tree, will be encoded in software that allows the development of user-friendly interfaces.

The generated knowledge base will become the core of an EDSS to analyze different treatment technologies for nitrate removal and suggest the most suitable solution to reduce the nitrate concentration of the groundwater to fulfil the legal limits and to assure the supply quality at each specific site. EDSS is a support tool in the decision-making process for administrators, managers and municipalities. It is most useful when choosing from different options to address a problem, but the final decision for the implementation of one or other technology will always have to be taken by the decision-maker. Looking forward, the Nitrates_EDSS tool will facilitate investments for the deployment of technologies to treat nitrates in groundwater.

CWP
CATALANWATERPARTNERSHIP

With its headquarters in Barcelona, the Catalan Water Partnership (CWP) is the Catalan Cluster of the sustainable use of water. CWP was launched in 2008, as a non-profit strategic association business-oriented comprising companies and research centers that work in the sector of sustainable use of water. The mission of CWP is to improve the competitiveness of its members that include consultancies, centers of knowledge, equipment manufacturers and other entities involved in the water cycle and in the solutions for water sustainability.

Visit: www.cwp.cat

PALESTINE

Providing drinking water for Gaza

Source: Union for the Mediterranean

There are three principal causes of water scarcity. 1) physical scarcity: when there is insufficient natural replenishment; 2) economic scarcity: when there are insufficient funds for constructing and maintaining infrastructure; and 3) scarcity can arise from poor governance, when politics or general poor management mean that things just do not get done. Gaza is unlucky enough to find all three contributing to its severe shortage of safe and sufficient drinking water.

Writer: Peter Easton, based on contributions from Miguel Garcia-Herraiz and Almotaz Abadi

The Gaza Strip covers an area of 365 km^2 – a little more than that of Malta – but with four times the population at nearly 2 million. With a density of 13,000 people per square kilometre, it is one of the most densely-populated territories in the world.

Its small size and arid climate leave the Strip with very limited natural water resources. Wadi Gaza, which passes across the middle of the territory, from Israel to the Mediterranean Sea, carries fresh water for only short periods, perhaps once a year after rains. The principal fresh water resource is from the underlying coastal aquifer, consisting mainly of sand and sandstone, which holds water within its pores, a bit like a hard sponge.

Moreover, annual water withdrawals from over 4,000 wells are 64% greater than natural replenishment rates, causing falling groundwater levels and seawater intrusion. Because the aquifer is also shallow and unprotected, it is contaminated by urban and industrial pollution and untreated wastewater. Israel supplies some water, but this is insufficient, so there are serious problems with both quantity and quality of water. According to the United Nations:

"The increasing population and unsustainable demands on Gaza's sole water source due to systematic over-extraction of the

underlying coastal aquifer has resulted in the intrusion of seawater and in 96.2% of the groundwater in Gaza becoming unfit for human consumption – up from 90% in 2012."

According to the World Bank, the water supplied by tap to homes is unsafe to drink and can only be used for general non-consumptive use. Safe drinking water must be purchased at a higher cost from trucks bringing treated water from small private desalination systems. Gaza uses 2 million cubic metres of water per year: approximately 100 m^3/person/year.

A partial solution to the Gaza water crisis is the development of a new desalination facility, which is labelled as a UfM project. The aim is **to provide safe drinking water for more than two million people** and **to decrease the pumping demands on the aquifer,** which in turn can help the small Gazan agricultural and tourism sectors.

The project has three main components:

- Construction of the seawater desalination plant with an initial capacity of 55 million cubic metres/year, growing to 100 million cubic metres/year.
- Construction of a new north-south delivery system to carry water throughout the Strip and with much reduced leakage losses compared to the existing network.
- Planning to reduce 'non-revenue' water losses, including leaks and unauthorised connections.

An important additional benefit of the project is job creation. As the largest infrastructure project in Gaza to date, it provides opportunities during construction and for ongoing operations.

The first phase of a small-scale low-volume plant run by UNICEF and funded by the EU was officially inaugurated in January 2017 and initially provided water to around 75,000 inhabitants. The next phase is due to serve an additional 150,000 people, so there is still some way to go to serve the target of two million people, but illustrates that with political will water can be brought to meet Gazans needs.

The success of a project of this size requires the support and cooperation of multiple international stakeholders. The UfM-labelled endorsement as the main facilitator is invaluable, but many implementation hurdles remain, including external financing. In addition to the technical design and construction aspects, the project includes a governance framework to support its ongoing successful implementation and operation.

Union for the Mediterranean
Union pour la Méditerranée
الإتحاد من أجل المتوسط

Lead promoter:

Palestinian Government (GoP) with support from UfM

Project partners:

- European Commission (EC)
- European Investment Bank (EIB)
- Islamic Development Bank (IDB)
- World Bank (WB)

Only 10% of Gaza's population has access to safe drinking water, compared to 90% in the West Bank or about 85% in MENA in general. (Source: World Bank, 2016.)

Chapter 7

Financing & PPPs

PPPs attract private capital to develop larger projects, enabling governments to **avoid excessive indebtedness** since they transfer it at rate paid for the use and consumption of the resource.

(Source: ALMAR)

Low water supply fees combined with high subsidy rates, often in the most water scarce parts of the region, results in an **undervaluing of water by users,** and insufficient attention to conservation and efficiency. (1)

In the Arab region, the price charged for water (from conventional sources) is, on average, only **35%** of the cost of water supply provision, and the price for desal water only **10%** of cost. (1)

For improvements in water conservation, pricing policies need to be accompanied by **educational efforts to raise awareness** about water consumption levels. (10)

The MENA region has **the lowest water tariffs** and **highest proportion** of GDP **(2%)** spent on public water subsidies. (1)

Sources: DWA (10), World Bank Water Group (1)
Image: Marshlands of Marathon, with Pentelikon mountains in the background, Greece. Source: Seisma

ALGERIA

The Hamma Water Desalination Project

Writer: Nancy Rivera

For almost 10 years, the capital of Algeria has enjoyed access to potable water on tap thanks to an innovative public-private partnership called the Hamma Water Desalination Project.

Public private partnerships (PPPs) are at the heart of the Overseas Private Investment Corporation (OPIC) mission to promote sustainable economic development by lending to the private sector for the realization of projects. Large privately-owned infrastructure projects invariably require collaboration with the host government. PPPs encompass a myriad of schemes. In the case of the Hamma project in Algeria, while the government has a minority ownership stake in the company, the most important PPP elements is the long-term agreement to build, own, operate, and sell water to the government water distribution company at a set price. This enables financial stability and the well-structured contract has the essential performance obligations to ensure water supply reliability and quality. This also means the plant is operated and maintained in accordance with international best practices. Private sector control results in a material difference from government-implemented and owned infrastructure where

construction cost over-runs are prevalent and life-cycle costs are not factored into project design resulting in deferred maintenance that diminishes an asset's utility and where the true cost of water cannot be determined. As with most large infrastructure concessions, the Hamma project was funded via an international project financing eliminating the need for large upfront government investment. International development finance institutions like OPIC provide additional layers of oversight to ensure the project's overall success, including appropriate environmental and social impacts of such large-scale infrastructure.

Providing Water Security

Increasing both the amount of available water and making its daily delivery the norm is a huge feat for the Hamma plant. OPIC repeated this water access impact with another iconic water project in Jordan where the Disi Water Conveyance Project provides 25% of the water for its capital Amman. That being said, with severe to extreme water-deprived countries such as Algeria and Jordan, the expansion of such large projects for providing potable water unfortunately does not ensure water security. Increased population, migration from rural areas to the capital, significant economic activity growth and the political battles over water distribution between residential, industrial and agriculture users continuously increase the demand for water and stress supply. Less wealthy countries with limited groundwater resources are particularly vulnerable since options to increase water supply are expensive and the cost of water to the end-user is invariably highly subsidized by governments. The good news is that governments from these water-deprived countries are tackling water supply security in a holistic way from both supply and demand management perspectives. An important component is the rehabilitation of distribution networks that suffer severe leakages. In Algiers, for example, water network losses previously exceeded 40%. Expensive new water sources like desalination and wastewater treatment have compelled utilities to repair leaks and to increase water tariffs given the renewed potential to deliver reliable and quality water services to customers.

Responsibility to the People

Awareness and education about water scarcity does not necessarily guarantee rational consumption. When work started on the Hamma Project, it was interesting to learn about the effects of the water shortages on people's lives. Water supply curtailment cut across all socio-economic classes indiscriminately and created challenges for industry, commerce and in citizens' daily lives. Water supply to a given neighborhood was scheduled and delivered reliably for numerous hours usually ever second or third day. To cope, users would hoard water to ensure their supply until the next scheduled date. At that next water service date, many ended up with excess water that was thrown out to refill their storage with fresh water. While water purchased from vendors would be extremely expensive, the scarce tap water was and continues to be quite cheap. Rational tariff pricing must be an essential component of responsible scarce

Rational tariff pricing must be an essential component of responsible scarce water consumption.

water consumption. High oil prices have forced countries to implement increased electricity tariffs at the risk of igniting civil unrest, meaning that to date raising water tariffs to aspire towards system cost recovery remains taboo. Consumption efficiencies based on technology applications is an important part of this conversation that requires greater government initiatives in areas such as fiscal incentives and regulation.

Algeria's Comprehensive Water Strategy

Hamma is not a single isolated solution in Algeria. The Algerian government is currently implementing a series of desalination plants strategically placed in other water scarce coastal towns that also had high competing demands from industry. Given the high energy requirements to produce desalinated water, some projects also included co-located power plants. In parallel, a programme was developed to improve the capture of upstream water sources by building new dams and rehabilitate existing ones, many of which were inoperable due to disrepair.

In Algiers, the government increased its reliance on public private partnerships by contracting with a private third party to assist in upgrading the distribution system and its operations. A key objective was to reduce system losses. This partnership has also been successful. As in many less developed countries, wastewater treatment remains largely an unexploited resource that can expand water supply at attractive prices relative to desalination. For example, Jordan – the second poorest water deprived country in the world – has only one large-scale reliable treatment plant in operation which only processes a fraction of its used water.

Before Hamma became operational almost 10 years ago, all citizens of Algiers lived with water delivered for only some hours every second or third day. Today, the city has reliable and constant water on tap. Prior to Hamma, the Algiers business community routinely had to limit hours of operation when they ran out of water which is no longer the case. We know that the burden of water scarcity falls disproportionately on women. On the home front, access to quantity and quality potable water on tap is a huge game-changer that allows women to better meet their families' needs with greater ease. While we are not aware of studies quantifying the economic impact to society of having constant flowing potable water in Algiers, but without a doubt the quality of life has improved significantly.

The expansion of large projects for providing potable water unfortunately does not ensure water security.

Hamma Water Desalination: Bringing Drinking Water to the Capital

ALGERIA

Country:

Algeria

Sector:

Infrastructure

Challenge:

Severe water shortages in the city of Algiers

Solution:

$200 million in OPIC financing for the construction of a reverse-osmosis water desalination facility to deliver 200,000 cubic meters of potable water to Algiers each day.

Impact:

The plant, currently operating between 85-95% capacity, provides water for about 350,000 families in and around Algiers.

Addressing severe water shortages

In 2005, Algeria's capital city of Algiers lacked the infrastructure to provide its residents with clean drinking water on a regular basis. For about half the population, clean water was available only one day out of three and these severe shortages led to both the stock-piling of water as well as the consumption of dirty water in household and agricultural uses.

With the region's groundwater table depleted, dams and other water infrastructure aging, and the city's water demand expected to double over the next decade, the Algerian government recognized the need to invest in alternate sources for drinking water. Because it also recognized that the high cost of desalinating seawater would make the cost of water too high for many Algerians, it agreed to subsidize the cost.

OPIC's first project in Algeria

The Algerian Energy Company entered a deal with Ionics Inc. of Watertown, Massachusetts (USA), in which Ionics agreed to build a water desalination plant and the state water authority took a minority stake in the plant and agreed to purchase the bulk of the clean water produced. OPIC provided a $200 million loan to Ionics, a desalination equipment manufacturer which was later acquired by GE. George Haddad, General Manager of Hamma Water Desalination, said that in addition to financing, OPIC brought extensive experience working in developing countries, and had well-established processes in place that helped the project move swiftly.

The Hamma Water facility, which opened in 2008, was Algeria's first privately-owned water desalination plant, as well as OPIC's first project in Algeria. The plant is located in a non-residential area near Algiers' Mediterranean Coast, with two offshore intake systems collecting seawater for processing. It operates around the clock.

For more details, visit:
www.opic.gov/opic-action/featured-projects/middle-east-north-africa

OPIC

The Overseas Private Investment Corporation (OPIC) is a self-sustaining U.S. Government agency that helps American businesses invest in emerging markets. Established in 1971, OPIC provides businesses with the tools to manage the risks associated with foreign direct investment, fosters economic development in emerging market countries, and advances U.S. foreign policy and national security priorities. OPIC helps American businesses gain footholds in new markets, catalyzes new revenues and contributes to jobs and growth opportunities both at home and abroad.

Solving water shortages in the Mediterranean region

The Mediterranean Sea is at the crossroads of three continents and has been the cradle of some of the world's great civilizations. Diverse cultural experiences have resulted in unequal levels of economic development and socio-political systems. With respect to water, the Mediterranean region is also marked by an extremely unbalanced distribution of resources. Water scarcity is concentrated mainly in the southern and eastern Mediterranean and water demand has surged in recent years due to population growth and the development of economic activities such as tourism and food and textile production.

The Mediterranean Sea is at the crossroads of three continents and has been the cradle of some of the world's great civilizations.

The intensive extraction of aquifers has exhausted the surface and groundwater resources and led to the intrusion of sea-water into coastal aquifers. Water demand by all sectors of the economy doubled to 280 km^3/year over the 50 years to 2007 and is still increasing. Water use efficiency is far from satisfactory, especially in agri-culture, and there is growing demand for irrigation water. Expert estimates show that developing countries use twice as much water per hectare of irrigated land than industrialized countries even though their yield is three times lower due to inef-ficient irrigation methods and high evapo-

ration rates, resulting in deterioration of the water quality.

Moreover, water quality is strongly affected by pollution due to intense human activities such as industry, tourism,… and the concentration of population in urban and coastal areas. The Mediterranean region covers 1.75 million km^2 and supports around 446 million inhabitants (7% of the world's population). It is experiencing rapid, unbalanced demographic growth and increasing rural-urban drift. Growing poverty in the urban centres is directly connected to water and its effect on health.

According to UN estimates, the population of the Mediterranean basin will grow to between 508 and 579 million by 2025. The population of the coastal areas in 2000 was 143 million, which represented 33% of the region's inhabitants – a figure that is expected to reach 174 million by 2025. This urbanization of coastal areas is also having a negative impact on the demand for and use of water resources caused by uncontrolled developments and infrastructures, sewerage, urban runoff and growing quantities of solid waste.

Natural water supplies no longer meet the growing demand in several Mediterranean countries.

The fact that water efficiency remains very low throughout the Mediterranean region is an added difficulty: leaks and misuse account for nearly 40% of the total water demand. These losses are mainly due to inefficient network maintenance and operation in addition to the poor irrigation techniques.

Another major challenge as a consequence of unsustainable water resource use in the Mediterranean basin is the loss of wetlands and aquatic ecosystems that play a major role in conserving biodiversity and mitigating climate change.

In view of the real situation – that the supply of natural water no longer meets the growing demand in several Mediterranean countries – unconventional water resources such as wastewater reuse and desalination are becoming increasingly important as additional sources to ensure water availability. Improving the performance of unconventional water sources requires better planning and regulation, coordinated investment, monitoring of operations, enhanced asset management capacity and mitigation of possible negative impacts on coastal areas where required.

Around the Mediterranean, despite the significant allocation of funds and inflow of aid, countries are struggling to secure the financial resources required to implement water-related strategies and plans. The lack of a sound governance framework limits the quality and sustainability of the water and sewerage sector. Poor management, low investment and lack of capacity at the national and local levels also hamper efficient administration and inflow of funding, especially from the private sector. Political unrest in the region also means that socio-political reforms are urgently needed.

However, the growing demand for adequate water supply and for greater participation by all parties, both public and private, is currently provoking a significant change in the water project funding model.

Moving Towards Public-Private Partnerships

Until a few years ago, the engineering, procurement and construction (EPC) model was the dominant type of procurement in the water sector when a utility or public authority required a new water infrastructure to provide service to its customers. Under this model, the financing of both the preliminary studies and the documentation from prequalification to contract award (including all technical, legal and surety procedures) and the final investment and operation of the plants were assumed by the contracting utility or authority. Due to the predominant involvement of public players in the EPC model it requires more thorough cost control which leaves ever-narrower margins for companies, and this is provoking a change of trend towards the public-private partnership model.

After the recent financial and economic crisis, many governments opted to increase public spending on drinking water and wastewater treatment as a means of stimulating the economy while the boom in the sustainable energy and natural resource markets between 2010 and 2014 created interest on the part of private capital in the water sector all over the world. In the post-crisis era, many governments, including those in the Mediterranean region, lack the funds required to finance investment in water. Consequently, they have attempted to make the sector more attractive for private investment.

A public-private partnership (PPP) is a procurement model that combines public and private resources to enable large-scale infrastructures. Under this model, a private entity provides financial and human resources for the construction and operation of an asset in exchange for the long-term operating and maintenance rights. The transaction is implemented through a water purchase contract for which the owner pays a rate for the daily water supply over a long-term period (20-30 years). After this concession period, the asset is returned to the public entity.

The Major Advantages of PPPs

The main advantage of public-private partnerships is that the human, financial and technical resources are shared, which enables optimal distribution since the most qualified organizations are responsible for implementing the project, which in turn has a favourable impact on the efficiency and cost of the project. There are also other advantages that are enabling the PPP procurement model to expand in the water sector and specifically in the Mediterranean region:

- It attract private capital to develop larger projects, enabling governments to avoid excessive indebtedness since they transfer it to the rate paid for the use and consumption of the resource.
- Wider management and operation experience are brought to the project since it is implemented by companies with experience in the specific sector and which compete on the market.
- It enable better access to the infrastructures by citizens.
- It distribute the responsibilities, risks and roles, which are allotted more efficiently to the stakeholders best fitted to perform them.
- It optimize efficient use of resources by deploying private management methods, which usually has valuation tools available to set and achieve objectives.
- By delegating daily operations to the private sector, governments can focus on their core functions of legislation, planning and regulation.
- It drive local and international employment.

► It foster training and new knowledge in the community.

► It enhance social responsibility.

► It drive innovation as a fundamental pillar of efficient technological and managerial improvement.

Opportunities and Goals Ahead

However, participation of the private sector in water distribution systems remains a sensitive political issue, especially in Europe and the Mediterranean. This means that most of the opportunities are in the construction, concession and operation of water treatment assets rather than direct supply to the end user. Private participation in the Mediterranean region began with desalination projects in the first decade of the twenty-first century, exemplified by emblematic programs such as the one developed by the government of Algeria and led by Sonatrach.

The market is currently undergoing restructuring, providing more opportunities for the private sector and international players to enter countries that were previously closed to private investment. This is the case in Saudi Arabia, which is analyzing new PPPs to enhance the efficiency and performance of its sewerage and wastewater treatment systems. Opportunities include 2.85 million m³/d of new desalination capacity and 1.57 million m³/d of treatment capacity in new wastewater projects.

Saudi Arabia aims to reuse more than 65% of its water by 2020 and more than 90% by 2040, transforming and upgrading its existing wastewater treatment assets and planning new reuse plants for the industrial sector. According to Global Water Intelligence estimates, Saudi Arabia's reuse market, worth more than $4.3 billion, will be the third largest in the world. As part of the strategic objectives of the National Transformation Program, Saudi Arabia seeks to increase the proportion of desalinated water produced by private operators between 16-52% by 2020 and to expand drinking water and sewerage services by 42-70% of its cities.

The United Nations Sustainable Development Goal 6 is to ensure the availability and sustainable management of water and sewage for all. The 2030 goal is to achieve universal and equitable access to affordable drinking water. These public-private partnerships enable the extension and improvement of access to drinking water, assurance of its quality and optimization of its service and administration through management, technology and financing tools capable of making this scenario a reality.

Based in the Middle East and Spain, Almar Water Solutions, among others, knows the water situation in the Mediterranean regions at first hand. Our team has more than 20 years of experience in the sector and has implemented projects in several countries in the area. We are currently working to provide sustainable solutions to the problems of water scarcity, pollution and lack of funding for renewable water production and treatment proposals in the Mediterranean.

ALMAR WATER SOLUTIONS

Almar Water Solutions is a provider of specialist expertise in water infrastructure development, including financing, design and operation. Its dedicated and experienced team draws on over two decades of worldwide individual experience in the industry and is today continuously working to develop integrated solutions to serve the growing needs of both municipal and industrial sectors.

AMWAJ 2018 أمـــواج

CONNECTING SUSTAINABILITY & ENTREPRENEURSHIP

around the Euro-Mediterranean and Middle East regions

9-11 OCTOBER 2018
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Beirut (2019), Tunis (2020)

ABOUT AMWAJ

To encourage awareness about sustainability interlinkages and to advance social entrepreneurship, **AMWAJ** ("waves" in Arabic) – **A** **M**editerranean **W**ater **A**nd **J**ournalism forum for sustainable development – is an international forum focusing on offering innovative ideas, sharing best practices and finding practical solutions to build inclusive societies for a sustainable future. **AMWAJ** brings together the private and public sectors, leaders in environmental sustainability, social entrepreneurs and media to create a socially-responsible, water- and energy-conscious community based on sharing natural resources.

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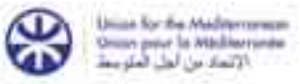

FEATURES

Water Tank
Jump into the conversation and record your opinion! Building momentum for greater sustainability.

Photo Exhibition
Moments from daily lives along the shores of the shared Middle Sea.

Field Visits
Join a trip and gain insight into water and energy projects in and around Barcelona.

SparkShow – Meet the Game-Changers
Entrepreneurs from around the Mediterranean pitch their projects to media and investors

FORUM

Social Enterprise Innovation Lab
Living the triple bottom-line of sustainability

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Historical map drawn by R. Bonne in 1771 as plate no. 30 in Jean Lattre's 1776 issue of the Atlas Moderne. Source: WikiCommons.


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TRIPOLI
Ougela
Murzuk
FEZZAN
Zala
Zuila
BERDOA
DE
BARBARIE
ECHELLE
La Caravane de Tripoli marche dans le lit de ce Torrent en allant au Pays des Negres.