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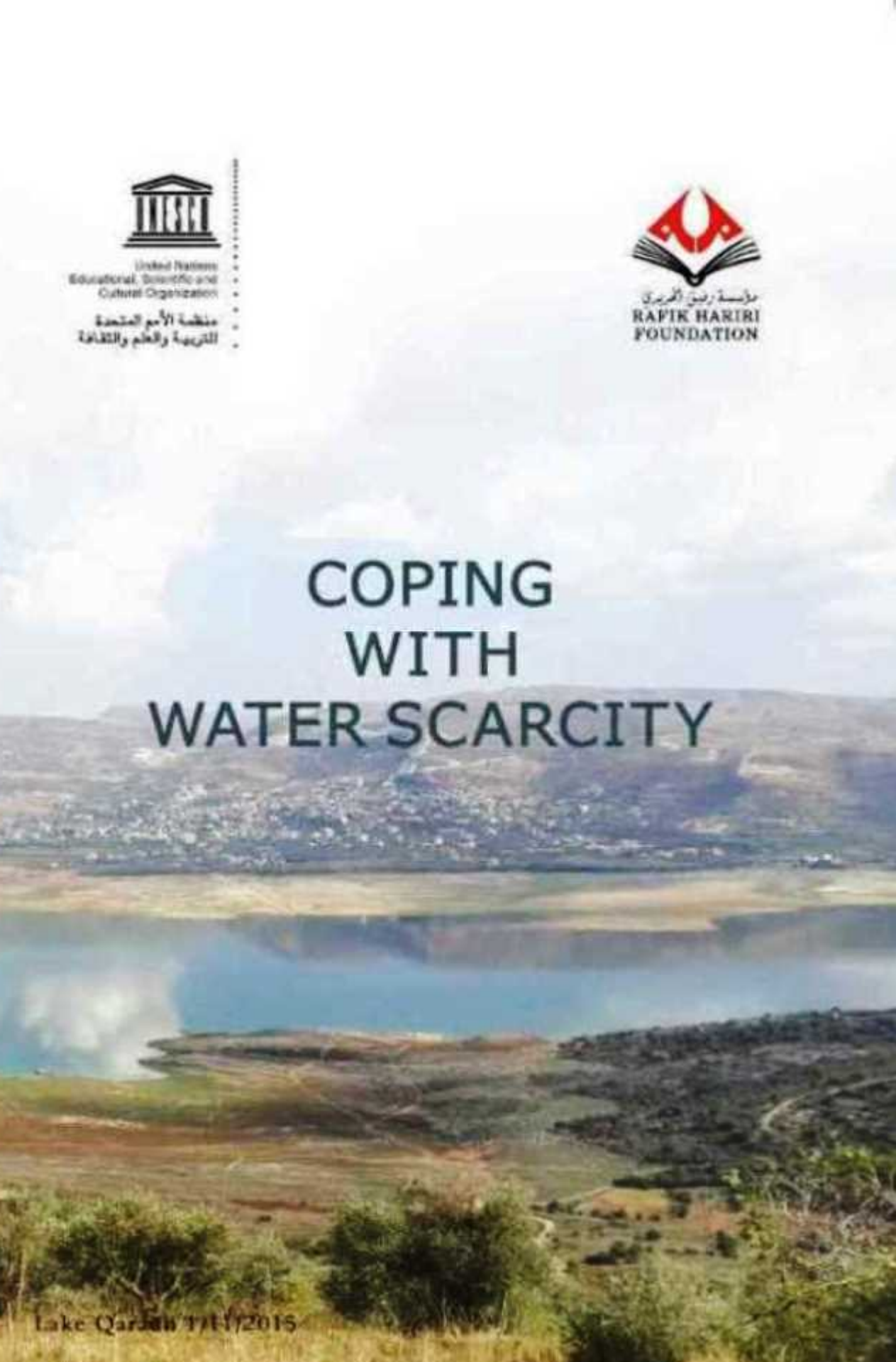
مؤسسة رفيق الحريري
RAFIK HARIRI
FOUNDATION

COPING WITH WATER SCARCITY



Coping with Water Scarcity

Phone 01-853055
Fax 01-853006

E-mail:
rhf@rafichariri-foundation.org

Website:
www.rhf.org.lb

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Coping
with
Water Scarcity

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Opening Session

Ms. Salwa Siniora Baasiri

Director General
Rafik Hariri Foundation

In accordance with the mission of the founding president, martyr Rafik Hariri, which stipulates getting engaged in whatever would serve national priorities and requisites for development, modernization, and progress, the Rafik Hariri Foundation has joined forces with the UNESCO office in Beirut to hold today's conference " Coping with water scarcity". To that end, they have collaborated with a wide circle of officials, public figures, stakeholders and experts, national and international, with the hope that their concerted efforts to tackle the problem of water scarcity, and their coordinated visions to deal with its ramifications, would lead to effective and sustainable strategies, policies, and action plans.

Distinguished guests,

It might be useful to recall that the United Nations General Assembly has realized, earlier in time, the risks that threaten humanity, if its people continue to deal with water issues the way they have been used to. Accordingly, it launched in 1993 the first International World Water Day, targeting to create awareness of the need to tackle water matters from a visionary and forward-looking perspective, also based on sound and enlightened planning. Hence, The twenty-second of March of every year is designated to celebrate the occasion by bringing to the forefront one topic on water issues, and have it analyzed and addressed.

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* The Original text is in Arabic

It was the issue of "Water and Sustainable Development" for the year 2015.It is to be "Water and Jobs" for 2016, "Wastewater" for 2017, and "Nature-based Solutions for Water" for 2018.

It is so obvious to observe that the aforementioned topics intersect, in their goals and objectives, with those stated in the World Bank report issued in 2013, which projected to have, by year 2025, up to 2.8 billion people suffering from the repercussions of the scarcity of water. The envisaged topics also interface with the UNDP statistics which denote that seven, out of the top ten most suffering countries from water scarcity worldwide, are Arab countries, where the Arab per capita share of renewable fresh water does not exceed 6% of what is enjoyed by the global counterpart, being at the expense of food, health, social, and economic security. However, if Lebanon is singled out for deeper analysis, the figures of the "World Resources Institute" indicate that the level of water stress in Lebanon is very high, being equivalent to 4.75 out of five points, thereby making it, according to the global estimates of 2020, rank 16 out of 167 countries, down from the 18th position it occupied in 2010.

If this is the situation at present, how things are going to look by 2050, when the Arab region population would be in the range of 634 million, i.e. almost double today's figures? The risks of renewable water shortage, coupled with fears from increased demand for fresh water reserves, would be then duly justified. Also health, food and power supply security would be threatened, leading to deterioration in the economic, social, and humanitarian affairs.

Ladies and Gentlemen,

You are well aware that the level of water scarcity is usually measured by the annual per capita of renewable water resources, which, as various statistics indicate, is dropping down dramatically in most countries of the world, and in particular in countries of the Arab region.

This could be explained by the persistent depletion of water resources in excess of the natural renewal rates, which in turn is mostly due to population growth, changing lifestyles, and irrational expansion in the use of water in agriculture, power supply, and industry. Still one of the major challenges that have led to water scarcity is climate change, which stands behind further decline in precipitation and higher evaporation rates, descanting to the inability of surface water to meet the growing needs. A challenge that is being exacerbated by an additional one which is the aggravated exploitation of groundwater, thus leading to leakage of salty and contaminated water into groundwater. This has been taking place without paying heed to the associated risks which threaten human security, best exemplified by water, food, and energy security, all being inter linked thus impacting the social and political stability or the absence of which. Accordingly, it is of atmost urgency to adopt a comprehensive approach in dealing with water scarcity, not only by looking for new sources of water, but also by resorting to what is more effective, namely the rational use of water resources and the enhancement of its productivity.

In other words, there is a need for a strategic cultural shift, from one based on pumping huge investments to increase water supply, to another, which is improved water management, with increased efficacy and rationalized consumption. In addition, there is a need to address the ramifications of climate change, resulting from pollution and heat emission, with the help of good governance, sustainable policies, legislative and institutional reforms, implementation of appropriate mechanisms, enhancement of research and scientific cooperation, in as much as raising awareness, particularly via education and academia.

Dear honored guests,

I am convinced that our distinguished participants shall tackle in depth the themes of the conference. Still they shall enrich the themes with their state of the art knowledge and comprehensive analogies. So

may I extend sincere thanks to everyone of them, also to the officials and the participating ministries and organizations. Special thanks go to our partner, UNESCO Beirut office, represented by Mr. George Awad, also to his excellency Minister of Agriculture Mr. Akram Chehayeb, who has been kind enough to give our conference due care and attention.

H.E. Akram Chehayeb

Minister
Ministry of Agriculture

Figures show that the average rainfall is unstable and moves between scarcity and abundance. For example, it is at the coastline between 800 mm and 900 mm a year, knowing that it recorded 370 mm in 2008 and 770 mm in 2013. The rate was back to its average in the past year, to drop again this year. For up to yesterday, and in most areas, it does not exceed half the annual average.

We are all aware that the volume of lost water is proportional to rainfall amounts. It is also proportional to the volume of water that is being carried by the surface conduits to the sea, along with what this water carries of soil from the lands that have become vulnerable to drifting, after they have become bare due to forsaking agriculture in the highlands.

Available figures forecast that we are in the danger zone. Particularly with such climate change, which we feel its repercussions in all seasons; in the torrents, in the receding snow, in the ebbing rain and in the mitigation confrontational policies at the national level. Hereby, our conference is of exceptional importance. In conjunction, we look forward to outcomes that would pave for thought-out scientific plans that deal with water management and address climate change and the associated water impacts. Perhaps, with the help of the conference outcomes we may get out of the danger zone to the rational use of our

* The original text is in Arabic

water wealth which demands a prudent policy and a scientific administration.

Dear friends,

We are not immune from danger in agriculture, and we are not immune from erroneous practices and wasting resources. So let us be clear about the following:

The methods followed in our agricultural production are no longer acceptable, while the sustainability of our agricultural production is subject to the ability of agriculture to cope with climate change, also the ability of agriculture to get by with the scarcity of fresh water.

So it is time to move towards what is called "smart agriculture" since it is capable of adaptation. And because it is due, the Ministry of Agriculture has given priority, in its strategy for the five year period, 2015 - 2019, to facing the challenge of water scarcity and the challenge of climate change.

Moreover, for a more effective way of dealing with these two challenges, we have begun working on assured procedures for an agricultural policy based on developing our methods for agricultural production, so as to become able to cope with climate change, competent to handle water scarcity and capable to contribute to food security, considering the great imbalance between production and consumption, also between exportation and Importation.

In addition, we have begun promoting the adoption of "clipboard agriculture", which reduces the amount water consumed in agriculture, being at present up to 55% of fresh water. It also saves tillage costs and provides sizable feed.

Along with “clipboard agriculture”, we keep on with guidance and orientation towards the rain-fed agriculture, together with the quality-

crops, which do not require lots of water. Further still, we are paying great attention to take on irrigation water-saving technologies since it is not plausible any more to continue with the traditional irrigation mainly that of traction.

Furthermore, and in order to supply water needs for agriculture, we have implicated a strategy of creating hill ponds and the dissemination thereof, so that agriculture would contribute to the collection of precipitations and the reduction of water waste..

Furtherstill, and so as not to continue relying on aquifers, especially in plains, and in order to ensure safe agricultural irrigation, we have practically started to take advantage of the treated wastewater, following the success of the sewage treatment experience in Ablah Bekaa, and following the construction of a pond for storing the treated water, thus using it in the irrigation of plantations.

It stands as a success story and sets a model that can provide:

1- Irrigation of orchards with monitored and appropriate water

2- Mitigation of pollution along the Litani River, which ended up as an outlet for domestic and industrial waste water, from its source to Lake Qaraoun. It is transformed from a vein beating with life into a struggling river that has almost passed into a dead river, all within the practice of throwing the industrial, agricultural and household solid and liquid wastes in the river and its tributaries. Also within the absence of sewage treatment plants, the non-activation of the accomplished ones, and the absence of implementing plans, studies, and the numerous and chronic projects. So we hope, with Ablah experience, to contribute to bringing life to our surface waters, its conduits, and its reservoirs.

Dear conferees,

The challenges are colossal, so controlling excessive consumption of fresh water has become a matter of urgency which requires policies, plans, projects, procedures, and work. In the same vein, if it is permitted or allowed to exploit the "streams" of groundwater through extraction wells located at the foothills of Lebanon's Mountains, which run parallel to the western coast, then, it is so urgent in parallel to put an end to the overexploitation of our underground water "reservoirs". Also there is a crucial need for creating a sensible fruitful strategy that is adept to reap our sanitary water; and simultaneously, able to restrict its squandering and the damages of its flow towards the sea, no matter whether it were in ponds or in safe dams situated in safe locations, under the most secure specifications of safety.

Again, we look forward to benefit from your expertise and the suggestions which the conference would come up with, for the purpose of developing our plans in the Ministry of Agriculture, and to set a national plan liable for implementation. Moreover, our objective remains to deal with water scarcity, herein this time of disturbing climate change. Conjointly we need to deal, with the scarcity and dearth of politicians infatuated by their homeland and its people, at the time of abundance of those who obstruct solutions and oust opportunities for compromises, together with those who stand in the way of positive initiatives that safeguard the safety of the nation and the citizens, their production, their economy, their life necessities, as well as the requisites for our country's survival, and the security of our Lebanon, which is amidst a volatile region that veered to a field of wars and blind murder.

We had faith in the settlement, and we still do, for the sake of the country and its people. However, opportunity loafers, coming from March 14 and March 8, have converged in aborting the settlement and in inducing failure on the positive initiative.

We wish they converge not on rejecting a compromise to elect a president, who can furnish an exit out of a fatal deactivation towards a horizon of solidarity. We wish they converge to ensure the national interest and that of the citizens.

They were joined by obstruction. May they wake up. May they meet to keep the bitter glass away and to put the flames out of Lebanon.

May I conclude by thanking the experts and specialists for debating a very vital and daily life issue.

I would like also to thank Rafik Hariri Foundation and the UNESCO Office in Beirut, for their serious work and for what they try to attain of a scientific plan and an action plan.

Mr. George Awad
National Program for Science and Communication Officer
UNESCO

I am so pleased to welcome you at the opening of the National Conference on "**Coping with water scarcity**". I am also pleased to convey to you the greetings of Dr. Hamad Al Hammami, the Director of UNESCO Regional Office in Beirut, along with his apology for not attending, due to unforeseen business trip; moreover, I convey his wishes of success and luck to our conference.

Ladies and Gentlemen,

Fresh water is the major resource to human health, prosperity, and safety. Likewise, it is essential for eradicating poverty; realizing gender equality, food security, and maintaining the ecosystem.

However, large number of people (in billions), all over the world, are facing serious challenges to fresh water; from water scarcity, to poor quality, lack of sanitary infrastructure, together with disasters related to water such as floods and droughts. Considering that approximately 80% of the world populations are living in zones that ilk with great threats of water security.

The United Nations General Assembly declared in July 2010 that access to clean water and sanitation is a human right. Not getting good quality and enough quantity of drinking water stands as one of the biggest health

* The original text is in Arabic

problems for humans globally. It is true that by 2010 the Millennium Development Goal on water availability was attained, however still more than 600 million people lack access to the prospect of safe drinking water; of whom, more than 40% are living in the desert of South Africa. It is unlikely as well to attain the MDG target on sanitation, where nearly 2.5 billion people in developing countries have no access to improved sanitation facilities. Moreover, the most inflicted are the poor rural population.

Ladies and Gentlemen,

Water resources are increasingly under intense pressure caused by climate change and other global factors. Inasmuch as, climate change alters rainfall patterns, soil moisture, humidity in general, and the balance of the ice blocs and the flow of rivers. Likewise, it causes changes in groundwater sources. Simultaneously, the pace and severity of floods or incidents of droughts accelerate. Moreover, it is expected that over the next 40 years, nearly 800,000 people around the world would move weekly to live in cities. Such population growth and rapid urbanization shall create more pressure on water resources; just as, tremendous impact on the natural environment.

The deterioration of water infrastructure in many parts of the world also affects the public health and the environment. Due to these challenges, the need for proper freshwater management is essential. Also, the sustainable development of water should be at the heart of the development agenda post-2015; conjointly the targets related to water should be specific and clearly linked to other development goals. Hence, UNESCO assists Member States to assume sustainable water management by providing guidance to setting public policies, disseminating successful experiences, building capacities, networking, and advocacy.

In parallel, the international community has a momentous opportunity this year to adopt the new sustainable development agenda and to reach a global agreement on climate change. The year 2015 is the year to work on a global level to build the future we want for all. For there stood UNESCO's effective contribution through a rich set of initiatives;

- The Education Sector assumes an important job in education on climate change in the context of education for sustainable development, following the successful conference in Japan last November
- The Communications and Information Sector operates with the press and the media to enhance public awareness on climate change
- The Natural Sciences Sector partakes in full in matters of climate change - on issues related to water, biodiversity, biosphere reserves, and disaster risk control, furthermore, in the field of renewable energy and in science and traditional knowledge policies
- The Social and Human Sciences Sector - especially the Management of Social Transformation program (MOST - contributes to the development of a comprehensive agenda for sustainability, such as the follow-up Global Report of Social Sciences in 2013 on global environmental change
- The Culture Sector and mobilizing the support for the World Heritage Sites; also mobilizing their managers to deal with climate change

With all these initiatives, UNESCO integrates the gender perspective in all the programs, because the empowerment of women modifies the rules of the game in favor of helping communities respond to the challenge of climate change, beginning with water management and preparedness to risks. That, in addition to a special focus to Africa, being one of the most affected areas by climate change.

Ladies and Gentlemen,

Our destiny is tied to the fate of our water resources. So to build the future we want, we need to strive for water security by enhancing the contribution of science and innovation. UNESCO supports this process as well as the undertaking of any fundamental action to enhance water security for the sake of sustainable development.

Based on the priorities and needs of Member States, which have been identified in the Nairobi meeting, the International Hydrological Program focuses on six areas to support Member States in their quest for better management, safe water, and essential human and institutional capacities. These areas are:

- Water-related disasters and hydrological changes
- Groundwater in a changing environment
- Addressing the scarcity and quality of water
- Water and human settlements in the future
- Hydrology and engineering harmony for a sustainable world
- Education in the field of water, the key to water security

In order to achieve this strategic plan, focus shall be on:

- Mobilizing international cooperation to improve knowledge and innovation to address the security challenges of water
- Strengthening the nexus amongst science policies in order to attain water security at the local, national, regional, and global levels
- Focusing on the development of institutional and human capacities for water security and sustainability

The role of human behavior, the cultural beliefs, the attitudes about water and the socio-economic research dedicated to understand and develop tools, to better adapt to the changing water availability, are all a few of the issues that must be addressed.

So, the International Hydrological Program contributes, through multidisciplinary tools and techniques that are environmentally sound and innovative, to take advantage of advancements in water science. Over and above, it builds competencies to cope with the challenges that fall within the global water threats which we face today.

Ladies and Gentlemen,

Based on the foregoing, and being convinced of the importance of the support of the authorities and partners on the national scene for the UNESCO programs, in particular the natural sciences program, the UNESCO Office in Beirut developed the idea of a national conference on **"Coping with water scarcity",** being a crucial subject and a step forward to arrive at a national plan for preparedness towards water scarcity. The work began with UNESCO partner, Rafik Hariri Foundation, and then together with the supportive parties in order to reach practical and participatory results, taking into account the existing expertise, and the successful experiences in Lebanon and the world. Moreover what is most important is the gathering we have of the largest number of key players from Lebanon- the public, private, and academic sectors, the civil society, as well as the regional and international organizations.

So, our conference shall shed light on:

- Challenges associated with water scarcity
- Water and climate change, and policies per sector
- Water Governance
- Lebanon and the sustainable development goals
- Addressing challenges

Although the topic of water is nettlesome and complex, but then again we are trying to tackle it from core angles, still building on the efforts undertaken so far at the level of Policies and applied procedures,

have them converted into tangible reality of proposals and clear steps in the direction of developing a national preparedness plan for water scarcity, which is envisaged to be under the umbrella of the ministries concerned; the Ministry of Energy and Water, the Ministry of Environment, and the Ministry of Agriculture.

Thus, we hope that we all benefit from the discussions ensuing in the next two days at the UNESCO Office in Beirut. And God willing, we can lay the foundations needed for a national preparedness plan concerned with water scarcity. Therefrom, 2016 would be the year for this plan to be transmitted into national initiatives, fit to address the challenge of climate change and in particular water management and risk preparedness.

In conclusion, I would like to very much thank the Minister of Agriculture, Mr. Akram Chehayeb for sponsoring and attending this activity owing to what it represents of importance at the national level. I also want to especially thank the experts in this workshop, who came from within and outside Lebanon, and the ministries and the institutions that we have cooperated with to make this conference succeed; Ministry of Energy and Water, Ministry of Environment, Ministry of Agriculture, the Presidency of the Council of Ministers, the National Council for Scientific Research, ESCWA, FAO, Issam Fares Institute at the American University of Beirut, Saint Joseph University, University A&M of TEXAS, Beirut Arab University, Rafik Hariri University, Association of Lebanese Industrialists, and Ibrahim Abdel Aal Foundation . Then of course, further thanks go to our partner in this conference; Rafik Hariri Foundation represented by the Director-General Ms. Salwa Siniora Baasiri for all the hard work leading to the realization of this work. In the hope that all our efforts bear fruitful results for the better good of Lebanon and its water resources and natural environment.

Session I

Dr. Fadi Comair
Director General of Hydraulic & Electric Resources
Ministry of Energy and Water

Lebanon suffers, as most countries located in the South-East Mediterranean, from limited water resources, sometimes combined with problems of quality. The stress is exacerbated by the consequences of climate change and impacts of wars, mass population movements (refugees). This is in a way destabilising the country and making it more difficult to cope with the situation, despite the positive political will.

Lebanon took recently two important initiatives to fight climate change and to support efforts towards adaptation, namely:

1- The signature of the pact of Paris during the International Cop 21, which highlighted the importance of adaptation actions at the basin level through a joint, participative, integrated and sustainable water resources management to minimize the impacts of climate change on; the populations' health and safety; the economic development and the environment, considering the importance of the protection of water-related ecosystems, on cooperation, coordination and exchange of information, dialogue, consultation and prevention of conflicts between stakeholders and to enhance the implementation of adaptation measures and the sharing of benefits on the basin scale

2- The participation in the symposium " Hydrodiplomacy and climate change for peace in the Middle East", which was been held at the Senate in Paris on 1st of December 2015, wherein solutions against water scarcity in South Mediterranean countries were debated

It has been more than a decade, since the Ministry of Energy and Water (MEW) introduced the Integrated Water Resource Management (IWRM) approach, which has been reflected in a number of legislative and strategic documents, including the revision of some key laws that regulate the sector, including the preparation of the 10 Years Strategy Plan and of the National Water Sector Strategy. The "Code de l'Eau" to improve the governance of the sector was also updated.

The ministry's interventions to improve the enabling environment for IWRM have both horizontal and vertical components.

On the one side, the focus has been on institutional reform, i.e. improving legislation (not only that which regulates the sector per se but also in relation to other key issues, such as private sector participation), enhancing water education, creating awareness and promoting capacity building.

On the other side, technical projects have been directed to ensure additional water quantities, e.g. through the exploitation of non-conventional resources (treatment and reuse of wastewater, grey-water, sub-marine freshwater springs, etc.), also to cope with flood management and to improve the quality and availability of water data to support decision-making.

Irrigation is a high water-demanding activity: as you know it can use up to 80% of the total available resources. Here in Lebanon, based on the 10-years strategy plan, the target is to increase the irrigated area from the current 100,000 ha to 280,000 ha, and to couple this with

measures to enhance irrigation efficiency through rehabilitating and modernizing the main irrigation networks and facilitating the creation of water users association. A draft law is being prepared for the operation and maintenance of medium and small irrigation schemes.

In parallel, MEW plans to support this development by securing additional water resources through hill lakes and by providing incentives and micro-credits for water-saving technologies (e.g drip irrigation). These efforts are carried out in close collaboration with the Ministry of Agriculture and the Green Plan, and a Memorandum of Understanding has been signed to that effect.

Moreover, for energy-scarce countries like Lebanon, it is very important to fully exploit renewable resources and to explore the possibility to combine these with more sustainable irrigation methods. This is of particular interest from the perspective of enhancing the water-energy-food-ecosystems nexus.

Good practices from other countries can be very useful and we are collaborating with many pertinent Regional and International organisations and Initiatives to take advantage of success stories and make best use of lessons learnt from other countries in coping with water scarcity.

The success of the water sector policies and the related investments in each country is mainly determined, by good governance, the engagement of various stakeholders, the monitoring/quality assessment system, knowledge sharing mechanisms, as well as enhanced training to the various sectors of water.

To this effect, a very important project for Lebanon, the “Centre d’Information et de Formation aux Métiers de l’Eau au Liban” has been launched and labelled, in the framework of the Union for the Mediterranean project “Towards a Mediterranean Knowledge Platform

on Water" (7 April 2014). The creation and functioning of this Centre will be a milestone for Lebanon, as it will allow enhancing the water information needed to evaluate, monitor and take decisions related to water management, also equipping technicians and managers, at all levels, with state-of-the-art knowledge and competences to address both the public and private sectors at the National and sub-regional (Mediterranean) level.

We are confident that this Conference on **"Coping with Water Scarcity"** will contribute to the fruitful exchange of expertise on these matters, and advance knowledge and sustainable practice to cope with water scarcity. Of course for knowledge to translate into action there is need for resources, both human and financial. However we are working closely on improving the enabling environment for private sector participation in the water sector in Lebanon, to mobilize new and increasing funding for coping with climate change and promote adaptation at the National and river basins level.

We at the ministry of Energy and Water wish the conference success and look forward to future collaboration in favor of the practical implementation of the Workshop's recommendations.

Dr. Wajdi Najm
Vice President for Administration
Saint Joseph University

Water Scarcity in Lebanon Experiences and lessons learnt

Lebanon, on the eastern shore of the Mediterranean Sea, represents a complex topography with altitude varying between sea level and 3880m. It is characterized by a diversified climate; coastal dry sub humid with average annual rainfall of 700mm, to humid at high peaks with rainfall reaching 2000mm, and snow cover lasting for several months. (Figure 1). The inland territories of Bequaa are distinguished by dry semi -arid climate with a rainfall as low as 200mm/year.

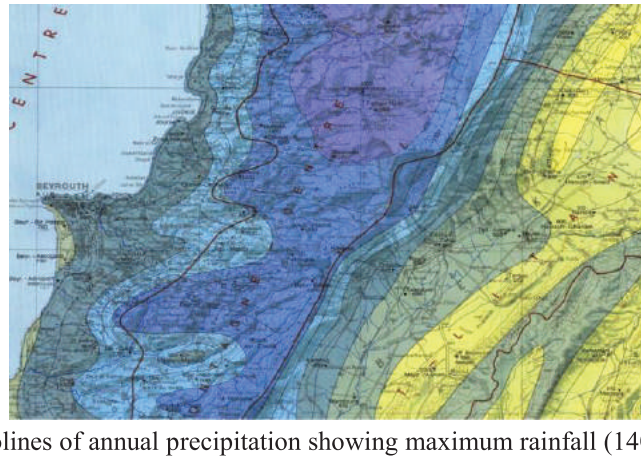


Figure 1. Isolines of annual precipitation showing maximum rainfall (1400 mm) on the western picks of Mount Lebanon (dark blue) and low precipitation (<400 mm) in the north eastern parts of the country.

As a way of assessing national hydrological resources, measurement of climatic parameters is needed to estimate the volume of renewable and exploitable water resources. According to the Groundwater and database project, Lebanon possessed prior to the civil war more than 150 weather stations distributed over the Lebanese territory (Figure 2). A total of 8 climatic zones characterize Lebanon, three on the coastal area, two on the central and northern mountains and three in inlands. All meteo stations before the war were exclusively managed by one institution: the Central Meteorological Service of the Ministry of Public Works based at the Rafik Hariri International Airport of Beirut.

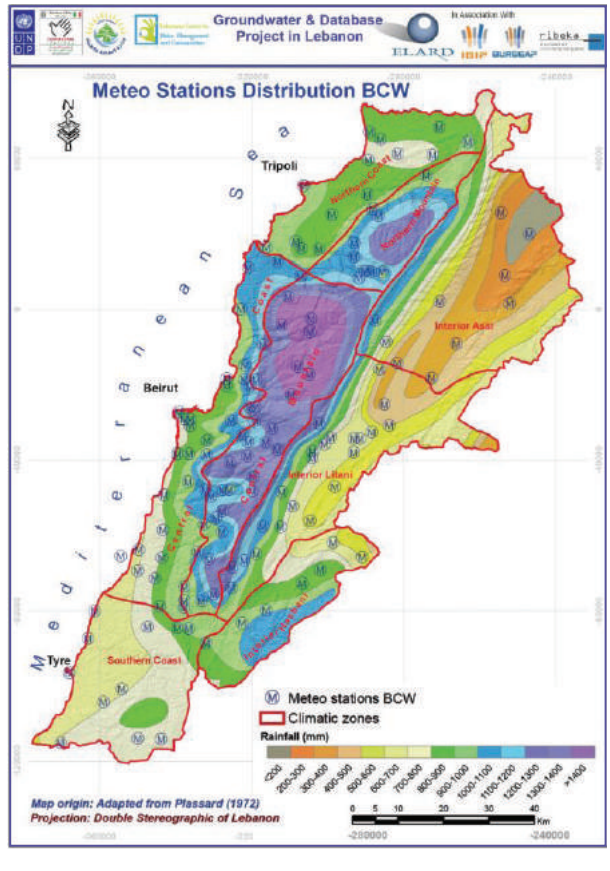


Figure 2. The distribution of meteo stations, prior to the civil war, over the 8 climatic zones of Lebanon

After the civil war, two factors came into the scene:

- The loss of more than 100 stations with only 9 functioning stations left.
- The appearance of new meteo stations, belonging to other national institutes, like the Lebanese Agricultural Research Institute (LARI), the American University of Beirut (AUB), and Taanayel Monastery (Figure 3).

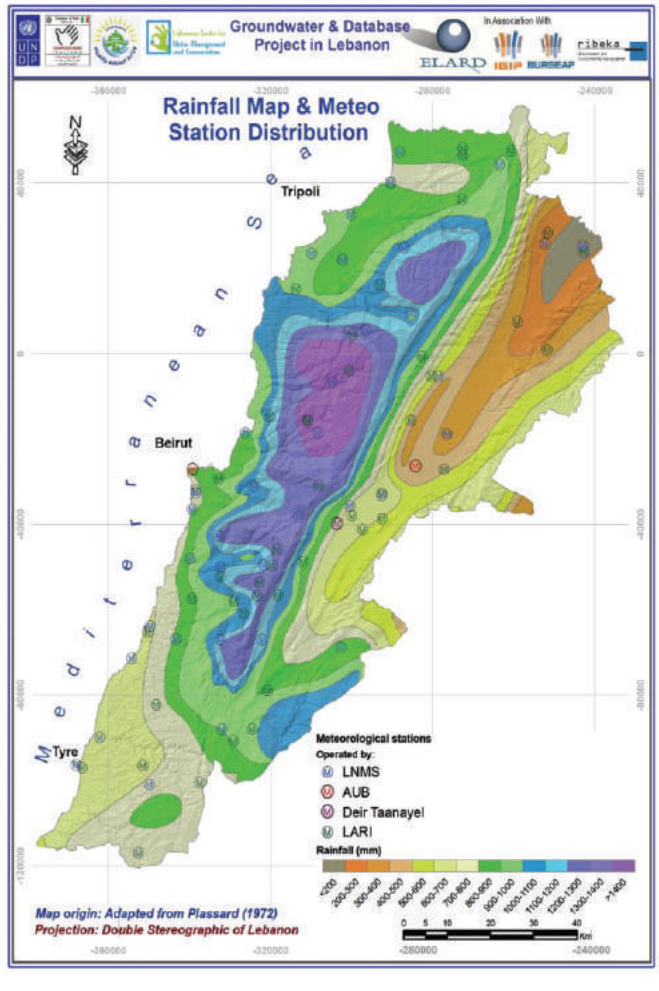


Figure 3. Rainfall map of Lebanon showing the distribution of part of the old and new meteo stations

Monitoring the snow cover, which represents the main source of fresh water in the country, is embraced by our studies, by using remote sensing (Figure 4).

Spot image February 2, 2000 ESIB-IRD

Figure 4. Satellite image of the French Spot showing the area of snow in Lebanon in February 2000.

Observing the snow cover from space is accompanied by extensive field work to measure the snow depth and snow density to derive the snow-water equivalent (Table 1)

Table 1. Measurement of fresh snow density in relation to snow thickness

couche n°	Date mois d'avril	épaisseur à partir de la surface (cm)	masse volumique kg.dm^{-3}
1	11	0-30	0.51
2	10	30-170	0.57
3	9	170-255	0.51
4	8 (jour)	255-275	0.51
5	8 (nuit)	275-295	0.51
6	7	295-330	0.57
7	6	330-365	0.58
8	4 (jour)	365-395	0.55-0.60
9	4 (nuit)	395-403	0.58- 0.62
10	3	403-405	0.73- 0.83

The Lebanese aquifers are mainly karstic, which complicate the study of feeding mechanism and monitoring of groundwater, mountain springs and submarine springs. Our research has been focusing on the characterization and behavior of karstic aquifers, thus allowing the evaluation of water resources and prevision of springs and rivers flow (Figure 5).

Figure 5. Prevision of spring outflow serves better management of renewable water in Lebanon

The flow of one of the major permanent rivers of Lebanon, Nahr Ibrahim, was simulated for the period 1968-1971 and compared against the measured outflow (Figure 6). The simulation model was based on two components:

1- The physical phase-treating snow accumulation
2- Snow melting and transfer based on degree/day and conceptual (MEDOR) for the rest of the basin not covered by snow.

Results followed the same general trend and showed good matching during the low flow periods

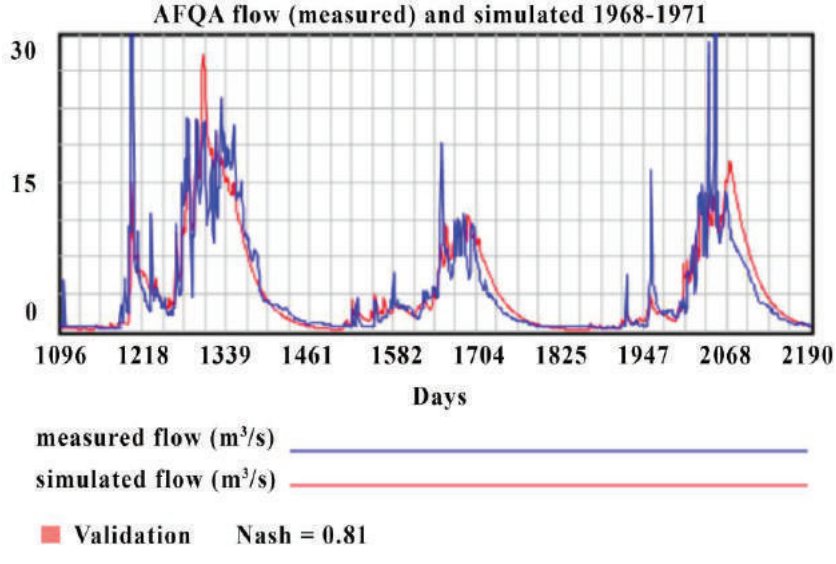


Figure 6. Measured and simulated flow of Afqa spring feeding Ibrahim River.

The Chekka submarine spring originate from the surrounding of Tannourine and is fed by the snow melting of surrounding mountains. The surface water stream is named Nahr El Asfour. Groundwater is driven toward the sea through karsted cavities and channels (Figure 7).

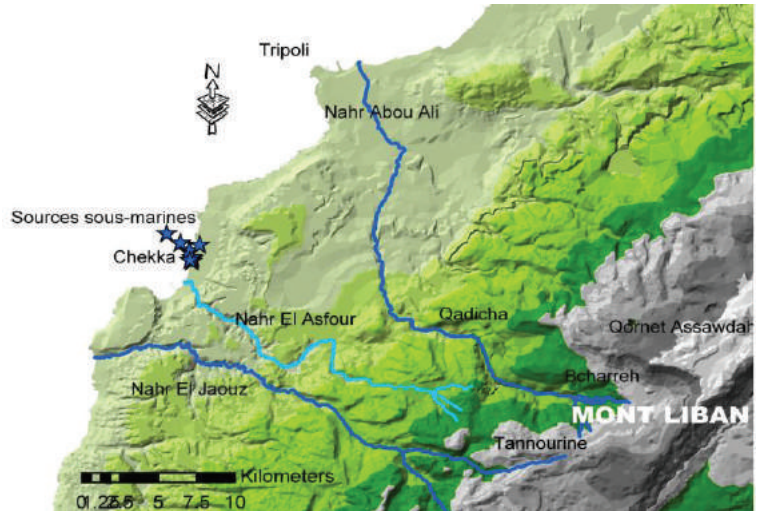


Figure 7. Monitoring of Chekka submarine spring

The salinity and temperature of seawater surface was monitored between 19/11/2005 and 9/9/2006. It showed significant variation, a drop in winter season and an increase in the dry season.

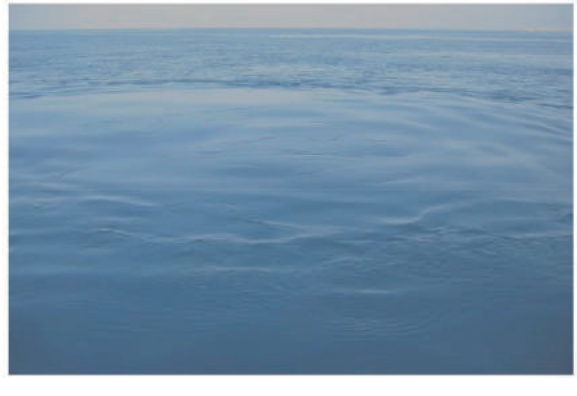


Figure 8. Variation of conductivity and temperature in S2 station between 19/11/2005 and 9/9/2006.

The fresh water of the spring S2, with a discharge of 30l/s, shows low conductivity and relatively low temperature compared to brackish water and seawater (Figure 9), notably during the flood period. In

summer, the spring water quality deteriorates and becomes close to the quality of brackish water.

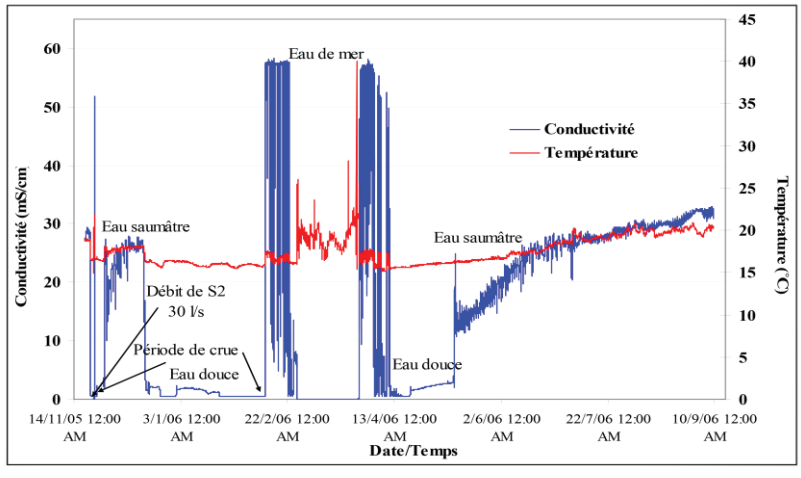


Figure 9. Variation of conductivity and temperature at the level of S2 station.

A calibration was done between seawater level and pressure, conductivity, temperature and spring discharge. Figure 10 shows variations along the winter and summer periods. Sea-level varied slightly between 31.75m and 32.40m, while spring water temperature did not fall below 20°C. The lowest discharge and highest temperature were recorded for the end of dry season (September).

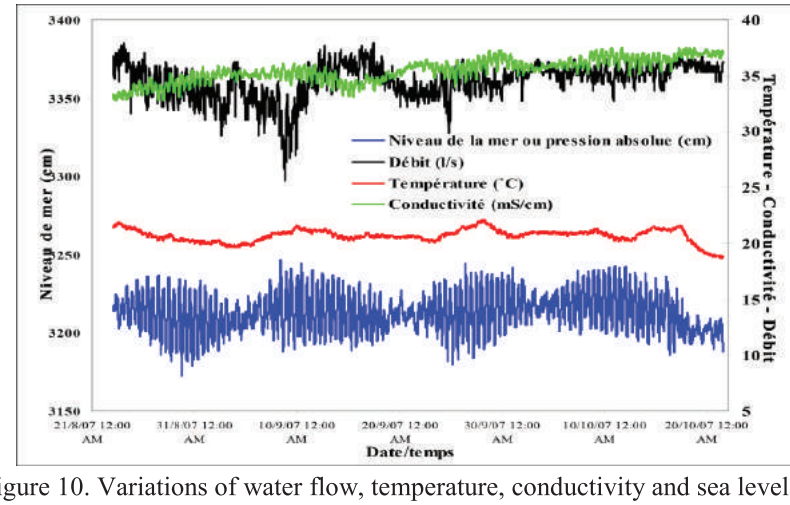


Figure 10. Variations of water flow, temperature, conductivity and sea level S2.

The potential consequences of the exploitation of S2 is the low reliability of the spring, given the highly variable water flow, which is low during the highest need for water, and the quality turns into brackish. This fact highlights the high vulnerability of coastal aquifers. They are very sensitive to littoral pumping, permitting marine intrusion into coastal aquifers. This complex submarine spring system represents a technical challenge, since water collection and transfer are costly and difficult. In low water season (May-September), the flow of water from spring S2 is below 1l/s and the marine intrusion is 60%.

The discharge of Nahr Ibrahim at the two sources: Afqa and Roueiss and its outlet at the Mediterranean sea were monitored and analyzed in relation to climate change (Figure 11).

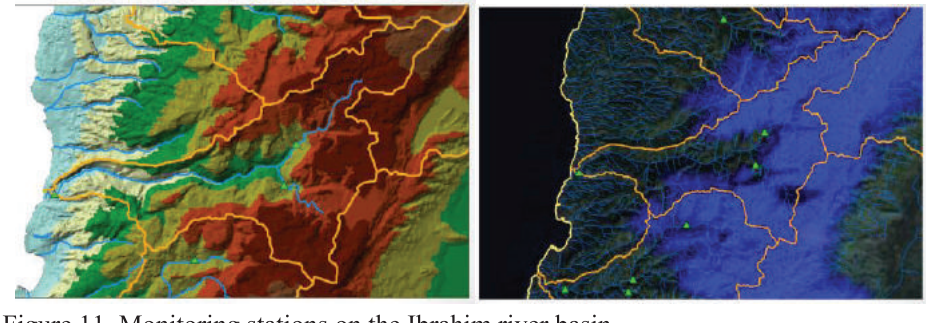


Figure 11. Monitoring stations on the Ibrahim river basin

A temperature increase of 2^{o}C is expected to result in earlier melting and a shift of pick river flow from 15 days to two months (Figure 12). During the 3 year forecast, the drying up season will occur 15-30 days earlier, thus prolonging the water shortage period for the same period (Figure 13).

In the agricultural sector, the yield will be harvested 15 days earlier without changes in crop productivity. While concerning the hydro electrical power generation, the production of electricity will not be affected, due to minimal change in river discharge. Fresh water provision will be significantly affected during the dry season.

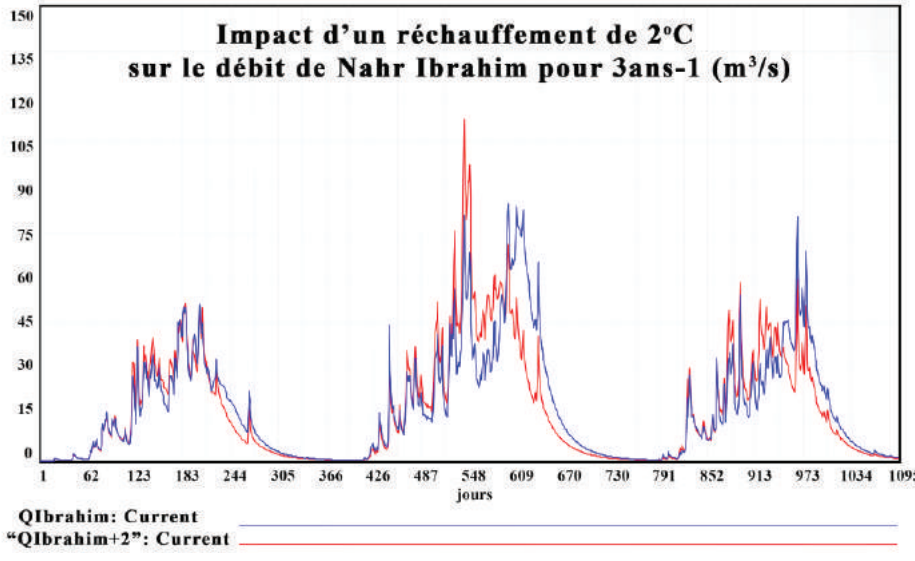


Figure 12. Simulated Ibrahim river flow under climate change and temperature rise conditions by 2°C

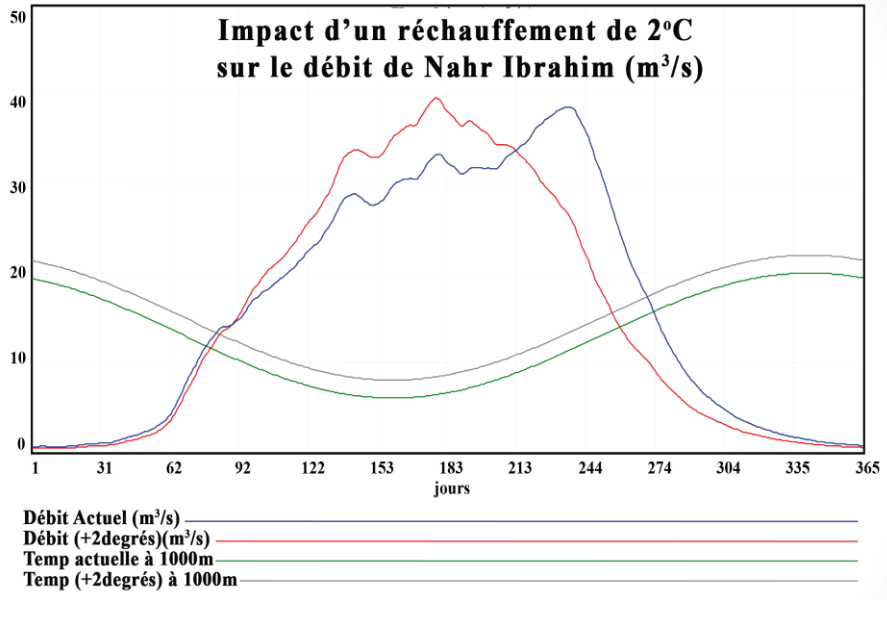


Figure 13. Impact of warming by 2°C on the discharge of Ibraim River (m3/s)

To assess current and future changes in the river discharge under the conditions of climate change, the digital elevation model of the Awali basin was used in the Topographic Kinematic Approximation and Integration (TOPKAPI-X model), which is **fully-distributed, physically-based hydrological model** that can provide high resolution information on the hydrological state of a catchment (Fig.13).

Figure 13. The DEM of the Awali based on pixels of 100mx100m used in the TOPKAPI-X model.

The model assessed the hydrological state of Awali basin and plotted the modified annual precipitation record to compare the aggregated control with the modified record, as a function of the modified annual temperature (Figure 14 and Figure 15). The historical record of temperature, since 1979, showed little discrepancy between the old control and modified T which increased towards the year 2009. This reflected on larger amplitude of difference in annual precipitation which impacts the annual discharge.

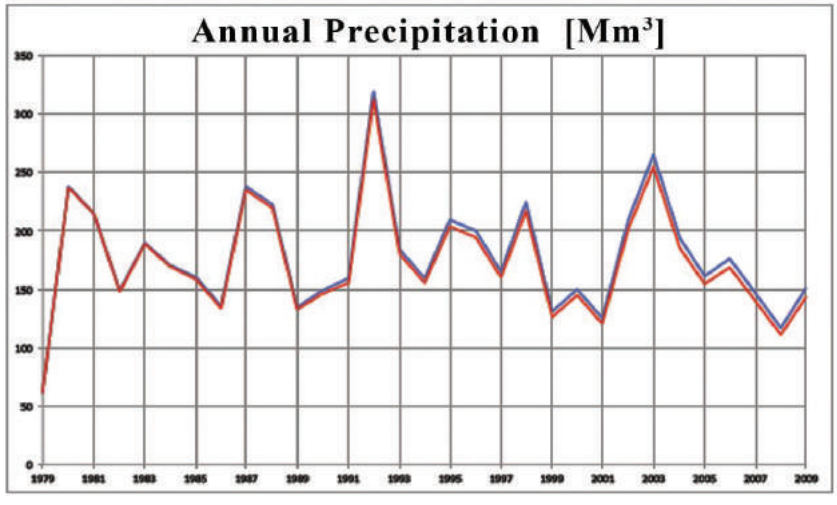


Figure 14. The modified precipitation record (aggregated at yearly level), control run in blue, modified record in red.

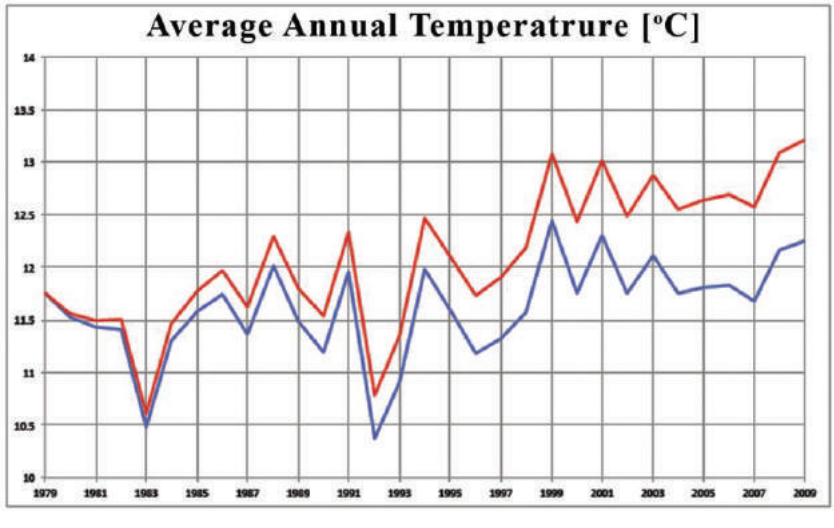


Figure 15. The modified average annual temperature; control run in blue, modified record in red.

The model was run under three scenarios: lower precipitation with constant temperature, equal rainfall with increased temperature and lower precipitation associated with increased temperature (Table 2).

Table 2. Simulation model of climate change scenarios applied to Awali River

Run	Precipitation	Temperature
I	<	=
II	=	>
III	<	>

The control and reduced precipitation and increased temperature showed good matching of trends in periods of highest precipitation, associated with a general decrease of rainfall peaks, notably during the fall and spring seasons (Figure 16).

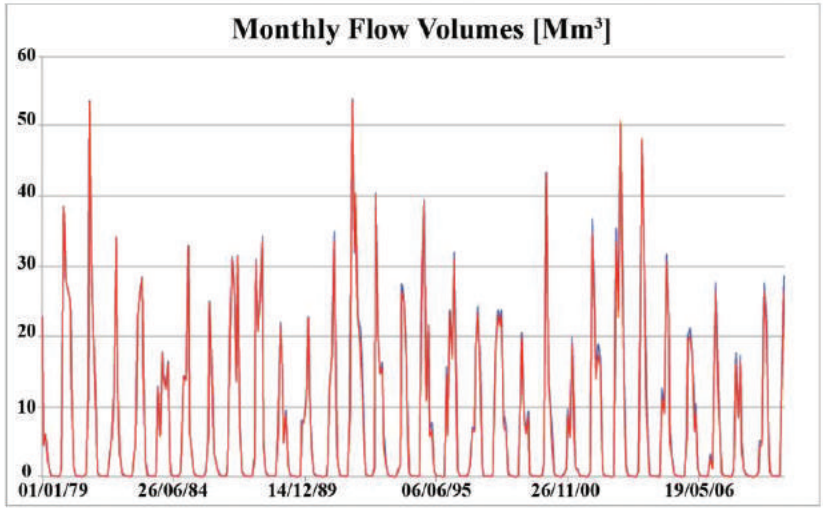


Figure16.The monthly flow volume at Marj Bisri, the control run is in blue while the reduced precipitation and increased temperature modified record is in red.

Dr. Rabi Mohtar
Tees Research Professor
Texas A&M University, USA

Dr. Riad Chedid
President
Rafik Hariri University

Water Security in Lebanon: A Holistic Water-Energy-Food Nexus Approach

I. Introduction

Lebanon faces increasing water security challenges. These challenges have direct implications on its social, economic and environmental well-being, and could in turn pose serious threats to its security and stability. Water, energy, and food (WEF) securities are sensitive keys for building sustainable economies. The three systems are interconnected and highly affected by defined external factors, such as growing population, changing economies, governance, dislocation, health risks, climate change, and international trade. The three resource systems are often managed from within separate 'silos' with little or no accounting of the impact of one 'silo' upon the other two. Sustainable solutions to overcome current water security challenges requires studying the existent inter-linkages between resources, and providing innovative tools that allow the decision makers who govern those

resources to better understand the scenario trade-offs and implications of their policy decisions.

The Lebanese economy is particularly vulnerable to water security challenges, in addition to its energy and food insecurity. Developing a robust water security plan, will branch beyond fixes within the water system, to include a holistic approach that acknowledges its interconnection with the food and energy resource systems, as well as with other externalities. Projections for future scenarios need to be guided by the characteristics of the area of study, such as levels of water and energy availability, spatial and temporal distribution, water and energy requirements, technologies, land requirements, nature of political system, level of economic development, etc.

This paper provides a view for an interdisciplinary, and multi-stakeholder approach that helps to understand the country's water security reality and would help in shaping a different future. How do we better manage and reallocate water across different sectors? How are we defining water security? How could we better integrate our knowledge of resource interconnectedness to minimize unintended consequences? What are possible legal framework and governance structures to guide the implementation of such a planning model? How do we better build the capacity of involved stakeholders at different levels?

II. Need for WEF Nexus Approach

Lebanon faces challenges of securing its energy and food needs, and allocating its water resources in a semi-arid climate, while being subject to dynamic externalities that exacerbate pressures on its resource systems. According to the World Bank (2015), Lebanon imports around 97% of the energy it consumes. It further imports 90% of its cereals (FAO, 2014). With a growing population approaching the 5 million (UN Data, 2015), Lebanon faces challenges of addressing demands through a combination of local allocation of resources and trade.

Table 1 illustrates the water supply portfolio in Lebanon. This water is allocated across domestic, agricultural, industrial and tourism sectors. According to projections for growth in water demand in these sectors during the coming decades, as presented in the National Water Strategy of 2010, the question of allocating this water will become increasingly critical. Agriculture consumes more than 60% of withdrawn water according to 2005 statistics (FAO, 2015).

Table 1. Water Supply Portfolio in Lebanon (Ministry of Energy and Water, 2010)

Water Supply	**MCM**
Surface Water	200 MCM (in summer time)- 1200 MCM (in an average year)
Ground Water	270 MCM (through 650 government wells and 43,000 private wells)
Surface Storage	235 MCM
Non-Conventional Water	-Limited desalination by Private Sector (4.5 MCM) & EDL (5.5 MCM) -Avg. WWT 4% in 2009 (virtually no reuse is being currently practiced)

The total agricultural area is 248,000, of which 42% is irrigated (Trærup& Stephan, 2015) and this is expected to grow to 85% by the year 2035. According to the Blue Gold of Lebanon Report (CIH, 2013), and based on 2011 estimates, water demand for agriculture is expected to increase by 47%. It also predicts a 67% increase in water demand for municipal use, and a 70% increase in water demand for industrial use for 2020. With such projections on the horizon, the stresses on the water resource system represent serious challenges to the country. The absence of integrative water, energy, and food strategies comes with considerable security challenges that have implications to the community's social, economic and environmental wellbeing. Improved understanding of the

integrated management of water, energy and food will highlight the tradeoffs that can enable decision makers to identify new policies to improve the state of all three securities under stress (Mohtar &Daher, 2014).

Figure 1 includes two main stages: the "nexus analytics", and "multi-stakeholder dialogue". In the first stage, projected scenarios are assessed with the benefit of scientific knowledge to better understand the trade-offs of different proposed strategies, while accounting for existing inter-linkages between resource systems. These analytics are then used to facilitate stage two, the multi-stakeholder dialogue, which needs to be inclusive of all stakeholders and account for their needs and interests, to move society from a potential conflict zone toward a potential zone of cooperation.

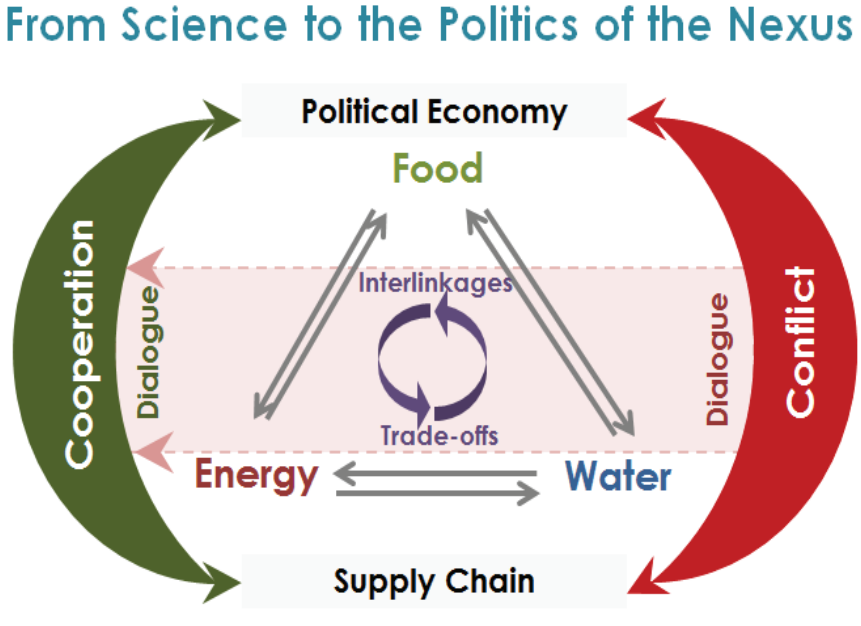


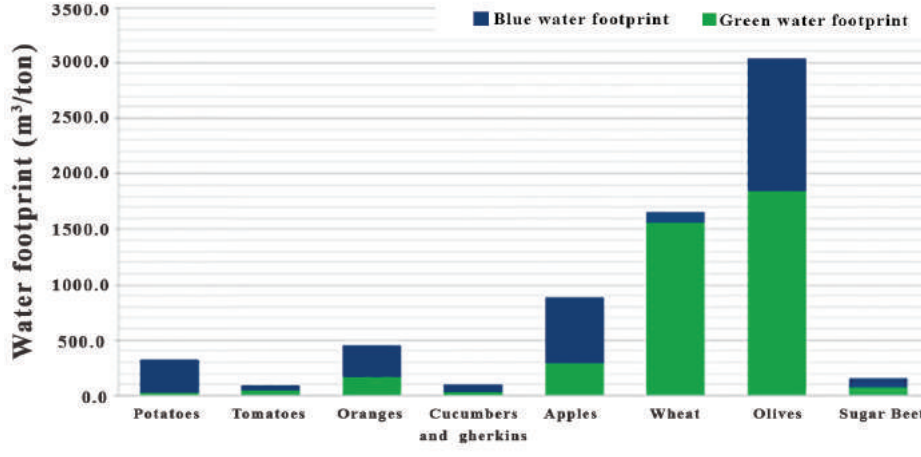
Figure 1: A generalized resources nexus platform outlining the dynamics of three communities: Science, Private sector/supply chain and, politics and policy (Mohtar and Daher, 2016)

III. Water-Food: Highlighting Virtual Water Trade and Embedded Water

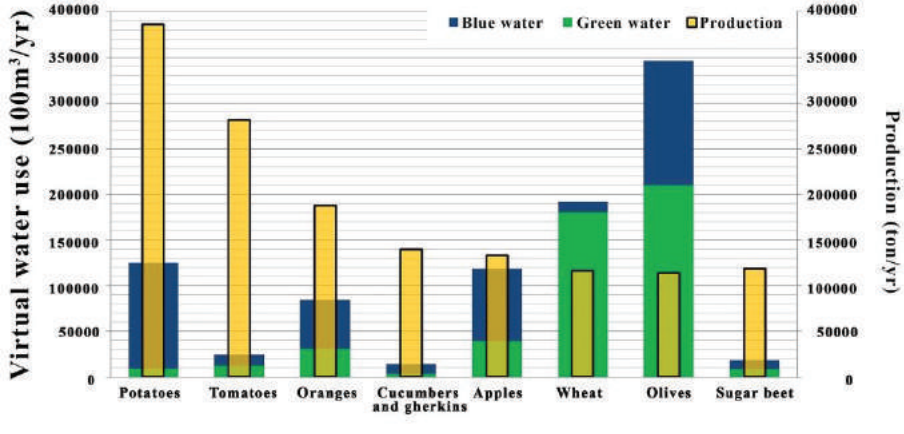
Lebanon is one of the main importers in the Arab world, mostly of cereals and meats, making food trade a key factor for its food security, which is closely related to water security, in terms of virtual water trade. The water used in production and processing crops becomes "virtual water" embedded in a product or commodity (Allan 1993). The virtual water trade (VWT) represents the amount of water embedded in products that are traded internationally. In Lebanon, which is dependent on food imports, VWT is regarded as the main variable for food and water security.

3.1- Green and blue water use for crop production using water footprint

Several studies were executed to quantify the water footprint of crops (Chapagain and Hoekstra, 2011). Water footprint can be divided into green and blue water: green water describes the soil water recharged from rainfall and blue water refers the irrigation water drawn from ground, reservoir, or river water. Figure 2a and b show the green and blue water footprints of the primary crops produced in Lebanon (Mekonnen and Hoekstra, 2010) and their respective virtual water consumptions. For example, Lebanon cultivates 370,000 ton of potato annually, and water footprint of potato is 324.2 m^3/ton which is divided into 24.0 m^3/ton (green water) and 300.2 m^3/ton (blue water). Therefore, the virtual water used for potato production is 125 thousand m^3/yr, and most of virtual water is supplied by irrigation facility in Lebanon. In contrast, the wheat grown in Lebanon uses mostly green water (non-irrigated), hence the total water (green and blue) used for wheat production in Lebanon was 192 thousand m^3/yr (181 and 11 thousand m^3/yr), respectively.



(a) Water footprint in Lebanon



(b) Virtual water use and production in Lebanon

Figure 2: Water footprint and virtual water use for crop production in Lebanon

3.2- The dependency on virtual water trade in Lebanon through food trade

Figure 3 reflects the internal and external water footprints for Lebanon. The virtual water import from wheat trade was less than 800 Mm^3/yr. during 1997 to 2002, but increased to 1134.9 Mm^3/yr. in 2012, with the greatest increases occurring between 2003 and 2012, except for

2006. Domestic production of wheat was significantly smaller than the import, thereby explaining the dependency on virtual water import through wheat reaching more than 80.0% in 2012.

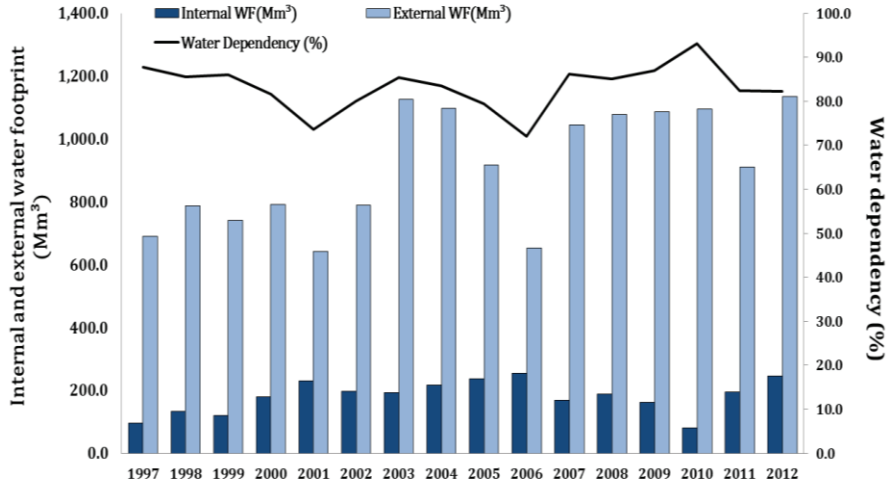


Figure 3. The dependency of Lebanon on virtual water import through internal and external water footprint

IV. Water-Energy: Inter-linkages, Challenges, and Opportunities

Lebanon is undergoing a general crisis in most of its service sectors and in particular, in the energy and water sectors. At the water level, the country has witnessed a change of climate resulting in a longer dry seasons, exceeding 7 months per year. In 2013, precipitation was especially low, resulting severe shortages, which caused the Ministries of Energy and Water to consider importing water from Turkey. For decades, the electricity sector has suffered from technical and financial shortages, and mirrors the problems encountered in many developing countries: inadequate planning of power systems resulting in incomplete or ill-operating infrastructure, enduring consequences of political instability, huge debts, unavailability of financing for desired projects and inefficiency in operation. The water and energy sectors are

interdependent given that each is required by the other, their strategic importance to the country, and the common problems hindering their further development.

An observer could ask why, after so many years of effort, the country still suffers from:

- Shortage in electricity and water supply
- Poor customer service
- Illegal connections to electricity and water networks
- Inappropriate tariff in both sectors
- Unacceptable quality of electric energy and water supplied
- Illegal businesses/service providers in the water and electricity sectors, which add alarming dimensions in safety and put extreme pressure on economic activities.

In reality, there is no single answer to the question of why the above issues continue to exist: the political divide in the country was and continues to be the major element hindering the implementation of meaningful reforms in both sectors. It is time to assess past experience and try to find solutions based on the understanding that the management of the energy sector cannot be done in isolation from the water and food sectors, and of course, the environment. Table 2 provides a comparison between the water and energy sectors with reference to 8 common issues. As can be seen, both sectors share common problems and challenges and hence it is unreasonable not to adopt an integrated approach for seeking solutions to their prevailing problems.

Table 2. Elements of Comparison between the electricity and water sectors

Issue	Water	Electricity
Supply Level	There is not a single village or city in Lebanon that receives an uninterrupted residential supply of water.	There is not a single village or city in Lebanon that receives an uninterrupted supply of electricity.
Loss	The level of non-revenue water was estimated at about 48% in 2010. Since there is little metering, it is difficult to estimate the level of non-revenue water. (Ministry of Energy and Water, 2012)	The level of technical and non-technical losses are estimated at around 40%. The absence of intelligent meters makes it difficult to identify loss locations, and the exact level of technical and non-technical losses
Uncontrolled private sector	Besides the public network, around 1,000 mostly private wells are scattered in the area of Beirut. Their depth varies between 50 and 300m and their average individual discharge is 35 liters/second. Total water supply from these wells could be higher than through the public water supply. Over-pumping from wells in the Beirut area has led to seawater intrusion into aquifers (FAO,2008)	Besides the energy supply by EDL, there are thousands of private generators operating mostly illegally and taxing the customers' additional bills with tariffs much higher than the one imposed by EDL. However, the absence of such generators is catastrophic for the economy and wellbeing of Lebanese citizens in the absence of a reliable supply from EDL.
Metering	No efforts were made to conserve water. Still today, Lebanon is one of the few countries in the Middle East that has almost no water meters.	The energy is measured through electromechanical meters. The absence of electronic intelligent meters makes it difficult to exercises control over energy demand and prevent theft.
Private sector service providers	In 2003 the municipality of Tripoli signed the first and so far only management contract for water supply in Lebanon. This was done after passing the law (Law 401) to allow public-private partnerships in water supply. The cost of 20 million Euro was	The service providers (SPs) in the distribution sector were introduced in 2011. The SPs were given the management of bill collection, maintenance and upgrade of distribution facilities, monitoring of electricity theft and installation of intelligent meters as

	financed by the French Development Agency. The contract included the operation, maintenance, and installation of equipment, the organization of the billing system and collection of water tariffs (European Water Initiative Mediterranean, 2010)	well as improve customer services. Several factors including political instability and tensions prevented the project from achieving its initial goals
External Partners	Arab Fund for Economic and Social Development, the European Investment Bank (EIB), France, Germany, Italy, Japan, Kuwait, Saudi Arabia, the United States, the World Bank and others	Same as in the water case
Laws	Law 221/2000 MOEW strategy and policy making entity: Distribution of drinking and irrigation water at national levels, Build major water facilities including dams and hill lakes, Protect water from pollution, License wells. Strategies: National Water Sector Strategy 2010, Includes plans on increasing irrigated lands Accounts for Environmental Assessment, Plans to build dams, but no mentioned hydropower.	Law 462/2000 MOEW strategy and policy making entity: Governs mostly the electricity sector (not the energy sector) Strategies: Policy paper 2010, Includes plans for rehabilitating existing power plants and adding new power plants increasing generation capacity, Includes plan for upgrading the transmission network and managing the distribution sector by the private sector, Includes plans for renewable energy technologies.
Tariffs	Tariffs are set at different levels for each of the four regional water establishments. Within each service area tariffs are the same, although costs differ significantly (Lebanon Social Impact Analysis, 2009)	Tariffs are set at different levels of consumption. Tariffs are below the production cost of energy and were originally set for a barrel of oil priced at US$25.

V. Legal Framework and Governance

Governance of water in Lebanon strives to be responsible in its approaches to the use and protection of water resources. The overall structure of governance, particularly as reflected in how the national ministries are defined and organized, tries to strike a balance in meeting a wide variety of political and social needs.

The task of managing water resources in Lebanon falls to a number of administrative agencies that both divide and share responsibilities. At the national level, the Ministry of Energy and Water has primary responsibility, although the Ministries of Environment, Agriculture, Interior, as well as Local Municipalities, and Public Health institutions all have roles in water management. The Energy and Water Agency has authority to prepare the national water plan and issue regulations that seek to protect public water supplies. It also has responsibility for managing electricity generation, since a significant amount of the electricity generated in Lebanon relies on hydro-electric facilities. Indeed, the decision to group water and energy into the responsibilities of a single ministry reflects a recognition of a connection between the two. On its face, it may seem a perfectly rational way to ensure that these connections are understood, and that policies and programs find a proper balance between them. In practice, of course, there is little to prevent one from overcoming the other in importance, such that the tradeoff may well favor one over the other. Concern has often been raised that this Ministry exhibits more interest in promoting energy generation for development and less interest in water protection.

Perhaps out of concern for the need to protect water supplies, in 2000 and 2002, the responsibilities for water source protection, sanitation, and waste water projects were decentralized and placed in the hands of four geographically-defined Regional Water Establishments – the Greater Beirut and Mount Lebanon Water Establishment, the North Lebanon Water Establishment, the Beqa'a Water Establishment, and the

South Lebanon Water Establishment. These Establishments replaced the system of regional water authorities and expanded the legal basis for water decision making by reducing the water authority of the Ministry. Each of these Establishments has authority to govern water resources and projects in their respective geographic areas. Geographically dividing water authorities in this way makes sense because each region faces its own mix of uses, with some using far less water for agricultural irrigation than others. (Makdisi, 2007: 372)

The challenge for Lebanon and many other nations moving forward is to develop the legal basis for an integrated understanding of the interconnectedness between water, food, and energy, and to find ways of administratively coordinating the associated governmental functions. Even with the combined water and energy functions, issues of food and agriculture are still left administratively uncoordinated. As Lebanon now contemplates its water futures, issues of coordinating administrative responsibilities must become a subject of explicit consideration.

VI. Conclusions

Solution to water security will not exclusively come from within the water system, but from the different interconnected systems; and through a holistic understanding of externalities and inter-linkages.

Stakeholders (ministries, municipalities, civil society, private sector) need to be identified and included in dialogue.

Dialogue needs to be facilitated by analytics which capture the interconnections between the different resource systems and helps assess the trade-offs among different projected strategies moving forward; while ensuring goals are being met, while minimizing any unintended consequences.

The Importance of capacity building has to be stressed across ministries, academic institutions, utility companies, farmers, operators, private sector and the general public/consumers.

The legal framework and governance structures in which resources are governed need to be in sync with the reality of their interconnections.

The need for accounting for the spatial and temporal attributes for resources as well as for hotspots of resource demands must be satisfied.

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Research done by:

1- Rabi Mohtar:
Biological and Agricultural Engineering Department and Zachry Department of Civil Engineering, Texas A&M University, College Station, TX 77843-2117, USA, mohtar@tamu.edu, +1 765 4090309.
2- Riad Chedid:
Rafik Hariri University, Beirut, Lebanon
3- Bassel Daher, Sanghyun Lee:
Biological and Agricultural Engineering Department, Texas A&M University, College Station, TX 77843-2117, USA.
4- Kent Portney:
Bush School of Government and Public Service, Texas A&M University, College Station, TX 77843-2117, USA,
5- Bruce McCarl:
Agricultural Economics, Texas A&M University, College Station, TX 77843-2117, USA,

Session II

Ms. Rana el Hajj
Senior Program Coordinator, Climate Change & Environment
Issam Fares Institute, AUB

On December 12, 2015 more than 195 countries adopted what was called a historic agreement on climate change. Within this agreement countries have agreed to hold the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels. Similar to this long term goal on mitigation, countries were able to agree on a global goal on adaptation to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change. This global goal on adaptation comes as a confession from all countries that no matter the level of mitigation, climate change impacts are already starting to be felt, and as such countries still need to adapt. Having such a goal on adaptation is considered as a breakthrough for vulnerable countries such as Lebanon.

When we talk about vulnerability to climate change we have to understand the expected impacts and the resources that are most likely to get affected. In the Middle East and North Africa region, water resources are first to come to mind as the most vulnerable of resources.

Water availability in Lebanon is already facing many stressors such as high population density, pollution, mismanagement including lack of integrity in the water sector, and influx of refugees. Lebanon's per capita share of available fresh water is already below the recommended threshold of 1000m3/capita/year. Furthermore, Studies

have shown that drought events in the region and in Lebanon are already becoming more frequent a trend that is expected to increase even more with climate change. The scarcity in water resources is a threat to Lebanon's water security and can play a chain effect on other vital sectors that are intrinsically linked such as agriculture, tourism, food industry and energy production.

The success of the Paris agreement is highly dependent on national efforts on all fronts. Countries now have to get to work to translate its aims into actions. So where does Lebanon stand on that regard? What are the expected impacts of climate change on Lebanon and consequently its water resources? What policies is Lebanon adopting to adapt to climate change impacts on the water sector? And how are other sectors such as agriculture, which is strongly dependent on water resources, mainstreaming climate change into its policies and sectoral work?

We hope answers would come through the interventions of our esteemed participants in this session which I am honored to moderate.

Ms. Lea Kai Abou Jaoude
Project Officer, Climate Change Unit
Ministry of Environment

Climate Change Impacts on Water Resources, LEBANON

I. Introduction

Developed through a scoping process, involving climate change experts from all relevant disciplines, the Fifth Assessment Report (AR5) of the United Nations Intergovernmental Panel on Climate Change (IPCC) was finalized in 2014, thus providing a "Summary for Policymakers", which includes a comprehensive view of the long-term changes and scientific observations in the atmosphere, the ocean and the land surface.

The main Physical Science Basis for the "Summary for Policy Makers" are:

- "Many of the observed changes are unprecedented over decades to millennia".
- The increase of CO_2, CH_4, and N_2O concentrations to levels unprecedented in at least the last 800,000 years.
- The rise of global mean sea level by 0.19m for the period 1901-2010
- The continuous shrinking of glaciers almost worldwide.

The Climate Change Project in Lebanon is established to assess the national greenhouse gas (GHG) emissions and to evaluate Lebanon's national GHG mitigation strategy, which is intended to reduce emissions from all sectors including energy, industrial, transport and agriculture. The project is funded by the United Nations Development Programme (UNDP) and the Global Environment Facility (GEF); it is being implemented by the Lebanese Ministry of Environment (MoE). The project is also intended to evaluate the impact of climate change on the socioeconomics and the ecosystems, including the country's water and agricultural resources. (www.climatechange.moe.gov.lb). The project has generated so far the Initial National Communication (INC, 1999), its update in 2000, the Second Communication 2011, LEBANON Technology Needs Assessment (Figure 1).

Work of the Ministry of Environment

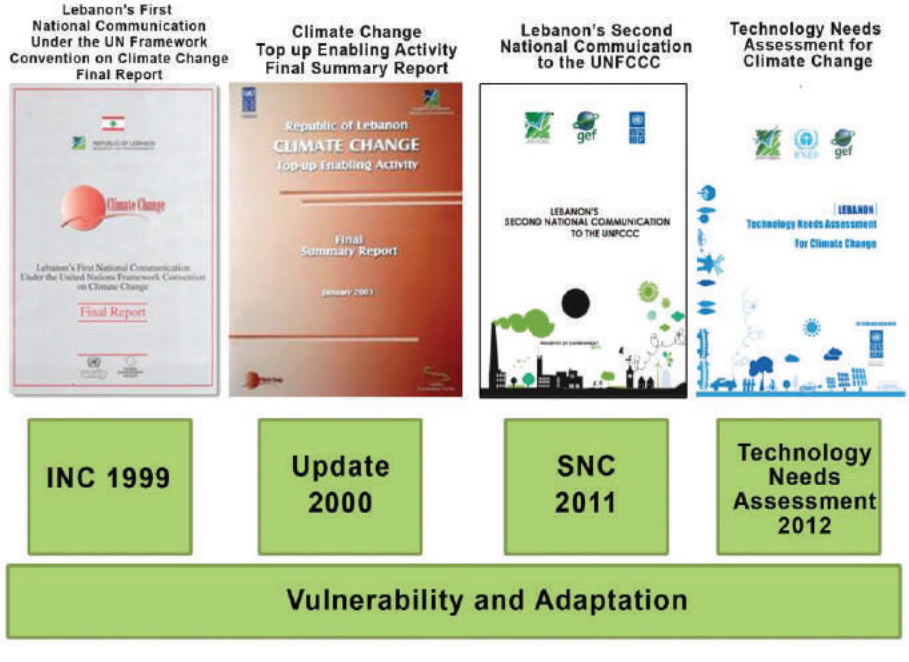


Figure 1. Products of Climate Change Project, Lebanon.

II. Climate Change Impact on Water

The full effects on Lebanon of; the anticipated increases in temperatures; the changes in precipitation, the rising sea levels, and the direct effects of continued global GHG emissions, have not been fully quantified. However; they are likely to be as follows (Figures 2, 3, 4, 5):

- Temperature will increase by around 1°C on the coast and 2°C in the mainland by 2040, and 3.5°C to 5°C by 2090.
- Rainfall will decrease by 10-20% by 2040, and by 25-45% by the year 2090. The total volume of water resources will decline 6 to 8%, in case of 1°C temperature increase and 12 to 16% in case of 2°C.
- By the end of the century, Beirut will witness 50 more days with temperatures exceeding 35°C, and 34 more nights with temperatures exceeding 25°C.
- Droughts will occur 15 days to 1 month earlier, and countrywide drought periods will extend 9 days longer by 2040 and 18 days longer by 2090. The already dry regions, such as the Bekaa, Hermel, and the South, will experience the sharpest effects. Thus, in addition, to irrigation needs, cost will shoot up, as more pumping hours will be required, therefore consuming more energy.
- Climate change will induce a reduction of 40% of the snow cover of Lebanon, in case of 2°C increase in temperature, and 70% in case of an increase of 4°C. Currently snow falls at 1,500 m high it might shift to 1,700 m by 2050, and 1,900 m by 2090 (figure2). So snow residence time will drop from 110 days to 45 days in the spring. Such changes will affect the recharge of most springs, reduce the water supply available for irrigation during summer and increase winter floods by up to 30%.

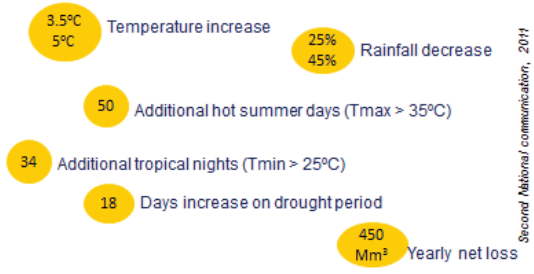


Figure 2. Projections of climate change for Lebanon in 2090.

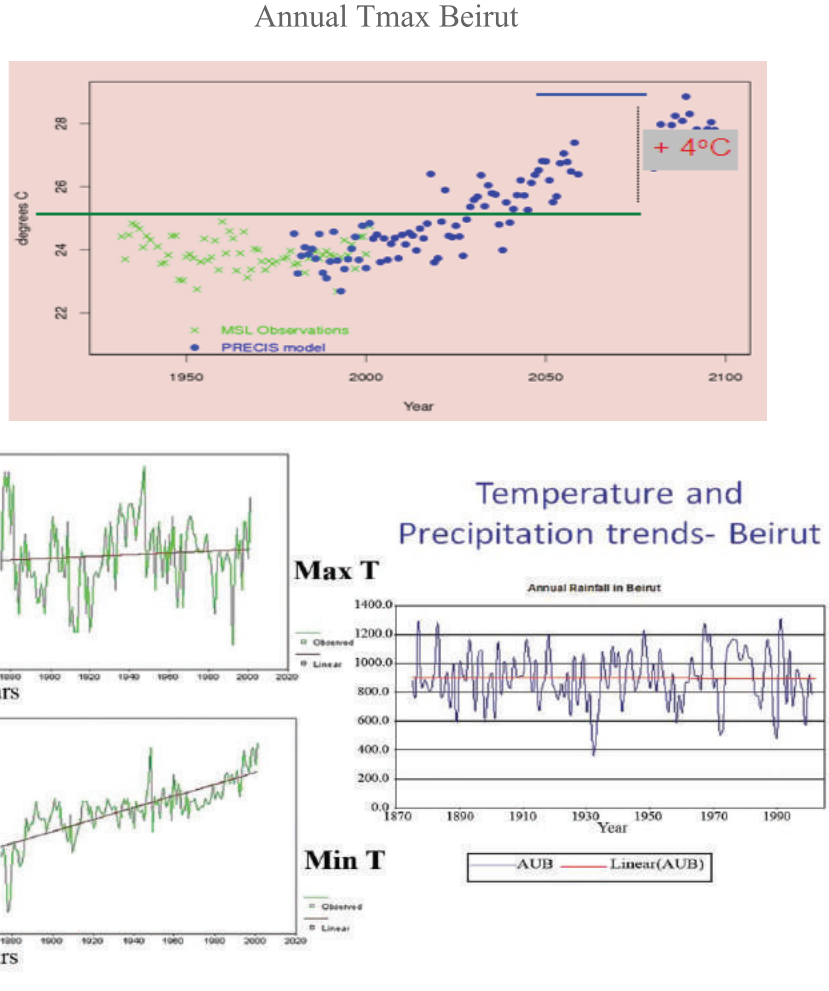


Figure 3. Temperature and precipitation trends in Beirut.

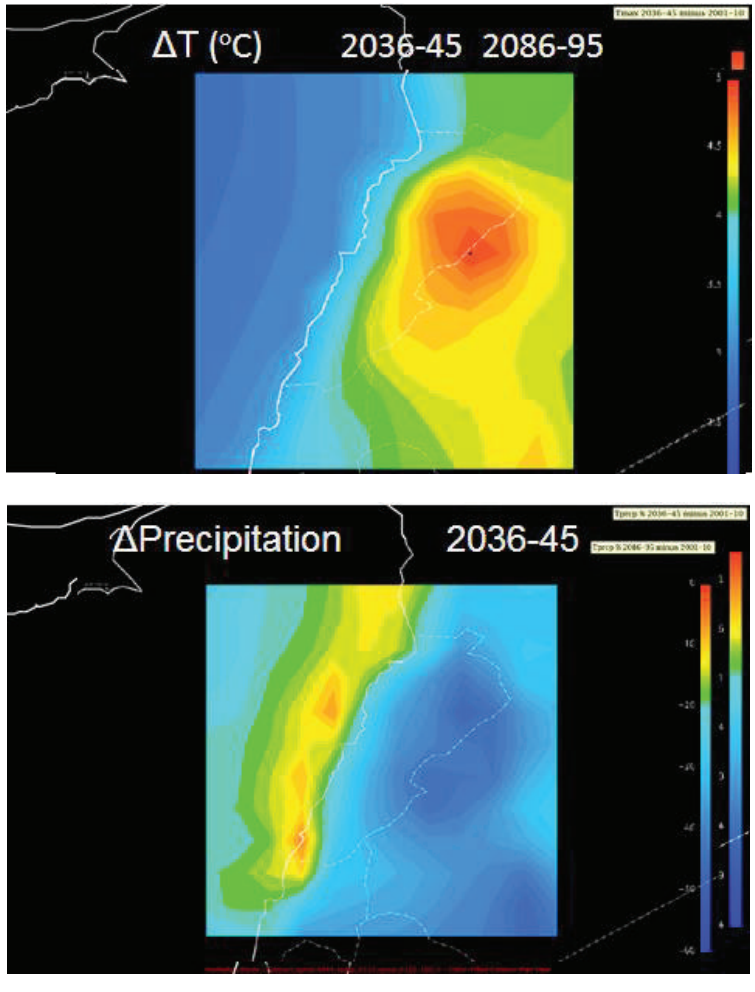
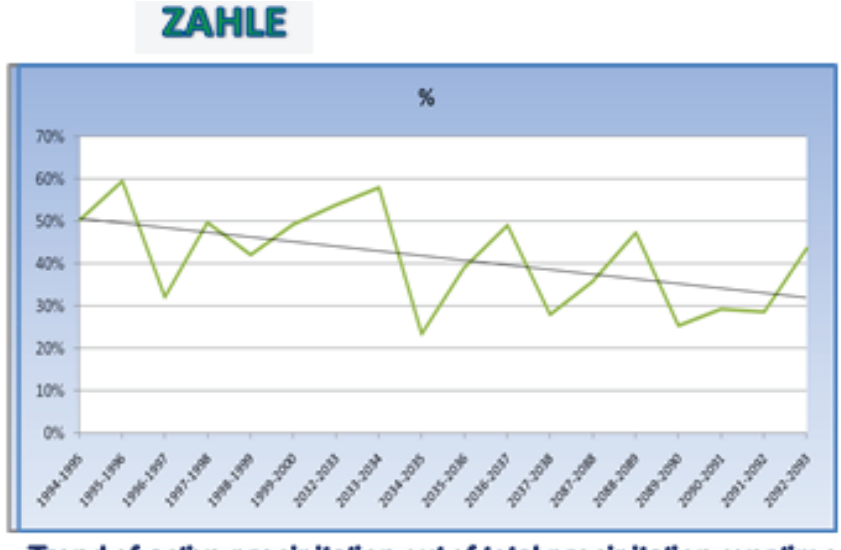


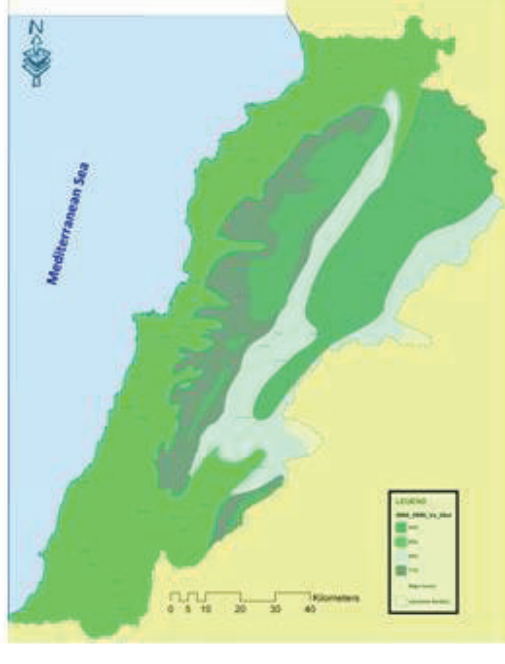
Figure 4. Projections of climate change impact for Lebanon.

Impacts of Climate Change on Water

a. Decrease in Water Availability



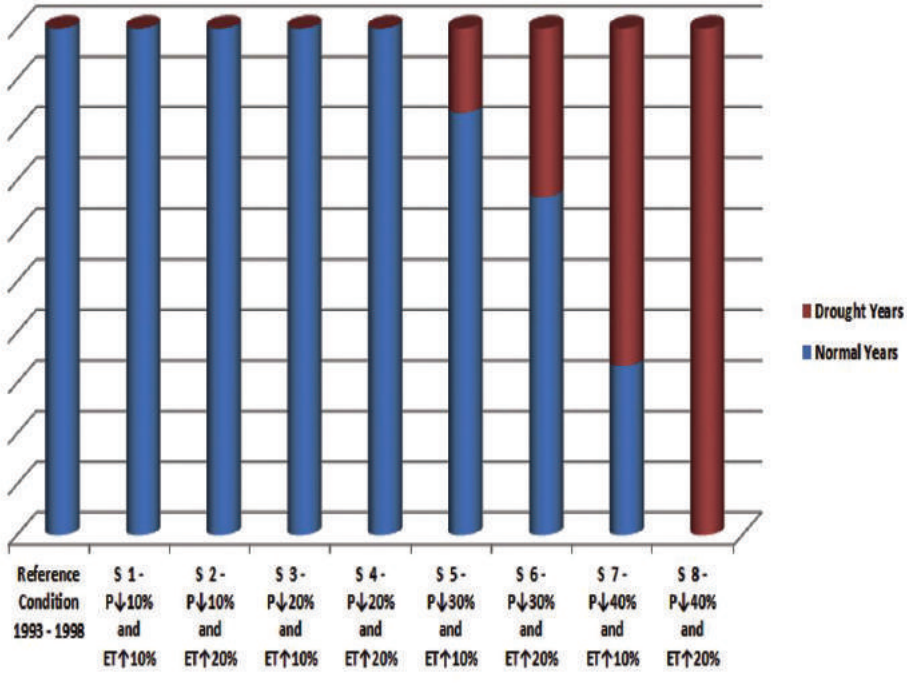
Trend of active precipitation out of total precipitation over time



Decline in the proportion of active precipitation out of total precipitation from the recent past to the distant future

(SNC, 2010)

b. Increase in the occurrence and frequency of droughts

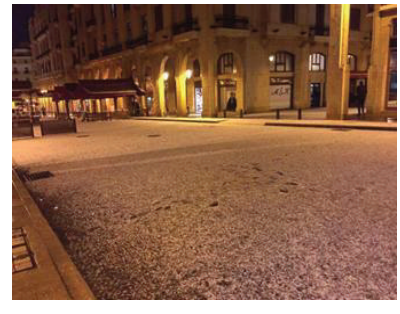


Figures 5.Impact of climate change on precipitation, occurrence and frequency of droughts in Lebanon.

2.1 Climate change impacts on water quality and quantity

- Exacerbation of existing challenges to water availability and quality
- Reduction of 40% to 70% of the snow cover of Lebanon
- A shift of elevation of snow from 1500m to 1900m
- A decrease in snow residence time from 110 days to 45 days

Winter 2014



Winter 2015

III. Lebanon's Third National communication

The current Third National Communication on Climate Change which focuses on the economic costs of climate change, describes the potential direct and indirect economic costs that the households, businesses, communities, and government of Lebanon might incur over the next several decades, if they and their counterparts around the world continue to behave in a business-as-usual manner. So if the emissions of carbon dioxide and other greenhouse gases would continue to grow at rates similar to those seen in recent years, the expected damage in each year from the direct impacts of higher temperatures and other changes in climate on agricultural productivity, human health, flooding, ecosystem productivity, etc. would impose costs on Lebanon of about USD 320

million in 2020, USD 2,800 million in 2040, and USD 23,200 million in 2080 (Table 1).

Table 1. Potential costs from the cumulative effects of global GHG emissions in 2015 and subsequent years.

Potential costs	2020	2040	2080
Direct annual damage from drought, etc. in Lebanon (millions)	USD 320	USD 2,800	USD 23,200
Forgone GDP in Lebanon (millions)	USD 1,600	USD 14,100	USD 115,700
Percentage reduction in GDP	3%	14%	32%
Total cost to Lebanon (millions)	USD 1,900a	USD 16,900	USD 138,900
Government's share (millions)	USD 610	USD 5,400	USD 44,300

3.1 Climate Change Economic Costs on Water supply:

a. Water Supply for agricultural, domestic / Industrial use

b. Water supply for generation of hydroelectricity

Figure 6.

Potential economic costs are expected to be incurred by the households, businesses, communities, and government of Lebanon over

the next several decades, if they and their counterparts around the world continue to behave in a business-as-usual manner. The emissions of carbon dioxide and other greenhouse gases would continue to grow at rates similar to those seen in recent years.

a. Cost of reduction in water supply

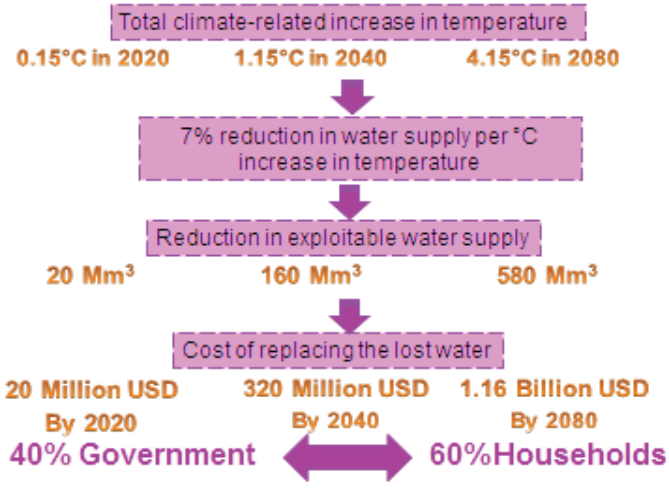


Figure 7. Climate change economic costs on water resources.

- 7% ref SNC

  - Cost would be USD 1 per m^3 in 2020, reflecting the estimated cost of reducing leakage in the water system and increasing water conservation (World Bank 2010 -*Public Expenditure Review*
  - Cost would be USD 2 per m^3 in 2040 and 2080, reflecting the cost of wastewater reuse World Bank 2010; and desalination (Fichtner, 2011
  - 60-40% between households and government the costs of inadequate provision of public water supplies. World Bank, 2010
  - The actual costs might be higher or lower than those indicated. All else equal, costs would likely be higher, insofar as

insufficient information exists to describe other potential costs from the impacts of climate change on water, such as:

- Climate-related reductions in water quality.
- Climate-related changes in the spatial and temporal distribution of precipitation.

Several factors might intensify the costs of climate-related reductions in water supplies. With higher temperatures and tighter water scarcity, for example, the value of each incremental reduction in water supplies might increase, perhaps steeply. Greater variability in precipitation, temperatures, and evapotranspiration might result in periods and places with extreme mismatches between water supply and demand, with severe shortages causing abnormally high economic costs

b. Cost of reduction in hydropower

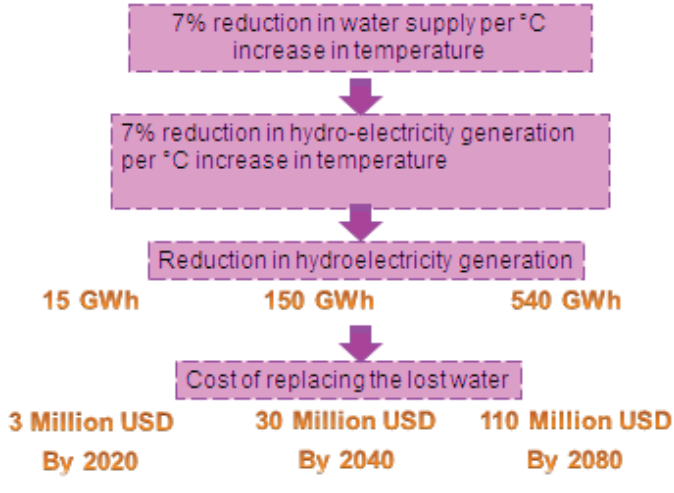


Figure 8. Climate change economic costs on water resources.

Assume the replacement of electricity would come from burning heavy fuel oil at a cost of about USD 210,000 per GWh (adapted from World Bank, 2008; p. 25, adjusted to 2015 USD).

The actual impact of climate change on hydroelectricity production would depend not just on the reduction in stream flows but also on the quantity and configuration of the hydroelectric dams. The actual cost of replacement supplies of electricity would depend on the type(s) of generation employed. The costs of replacement electricity from other sources might rise initially, for example, but then decline as new technologies, such as solar, become more efficient. Costs also will be sensitive to changes in the supply and prices of natural gas and other fuels. Government likely would directly bear the costs of central generating facilities integrated into the grid. Households and businesses likely would indirectly bear some of these costs through payments for electricity consumed from the grid and directly for

Sentence incomplete.

3.2 Climate Change Economic Costs on Other Sectors

It is important to note that the limitations in the currently available data, models, and other information prevent the report from quantifying all types of potential costs such as the impact of water scarcity on other sectors (Figure 9).

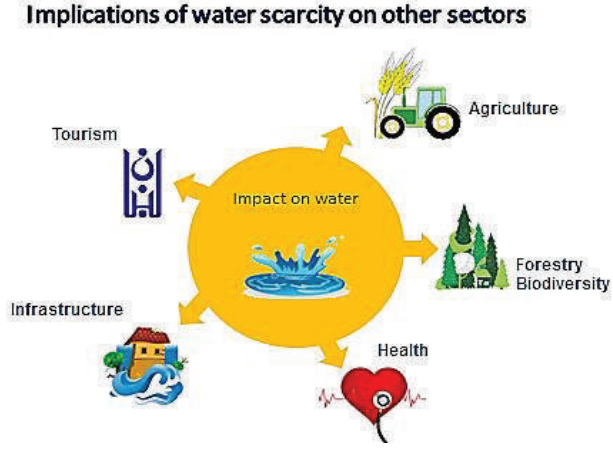


Figure 9. impact of water scarcity on other sectors.

IV. Needs and Means for Developing a Better and Broader Understanding of Climate Changes Impact in Lebanon:

4.1 Problem Definition:

- Poor level coordination on climate change & environment issues
- Lack of resources to move CC agenda
- Lack of awareness on needed adaptation & mitigation options at the national level
- Difficulty in access of data

4.2 Role of Climate Change Coordination Unit

- Coordinate activities of 40 representatives and projects in Lebanon. Among the projects
  - National adaptation projects and studies
    - Technology needs assessment.
    - Pilot project: rainwater harvesting from greenhouse tops for irrigation (Fig. 10).
    - Economic Assessment of climate change impacts.
  - Regional and international projects
    - ClimaSouth: Early Warning System.
    - ACCWAM: climate proofing and mainstreaming of water projects.
    - CAPWATER: updating the national adaptation plan of the water sector.

- Mainstream CC into national and sectoral development plans.
- Establish a platform for exchange of information
- Increase Lebanon's engagement in UNFCCC and KP negotiations.

- Enhance decision makers and general public's awareness and capacities.
- Maximize benefit from international climate change funding opportunities.
- Push CC agenda on a national level.

Increasing Farmer's Resilience through Rainwater Harvesting from Greenhouse tops – Pilot Projects

Figure 10. Pilot project: rainwater harvesting from greenhouse tops for irrigation.

Dr. Nadim Farajalla
Director of Research, Climate Change and the Environment Program
Issam Fares Institute, AUB

Adaption Plan for the Water Sector

I. Introduction

The main aim of an adaption plan for the water secure is to reduce vulnerability and improve resilience through effective and targeted adaptation

1.1. Key Definitions

- Vulnerability: the degree to which a social-ecological system is susceptible to and unable to cope with the adverse effects of climate change, including climate variability and extremes
- Resilience: the capacity for social-ecological systems to sustain shocks and maintain the integrity of functional relationships in the face of external forces
- Adaptation: adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities

II. Water Resources Aspects – Resilience

2.1- Physical/Natural

- All of the exploitable rivers, streams and springs are nationally confined, thus a very low dependency ratio – 0.78% (from a range 0 – 100)
- Renewable groundwater
- Topography allows for a multitude of surface storage options
- Varied topography of the country creates micro-climatic conditions - diversified agricultural zones. Greater options within the Water-Food nexus
- Vulnerability
- Vulnerability - Physical/Natural
- Lebanon's water resources rely directly on precipitation while climate models are projecting an increased frequency of dry years
- Seasonal and inter-annual variability of precipitation and consequently surface flows and groundwater recharge
- Over exploitation of groundwater

III. Anthropogenic aspects

- Water efficiency in the agricultural sector: >60% furrow irrigation
- Losses in water networks: Unaccounted for Water > 48%
- Pressure on groundwater resources: 20,000 licensed wells and 60,000 unlicensed, salinity along the coast, dropping water table
- Tariffs policy: flat rate tariff policy for domestic and agricultural water use
- Water storage: Very limited – one major dam, several hill lakes

- Groundwater recharge: abstraction rate average of 700 Mm3, natural renewal rate is estimated at 500 Mm3
- Wastewater treatment and reuse: 8% treated

Table 1: Water authorities role – Lebanon

Authority	**Role**
Ministry of Energy and Water	• Producing national water policies and strategies • Oversee and monitor the WEs and all other public institutions working in the water sector • National scale studies (related to water resources management monitoring, and controlling) • Designing, building and implementing major water facilities i.e.: dams, hilllakes (>200,000 m^3), water conveyance and supply networks....
Water Establishments: 1) North Lebanon 2) South Lebanon 3) Bekaa Valley 4) Beirut and Mount Lebanon 5)Litani River Authority	• Plan and distribute water resources within their respective areas • Operate and maintain the system, including cost recovery, and renewal • Implement the national water and wastewater plans • Study, implement and invest in drinking and irrigation water plans and water quality • Monitor rivers and manage their basins

3.1 Anthropogenic – Institutional

- Ministry of Energy and Water is understaffed - vacancy rate at the Ministry reaches 80% at the ministry and 50% in the water establishments
- Lack of coordination between different ministries on key water issues and common priorities
- No implementation of NWSS and disregard of key elements within it – namely IWRM including demand management
- Localized management of water is absent – no WUA
- Lack of easy access to information and the unavailability of data are pervasive

3.2 Anthropogenic – Economic and Educational

- Low GDP per capita 9,928 USD in 2013
- Economic inequality more > 25% of population classified as poor or extremely poor
- Low investment in the education – 1.6% in 2012, reduces mainstreaming of climate change into the educational system thus reduces awareness

IV. Recommended Framework for a National Action Plan

1st Ultimate Goal: Restructure of water governance towards a climate-responsive water sector

Proposed Action: Establish a Water Board responsible for managing all aspects of the water sector

Prepare terms of reference and description of on the framework of operations of the board.

Establish a dedicated administrative and technical body selected from the public and private sectors

Maintain and continuously enhance the level of operations at all administrative levels - with a special aim of improving coordination between various stakeholders

Fill up vacant positions at MoEW and Wes

Identify sources of financing and revenues for the board and develop mechanisms to ensure sustainability

Ministry of Energy and Water (with support from other ministries

2nd Ultimate Goal: Implementation of climate change adaptation and vulnerability reduction measures for water resources and infrastructure

Proposed Action: Profiling watersheds and river basins

Identify and delineate priority watersheds and river basins for implementation of IWRM

Conduct groundwater vulnerability assessment in water stressed areas

Map areas not suitable for large water infrastructure development and settlements

Ministry of Energy and Water

3rd Ultimate Goal: Improve equitable access to sustainable water supply

Proposed Action: Increase safe water supply to water-stressed communities

Conduct survey to identify water-stressed or deprived communities.

Construct new water supply infrastructure for these communities

Review financing, tariffs, and incentives that reflect the full cost of providing safe water equitably.

Develop public financing system for water supply infrastructure rehabilitation and development.

Ministry of Energy and Water
Ministry of Environment
Ministry of Agriculture
Ministry of Public Health
Ministry of Finance
Office of the Minister of State for Administrative Reform
Academic Sector (CNRS, Private and Public Universities)

4th Ultimate Goal: Enhance knowledge and capacity for CC adaptation in the water sector

Proposed Action: Strengthen existing human resources capabilities and capacities in the water sector

Conduct a detailed assessment of the resource needs of key agencies working in the water sector.

Enhance and streamline protocols for coordination and cooperation between public sector agencies.

Develop and maintain a focused program for technical and scientific improvement in the water sector.

Secure international accreditation for all public sector laboratory resources for improved water analysis services.

Promote public disclosure and sharing of data and key research findings with the public as well as national and regional organizations.

Ministry of Energy and Water

Acknowledgement

Work is derived from a World Bank Funded Program - Regional Coordination on Improved Water Resources Management and Capacity Building Program" (CAPWATER) - Managed by the CNRS and directed Dr. Talal Darwish

Dr. Maya Mhanna
Head of Rural Engineering Service
Ministry of Agriculture

Mainstreaming Water and Climate Change into Sectoral Policy

I. Introduction

Agriculture is recognized as the economic sector most impacted by climate change in Lebanon. The sector is directly influenced by changes in precipitation and temperature. Climate change, lack of appropriate water management, increasing urbanization and increasing demand have all resulted in severe challenges to agriculture and its future in the country (Figure 1).

Figure 1. Sprinkler irrigation of agricultural fields, Lebanon.

II. Water is One of Lebanon's Most Precious Natural Resources

Located on the eastern part of the Mediterranean, Lebanon is characterized by distinct geographical features. It occupies an area of only 10,452 km2 with two parallel mountain ranges that run north-northeast to south-southwest of the country. They are separated by the elevated upland basin of Bekaa, the main agriculture hub of the country where major economic crops of wheat, fruits and vegetables are cultivated. The main hydrological features (Figure 2) of the country are:

- Annual precipitation of 8.6 BCM
  - Loss : 50% ET
  - 12% : groundwater seepage
  - 8% : surface flows
- Net available surface and groundwater around 2.7 BCM.
- Net exploitable surface and groundwater 2.0 BCM.
- Water Resources are under stress:
  - Renewable resources 926 m3 /capita/yr, 1000 m3/capita/yr, expected to drop to 839 m3.

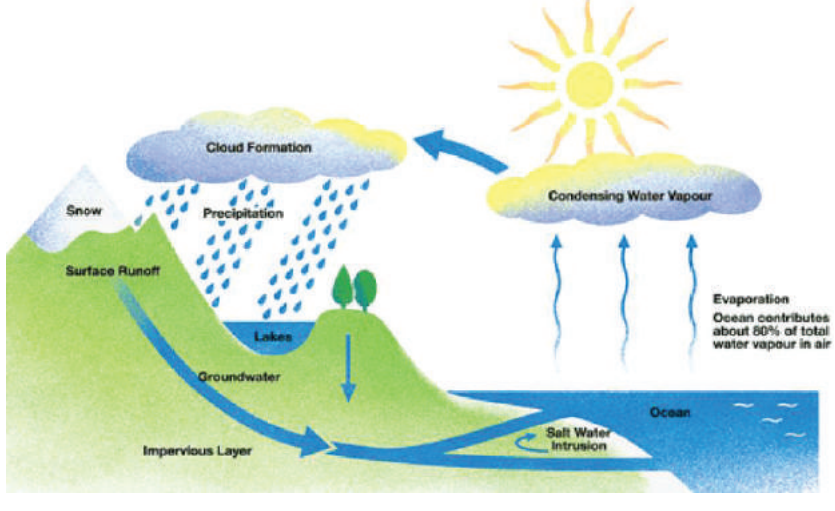


Figure 2. The hydrological cycle.

III. Challenges Facing Water Resources

The main challenges facing water resources of Lebanon are: increasing demand and consumption, quality degradation and impact of climate change.

- Increasing Distress Facing Water Resources

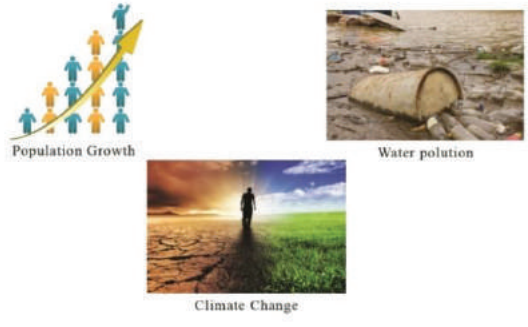


Figure 3. Challenges facing water resources of Lebanon.

a. Water consumption breakdown is difficult to determine

System Leakage >50%
Losses & Contamination

Unlicensed wells

Syrian Refugees

b. Water Withdrawal 1,473-1530Mm3/year (MoEW (2010)-WB (2009):)

Agriculture 61%

Domestic 18%

Industry 11%

c. Water consumption by sector

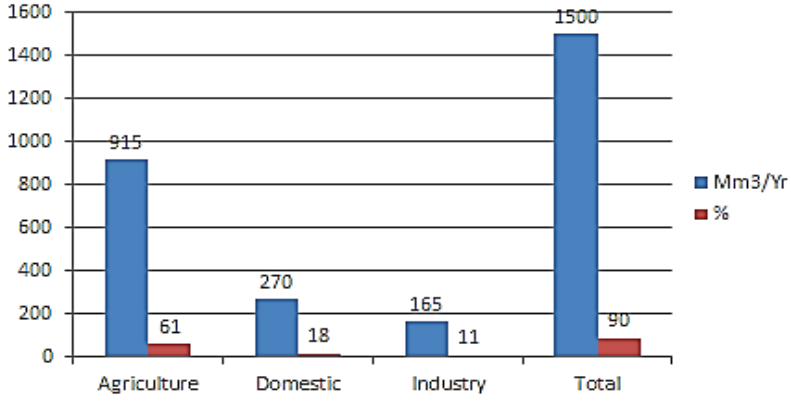


Figure 4. Water consumption

IV. Increasing Irrigated Areas in Agriculture

According to FAO, World Bank and Ministry of Agriculture census, irrigated areas in Lebanon changed with time (Table1), with Bekaa having the largest share of the total (around 28.285 %, Fig.5).

Table 1. Irrigated areas in Lebanon (1956 – 2010)

Year	Irrigated area (ha)
1956	23000
1966	54000
1970	48000
1993	87500
2000	90000
2010	112955

- Total Agricultural Area : 230 000 ha
- Total irrigated area : 112 955 ha → 49% of TAA
- Irrigation increase with the increase of the area of the property going from:

  - 38% of properties less than 2 ha are irrigated
  - 65 % of properties more than 20 ha are irrigated

Irrigated areas by Mouhafaza – Lebanon

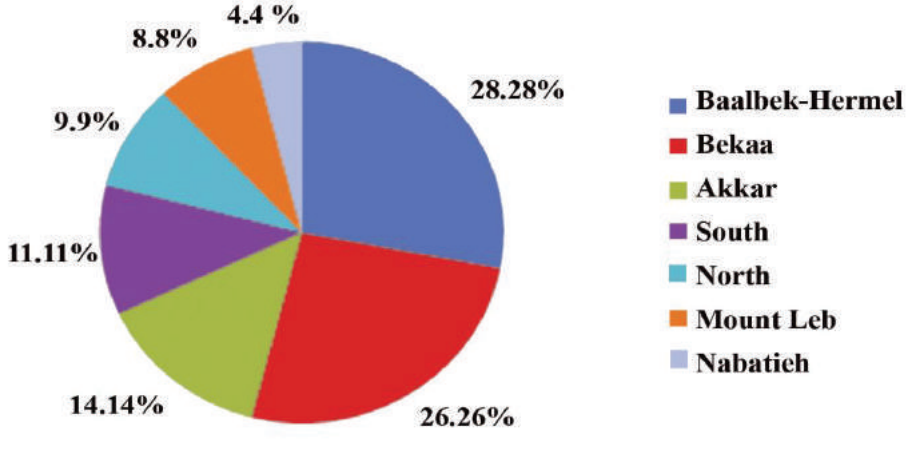


Figure 5. Shares of irrigated areas

V. Irrigated areas according to sources and Irrigation Techniques

Groundwater, surface water, hill lakes and reserves represent the most common sources for irrigation. In paralleled three major types of the techniques of the irrigation are being used, with surface irrigation still representing 50% of total.

- Irrigated areas:
  - According to the irrigation technique

  - According to different sources of irrigation

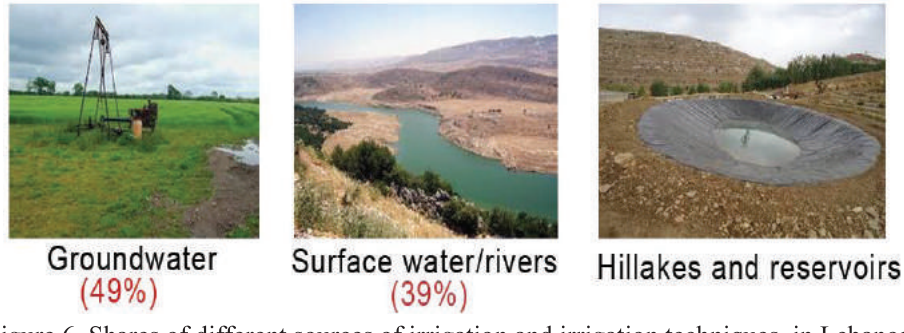
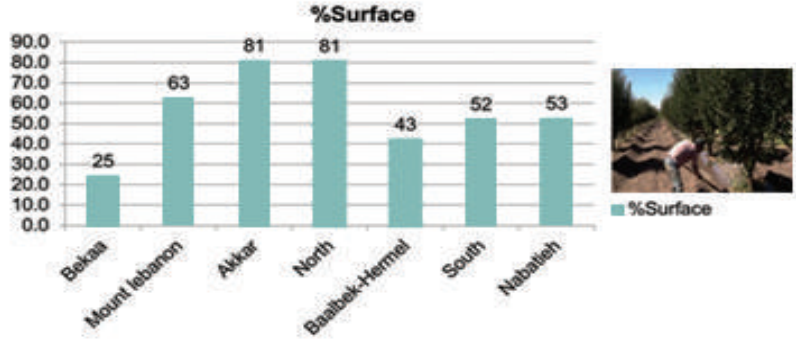
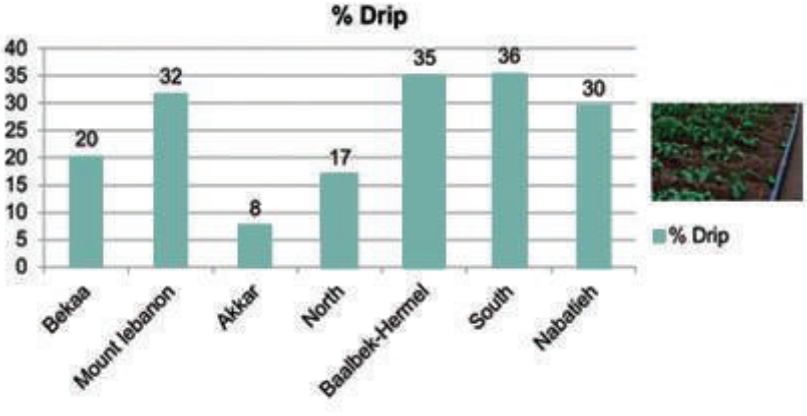


Figure 6. Shares of different sources of irrigation and irrigation techniques in Lebanon.

Surface Irrigation by Mouhafaza



Drip Irrigation by Mouhafaza



Sprinkler Irrigation by Mouhafaza

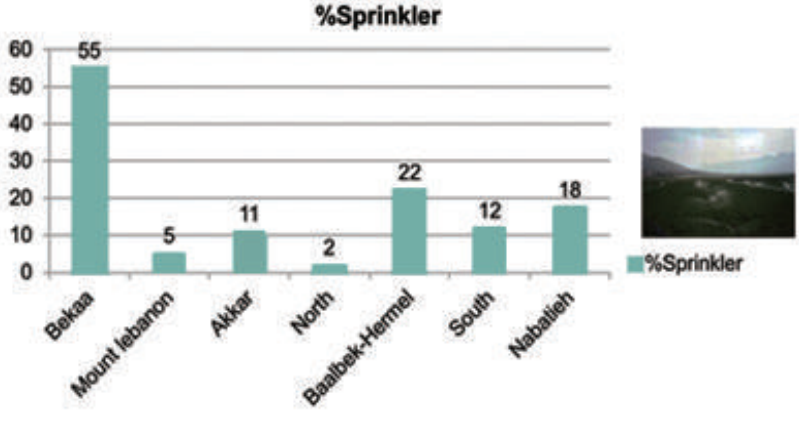


Figure 7. percentage of different irrigation techniques by mouhafaza in Lebanon.

VI. Irrigation Requirements

Irrigation requirement at country level is estimated at 1050 MCM for 113 000 ha of irrigated land (MoA,2010). It is mainly over an eight months period, with varying degrees of intensity whereby the month of July stands out as the period for highest irrigation needs. In turn it is Baalbeck – Caza that requires, irrigation most, resorting mainly to wells.

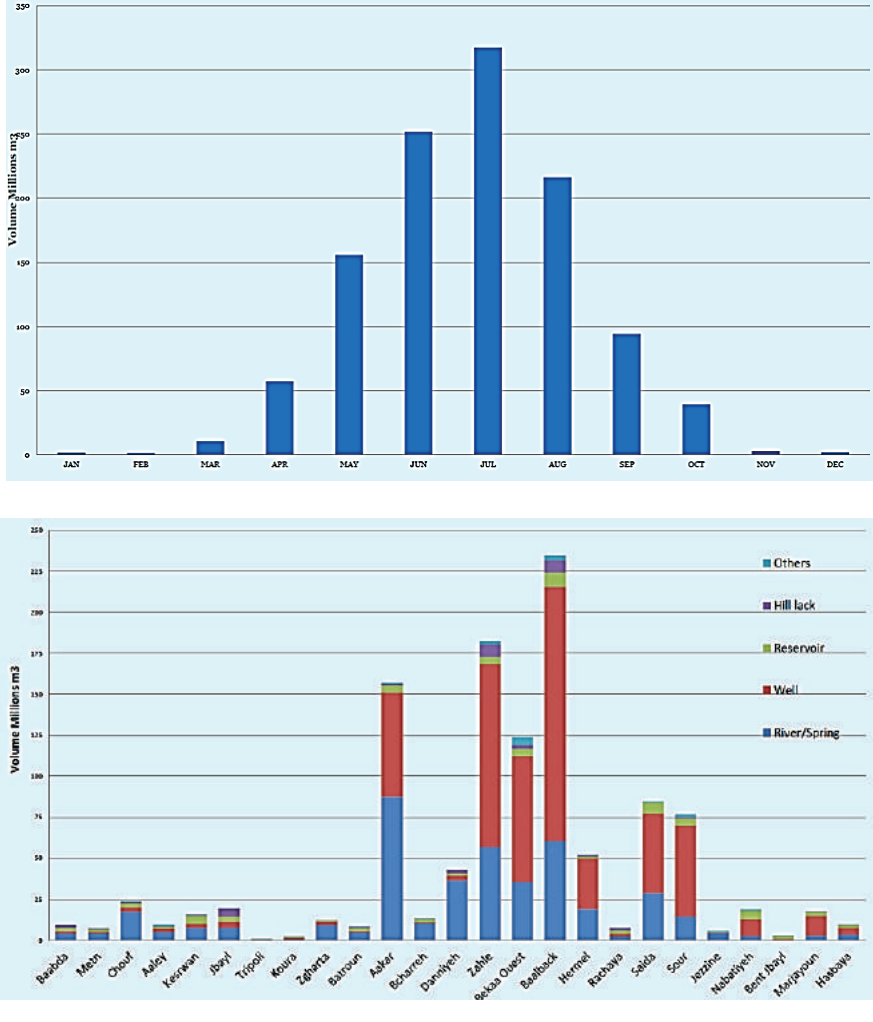


Figure 8. Monthly levels of irrigation requirements.

VII. Agricultural challenges

- Agriculture's contribution to Lebanon's GDP is small and has been dropping over the years from about 7% in 1994 to about 5.5% in 2013
- Climate change is projected to lead to decrease in water availability
- Reduction in agricultural productivity especially for the crops that depend on irrigation
- Estimation : 20 days decrease in the time dense snow cover persistence (Shaaban 2009) leading to less water, deterioration of quality and increase in salinity
- Demographic pressure and climate change are expected to cause a decrease in the production of exportable crops mainly Citrus crops, Banana, Apple, and Potato.
- Irrigation needs are highly compromised with decreased water supply due to water shortage in the future.
- Current trends in population growth will exert pressure on agricultural production. The higher demand for food will lead to the usage of more intensive agricultural practices, characterized by the increase in the use of water for irrigation (MoE 2011).
- Projections up to 2030 show that the estimated need for irrigation water lies at 1,600 Mm3 (CDR, 2005).
- Ministry of Environment estimates that by the year 2015, only 60% of water resources will be left to agricultural use (as compared to 74% in 1994). Water withdrawal figures for 2005 show that the share of agriculture had already dropped below 60% (FAO, 2010).
- Surface irrigation still widely used mainly in small plots areas:
  - High investment cost irrigation systems
  - Lack of knowledge

- Groundwater represents 49% of irrigation water source. An increasing practice due to increasing demand and decreasing supply.
- Waste Water is widely used in uncontrolled manner in irrigation.
- High running cost in irrigation is due to fuel consumption, especially that most agricultural areas are not connected to the grid.
- Irrigation consumption is not measured due to:
  - Leakage in networks
  - Unlicensed and not monitored wells

VIII. Ministry of Agriculture Actions to Improve Irrigation Sector

In response to the increasing challenges, MoA has undertaken several actions to improve the irrigation sector and reduce pressure on fresh water. The following projects may provide an overview of to date most important, implemented projects

8.1 Renewable energy (RE) projects

Three solar systems have been installed by MoA to pump water and use it for irrigation:

- Deir el Ahmar Nursery (15 du, pumping depth 250 m)
- Hammana Nursery (8 du, centrifugal pump from reservoir)
- Kfardebian Druit Trees Plot (15 du, pumping depth 80 m)

Moreover, a study within GRE.NE.CO project was undertaken describing use of RE in agriculture sector in Lebanon

Figure 9. Solar pumping projects in Lebanon.

8.2 Wastewater Treatment Projects

To reduce pressure on fresh water, 3 projects using treated wastewater (Figure 10) are or have been implemented within Ministry of Agriculture:

- TCP with FAO: At the end of this project, Guidelines for the use of Treated Waste Water in Lebanon were issued
- Coping with water scarcity (MoA/LARI/MoEW and FAO). This project included:
  a. Transmitting treated water from Ablah treatment plant
  b. Running capacity 600-700 m^3/day and full capacity 12000 m^3/day
  c. Irrigating at 1st phase 220 du in Iaat (forage maize, Wheat, barley, forest trees (Populus), using drip irrigation on 30 du)
- ACCBAT project (EU/MoA)
  a. Transmitting treated water from Ablah treatment plant
  b. Running capacity 800 m^3/day and full capacity 2000 m^3/day
  c. Irrigating at 1st phase 15 dun of vineyards in Ablah
  d. A collection reservoir of a capacity of 15000 m^3 is being constructed to collect water from the treatment plant

Figure 10. Wastewater treatment project in Lebanon

8.3 Extension and trainings

Within its program, MoA is regularly conducting trainings to:

Farmers on:

- New pressurized irrigation techniques
- Irrigation schedule
- Safe use of waste water in agriculture

Technicians and professionals (in collaboration with EU organizations:

- Regulated deficit irrigation
- Non-conventional source of irrigation (treated waste water)

Figure 11. MoA Training programs

8.4 Subsidies to the farmers

In accordance with its objective to reduce the costs on farmers and encourage them to shift to water savings irrigation techniques:

- MoA distributed In 2013 irrigation equipment for free to a number of fruit trees growers
- Accordingly at least 30% of the beneficiaries shifted from surface to pressurized irrigation networks

IX. Ministry of Agriculture Strategy 2015-2019

Within the framework of MoA Strategy 2015-2019 different strategic axes were determined to promote the irrigation sector in Lebanon.

- Technical and demonstrative brochures addressed to farmers
  - Irrigation techniques of fruit trees and vegetables
  - Irrigation schedule and Water Requirements
- Training for a sustainable irrigation will continue in all Mouhafazas for farmers and professionals
- Shift the irrigation scheme of 1 000 ha/year from surface irrigation to pressurized irrigation, by subsidizing the irrigation materials at 50% of their initial cost

- Establish committee for Treated Waste Water use in Irrigation that gathers stakeholders to promote and legalize the use of TWW in irrigation
- Renewable Energy in Agriculture
  - Economic study on the use of RE in Agriculture is undertaken
  - 8 demonstration plots, using RE in agriculture (Bekaa, Nabatieh and Mount Lebanon) are under preparation

X. Recommendations

- improve irrigation efficiency of existing and planned irrigation schemes
- optimize farm irrigation techniques.
- Adopt government plans for the development of the irrigation sector
- Increase irrigated areas in line with government policies.
- Promote the management of small scheme network through the establishment of WUA.
- Protect ground and surface water from pollution
- Choose planting varieties resistant to drought and high temperature
- Adjust planting dates
- Shift planting location

Session III

Mr. George Awad
Programme Officer
UNESCO Beirut office

Challenges Associated with Water Scarcity

I. Introduction

For several countries, water scarcity represents the most pressing challenge to human development and economic growth at large. Water lies at the heart of sustainable development as it provides a vast range of services that play vital role in poverty eradication, economic growth, environmental sustainability and improvements in social well-being and livelihoods of billions of people around the world. Although the amount of fresh water on Earth is adequate to meet the needs of the world, its uneven distribution both in time and space and lack of its sustainable management makes it the most vulnerable resource to natural and man-induced impacts. Water scarcity occurs when demand for water cannot be fully satisfied. Climate change can severely exacerbate this condition in arid and semi-arid areas like most of the Arabic countries which are water-stressed. Thus, it is critical to address, in an integrated manner, the various aspects of water scarcity and the relevant policies and strategies to cope with it.

II. Some of the 21st Century key challenges

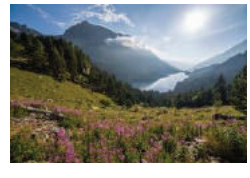
85% of the human population live in arid and semi arid areas

6-8 million human beings are killed each year from water-related disasters & diseases

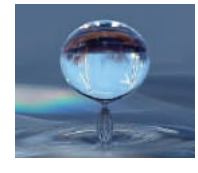
750 million people lack access to safe water and 2.5 billion to adequate sanitation

Almost 85% of the world's total wastewater is discharged without adequate or any treatment

In just thirty years, freshwater populations species declined by 50%



145 nations have transboundary river basins and there are 650 transboundary aquifers shared by 2-4 countries



Nearly 80% of the world's population are exposed to high levels of threat to water security

- IPCC's Fifth Assessment Report on Impacts, Adaptation and Vulnerability (AR5) 2014; ***Water Security is at risk***

III. Key risks at the global scale

- Of the global cost of water-sector adaptation, most (near 85%) is occurring in developing countries where there are many opportunities for anticipatory adaptation.
- Barriers to adaptation include:
  a. lack of human and institutional capacity
  b. lack of financial resources
  c. lack of awareness
  d. lack of communication
- AR5 IPCC (2014)

IV. How should Water Management be Modified in the Face of Climate Change?

		
RESEARCH AND INNOVATION Long-term planning (over several decades) is needed for a future that is highly uncertain	**EDUCATION** A flexible portfolio of low regret solutions producing benefits regardless of the impacts of climate change	**AWARENESS RAISING** Use current available experience on adapting policies and practices to the weather

V. Water Security: Responses to Local, Regional & Global Challenges

- New eight-year Medium-term Strategy of UNESCO (2014-2021) of 6 Themes and 3 Axes for the International Hydrological Program phase eight (IHP-VIII) was prepared. IHP-VIII aims to improve water security in response to local, regional, and global challenges. It also aims to improve knowledge and innovation to address water security challenges applying IWRM principles.

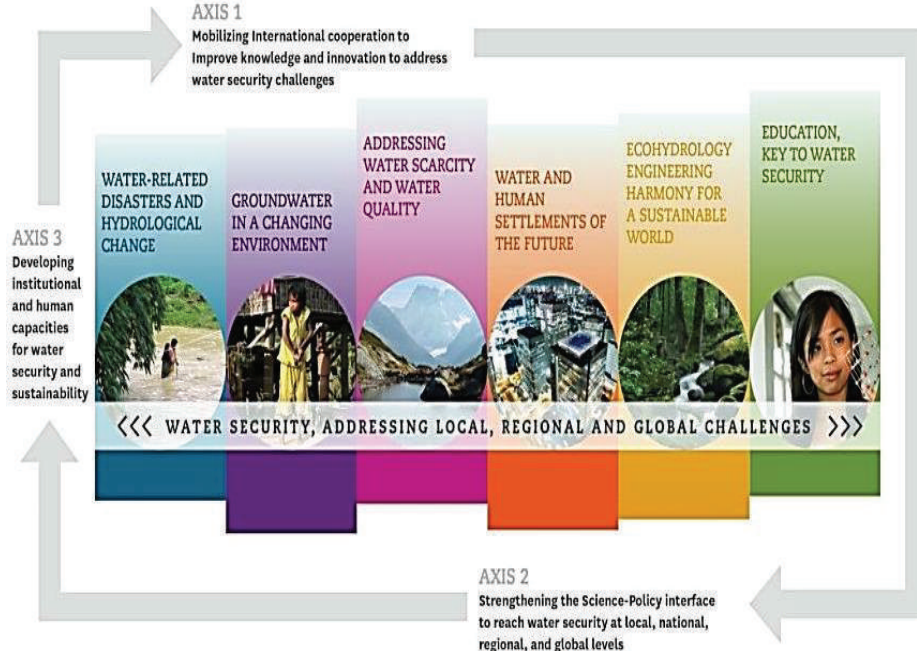


Figure 1: New eight-year Medium-term Strategy of UNESCO (2014-2021) for the International Hydrological Programme.

5.1 New eight year medium-term strategy

Theme 3: Addressing Water Scarcity and Quality

a. Challenges

Significant future reduction of renewable water in quantity, quality and reliability terms

Energy and Food security at risk because of lack of water & increased water demand

Competition among uses and users, exacerbated at the local, regional and global levels

b. Focal Areas

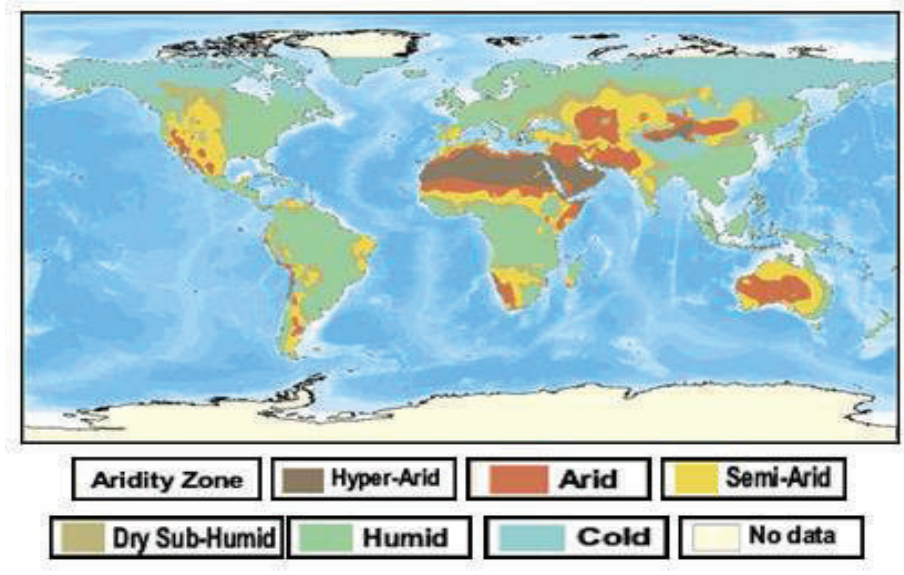


- Improving management, allocation, and efficient use of water resources
- Dealing with present water scarcity and developing foresight to prevent undesirable trends
- Promoting tools for stakeholders involvement and awareness, and conflict resolution
- Addressing water quality and pollution issues within an IWRM framework (legal, policy, institutional and human capacity)
- Promoting Innovative tools for safety of water supplies and controlling pollution

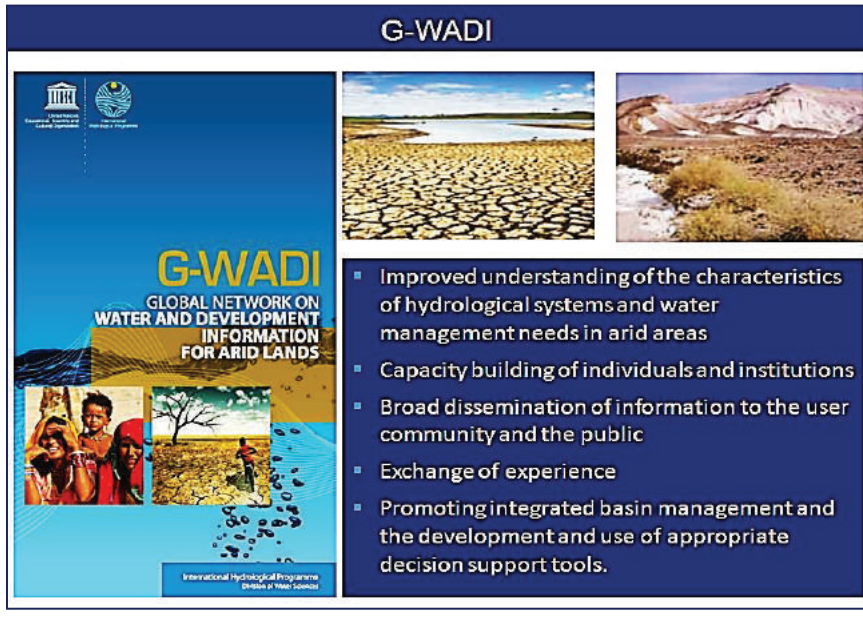
c. IHP related Projects

1. UNESCO-IHP International Initiative on Water Quality (IIWQ)
2. Global Network on Water and Development Information for Arid Lands (G-WADI) (Figures 2,3,4)
3. International Drought Initiative (IDI)
4. UNESCO Project on Emerging Pollutants in Water and Wastewater

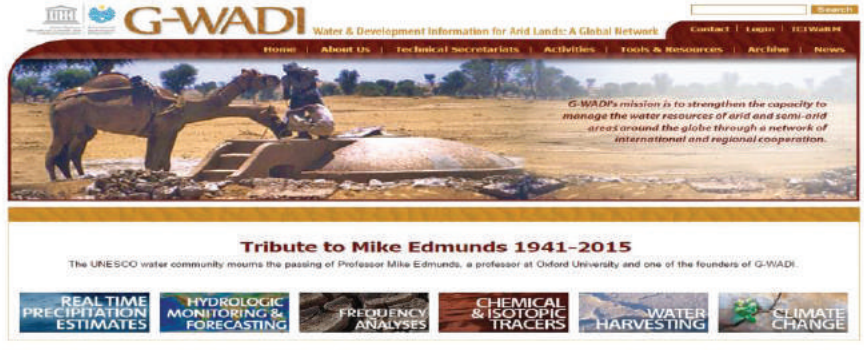
The arid and semi-arid Regions of the World



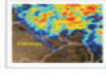
VI. The Global Network on Water and Development Information for Arid Lands (G-WADI)



G-WADI Website



News & Recent Events



Namibia Uses IHP-supported G-WADI's Precipitation Estimates in their Daily Flood Bulletin

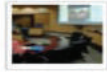
2016-02-15

All of Namibia's perennial rivers are border rivers and have their origin outside of the country. In the northeast, the Kunene,...

RainMapper – A New Mobile Device Application for Real-time Global Precipitation Monitoring

2015-11-12

The cohort of UNESCO's International Hydrological Program (IHP) and the Center for Hydrometeorology and Remote Sensing (CHRS,...



CHRS experts train on the use of the PERSIANN Satellite Rainfall Product in Bangkok, Thailand.

2015-11-06

Experts from the Center for Hydrometeorology & Remote Sensing (CHRS), at the University of California Irvine, participate in a...

The Latin American Drought and Flood Monitor Launched

2015-11-05

In November 2014, the Latin American and Caribbean Flood and Drought Monitor was launched to identify current and future...

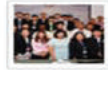
See all news & announcements >>

News & Recent Events

New brochures available for 'Latin American Flood and Drought Monitor' and 'Latin American and Caribbean Drought Atlas'

2015-09-30

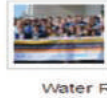
Following up with the development of the Latin American Flood and Drought Monitor...



Technical training session on PERSIANN held during Thai Hydrologist Association's (THA) 2015 conference

2015-01-29

About 50 water scientists and engineers attended a technical training session on "Satellite-based Rainfall (...



Expert Symposium "Coping with Droughts" and Flood and Drought Monitor for Latin America and the Caribbean workshop in Santiago de Chile

2014-11-19

As part of the GWADI Network and in the setting of the Project "Managing Water Resources in Arid and semi-Arid Regions of Latin...

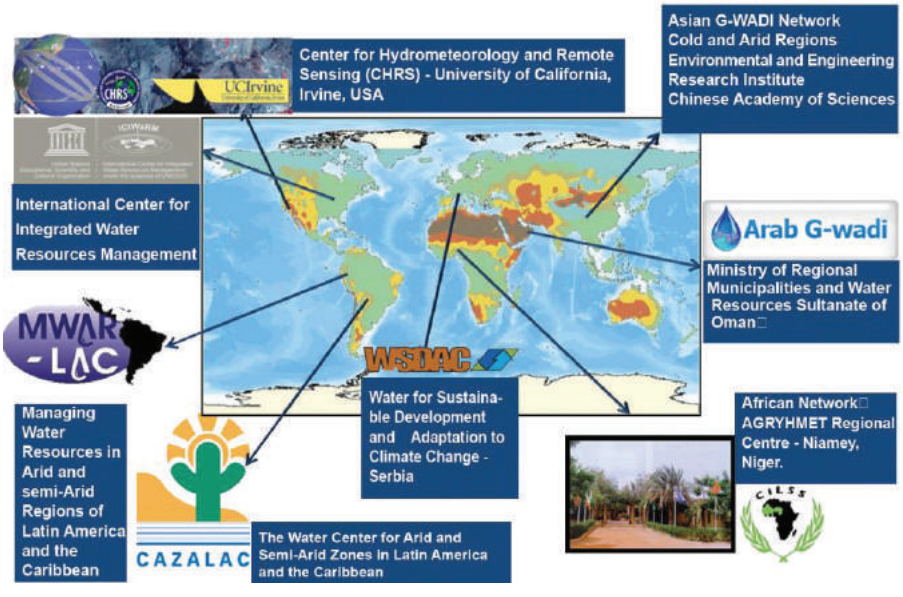
ICIWARM Deputy Director strengthens ties with Oman Water resources authorities and supports the Arab GWADI regional network.

2014-10-16

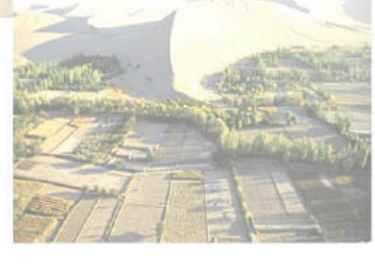
ICIWaRM Deputy Director Dr. Will Logan participated in the Water Sciences and Technology Association's (WSTA) 11th Gulf Water...

http://www.gwadi.org/

G-WADI Networks



G-WADI Networks

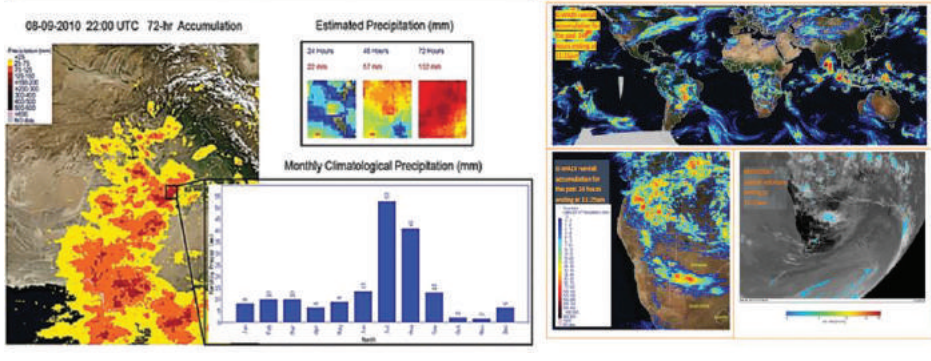


G-WADI geoserver application in Namibia anf Pakistan

Namibia Hydrological Services
Private Bag 13184
Ministry of Agriculture, Water and Forestry
Government Office Park
Namibia

Enquiries:
Ms Pauline Mufeti
Tel :(+264) 61 208 7191
Fax :(+264) 61 208 7256
Email: MufetiP@mawf.gov.na &
hydrologynamibia@gmail.com

HYDROLOGICAL SERVICES NAMIBIA- DAILY FLOOD/ HYDROLOGICAL DROUGHT BULLETIN: 07 DECEMBER 2013

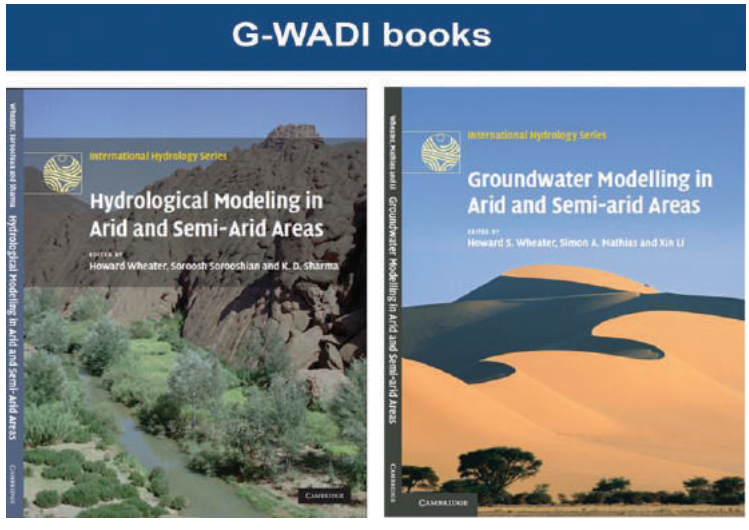


African G-WADI Secretariat

The experts group is composed of representatives of ICPAC, AGRHYMET, SADC, UCAD and UNESCO, and is chaired by Prof. Cheikh Gaye from UCAD.

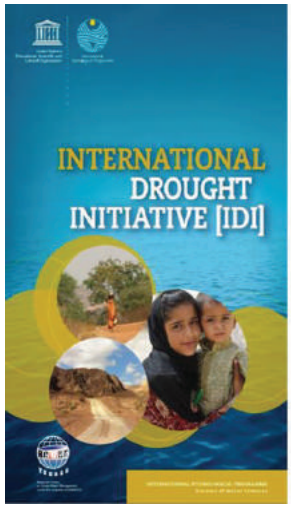
African G-WADI maintains a training work-shop on the Drought Monitor of Princeton University/AGRHYMET

http://www.agrhymet.ne/eng/



VII. International Drought Initiative (IDI)

IDI provides a platform of global networking and knowledge sharing between international entities actively working on droughts (as UNESCO Category II centers and water chairs, WMO, WWC, FAO, UNDP, ISDR and GWP).



Launched in 2010 at the 19th Session of the Intergovernmental Council (Iran proposal) is hosted at the Regional Centre on Urban Water Management (RCUWM) in Teheran.

7.1 Functions:

- Surveys drought management
- collects information
- helps affected countries
- develops capacity building
- strengthens public participation and,
- promotes regional and international cooperation on drought issues

Figure 5: Intergovernmental Council of the (IHP) of UNESCO held its 20th session from 4 to 7 June 2012 at UNESCO Headquarters, Paris.

7.2 IDI - Strategic Activities

a. Training and capacity building

- Public awareness
- Technical trainings
- Providing scientific and technical information
- Holding international and regional conferences

b. Research

- Identifying gaps and future requirements between developed and developing countries in relation to drought
- Compiling a document entitled as “International and National Policies and Visions in the Field of Drought”
- Provide a literature review on drought management issues

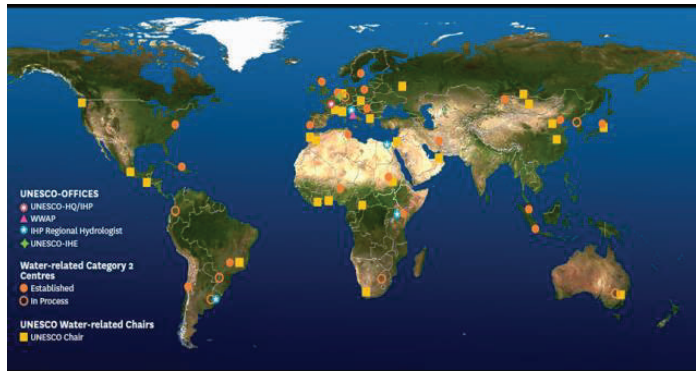
c. Data/information networking

- Contributing to the existing data bases in the field of drought at national, regional and international levels
- Collecting and documenting information on early warning systems
- Preparing and compiling a World Report on Drought Management (WRDM)

d. Tools

- Preparing and recommending policies and strategies to drought management.
- Developing procedures for addressing environmental conflicts.
- Providing effective strategies for drought risk reduction and response measures.

The UNESCO Water Network



27 centres approuvés, 22 accords signés (établis)
5 nouveaux centres en cours de création
30 chaires relatives de l'eau

Ms. Mona Fakih
Director of Water
Ministry of Energy and Water

Water Governance

I. Introduction

Water scarcity is one of the main problems currently facing the country.

The current situation indicates:

- Limited Water Resources, with additional stress exacerbated further from the consequences of climate change and of mass population movements
- Increase in water demand across sectors, Irrigation is a high water consuming
- Inadequate water supply systems and water use
- Environmental dilemma
  - Pollution of water resources
- Lack of Data quantification and qualification of surface and ground water resources inadequate development of management and planning practices

II. Ministry of Energy and Water (MoEW) & Integrated Water Management (IWRM) Planning in Lebanon

MEW has been engaged in several initiatives mainly aiming at:

- Strengthening National Policies and Strategies of IWRM
- Improving knowledge of water resources, their uses and governance
- Strengthening administrative, legal, financial and technical capacity of the various organizations of the water sector

2.1 Progress & Achievements

- IWRM concepts and approaches have been introduced in Lebanon in the late 90s and have inspired:
  - Gathering political will and support for IWRM and the planning process;
  - Creating a framework for broad stakeholder participation
- Revision of water Legislation (2000) and its amendment (2001)
- A national 10-year Strategy Plan for the Water Sector, in line with IWRM principles, has been prepared by GDHER / MEW (2000-2010) and endorsed by the Parliament
- National Water Sector Strategy (NWSS) (approved March 2012).
- MED EUWI Country Policy Dialogue on IWRM in Lebanon (Phase I - concluded in 2009). Review of the 10 Year Strategy Plan for Water, including the promotion of consultations and dialogue with relevant stakeholders (Phase II 2010-2012)
- The development of the Water Code, through a cooperation programme between the Lebanese and the French Government. It aims to tackle and recommend provisions for the implementation of sustainable management of water resources following a comprehensive and integrated framework for governance, institutional and management issues. The Water

Code has been submitted to the Council of Ministers for approval

- Creation of «de Centre d'Information et de Formation aux Métiers de L'eau C.I.F.M.E au Liban ». The center has, to date, made the following achievements.

2.2 Information Component

- This center has been labeled by UfMon 7th of April by a unanimous decision of 43 Member Countries of the Union, under project: "Towards a Mediterranean Knowledge Platform on Water"
- A preliminary study of a National Information system for Lebanon has been conducted by EMWIS, and Status report with proposed action plan was issued

2.3 Training Component:

- A feasibility study has been recently implemented by OIEau and Funded by AfD

III. National and Regional Needs

- Ameliorating the knowledge about the water resources, uses and aquatic ecosystems
- Developing the necessary research for best governance
- Reinforcing Capacity building, Administrative juridical, financial and technical for all the stakeholders
- Providing equitable and sustainable use of available resources

IV. The National IWRM plan for Lebanon

The MEW IWRM plan for Lebanon (figure1) makes use of the Stockholm Environment Institute (SEI) Water Evaluation and Planning (WEAP) system.

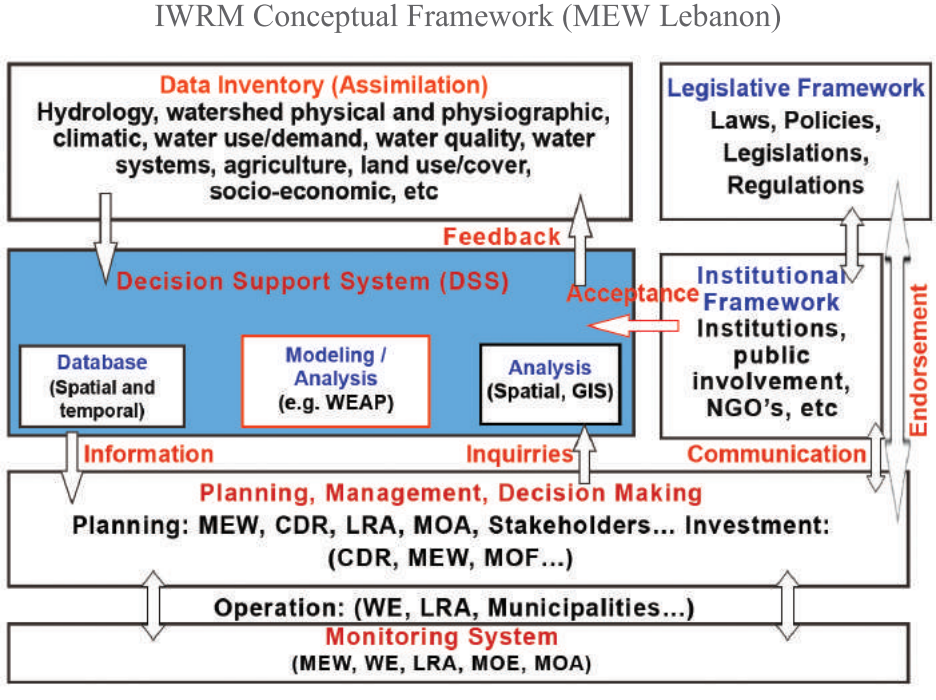


Figure 1. IWRM conceptual framework

WEAP is a generalized water resources software that provides flexible user-friendly interface to build custom applications. A Decision Support System tool will be developed for:

- Integrated : Hydrology with priority-based demand allocation
- Comprehensive: Can include equity, environmental constraints, financial Aspects, water quality and other aspects
- Cross-Scale: From a single house to a city to a river basin (figure2)

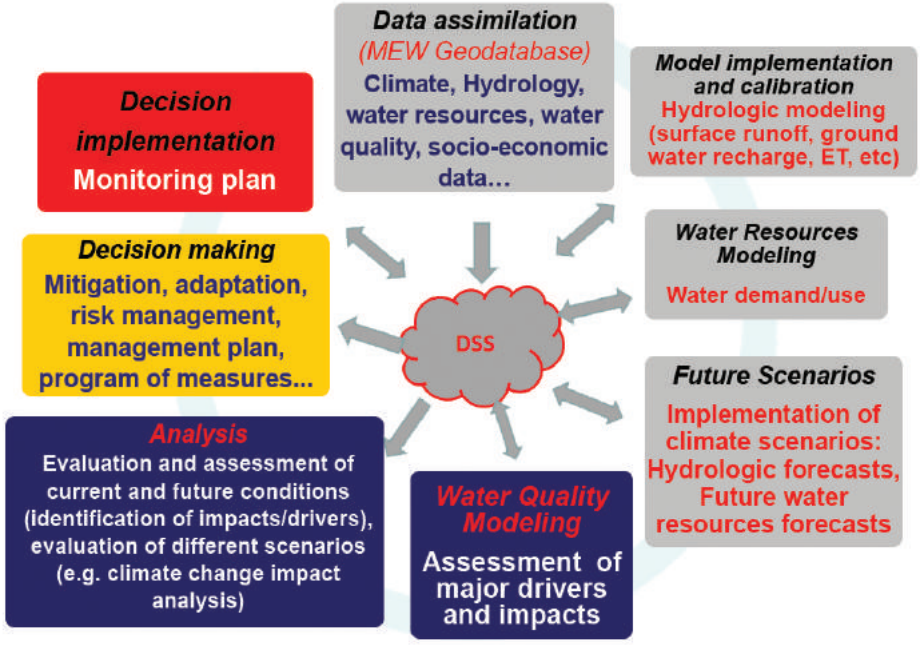


Figure 2. Decision Support System of IWRM

WEAP allows running different scenarios (including climate change scenarios) and calculate the socio-economic and environmental impacts of such scenarios.

V. General Objectives of the National Strategy for Water Sector

- Improve knowledge about Water Resources and their use for ensuring good Water Governance, including adaptation to Climate Change
- Train field workers in the use of innovative technologies to improve water use efficiency, demand Management, mobilize new resources and protect the environment and the ecosystems
- Develop a sub-regional center of excellence, making other countries benefit of the experience acquired in training and

information systems, as well as facilitating their access to the outstanding educational facilities of the Centre (Figure 3)

Figure 3. Centre « d'Information et de Formation aux Métiers de l'Eau » C.I.F.M.E au Liban.

- Ameliorating the knowledge about the water resources and their uses referred to as «Information Component»
- Capacity building of the relevant stakeholders working on how to use and adopt the best innovative technologies referred to as " Training Component"

VI. Specific Objectives of Information Component of National Strategy

- Implementation of a national information system on water that is coherent with the Mediterranean strategy
- Evaluation and monitoring of the water sector at the regional level of the various countries through the establishment of:
  a. Database for the Water Resources and their uses
  b. Pertinent documentation related to water sector, through the support of universities and research centers

Information Component – Principles

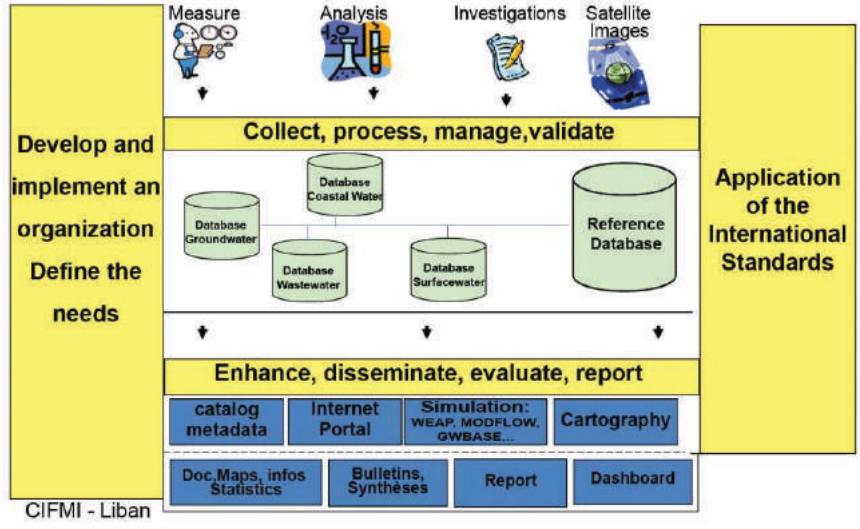


Figure 4. Principles of the "Information Component" of National strategy.

Overview of NWIS and sub-systems overall architecture with the main stakeholders

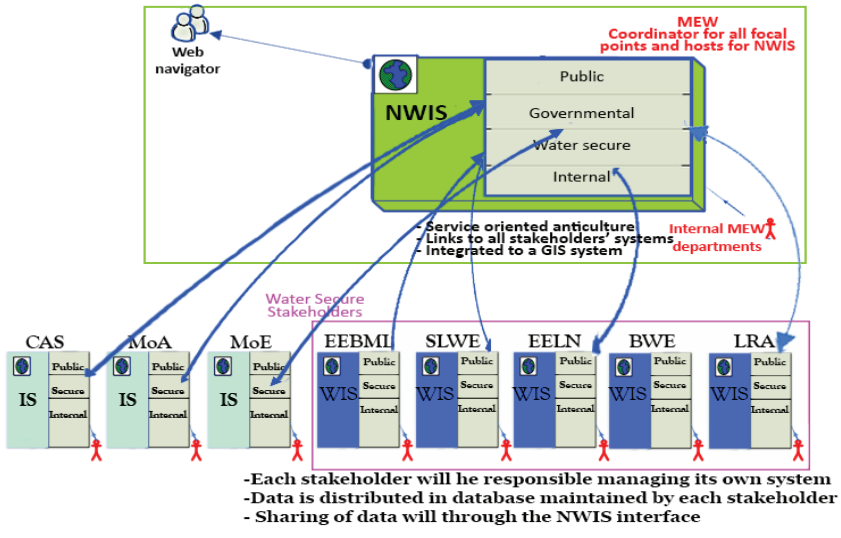


Figure 5. Overview of NWIS and sub-systems overall architecture with the main stakeholders.

MoEW Achievements to be integrated in the National Information Component of the centre when constructed and be operational.

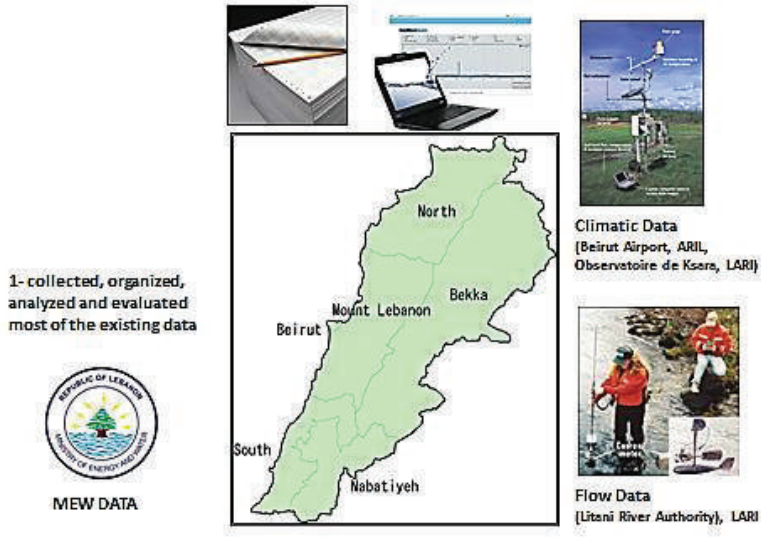


Figure 6. Data collection and management for the *National Information Component*

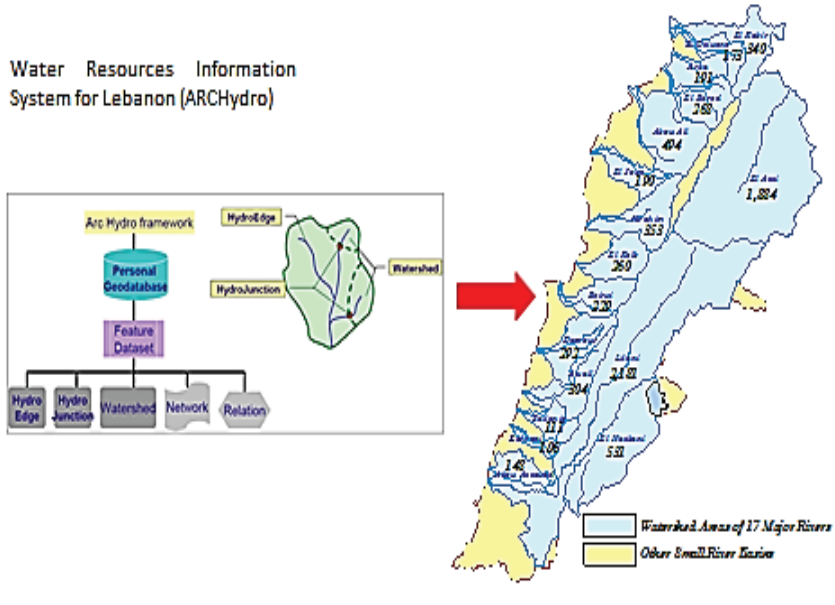


Figure 7. Water Resources Information System for Lebanon (ARCHydro).

From data to Information(IWRM Indicators)

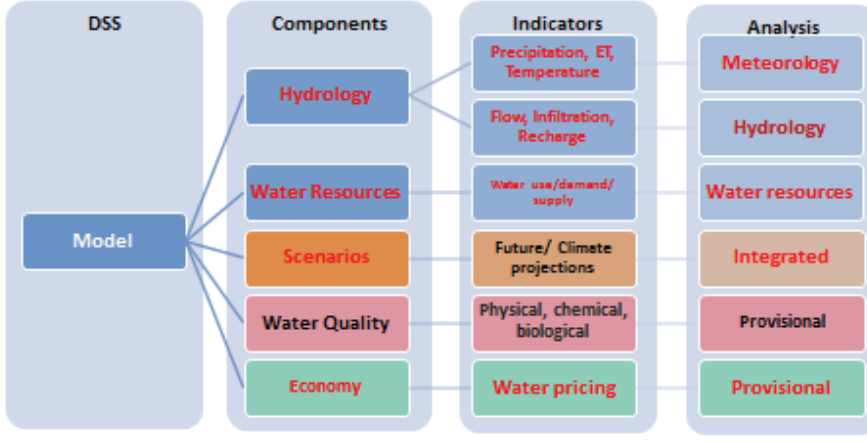
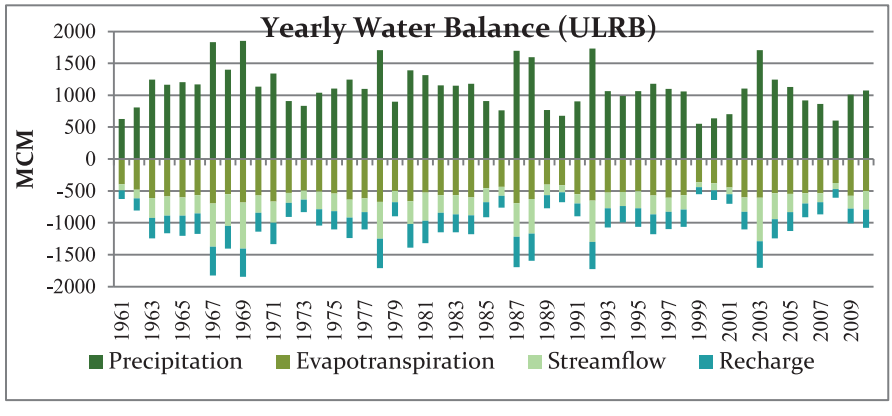
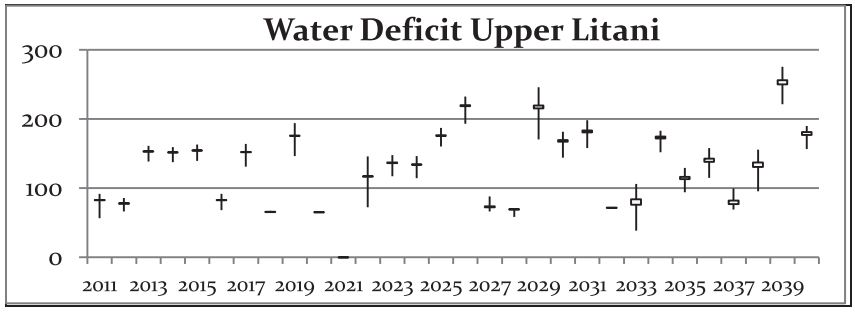
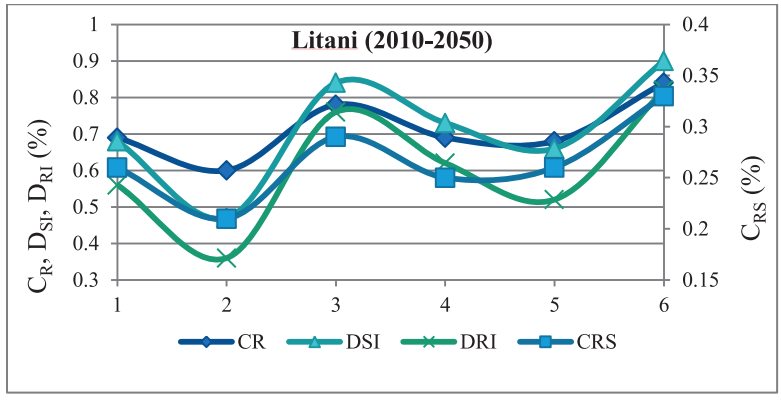


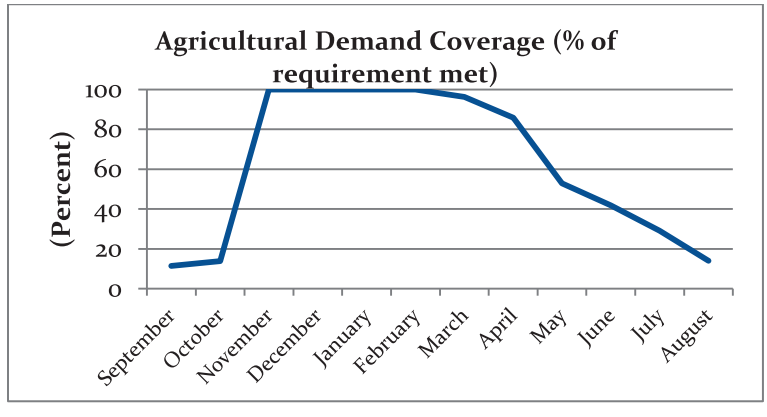
Figure 8. Data flow and indicators of IWRM

Indicators









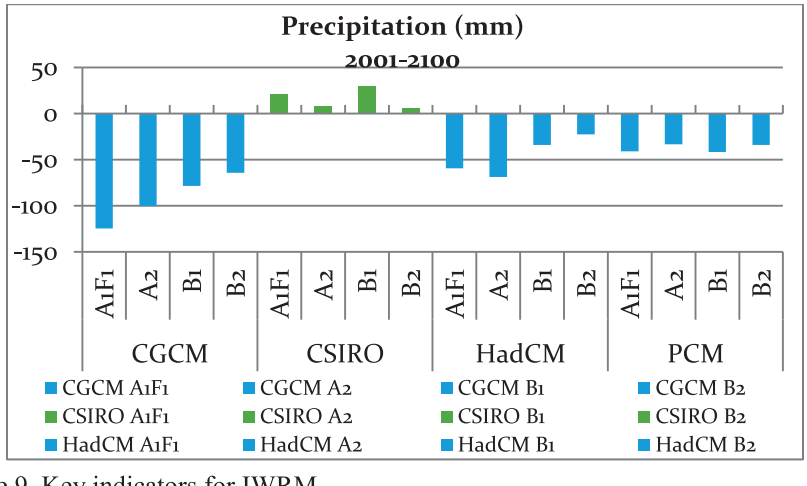


Figure 9. Key indicators for IWRM

VII.The Training Component of the National Strategy

7.1 Specific Objectives

- Responding to the training needs of staff members, targeting Water Sector at all levels of responsibilities, management, governance, and technical.
  - Governmental Institutions
  - Local Authorities
  - Private sector and Associations
- Dealing with thematic coverage: management, operation and maintenance of drinking water, collection and treatment of sewage and irrigation.
- Creating water awareness, mainly among farmers for best practices regarding preserving water resources
- Providing knowledge on Integrated Water Resources Management and good Water Governance,
- Empowering with technical and administrative skills, necessary for the design, study and monitoring of projects' implementation.
- Initiating training platforms, networks and pilot stations, as well as various equipment and tools enabling it to conduct trainings with a strong focus on job learning and on acquiring skills that can be directly applied.
- Once the educational facilities (including information technologies) are available for other countries of the region.
- Setting up a priority training program to meet immediate needs in terms of water demand management and use of non-conventional water resources. It mainly targets the heads of concerned departments with the objective to let them know about the existing solutions and innovations, the conditions for making them operational, the necessary accompanying measures, the costs, etc….

7.2 Proposed Instruments

- Training staff
- Infrastructures: Building and Open Platforms:
  - Administration &Management, lecturing rooms,
  - Technical and external platforms buildings with equipment and workshops for practical work.

7.3 Infrastructure and educational systems and tools:

- Training platforms, networks and pilot stations,, etc.
- Materials and tools for learning and acquisition of direct operational skills.

7.4 Implementation Stages

- Study detailed design
  - Juridical status of the centre
  - Functional and technical specifications
  - Cooperation Agreements
- Construction
  - Building, plat forms techniques

- Equipment, software, models, IT
- Monitoring
- Training

• Start Operating

7.5 Funding

• Overall Budget: about 11,54 M€
  - Infrastructure and Equipments for the center,
  - Operation over 3 years
• Contribution from the Lebanese Government:
  - Piece of Land (7 000 m2)
  - 4 Billion of Lebanese pound(2 M€) => for the construction of the Building
• Support from France
  - Feasibility study has been done by OIEau, funded by (AfD)

Still need searching for Funds from International organizations: European Commission, Spanish and Italian cooperation,, USAID….

Dr. Bruce McCarl
Distinguished Professor of Agricultural Economics
Texas A&M University
Nobel Prize Recipient 2007

Water Scarcity Forces and influences on Management and Governance

I. Introduction

An Economist's view on when Governance Change is needed to address water scarcity

- Generally we think of a market failure when there are very different use values for water on behalf of different users, and when there is no way for high valued users to get low valued users to trade water
- We also think that we would raise efficiency if we could reflect true value of water on use decisions
- We believe in induced innovation in that high differentials in water use

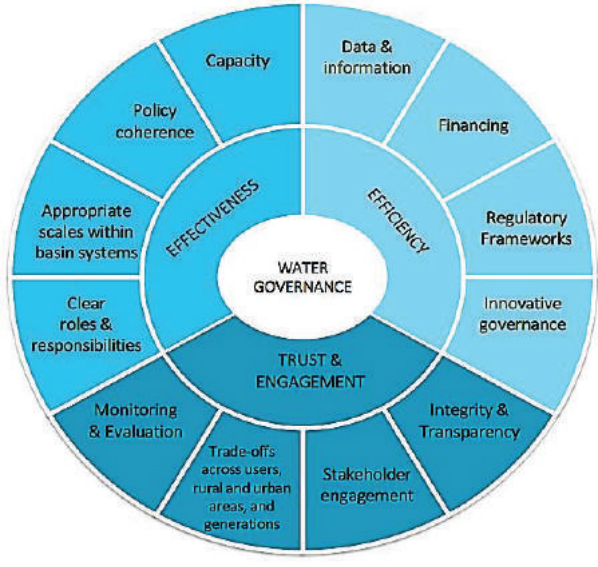


Figure 1. Overview of OECD principles on water governance

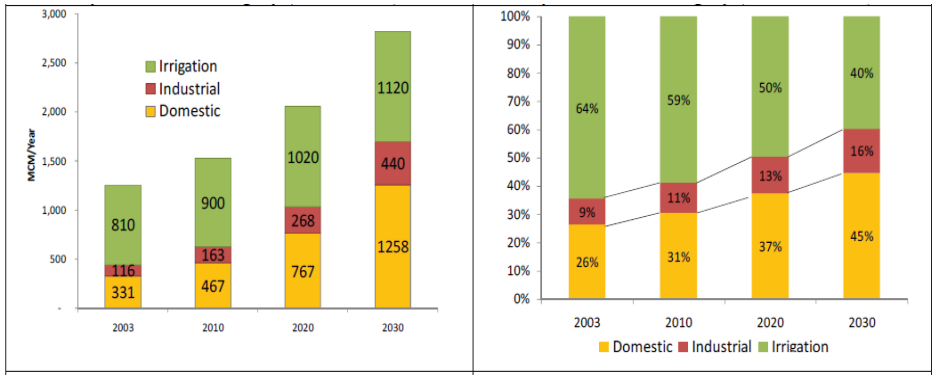
II. Scarcity Forces are Rising

2.1 Lebanon Water Demand

Population Growth – food and water demands

Annual Water Demand, 2003-2030 by Water Use Category

(MCM/Year) **(Share of Total)**



Source: World Bank 2003. MCM = million m3

Source: World Bank 2003.

Figure 2: Lebanon: Water Demand

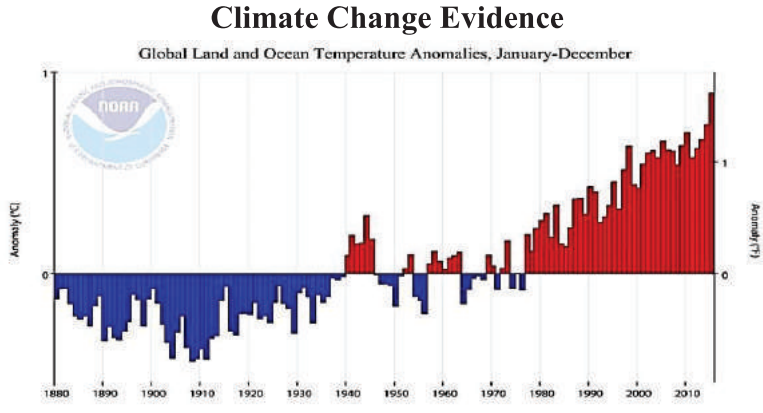


Figure 3: Global Land and Ocean Temperature Anomalies, January-December
http://www.ncdc.noaa.gov/cag/time-series/global/globe/land_ocean/ytd/12/1880-2015

The NOAA State of the Climate report the following:

- 2014 was the warmest since records began in 1880
- temperature was 0.69°C (1.24°F) above 20th century average
- 38th consecutive year that the global temperature was above historic average
- 14 of the 15 warmest in 135-year record occurred in 21st century
- 1998 is the other one

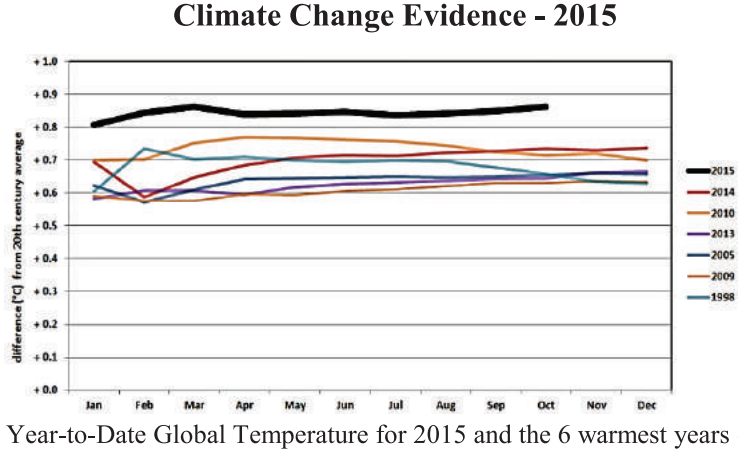


Figure 4: Year-to-Date Global Temperature for 2015 and the 6 warmest years on record

2.2 US water governance and water scarcity:

- There are separate regimes for surface and ground water
  - Surface water:
    - Riparian; use what is available
    - Appropriative; first in time is first in right
    - Appropriative and tradeable markets
    - Cooperative and participative
  - Ground water:
    - Right to all water under property
    - Groundwater associations
    - Some limits
    - Some tradable permits

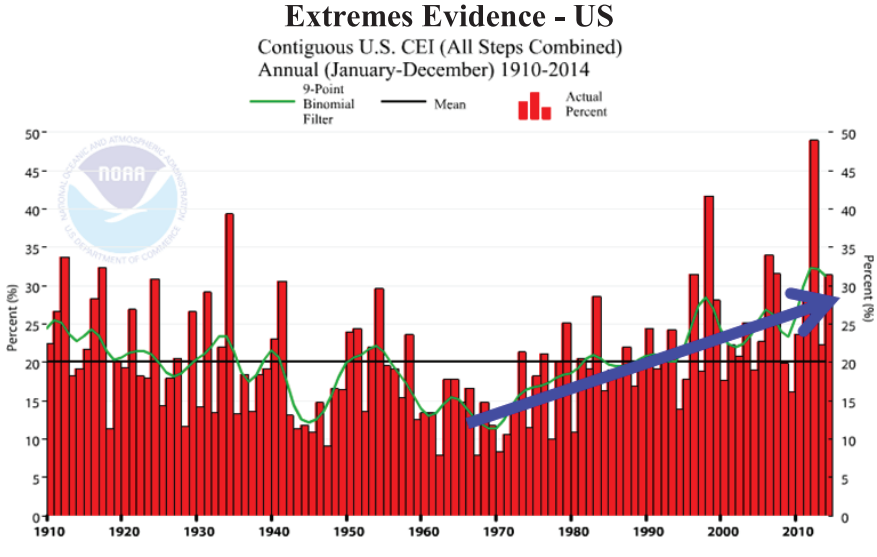


Figure 5.

We see an increase in events and variability since about 1970 when warming began

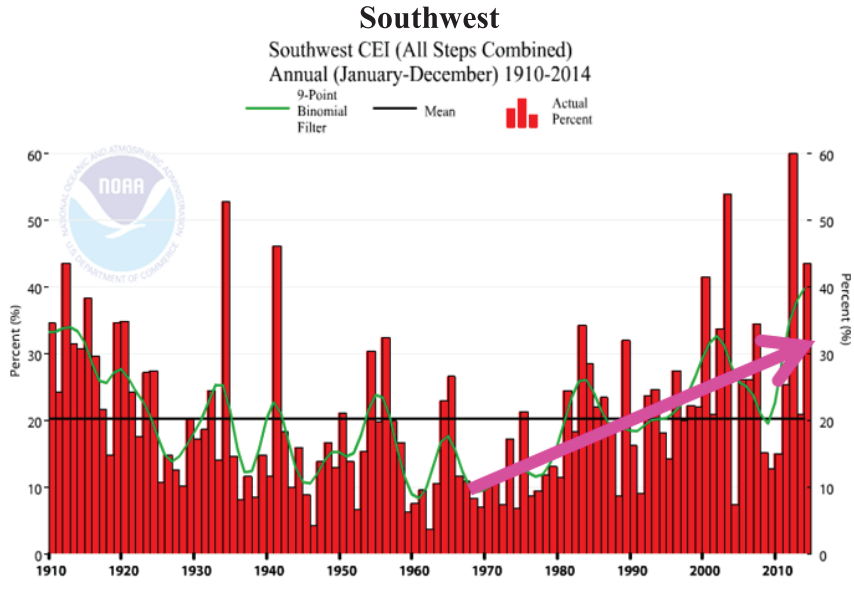


Figure 5: From noaa climate extremes index

http://www.ncdc.noaa.gov/extremes/cei/introduction

- Average of percentage of conterminous U.S. area:
- With maximum temperatures much below or above normal
- With minimum temperatures much above or below normal.\
- Under severe drought
- With severe moisture surplus
- With a much greater than normal precipitation from extremes
- With a much greater than normal number of days with precipitation
- With much greater than normal days without precipitation.

2.2.1 A Water Governance Case Study of Texas Edwards Aquifer

The aquifer is a place where governance is evolving. Ground water absolute ownership being replaced with ground water pool or common property management that is marketable.

This was due to:

- Scarcity is rising
- Uncertainty is pervasive
- Marketing sends proper price signals

Texas Edwards Aquifer is an underground layer of porous, honeycombed, water-bearing rock that is between 300-700 feet thick. It is one of the most prolific artesian aquifers in the world. Located on the eastern edge of the Edwards Plateau in the U.S. state of Texas.

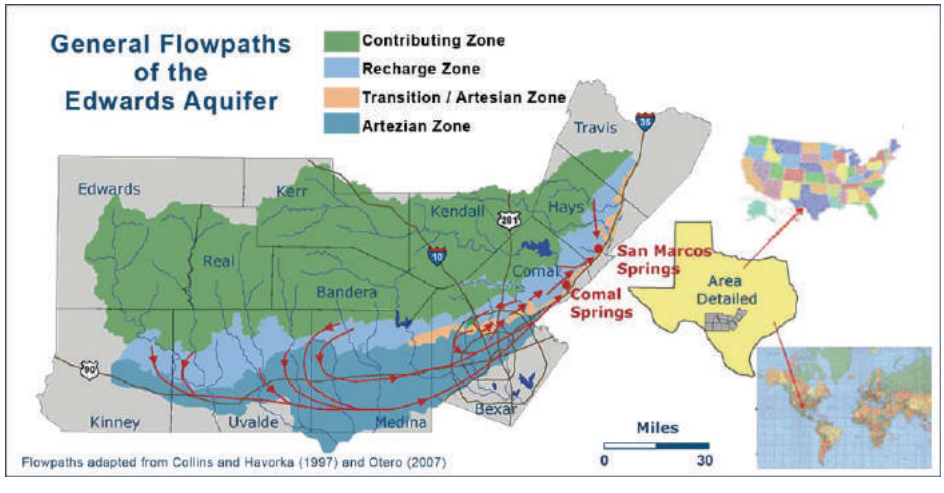


Figure 6.

It is the primary water supply for agriculture in Kinney and Medina counties and urbanized center of Bexar in the aquifer's region. In addition, the Edwards Aquifer feeds some springs of the East of the region (Figure 7).

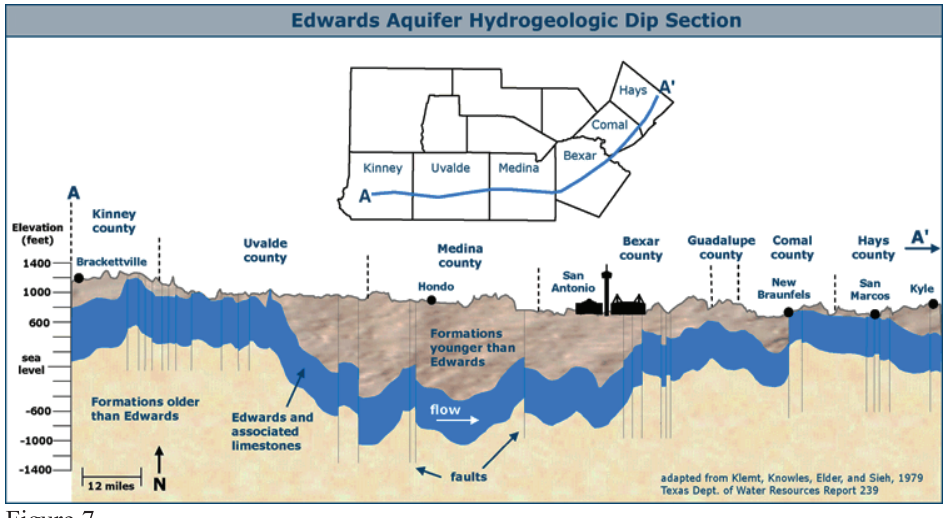


Figure 7.

The evolution of annual discharge and use during 1955-2013 is shown in (Figure 8). Whereas the evolution of the annual recharge during 1934-2013 is shown in (Figure 9).

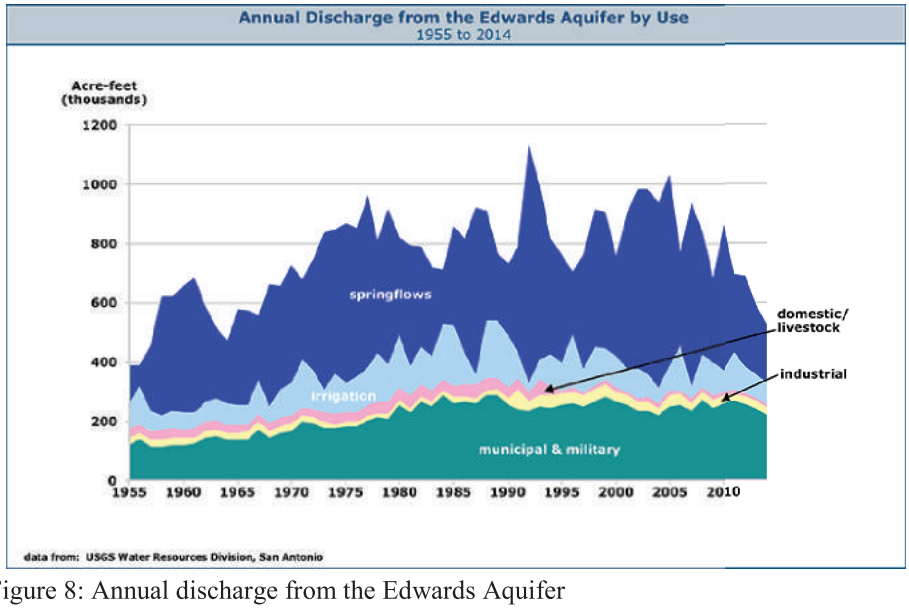


Figure 8: Annual discharge from the Edwards Aquifer
Source http://www.edwardsaquifer.net/charts.html

Increasing use up to 1990 , followed by decreasing spring flow, and then environmental suit cut back usage

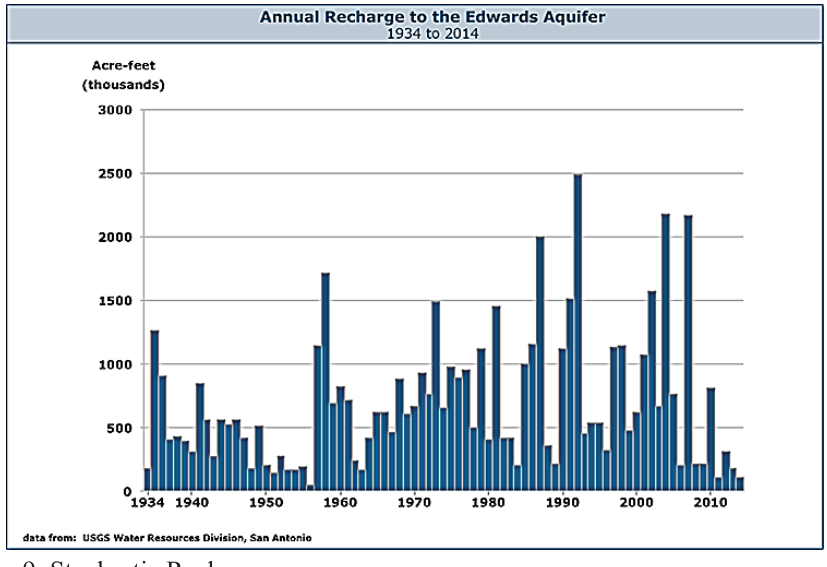


Figure 9: Stochastic Recharge

Source http://www.edwardsaquifer.net/charts.html

III. Governance Evolution of Edwards Aquifer

3.1 The evolution of the aquifer governance went through the following steps:

- Terrible drought in the 1950s, caused water planning desires but little progress
- Edwards Underground Water District created 1959 without authority to restrict pumping
- Painfully pointed out by catfish farm in 1991 using 1/4th as much water as San Antonio.
- In 1991, Sierra Club filed lawsuit against U.S. Fish and Wildlife service claiming the Service was not adequately protecting endangered species that depend on the Aquifer. 0
- In 1993 Judge ruled in favor of Sierra Club and ordered spring flow must be maintained.

- In 1993 Edwards Aquifer Authority was formed authorized to issue permits and regulate groundwater withdrawals
- Metering began
- In February 2002 the Texas Supreme Court reaffirmed Authority's powers.
- Now water rights defined up to 450,000 acre feet and then junior from there on
- Water is trading mainly from agriculture to city

More Info:
http://www.edwardsaquifer.net/pdf/the-little-fish-ssrn.pdf
http://www.edwardsaquifer.net

3.2 Governance Evolution Other aspects

- Dry year option
  - El Nino , La Nina forecasting
- Water rates to induce conservation
- Water development
  - pipeline from central Texas
  - desalination
  - leak repair
- Buy water from agriculture

IV. Current Drought Management

CRITICAL PERIOD TRIGGERS, STAGES, AND WITHDRAWAL REDUCTIONS

EDWARDS AQUIFER AUTHORITY

The following Critical Period triggers and percent reductions apply to all Municipal, Industrial and Irrigation users authorized to withdraw more than 3 acre-feet.

San Antonio Pool

Critical Period is declared in the San Antonio Pool when the 10-day average of the rate of springflow at either the Comal or San Marcos springs, or aquifer reading at the J-17 Index Well in Bexar County drops below the Stage I trigger level. Likewise, a more restrictive stage of Critical Period is activated by any one of these triggers. However, the declaration of a less restrictive stage of Critical Period requires the 10-day averages of all three trigger levels to be above the activation thresholds of the particular stage in effect at the time.

TRIGGER (based on 10-day average)	CRITICAL PERIOD STAGE I	CRITICAL PERIOD STAGE II	CRITICAL PERIOD STAGE III	CRITICAL PERIOD STAGE IV	CRITICAL PERIOD STAGE V
Index Well J-17 Level (MSL)	<660	<650	<640	<630	<625
San Marcos Springs Flow (CFS)	<96	<80	N/A	N/A	N/A
Comal Springs Flow (CFS)	<225	<200	<150	<100	<45/40*
Withdrawal Reduction	20%	30%	35%	40%	44%

Uvalde Pool

The Uvalde Pool enters Critical Period at Stage II based on the 10-day average of aquifer level readings at the J-27 Index Well in Uvalde County.

TRIGGER (based on 10-day average)	CRITICAL PERIOD STAGE I	CRITICAL PERIOD STAGE II	CRITICAL PERIOD STAGE III	CRITICAL PERIOD STAGE IV	CRITICAL PERIOD STAGE V
Index Well J-27 Level (MSL)	N/A	<850	<845	<842	<840
San Marcos Springs Flow (CFS)	N/A	N/A	N/A	N/A	N/A
Comal Springs Flow (CFS)	N/A	N/A	N/A	N/A	N/A
Withdrawal Reduction	N/A	5%	20%	35%	44%

**San Antonio Pool only: In order to enter into Critical Period Stage V, the applicable springflow trigger is either less than 45 cfs based on a ten-day rolling average or less than 40 cfs based on a three-day rolling average. Expiration of Critical Period Stage V is based on a ten-day rolling average of 45 cfs or greater.*

Definitions: (MSL) Mean Sea Level; (CFS) Cubic Feet Per Second

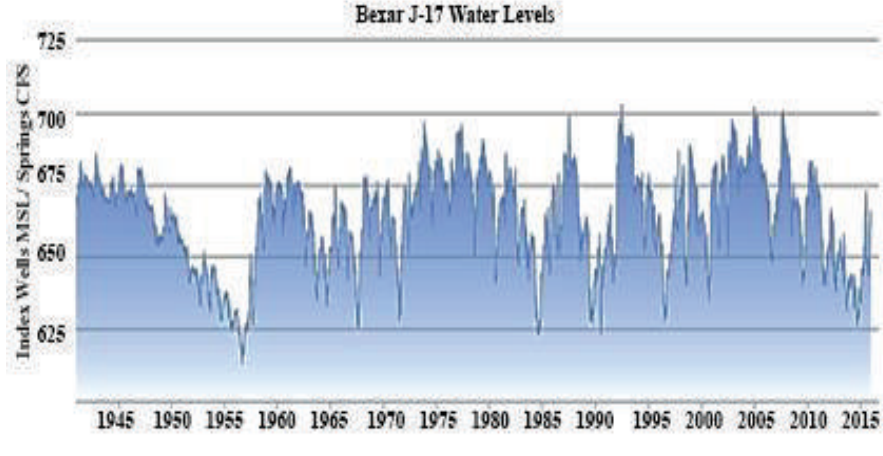


Figure 10.

4.1 Changing Governance -Other evolutions have and are happening:

- Movement from riparian to appropriative in US west and some in the east (lat 1800's)
- Broad movement to water marketing in west (last 30 years)
- California Ground water revision under recent drought
- Ogallala aquifer increasing management

4.2 Impact of Climate Change: further stress on the aquifer

Study of effects on Edwards Aquifer Regional Climate from GCMS.

Projections of climate changes by the Canadian Climate Center Model (CCC), Hadley Climate Center Model (HAD) show increases in temperature and decreases in precipitation.

Table 1. –Effects of Climate Change

Climate Change Scenario	Temperature (^{0}F)	Precipitation (Inches)
HAD 2030	3.20	-4.10
HAD 2090	9.01	-0.78
CCC 2030	5.41	-14.36
CCC 2090	14.61	-4.56

Chen, C.C., D. Gillig, and B.A. McCarl, "Effects of Climatic Change on a Water Dependent Regional Economy: A Study of the Texas Edwards Aquifer", Climatic Change, 49, 397-409, 2001.

4.3 Projected Effects on Water recharge and Municipal Use

Table 2. -Results for EA Recharge Prediction

(% change from the BASE)	Hadley	Canadian
Recharge in Drought Years	-20.59	-29.65
Recharge in Normal Years	-19.68	-28.99
Recharge in Wet Years	-23.64	-34.42

4.4 Municipal Demand

It is forecasted that climate change will increase municipal water demand by 1.5% (HAD) to 3.5% (CCC).

4.5 Projected Climate Change Implications

- Strongest effects fall on springflow and the Ag sector
- Shifts in the sectoral water use share form Ag to M&I
- Welfare loss
- Decrease in M&I surplus
- Farm income falls 16-30% under the 2030 scenario and 30-45% under the 2090 scenario.
- Value of water use permits increases by 5-24%.
- Decrease in Comal springflows by 10-16% under the 2030 scenarios and by 20-24% under the 2090 scenarios
- Endangered species

4.6 Maintaining Environmental Services:

- Pumping level to keep springflows at the BASE
  - ⇨ decreases 35,000 to 50,000 af in 2030 scenarios
  - ⇨ decreases 55,000 to 80,000 af in 2090 scenarios
- Agricultural and M&I water use reduction
- Substantial economic costs: an additional cost of $0.5 to $2 million per year
- Increase in EA authority surplus or rents to water right holders
- "Regional environmental preservation becomes more costly"

4.7 Other key factors influencing water governance

- Issues in water markets:
  - ⇨ Diversion vs consumption
  - ⇨ Return flows and third party

- ⇨ Water reuse
- ⇨ Conveyance losses
- ⇨ Instream flow – hydropower, dilution, environment
- ⇨ Water quality/ salt water intrusion
- ⇨ Seniority and uncertainty
- ⇨ Transactions costs
- ⇨ Private non disclosed information
- ⇨ Groundwater overexploitation
- ⇨ Adaptability to non stationarity
- ⇨ Rebound effect

V. Climate Change

What could we do about climate change in general and water governance in particular

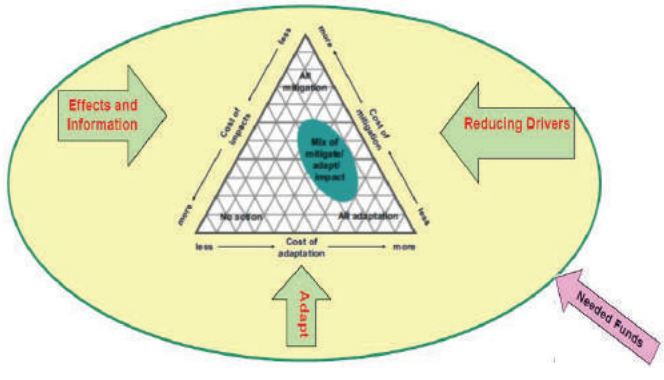


Figure 11: McCarl, B.A., "Some Thoughts on Climate Change as an Agricultural Economic Issue", Journal of Agricultural and Applied Economics, vol 44 no 5, 299-305, 2012.

5.1 Reactions to climate change basically consist of four directions:

- Live with the effects – do little

- Reduce future extent by limiting GHG net emissions - Mitigation
- Alter the way we do things adapting so as to reduce the impact of change - Adaptation
- Monitor what is happening- Information

Knowing that the last three compete with traditional investment

5.2 Scarcity Forces are Projected to rise yet more

- Actions to adapt are inevitable

  ⇨ ACTION ERA 1 – Between now and 2040, there is not much contribution from limiting emissions with an inevitable amount of climate change.

  ⇨ ACTION ERA 2 – Between 2040-2100, there is warming but limiting emissions has an effect.

  ⇨ Climate Goals - Requires adaptation plus mitigation.

5.3 Climate change Projections

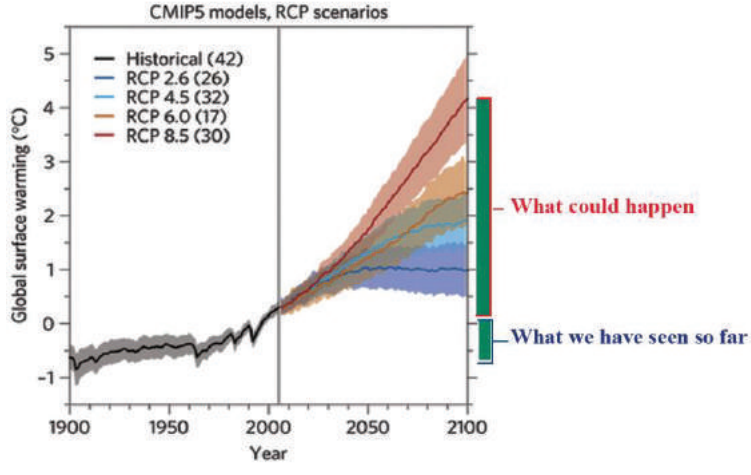


Figure 11: Global temperature change and uncertainty. From Robustness and uncertainties in the new CMIP5 climate model projections
Reto Knutti & Jan Sedláček, Nature Climate Change 3, 369–373 (2013) doi:10.1038/nclimate1716

5.4 Governance adaptation to water scarcity can be “natural” or “autonomous” or “planned”:

- Natural adaptations are actions in ecosystem stimulated by species reacting to climate
- Autonomous adaptations are actions taken voluntarily by decision-makers (such as farmers or city leaders)
- Planned adaptations are those by governments to address needs judged unlikely to be met by autonomous actions
- Public sector may play important roles in all cases:
  - Support autonomous adaptation by providing information, shaping markets plus developing technologies.
  - Act directly by developing strategies, providing resources, and carrying out projects (infrastructure development).
  - Influence natural adaptation by managing the unmanaged.

5.5 Approaches to adaptation

- Mainly Private
  - Altered management, facility investment, enterprise choice, or resource use
  - Altered locations of production, transport /processing
- Mainly Public
  - Altered emergency response procedures
  - Changes in norms and regulations to facilitate private actions (e.g., technical standards, environmental regulations)
  - Managing the unmanaged (e.g. moving butterfly populations or sugar maple seeds).
  - Direct capital investments in infrastructure (e.g., water management, roads)

- Both Public and Private

  - Technology development (e.g., develop crop varieties)
  - Creation and dissemination of adaptation information (through extension or other communication vehicles)
  - Education (e.g., investment in adaptation ability)
  - Adaptation institutions (e.g., altered insurance or early warning approaches)
  - Incentives for Alterations in individual behavior (public incentives)
  - Assistance in implementing adaptation (loans or facilitating migration).

Ms. Patricia Haydamous
Climate Change and the Environment Program
Issam Fares Institute for Public Policy and International Affairs
American University of Beirut

Water Scarcity and Institutional Frameworks
Case studies: Lebanon, Jordan and Tunisia

I. Introduction

The UN defines scarcity as "the point at which the aggregate impact of all users impinges on the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully". Actually under current water use practices, coupled with population growth, increase in water consumption, competition for water resources, demand for water will intensify, further exacerbating water stress and leading to water scarcity.

1. Two main types of water scarcity could be addressed:

a. Physical Water Scarcity which occurs when access to water is limited and when the demand outstrips the lands ability to meet water demand. Dry parts of the world or arid regions are mostly associated with physical scarcity. However, overexploitation and lack of appropriate management can lead to a man-made serious physical scarcity.

b. Economic Water Scarcity is almost entirely a lack of good governance and necessary monetary means to utilize an adequate source of water. Economic water scarcity is when equal distribution of water resources is impeded for many reasons, including political conflict.

Physical Water Scarcity

Economic Water Scarcity

Figure 1.

1.2 Risks to Water Scarcity:

- Drought and drought cycles
- Contamination of resources
- Institutional and political risk
- Capacities for water governance
- Shared resources and conflict risk
- Local community and stakeholder expectations

1.3 MENA Precipitation levels

Almost all of the IPCC models project that under usual greenhouse gas (GHG) emissions, projected precipitation in the MENA region will decrease, whereas temperature is estimated to increase. The resultant reduction in available water is likely to have devastating consequences for the people of the region - many of whom already live in conditions of water poverty.

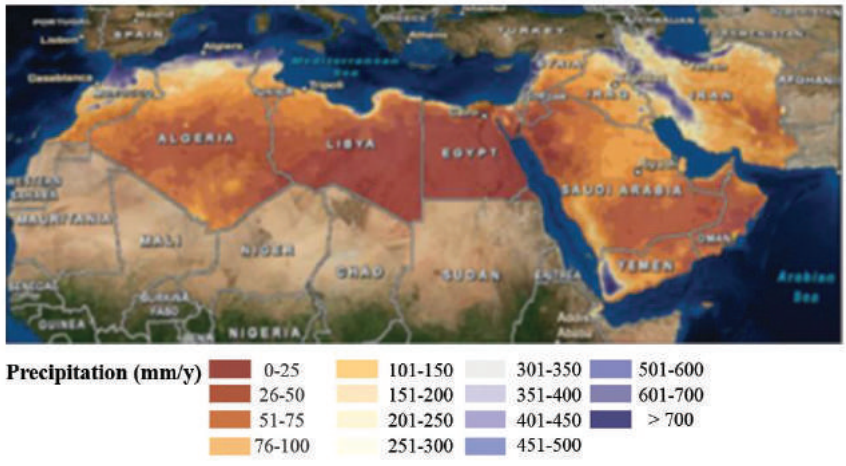


Figure 1. Current precipitation level in the MENA region

1.4 Aridity in the MENA

The MENA region is the most water scarce region of the world. The region averages less than 1000 m3 per year per capita. Most of MENA countries fall below this level, further still . Climate change is expected to cause a decline in water availability.

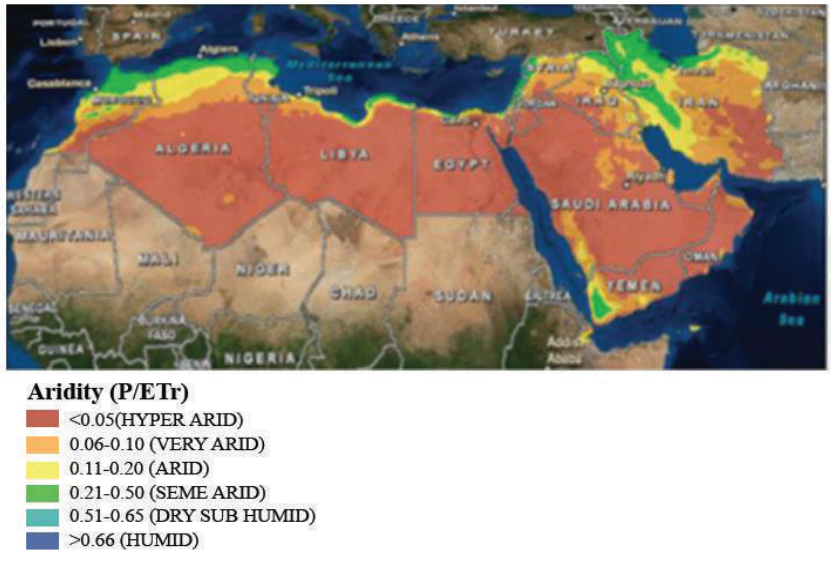


Figure 2. Aridity Level in the MENA Region

II. Water scarcity and Institutional Frameworks

A comparative study water on scarcity and institutional frameworks in Lebanon, Jordan and Tunisia was prepared[1] and here are some briefs about the study findings:

2.1 The natural properties and water availability in the countries under study are illustrated here below

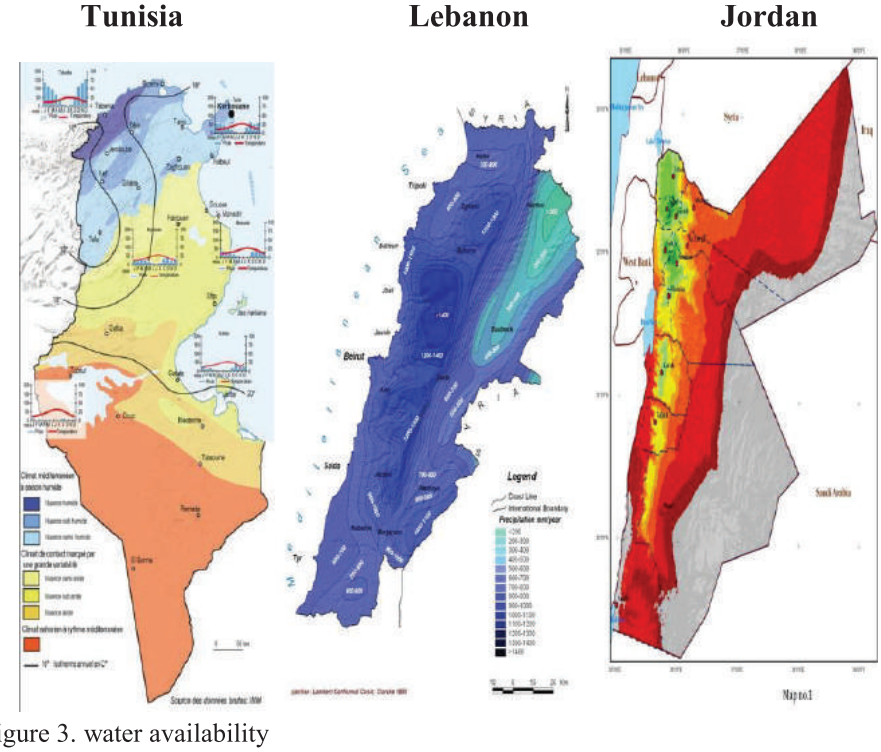


Figure 3. water availability

[1] ANNEX 1 the full text of the study

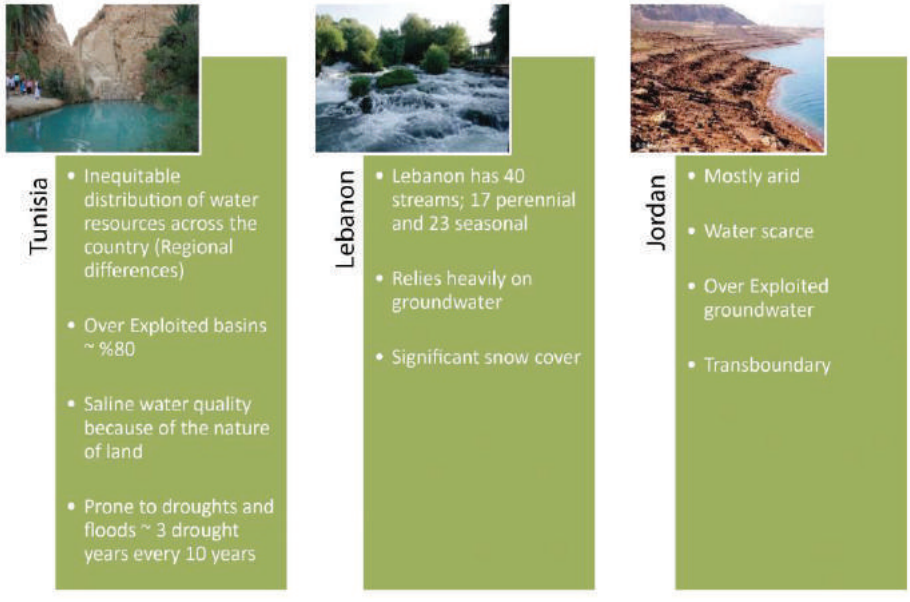


Figure 4. Natural properties

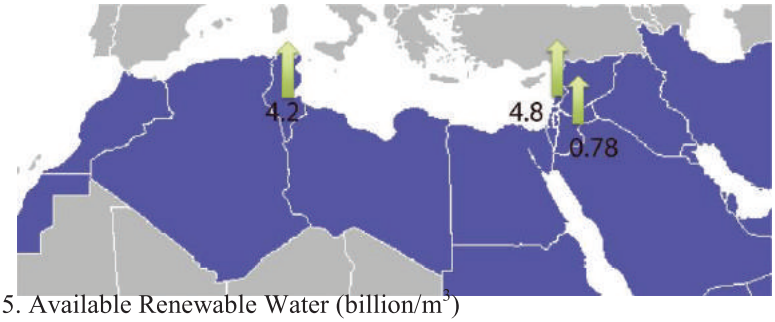


Figure 5. Available Renewable Water (billion/m^3)

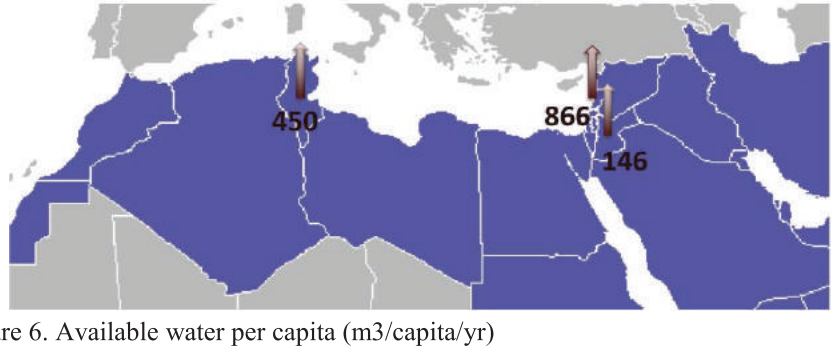


Figure 6. Available water per capita (m3/capita/yr)

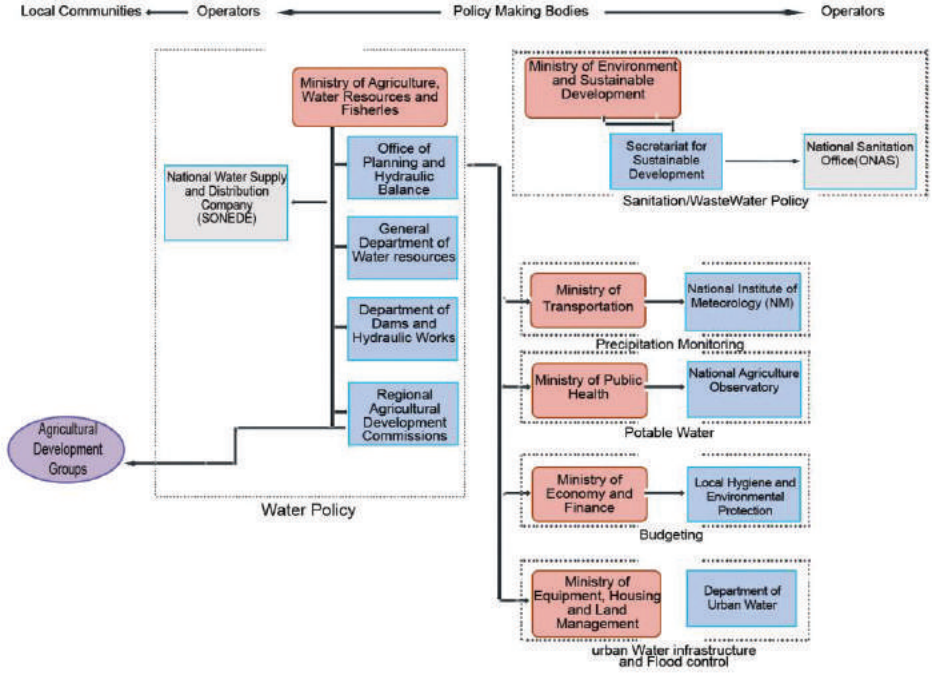
Table 1 - Facts and Figures

		Tunisia ("SEMIDE," n.d.)	**Lebanon** (Ministry of Energy and Water, 2010)	**Jordan** (Ministry of Water and Irrigation, 2013)
Population		~11 million	~4.5 million	~6.5 million
Area		163,610 km^2	10,452 km^2	89,342 km^2
Natural resources	Groundwater	2.1 Billion m^3	0.5 Billion m^3	0.275 Billion m^3
	Surface water	2.7 Billion m^3	2.2 Billion m^3	0.475 Billion m^3
	Total available renewable	4.8 Billion m^3	2.7 Billion m^3	0.78 billion m^3
Artificial Surface Storage	Number of Dams	30	2	30
	Dams Capacity per capita("UN-Water: KWIP,".)(UNDP, 2013)	237.1 m^3	53 m^3	43 m^3
Groundwater sources	Wells*	~2300	~269	>3000
Nonconventional Sources	Desalinated Water	29.7 million m^3	-	50 million m^3
	Treated Wastewater	296 million m^3	N/A	98 million m^3
	Waste water treatment plants	106	7	24

2.2 Institutional Structure for Water Policy and Management:

The institutional structure for water policy and management in each of the countries under study:

- **Institutional Structure – Tunisia**



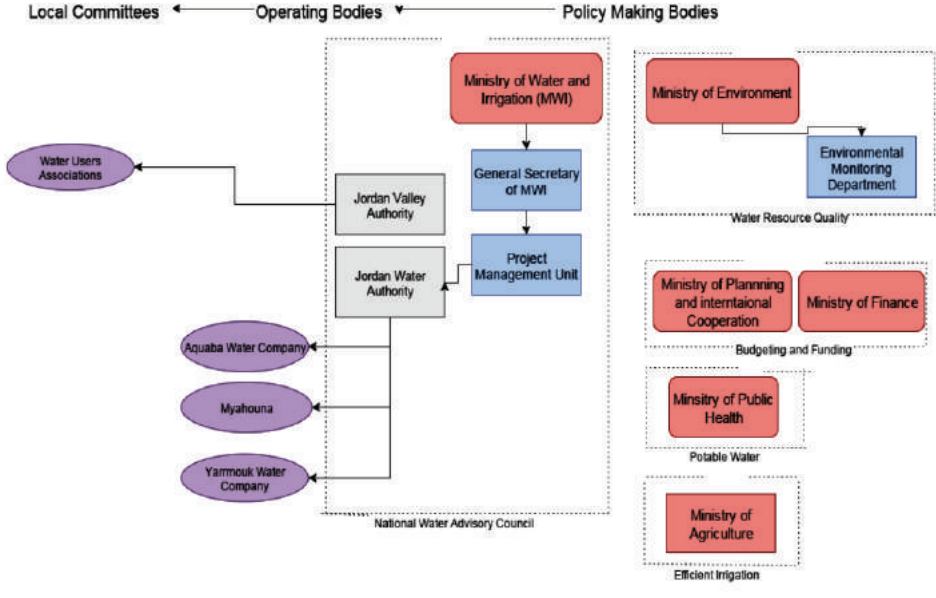
a. Water Laws and Policies - Tunisia

- 1995: Water Saving Policy
- In 1999, a drought management plan. Tunisia published the first guide on drought management titled “Practical Guide to drought management in Tunisia”. The management system of drought in Tunisia has three main successive stages:

1. Announcement of the drought
2. Warning
3. Implementation of actions

- Implementation of IWRM
- Improving water Mobilization

- **Institutional Structure – Jordan**



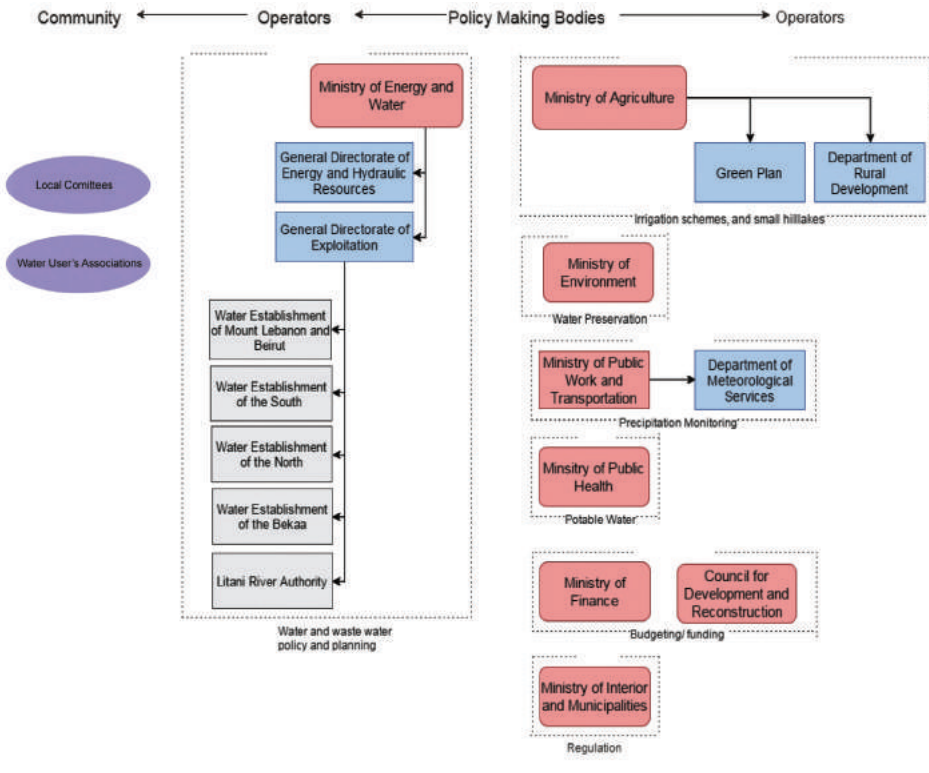
a. Water Shortage Policies - Jordan

Jordan's Water Policy (2008 -2022)

1. The use of treated wastewater for agriculture to gain the highest socio-economic benefits will be introduced and reinforced.
2. Operate the desalination projects at the Red Sea
3. Promote and encouraging rainwater harvesting

Provide sufficient infrastructure for desalination of sea and brackish water

- **Institutional Structure - Lebanon**



a. Water Laws and Policies – Lebanon

1. National Water Sector Strategy – plans to build dams to capture approximately 650 Mm3/year
2. Water infrastructure needs upgrade, half of the water distribution networks suffer from leakage – unaccounted for water ~ 48% nationally
3. No Drought Policy**!**

2.3 National Planning

Table 2 – National Planning

		Tunisia	Lebanon	Jordan
Technical	Dams % of total renewable	55%	4.7%	16.3%
	Desalination of total	0.27%	-	0.2%
	Monitoring of Illegal wells		Still in the identification phase	Forcing control on illegal wells
Plans and strategies		Drought preparedness plan		Beginning of a drought preparedness plan
Institution framework		Water is managed by different ministries	One line ministry	One line Ministry

2.4 Risk Aversions

Table 3 – Risk Aversions

	Tunisia	Lebanon	Jordan
Drought Preparedness	+	-	±
Water treatment and testing of quality	+	+	+
Wastewater treatment and reuse	±	-	+
Political Preparedness	+	-	+
Water governance bodies	+	+	+
Controlled Cross boundary water bodies	+	-	-
Community participation and involvement	-	-	+

2.5 Common Difficulties and Obstacles to Develop Draught Policy:

- Lack of regional drought data
- The lack of proper policy integration techniques within the current institutional structures
- The need for better monitoring of water resources

Session IV

Ms. Zeina W. Majdalani
Economic Expert / Civil Engineer
Office of the Prime Minister

A new agenda for Sustainable Development was adopted at the United Nations Sustainable Development Summit on 25 September 2015 which included 17 Sustainable Development Goals, also referred to, as SDGs.

The 17 new Sustainable Development Goals aim, by 2030, to end poverty and inequality, take action on climate change and the environment, improve access to health, education, water and energy, build sustainable infrastructure, strong institutions and partnerships, and more.

Goal number 6, in particular, is related to ensuring availability and the sustainable management of water and sanitation for all by 2030, which includes equitable access to safe and affordable drinking water, adequate sanitation, improving water quality by reducing pollution, implementing integrated water resources management at all levels, increasing water-use efficiency across all sectors to address water scarcity as well as expanding international cooperation and capacity building support to developing countries in water- and sanitation-related activities and programmes.

In this perspective, the development office of the Prime minister, in coordination with the Ministry of Environment in Lebanon has

launched in March 2015 a National Sustainable Development Strategy, that includes a specific section on the water and wastewater sectors which shall be aligned with the SDGs. The strategy currently being developed is still in a draft form and shall be validated once the consultation process with the involved stakeholders is completed.

To know more about the relation between SDGs and water scarcity I will give the floor to our 2 speakers Dr. Ralf Klingbeil and Dr. Lamia Mansour.

Dr. Ralf Kingbeil
Regional Advisor Environment and Water
ESCWA

Water, Water Scarcity and Sustainable Development

I. Introduction

Lebanese Newspapers reported a decrease in precipitation as recoded mid December 2015, with a total rainfall of 165 mm, equivalent to 50% of the previous year and 30% less than the annual average. This means severe hydrological drought and reflects on agricultural production and domestic water use in the country.

Figure 1.

The relatively high rainfall in 2014 did not mean that all domestic and agricultural sectors were provided sufficient water. Thus five questions arise in the regard:

1. Why did we fail to provide sufficient water to all people in Lebanon in the summer of 2014?
2. Did we not know about the water shortage to come ?
3. Could we have done better ?
4. Have we not been prepared ?
5. Why didn‘t we do better ?

The answer is simple: Yes, we can be prepared for future water scarcity/drought and provide better services for the people!

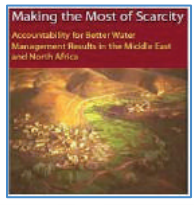
II. Levels of Water Scarcity

2.1 Three levels of water scarcity may characterize the challenge[1]:

a. Scarcity of physical resources and engineering infrastructure
b. Scarcity of organizational capacity and integrated planning and regulation of demand management
c. Scarcity of accountability for achieving sustainable outcomes, efficient allocation, inclusive decision making and access to justice. The solutions may be: efficient storage and distribution, supply augmentation, associated with sustainable public investment and reliable services and accompanied with equitable service provision and water allocation system to highest value use, responsive to variations in supply and demand, while considering environmental issues

[1] The World Bank 2007. Making the Most of Scarcity

2.2 The potential outcomes



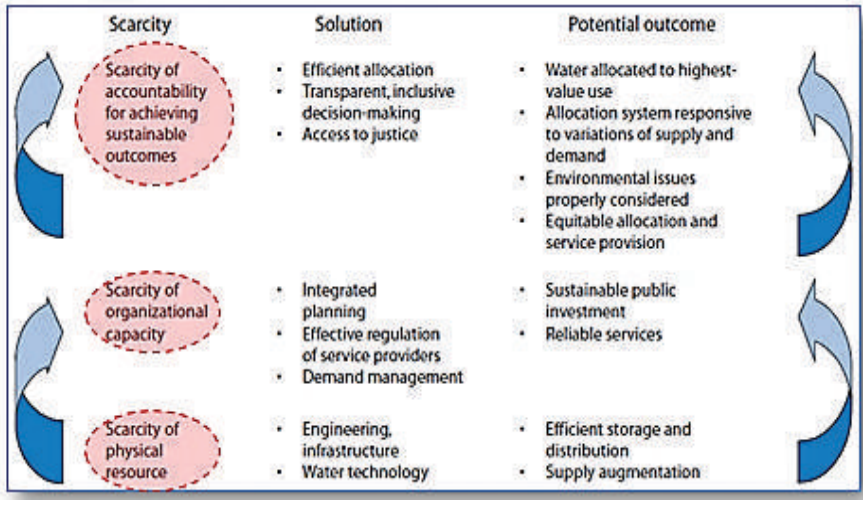


Figure 2. The World Bank, 2007. Making the Most of Scarcity

2.3 2014 an exceptional water scarce year

An official at the Airport's Bureau of Meteorology[2] said that the lack of rain so far this season is considered "normal." There is no indication that this winter will witness less rain than usual, reoccurring dry years have been common in Lebanon's recent history, with frequent occurrence of 2 to 3 consecutive dry years[3].

[2] The Daily Star, 2013. Water shortage leaves Beirutis fuming, The Daily Star, 2014. Droughts put agriculture, tourism at risk.

[3] A. Tayar, MEW, 2014. Ensuring Preparedness for Water Scarcity in Lebanon. 37th WSCG Meeting, March 2014

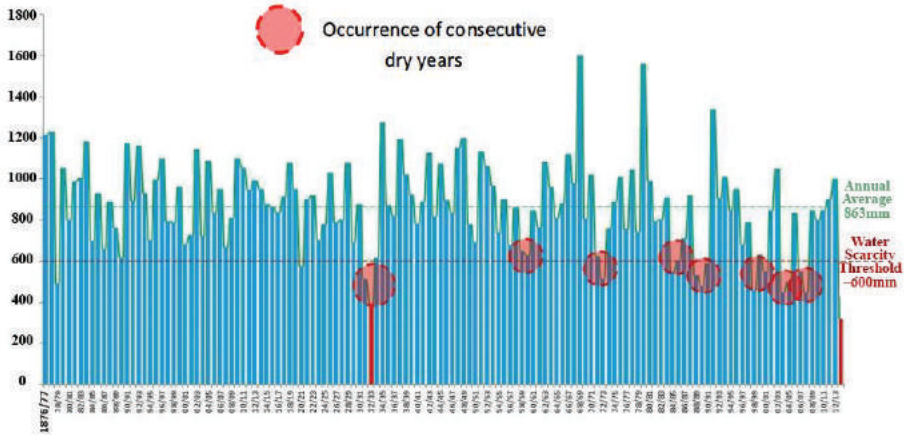


Figure 3. Precipitation in Beirut and the Occurrence of Consecutive Dry Years (1876 – 2014) dry years

The critical years with significant hydrological drought occurred in 2003-2004, 2007-2008 and 2013-2014[4] as recorded from the annual rainfall and cumulative rainfall in Beirut Airport.

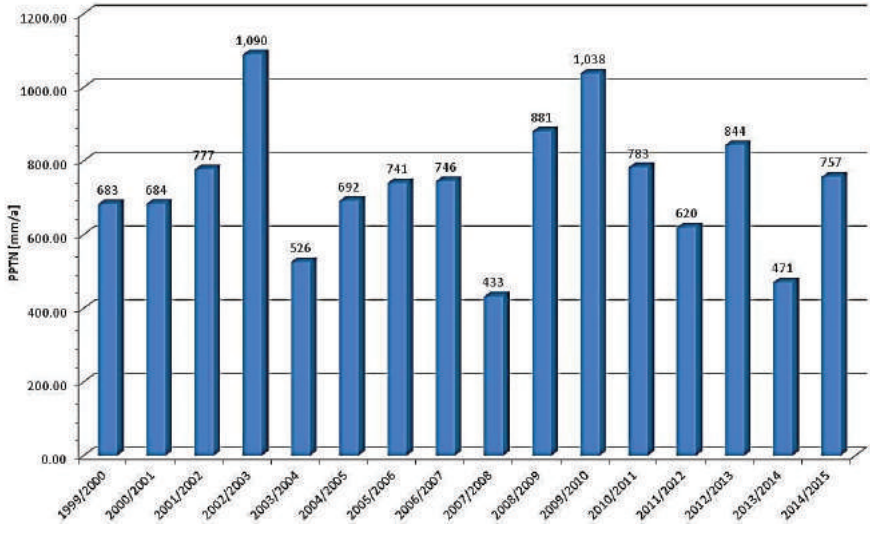


Figure 4. Hydrological years (Sep-Aug) 1999-2000 to 2014-2015

[4] TuTiempo.net, 2015. http://en.tutiempo.net/climate/ws-401000.html

Cumulative Precipitation @ Beirut Airport

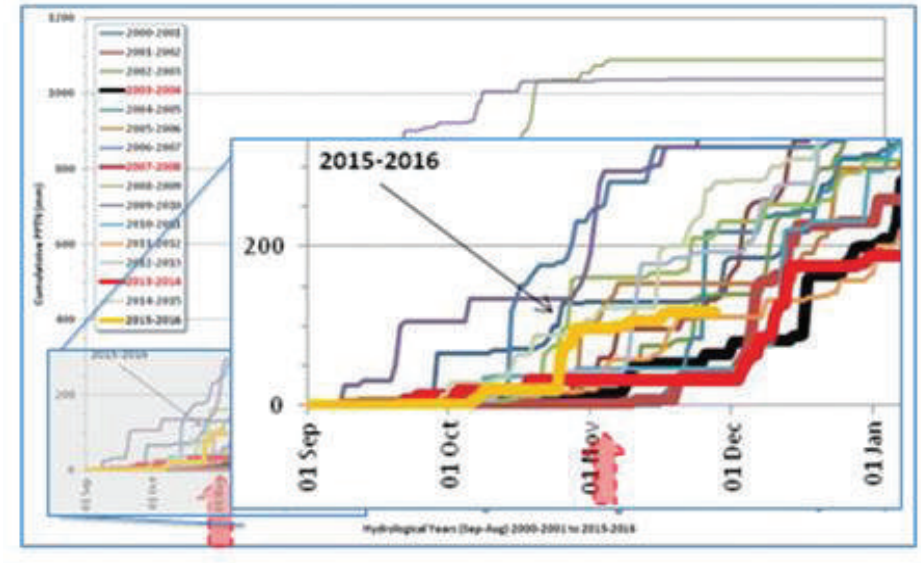


Figure 5. Hydrological years (Sep-Aug) 2000-2001 to 2014-2015

2.4 Groundwater, Spring Discharges Affected

Discharge of Assal spring and cummulative rainfall at the station of Beirut airport (m^3/s and mm, Oct 2012 – Aug 2014) followed similar trends[5] .

The monthly discharge of the Assal spring (m^3/month), monitored during the period Jul 2010 – Aug 2014, showed that groundwater discharge was significantly, affected by water scarcity and pumping intensity.

[5] . Margane, BGR, 2014.

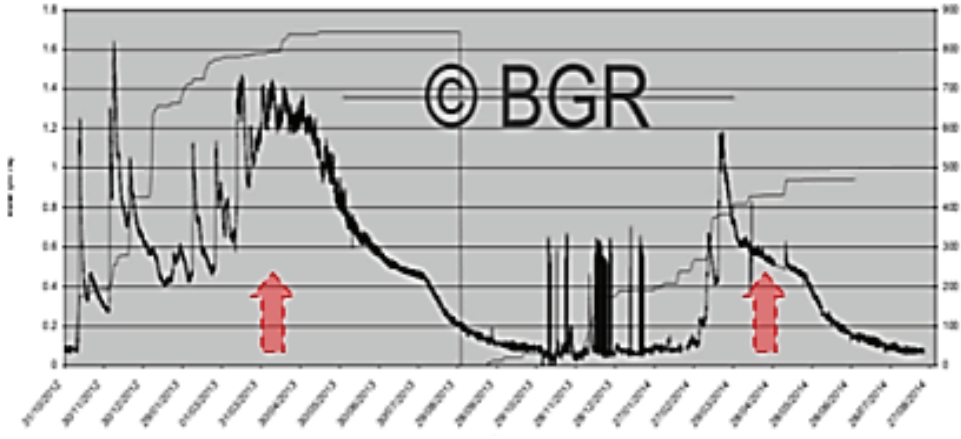


Figure 6. Assal spring – Flow (ADCO) – rainfall Beirut airport

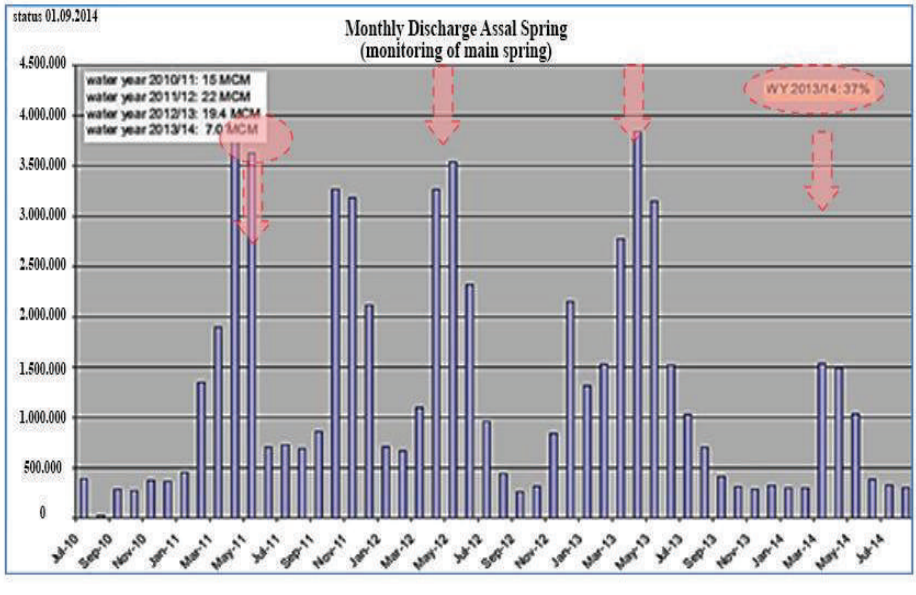


Figure 7. Discharge of Assel spring

2.5 Official reaction on drought: May 2014

Currently, three different ministerial and parliamentary committees are actively involved in water scarcity issues and drought mitigation:

a. An interministerial Committee from different ministries dealing with water and a water scarcity task force was formed on May 8, 2014 including officially appointed representatives of ministries concerned with the water sector[6]. The key role of the task force is to find and enforce solutions to address water scarcity and engage inter-ministerial committee and parliamentary if needed.

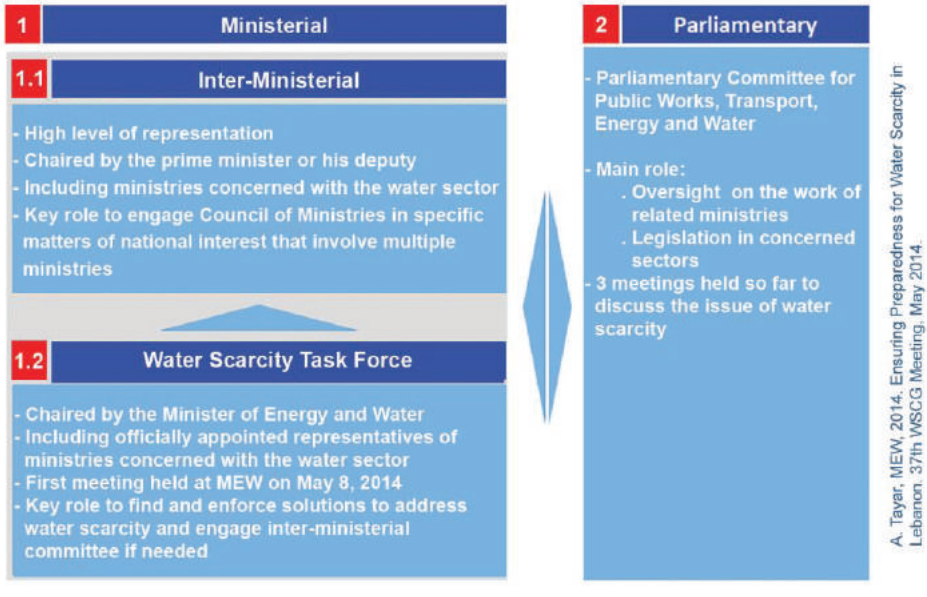


Figure 8.

On May 2 2014, the Council of Ministers took a decision to establish a ministerial committee to address the drought situation in the country. The Committee is chaired by the Deputy Prime Minister and formed from the five key ministries dealing with water and drought. The main mandate of the Committee is to monitor the drought situation

[6] A. Tayar, MEW, 2014. Ensuring Preparedness for Water Scarcity in Lebanon. 37th WSCG Meeting, May 2014.

during the summer season and follow up and advise concerned institutions on recommendations to overcome the crisis and provide proposals to Council of Ministers to address the situation if/when needed.

Composition

- Deputy Prime Minister, *Chairman*
- Minister of Energy and Water, *Member*
- Ministry of Agriculture, *Member*
- Ministry of Public Works and Transport, *Member*
- Ministry of Industry, *Member*
- Ministry of Environment, *Member*

Responsibilities

- Monitor the drought situation during the summer season
- Follow up and advise concerned institutions on recommendations to overcome the crisis
- Provide proposals to Council of Ministers to address the situation if/when needed

Figure 9.

b. The Water Scarcity Task Force (WSTF), which is comprised of key water users and stakeholders from the Ministries of Energy and Water, Environment, Agriculture, Industry, Public Works, Public Health, Interior and Municipalities, it involves also the 4 Water Establishments, of which Litani Authority, Council for Development and Reconstruction. The first meeting of the WSTF, held on May 8, 2014, decided that the MoA support the adoption of drip irrigation system. For instance, the MoA has plans to distribute 1,000 drip systems to serve a 4,000 m2 farm each for a total of USD 1M. the Government strengthens the Water Establishments and provides the needed infrastructure. It addresses the donors and humanitarian organizations.

c. The parliamentary Committee on Public Works and Water (PCPWW) created a Committee from the PCPWW, the Ministries, Director Generals, Representatives of concerned organizations, advisors, NGOs and experts. Upon its meeting on April 29, 2014, the Committee developed other short and long term measures focused on water demand management and distribution cost. It recommended water distribution to people in tankers during the drought periods, also the provision of credits to farmers and the enforcement to adopt modern irrigation systems and other emergency measures along with awareness and extending services to delay the irrigation of vegetables and stop car washing.

2.6 The WASH Working Group issued a map showing those villages in the Bekaa area which face water scarcity[7]. Villages have been divided into rankings of high medium and low.

[7] WASH Working Group Lebanon, 2014. UNHCR - UNICEF

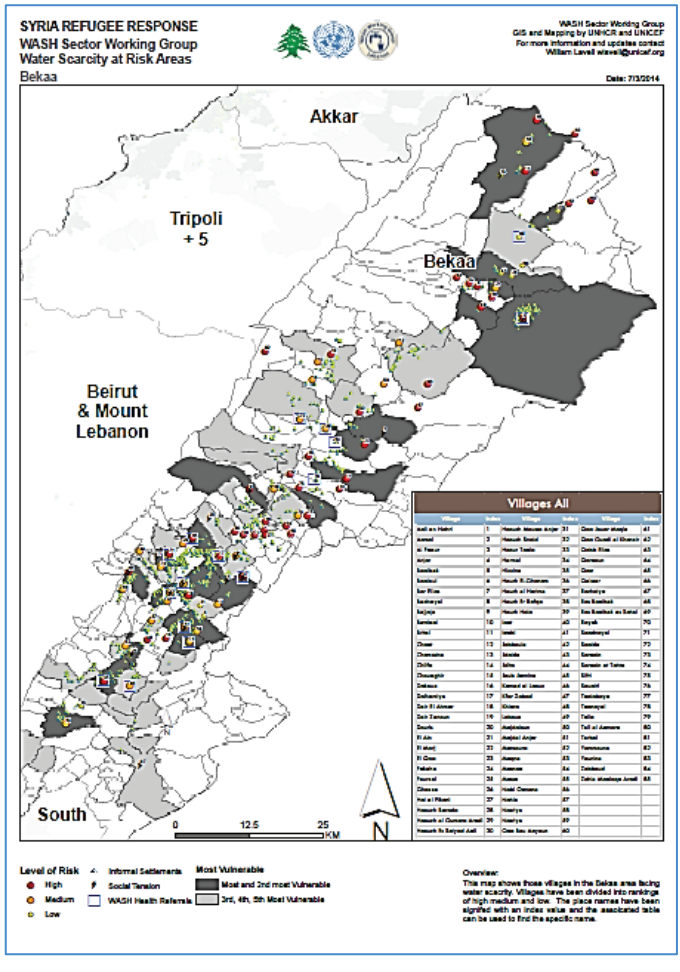


Figure 10.

Meanwhile, a National Water Conservation Campaign was started 15 July 2014, but all throught the Blue Gold Advertising campaign (2013-2014)[8].

[8] CIH, 2013. Blue Gold of Lebanon. www.cihlebanon.org

Figure 11.

III. Why to prepare for water scarcity and drought?

Droughts are hard to avert, but their effects can be mitigated. The price of preparedness is minimal compared to the cost of disaster relief. Let us therefore shift from managing crises to preparing for droughts and building resilience."[9] We expect in the next 100 years, mass animal distinction, forest and bush fires and severe water drought[10].

Figure 12.

[9] UN Secretary-General Ban Ki-moon World Day to Combat Desertification 17 June 2013

[10] Photo: Cornish, P., 2009. Australias Drought.

a. Experience from the region could be cited. Proactive measures were taken to mitigate drought, including the formation of national drought monitoring observatory (Morocco)[11].

Morocco proactive response, for drought

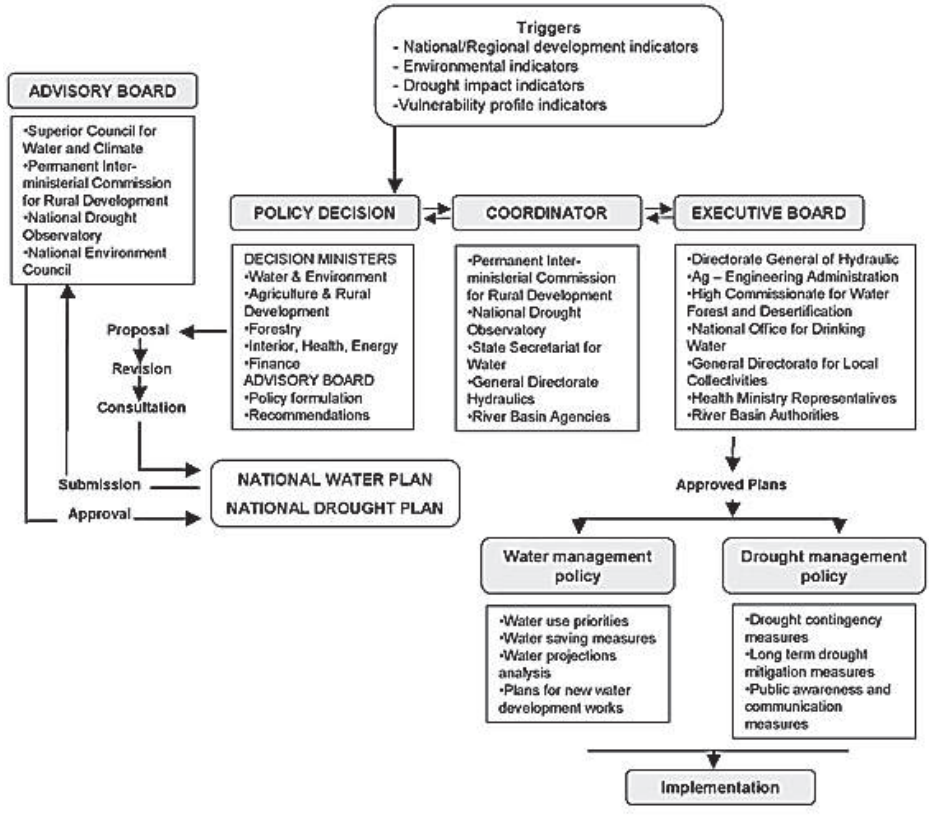


Figure 13.

b. Community at risk of water scarcity was also mapped for Palestine[12].

[11] Ouassou, A. et al., 2007.
[12] UN OCHA - PAL, 2010.

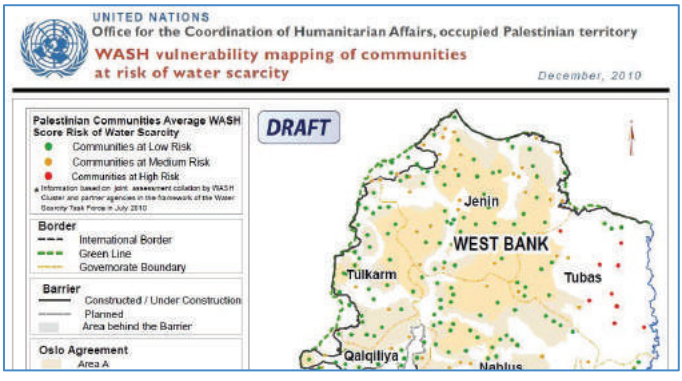


Figure 14.

c. The Mediterranean Drought Preparedness and Mitigation Planning (MEDROPLAN) prepared a Planning Framework to mitigate water scarcity. The plan has four components organizational, methodological, operational and public review components[13].

The operational of drought management strategies developed by MEDROPLAN include permanent measures and measures to be implemented during the drought event.. The drought preparedness planning, before the drought, previews the creation of early warning for continuous monitoring of normal and drought periods. The program establishes priorities, sets management objectives, and defines thresholds and actions. The implementation plan during the drought events triggers the implementation of actions.

MEDROPLAN proposed indicators and actions (measures) from drought monitoring system for operational drought threshold management and objectives. The indicators and actions consist of pre alert, alert and emergency risks.

[13] Gabiña, D., MEDROPLAN, 2013.

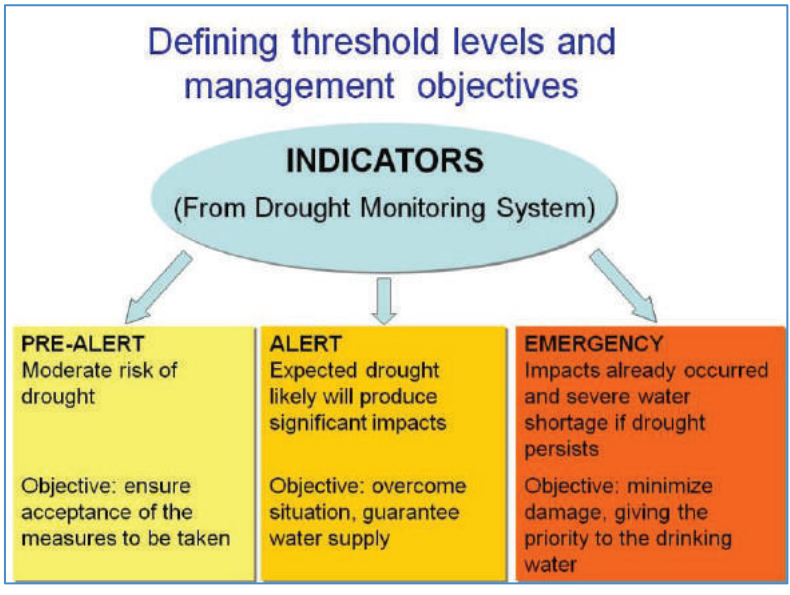


Figure 15.

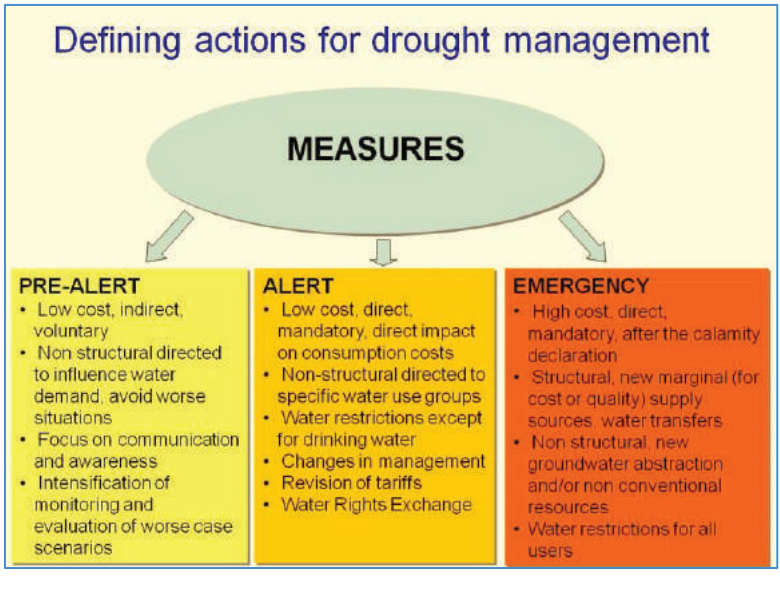


Figure 16.

d. Recommendations for Better Preparedness[14]

- Coordinate → Cooperate → Concerted Action
- National Strategy to Overcome Water Scarcity (NaSOWaS)
- National Monitoring Network
- Research on Recharge Mechanisms
- Legal Basis for Rationalizing Water Use

IV. Water (And sanitation) and the sustainable development goals (SDGS)

Water is essential for descent life and activities, it is key for:

- Poverty reduction
- Inclusive growth
- Public health
- Food security
- Lives of dignity for all
- Long-lasting harmony with Earth's essential ecosystems

[14] R. Klingbeil, 2014. Coping with Water Scarcity in Lebanon? Some Suggestions and Approaches Based on Experiences from the Region. 37th WSCG Meeting, March 2014, www.slideshare.net/RKlingbeil .

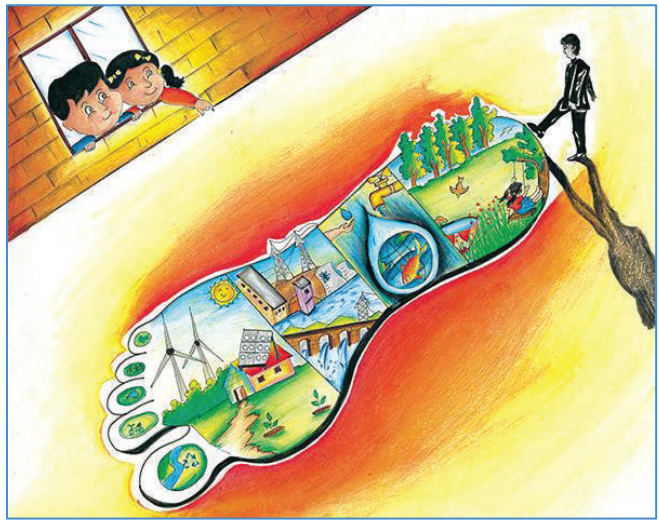


Figure 17.

Water is essential, finite and vulnerable, in as much as Water is a driver for development and enables health, nature, urbanization, industry, energy, food and equality[15].

4.1 2030 Agenda for Sustainable Development : Development indicators

On 25 Sep 2015, the 193-Member United Nations General Assembly adopted the 2030 Agenda for Sustainable Development, including Sustainable Development Goals (SDGs)[16]

The Interagency Expert Group on SDG indicators set 17 goals, 169 indicators and open number of indicators[17] identified by:

[15] Cap-Ne UNDP and UN-Water, 2015.
[16] https://sustainabledevelopment.un.org
[17] http://unstats.un.org/sdgs/iaeg-sdgs

green (consensus)

yellow (unresolved issues)

grey (lack of metadata, needs more discussion, pending methodological questions).

Figure 18.

But the challenge is to keep the number of indicators limited and maintain ambition of all SDGs and their targets, covering every aspect of all targets, addressing issues of inequality and covering all population groups.

4.2 Goal 6 ensured availability and sustainable management of water and sanitation for all[18]:

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

6.1.1 Percentage of population using safely managed drinking water services

6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special

[18] https://sustainabledevelopment.un.org

attention to the needs of women and girls and those in vulnerable situations

6.2-1 Percentage of population using safely managed sanitation services 

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

6.3-1 Percentage of wastewater safely treated, disaggregated by economic activity 

6.3-2 Percentage of receiving water bodies with ambient water quality not presenting risk to the environment or human health 

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity 

6.4-1 Percentage change in water use efficiency over time.

6.4-2 Percentage of total available water resources used, taking environmental water requirements into account (Level of Water Stress) 

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.5-1 Degree of integrated water resources management (IWRM) implementation (0-100) 

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

6.6-1 Percentage of change in fresh water ecosystems

6.a. By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

6.a.1. ODA for water and sanitation related activities and programmes

6.b. Support and strengthen the participation of local communities in improving water and sanitation management

6.b-1 Percentage of local administrative units with established and operational policies and procedures for participation of local communities in water and sanitation management

4.3 Mapping of Stakeholders Per Goal / Target / Indicator

The SDG defined the stakeholders for each goal/target/indicator. For instance, the Ministry of Agriculture was attributed the SDG2 to finish with hunger, the Ministry of Economy the SGG9 and 12 (industry, infrastructure, production), the Ministry of Environment was attributed the SDGs 13, 14, and 15 (Climatic actions, use of underwater and use of land), the Ministry of Energy and Water was attributed the SDG 6 and 7 (clean water and sanitation, and affordable energy).

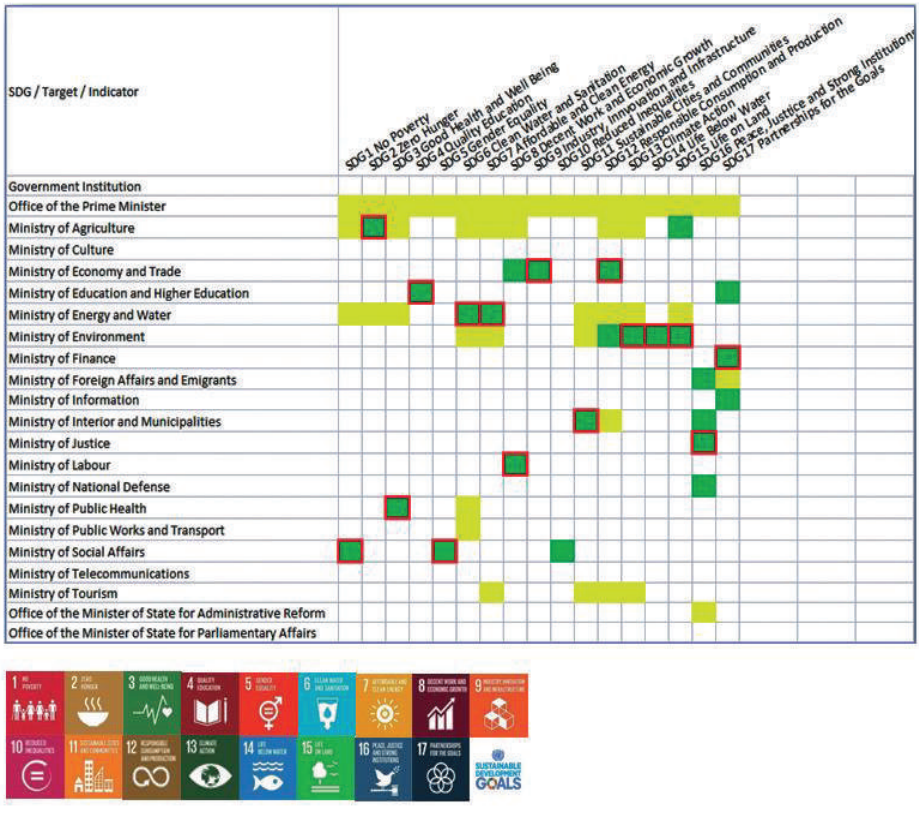


Figure 19.

V. CONCLUSIONS AND RECOMMENDATIONS

- Most SDGs depend on water: Water institutions ought to be aware of links to all SDGs – not only SDG 6
- National Coordination among government institutions, ideally to be under independent government body / Cabinet
- Mapping of Stakeholders per Goal / Target / Indicator
- Lead Institutions per Goal / Target / Indicator, plan for consultation with stakeholders and civil society / public !!!
- Data !!! National Statistics Office to seek active cooperation with sector institution and vice versa
- Funding for core concerns and capacity development of government staff to improve monitoring quality

Dr. Lamia Mansour
Policy Expert
Ministry of Environment/European Union

Lebanon's preliminary preparations for convergence with the 2030 Agenda for Sustainable Development

I. Introduction

At the SDGs summit held in New York in September 2015, a key document has been agreed upon by the United Nations: "Changing our world: 2030 Agenda for Sustainable Development" which is the result of over two years of intensive public consultation and engagement with civil society and other stakeholders around the world.

The 2030 Agenda for Sustainable Development[1] sets forth "a plan of action for people, planet and prosperity" and "seeks to strengthen universal peace in larger freedom". It is an integrated plan of action structured in four main parts:

(i) A Vision and Principles for Transforming our World as set out in the Declaration;

[1] Available at:
https://sustainabledevelopment.in.org/post2015/transformingourworld

(ii) A results framework of global Sustainable Development Goals – SDGs
(iii) A Means of Implementation and Global Partnership
(iv) Follow-up and Review; as presented below.

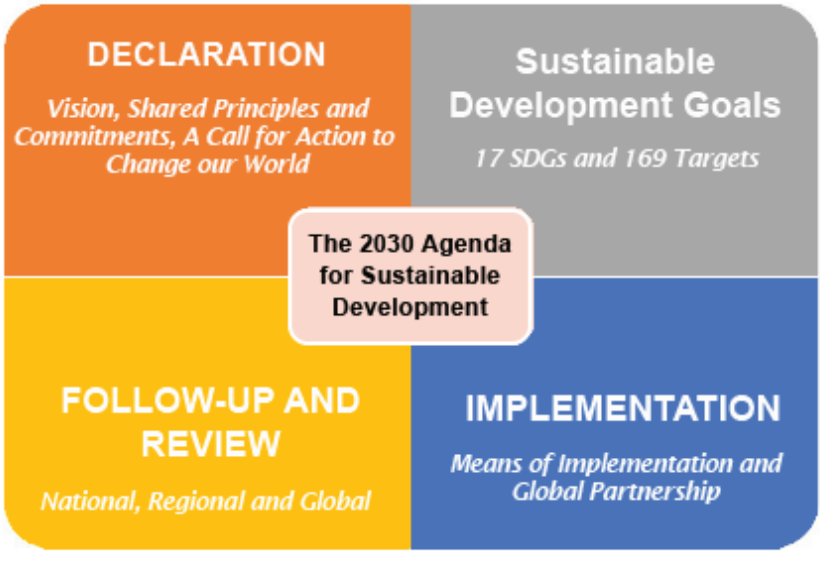


Figure 1. Structure of the Agenda 2030 for Sustainable Development

The 2030 Agenda for Sustainable Development consists of 17 SDGs with 169 targets (refer to Box 1 for a list of the SDGs). The SDGs "*seek to build on the Millennium Development Goals and complete what these did not achieve*". Additionally, the SDGs are "*integrated and indivisible and balance the three dimensions of sustainable development: the economic, social and environmental*". The targets are defined as "*aspirational and global, with each government setting its own national targets guided by the global level of ambition but taking into account national circumstances*". As such it is foreseen that "*Each government will also decide how these targets should be incorporated in national planning processes, policies and strategies*".

Box 1. The 17 SDGs of the Agenda 2030 for Sustainable Development

Goal 1	End poverty in all its forms everywhere
Goal 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
Goal 3	Ensure healthy lives and promote well-being for all at all ages
Goal4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5	Achieve gender equality and empower all women and girls
Goal 6	Ensure availability and sustainable management of water and sanitation for all
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
Goal 10	Reduce inequality within and among countries
Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable
Goal 12	Ensure sustainable consumption and production patterns
Goal 13	Take urgent action to combat climate change and its impacts
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development
Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels
Goal 17	Strengthen the means of implementation and revitalize the global partnership for sustainable development

http://www.un.org/sustainabledevelopment/ar/mdgs/

II. The UN approach for the implementation of the 2030 Agenda

In order to support an effective and coherent approach in implementing the 2030 Agenda, the UN development system has adopted a common approach, referred to as 'MAPS': Mainstreaming, Acceleration and Policy Support[2]. The approach focuses on policy coherence and multi-stakeholder engagement, paying special attention to the crosscutting elements of partnerships, data and accountability.

- Mainstreaming means landing The 2030 Agenda for Sustainable Development at the national and local levels, and integrating into national, sub-national, and local plans for development; and subsequently into budget allocations;
- Acceleration refers to targeting national (and UN) resources at priority areas identified in the mainstreaming process, paying special attention to synergies and trade-offs across sectors reflecting the integrated nature of the agenda), bottlenecks, financing and partnerships, and measurement; and
- Policy Support is about making sure that the skills and expertise held in the UN development system is made available in a timely way and at the lowest cost possible.

These components will often not be separate or follow in chronological order, but they can act as framing to describe the support that the UN development system intends to provide.

In order to further support countries in adopting the proposed approach for "Mainstreaming, Acceleration and Policy Support", the United Nations Development Group (UNDG) has developed a reference guide to address the 'Mainstreaming' component of the approach on the

[2] https://undg.org/home/undg-mechanisms/sustainable-development-working-group/country-support/

basis that complementary guidance would be developed for the other components at a later stage[3].

The UNDG guide covered eight implementation areas that can serve as the basis for governments and stakeholders in landing The 2030 Agenda for Sustainable Development and SDGs at the national level, sub-national and local levels as presented in Figure 2 below. It is expected that some areas can be initiated swiftly, given their core role in landing The 2030 Agenda and SDGs at the national level, including the following:

- Raising Public Awareness
- Applying Multi-stakeholder Approaches
- Tailoring SDGs to National, Sub-national and Local Contexts
- Monitoring, Reporting and Accountability

Other areas address deeper levels of mainstreaming and can be initiated over time such as:

- Creating Horizontal and Vertical Policy Coherence
- Budgeting for the Future
- Assessing Risk and Fostering Adaptability

[3] United Nations Development Group, 2015. Mainstreaming the 2030 Agenda for Sustainable Development: Interim Reference Guide to UN Country Teams

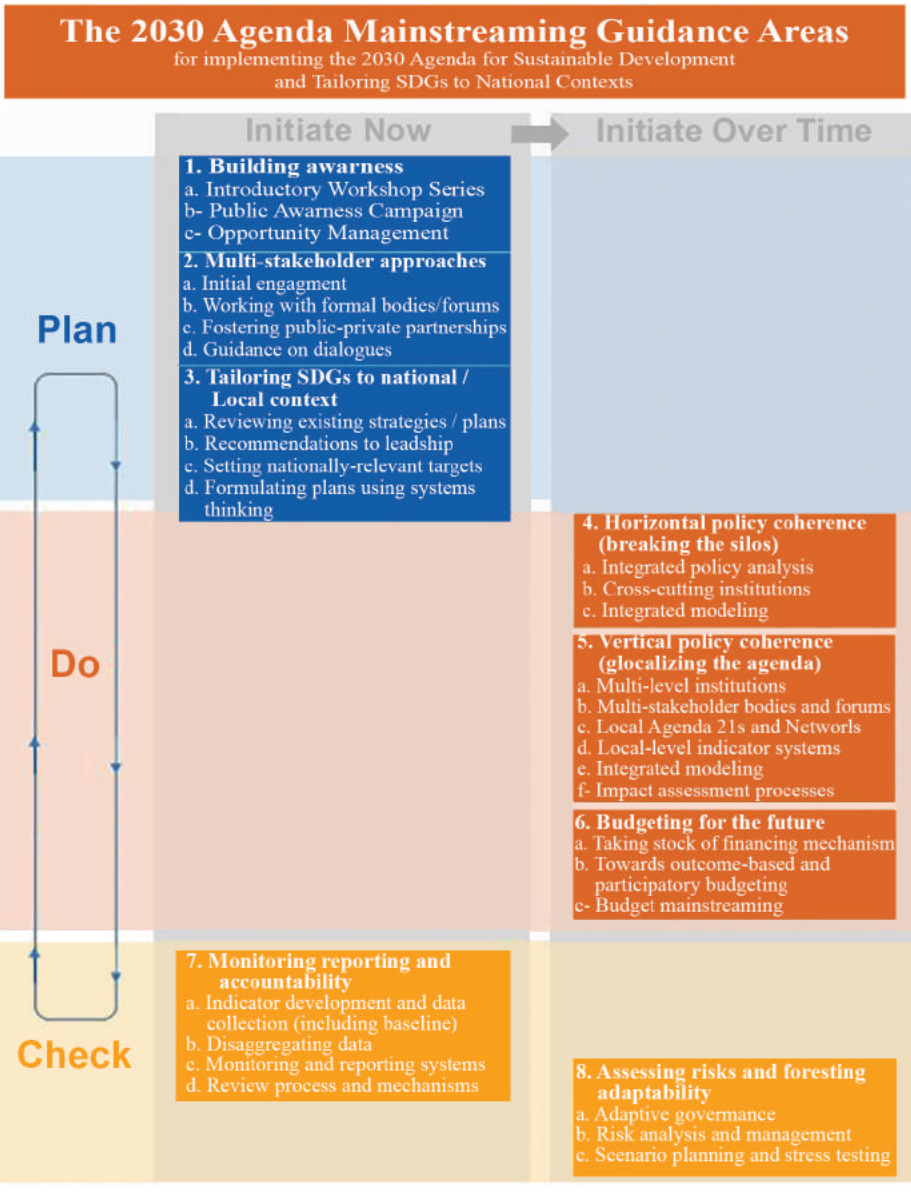


Figure 2. Proposed approach for mainstreaming the 2030 Agenda at national/local levels

III. Lebanon's Key National Policies and Reports on Sustainable Development

Lebanon has prepared an array of national strategies and plans in support of sustainable development principles. Key sectoral strategies and plans related to sustainable development include the following:

- National Physical Master Plan of the Lebanese Territory (CDR, 2005)
- National Water Sector Strategy (MoEW, 2010)
- Policy Paper for the Electricity Sector (MoEW, 2010)
- National Social Development Strategy for Lebanon (MOSA, 2011)
- Economic & Social Reform Action Plan (PCM, 2012)
- Lebanon SME Strategy: A Roadmap to 2020 (MoET, 2014)
- The Ministry of Agriculture 2015-2019 Strategy (MoA, 2014)
- Rural Tourism Strategy For Lebanon (MoT, 2015)
- National Strategy for the Industrial Sector (MoI, 2015)

While institutionally, several governmental institutions are mandated with overall coordination of aspects related to sustainable development, including PCM and CDR, the Lebanese government nominated the Minister of Environment as a national coordinator for sustainable development, through two legal texts:

- Council of Ministers Decision 103 on 06/04/2006
- Decree 2275 on 15/06/2009, Article 33, paragraph 3

For a more focused analysis of existing planning and reporting developments related to sustainable development as a whole in the country, it is possible to refer to following 3 key reports/initiatives which can be considered as the most recent developments related to sustainable development in Lebanon:

1. The National Report to the United Nations Conference on Sustainable Development (Rio +20)

This was the first report prepared by the Ministry of Environment since its appointment as the coordinating ministry for sustainable development, and it was prepared, in preparation for Rio +20 Conference of 2002.

This report presents the current situation with regards to sustainable development, in different Lebanese sectors including social justice, environment and economy, and it includes a chapter that presents the environmental and legislative framework (legislations, institutions and enforcement). It also presents some of the initiatives taken by the Lebanese government, civil society institutions and international institutions regarding sustainable development.

The report is concluded with four global recommendations submitted by the Lebanese government to the United Nations Conference on Sustainable Development.

2. Lebanon's Millennium Development Goals Report for 2013

This report is the third of three reports prepared by the Lebanese Government to follow up on the progress of meeting the Millennium Development Goals (MDGs) in 2013, noting that the previous reports were prepared in 2003 and 2008.

This report showed that Lebanon has succeeded in meeting some of the year's MDGs, specifically at the level of goals 2, 4 and 5, which are related to education and health (the latter two goals were partly met). The report indicated that goals 1 related to poverty and 7 related to sustainable environment have not been met. An incomplete progress has also been noticed in goals 3 concerning gender equality and 8 concerning global partnership.

The report has summarized the main obstacles which faced Lebanon for meeting the MDGs and including the needed response to the impact of the Syrian conflict on development in Lebanon.

At a more strategic level, the report has identified the post-2015 agenda which Lebanon will carry forward, including the plight of the Syrian refugees and their impact on Lebanese host communities, in order to resolve the unfinished work of the last decade. The analysis provided in the report is summarized in Table 1 below and includes the main priorities that Lebanon needs to carry beyond 2015 and can be considered as a important basis for planning sustainable development frameworks for Lebanon beyond 2015.

Table 1. Summary of Emerging Issues under the MDG Framework[4]

Priority Area Theme	Emergency Intervention Areas	Post-2015 Themes	Sub-national Or Specific Themes
Poverty	- Integrated poverty targeting approach - Community poverty alleviation - Short-term quick job creation - Active labour market policies	- Multi-dimensional poverty	- Poverty statistical capacity-building - Integrated rural poverty interventions - Urban poverty - Geographical inequality
Employment		- Job-centred economic growth - Ensuring decent work conditions in informal sector	- Social protection - Youth employment and reverse brain drain - Labour productivity
Education	- Enrolment in intermediate and secondary education	- Reduction of drop outs - Education beyond primary	- Bridging gap between private & public education system - Capacity building and

[4] CDR/UNDP, 2014. Lebanon's Millennium Development Goals Report for 2013

Education	- Integration and adaptation of curriculum and teaching (alternative education) - Quality of education	cycle	upgrading of curriculum - Integration of special needs learners
Health	- Primary health care - (immunization) - Early warning disease - surveillance capacity building	- Quality of public sector health services - Health system reform	- Universal health coverage (for elderly, informal sector and other vulnerable groups) - Non-communicable diseases
Gender	- Containing gender based violence	- Political and public participation - Economic participation	- Personal and family civil rights - Gender-based violence - Quotas for women's political representation - Public social services and infrastructure promoting a shared social responsibility of unpaid care work
Environment	- Water and sanitation utilities expansion and upgrading	- Pollution - Water - Electricity - Sanitation - Oil exploration Biodiversity	- Ecosystem conservation - Sea protection - Forest fires - Water and sanitation security and fair access - Solid waste management - Water and sanitation functioning infrastructure - Electricity fair access
Political Governance, Security and Peace building	- Security threats and violence	- Equal and inclusive citizenship and civil rights - Democratic governance	- Civil rights - Clientelism and sectarianism - Accountability - Institution building - Social pact and commitment to poverty reduction and development

3. National Sustainable Development Strategy initiated in 2015

The National Sustainable Development Strategy (NSDS) is the first national strategy for Lebanon to be prepared in a comprehensive level and deals with various Lebanese sectors from the perspective of sustainability. The NSDS includes seven strategic objectives, covering environment, economy, social justice, governance and international aspects. The NSDS is being jointly developed by the PCM and MoE; a roadmap for the development of the NSDS was launched in March 2015[5], and it is expected that the strategy will be completed in 2016 following a consultation process with the concerned partners (ministries, municipalities and unions of municipalities, private sector, civil society, the academic sector) as per Figure 3 below.

Involvement of all concerned stakeholders (public, private, civil society) through:

- E-participation
- Consultation meetings
- Working Groups

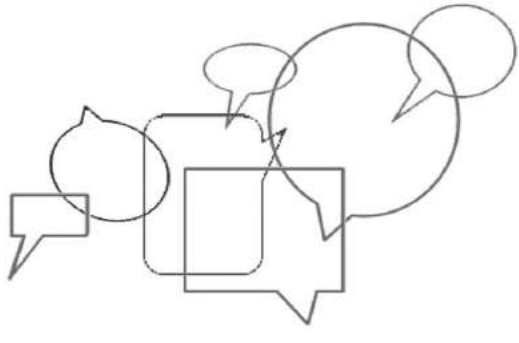


Figure 3. Methodology of preparing the NSDS

[5] http://nsds.pcm.gov.lb

IV. Initial Alignment of the National Sustainable Development Strategy with the 2030 Agenda for Sustainable Development

The development of Lebanon's National Sustainable Development Strategy (NSDS) comes at an opportune timing for the alignment of Lebanon's sustainable development planning objectives with the UN Sustainable Development Goals (SDGs).

At an initial step, and in cooperation with the international organizations supporting Lebanon's NSDS development process, a preliminary assessment exercise has been conducted to identify the levels of alignment between the NSDS initiatives and the SDGs; this initial work allows to identify the linkages between the national objectives under the NSDS with those of the SDGs and identify where synergies have been created and if there are major gaps which need to be addressed.

The initial assessment conducted by Lebanon is presented in Annex 1 below and shows the alignment of the NSDS Strategic Objectives and Initiatives with the UN SDGs. The assessment has confirmed that the seven Strategic Objectives of the NSDS are consistent with the 17 SDGs, even if some of the national Strategic Objectives may converge with several SDGs.

Following this initial assessment, it is important to conduct more in-depth assessments to strengthen the convergence between the NSDS and the SDGs and ensure effective mainstreaming of the SDGs leading to an effective creation of needed Horizontal and Vertical Policy Coherence, the identification of needed financial requirements and a continuous risk assessment and adaptation as called upon in the UN guidance

This will enable Lebanon to document its efforts to meet the SDGs through periodic reports which will be prepared in a collaborative approach between all national and international institutions concerned.

Annex 1. Comparative analysis between the SDGs under the 2030 Agenda and the National Initiatives under the NSDS

National Strategic Objective 1. Providing a World Class Human Capital	
UN Sustainable Development Goals related to the National Initiatives	National Initiatives
Goal 4- Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Education (basic, higher, technical, and vocational)
Goal 9-Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation Goal 12- Ensure sustainable consumption and production patterns Goal 14- Conserve and sustainably use the oceans, seas and marine resources for sustainable development Goal 17- Strengthen the means of implementation and revitalize the global partnership for sustainable development	Research and development
Goal 4- Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all Goal 8-Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	National Youth Policy
Goal 8- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Jobs-quantity and quality

National Strategic Objective 2. Strengthening Social Cohesion	
UN Sustainable Development Goals related to the National Initiatives	National Initiatives
Goal 1- End poverty in all its forms everywhere Goal 3- Ensure healthy lives and promote well-being for all at all ages	Social care and social development
Goal 5- Achieve gender equality and empower all women and girls	Promoting gender equality
Goal 3- Ensure healthy lives and promote well-being for all at all ages Goal 6- Ensure availability and sustainable management of water and sanitation for all	Health care and medical care for all
Goal 10- Reduce inequality within and among countries	Addressing the issue of refugees and displaced persons
Goal 16- Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Citizenship and personal status
Goal 2- End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Rural development

National Strategic Objective 3. Providing the citizens' daily priorities	
UN Sustainable Development Goals related to the National Initiatives	National Initiatives
Goal 6- Ensure availability and sustainable management of water and sanitation for all Goal 15- Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Water (quantity, quality, uses, sewage)
Goal 2- End hunger, achieve food security and improved nutrition and promote sustainable agriculture	Food security and food safety
Goal 7- Ensure access to affordable, reliable, sustainable and modern energy for all	Energy (electricity, petroleum, renewable energy,..)
Goal 7- Ensure access to affordable, reliable, sustainable and modern energy for all Goal 9- Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Transport (land, maritime, and air transport; public transport)
Goal 11- Make cities and human settlements inclusive, safe, resilient and sustainable	Sustainable cities
Goal 11- Make cities and human settlements inclusive, safe, resilient and sustainable Goal 12- Ensure sustainable consumption and production patterns	Integrated solid waste management
Goal 1- End poverty in all its forms everywhere Goal 2- End hunger, achieve food security and improved nutrition and promote sustainable agriculture Goal 11- Make cities and human settlements inclusive, safe, resilient and sustainable Goal 13- Take urgent action to combat climate change and its impacts	Disaster prevention and management

National Strategic Objective 4. Enhancing Economic Growth	
UN Sustainable Development Goals related to the National Initiatives	National Initiatives
Goal 10- Reduce inequality within and among countries Goal 17- Strengthen the means of implementation and revitalize the global partnership for sustainable development	Managing public debt/deficit and reforming public finance
Goal 8- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all Goal 12- Ensure sustainable consumption and production patterns	Rethinking the economic model-including green economy
Goal 8- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Improving the business environment
Goal 17- Strengthen the means of implementation and revitalize the global partnership for sustainable development	Activating Public Private Partnership
Goal 9- Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Developing the Information/Communication/ Technology sector
Goal 8- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Modernizing productive sectors
There are no precise goals in this area	Developing capital markets

National Strategic Objective 5. Conserving the Natural and Cultural heritage	
UN Sustainable Development Goals related to the National Initiatives	National Initiatives
Goal 15- Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Promoting protected areas and natural sites
Goal 15- Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Restoring biodiversity
There are no precise goals in this area	Rehabilitating degraded sites
Goal 14- Conserve and sustainably use the oceans, seas and marine resources for sustainable development	Respecting the Mediterranean Sea
Goal 11- Make cities and human settlements inclusive, safe, resilient and sustainable	Preserving archeological sites
Goal 4- Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	Managing other cultural issues

National Strategic Objective 6. Promoting good governance	
UN Sustainable Development Goals related to the National Initiatives	National Initiatives
There are no precise goals in this area	The completion of a contemporary law
Goal 11- Make cities and human settlements inclusive, safe, resilient and sustainable	Municipal development

National Strategic Objective 6. Promoting good governance	
UN Sustainable Development Goals related to the National Initiatives	National Initiatives
Goal 9- Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Establishing e-government
There are no precise goals in this area except Goal 10- Reduce inequality within and among countries	Modernizing laws and the law making process
There are no precise goals in this area	Government system and administrative reform
Goal 16- Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Enhancing judiciary system and accountability
Goal 16- Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	Public participation and transparency-including access to information

National Strategic Objective 7. Repositioning Lebanon on the Arab, Mediterranean, and international map	
UN Sustainable Development Goals related to the National Initiatives	National Initiatives
There are no precise goals in this area	Enhancing representation in international and regional fora and activating embassies
There are no precise goals in this area	Pursuing Lebanon's rights
There are no precise goals in this area	Conserving the banking and insurance sectors

National Strategic Objective 7. Repositioning Lebanon on the Arab, Mediterranean, and international map	
UN Sustainable Development Goals related to the National Initiatives	National Initiatives
Goal 10- Reduce inequality within and among countries	Promoting the products of productive and creative sectors, and attracting direct foreign investments
Goal 8- Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all Goal 12- Ensure sustainable consumption and production patterns	Developing tourism, including rural, ecological, and medical tourism

List of Acronyms

CDR - Council for Development and Reconstruction
MAP - Mainstreaming, Acceleration and Policy Support
MDGs - Millennium Development Goals
MoA - Ministry of Agriculture
MoET - Ministry of Economy and Trade
MoEW - Ministry of Energy and Water
MoI - Ministry of Industry
MoSA - Ministry of Social Affairs
MoT - Ministry of Tourism
NSDS - National Sustainable Development Strategy
PCM - Presidency of Council of Ministers
SDGs - Sustainable Development Goals
UNDG - United Nations Development Group

Session V

Dr. Roger Melki
Economist
Water Management Expert

Framework for a National Water Tariff Strategy in Lebanon

I. Introduction

Strategies are normally prepared in the frame of an overall policy intended to set a whole strategy for development in a country.

1.1 Water Tariff Strategy Framework

- Water and wastewater tariff strategies play a key role in the supply and management of water resources. usually
- Tariff strategies vary according to:
  - The desired objectives and priorities decided by the Public Authorities
  - The existing infrastructure of water production and distribution
  - The management organization
  - The current tariff situation

1.2 General Principles of Water Tariff Strategies

- Economic efficiency: water resources are used at lowest social cost, from financial, resource, and environmental perspectives;

- Cost-recovery: produce revenue sufficient to meet the financial needs
- Fairness: tariffs should treat all consumers equally. Cross-subsidy needs to be limited to a last-resource tool;
- Financial stability: minimize risks of unexpected fluctuations;
- Resource conservation: encourage resource conservation
- Social orientation of water services: guaranteed provision to all
- Water utility is not a social agency.
- Economic and social incentives cannot be used as political objectives
- Simplicity and understandability no unnecessary complexity

II. Tariff Strategy: The Lebanese Context

2.1 Parties Involved within the National Water Plan

- Ministry of Energy and Water,
- The 4 water establishments.
- Other involved bodies are:
  - CDR
  - Council of the South
  - Ministry of Environment
  - Ministry of Public Health
  - Ministry of Public Works
  - Ministry of Interior and Municipal and the Municipalities
  - Ministry of Finance gives his approval on water tariffs

2.2 Actual Tariff Policies in Lebanon

- Involved institutions
  - "Water establishments will be in charge…. taking into consideration social, and general economic constraints"
  - Ministerial decrees based on proposals by the Minister of Energy and Water together with the Finance Minister.

- Tariffs Financial Concepts
  - Tariffs are disconnected with the real cost of the provided services and fail to cover not only sector investment, but in many cases operational costs.
  - The existing fees finance mainly the salary charges and a small part of the operation and maintenance costs;
  - Tariffs are therefore highly subsidized.
- Tariffs structures
  - Flat tariffs are applied on subscription not related to real consumption.
  - The main part of the bill is the consumption charge.
  - Other fixed charges are the connection charges.
- Cost covering
  - Unrelated Links Between Costs, Prices and Consumption neither the water utilities nor subscribers are able to measure volumes of water effectively used or paid for
- Privileges
  - Although some few exceptions remain, all individuals or organizations including administrative institutions, public schools and the army… are due to pay water charges.
- Management environment
  - Limited Autonomy of Water Establishments
  - Insufficient Technical and Managerial Human Resources.
  - Obsolescence of the Network
  - Problems in Electricity Supply charges.
  - Poor Billing and Collection
  - Weakness of Infraction Control
  - Water Leakage and Losses
  - Absence of Accurate and Reliable Data for the Sector
  - Absence of Accurate Financial Information

III. Setting a Tariff Strategy Framework

Various elements and components to any tariff strategy.

- Cost Components objectives

Several cost components are associated with providing water services:

  - Operation and maintenance (O&M) costs of the water and wastewater systems;
  - Depreciation costs of existing assets;
  - Debt service or financing costs;
  - Replacement and expansion costs;
  - Profit margin
  - Environment rate

- Rate Structures
  - Tariff structures may include fixed and variable components elements
- Increasing Block Rates
  - Tariff strategies are given priorities to designs addressing water conservation in addition to cost of service concern
- Minimum Charges
  - A minimum charge is a fixed regardless of whether or not the water is used
  - Metering, Billing, Collecting
  - Main component of the tariff strategies
- Low Income Affordability Rate
- To keep water services affordable for very small water users
- Negotiated Rates
- A utility may set a negotiated contract rate tailored to meet a customer's needs under special circumstance
- Economic Development Rates

- An economic development rate encourages economic development in some areas or sector activities

IV. Conclusion

- Integrated Approach - Global Action Plan
- Guiding Principles
- Concerned Stakeholders
- Political Commitment for Water Resources Management
- Public Private Partnership
- Role of International Funding/Financing Agencies

Mr. Ibrahim Mallah
President of the Sustainable Development
Environment & Energy Committee

Promoting Water and Energy Use Efficiency in the Lebanese Industry

I. Introduction

The Association of Lebanese Industrialist (ALI) is the overall Representative of the Manufacturing Industry in Lebanon. It is an NGO, which was founded in 1943. It groups Top Industrialists & Industrial Syndicates. Its mission is to create and maintain a favorable environment for industrial investment, growth and development. It is engaged sustainable development efforts and environment and renewable energy related issues since 1992.

The Green Production Help Desk (GHD) at ALI provides information and technical advice to Lebanese Industries that want to engage in the emerging green economy. Its main goal is strengthening capacities in Lebanon on greening the industrial sector through:

- Information Sharing 
- Training
- Networking 

II. Environmental impact of the Lebanese Industry

Consumption of natural resources is essential to produce goods. However it should not mean overuse or depletion of environmental resources.

2.1 Facts on Water & Energy usage in the Lebanese Industry

Three Main Environmental Issues are associated with Industrial activities:

- Energy Consumption
- Water Consumption
- Wastewater Generation

- ENERGY:
  - The Electricity Cost incurred by the Lebanese industry is very high, due to the fact that energy cost is highest in the region.
- WATER:
  - The generated wastewater by the Lebanese industry is disposed of untreated into the environment, thus causing contamination hazards to public health, soil and water resources.
  - Water is somehow used irresponsibly, resulting in low water productivity in almost all the sectors of national economy.

The heavy toll on the industrial sector leads, to high cost of production and unfair competition.

III. What can be (or being) done in many industries?

3.1 Energy consumption:

- Create power generation plant, employing new generators and more effective burning systems.
- Organize the hours of the heating, ventilation, and air conditioning (HVAC) system in order to save energy.
  - Enhance the lighting system of the establishment; remap light bulbs and change for energy efficiency.
- Improve power generators by setting heat exchangers on the exhausts of the generators to reduce the consumption of energy and increase efficiency

Figure 1.

3.2 Wastewater:

Establish an onsite wastewater treatment plant and reuse the treated water in the process system again, either for cooling or in the production process when possible.

Figure 2.

3.3 Water Consumption:

- Put water meters to detect leakages as well as water saving devices.
- Change the design of water usage or landscape of the establishment to consume water more efficiently.

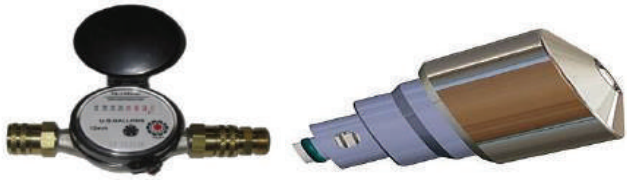


Figure3.

IV. Recommendations

- Create green industrial cities equipped with a developed infrastructure, including sewage systems, water treatment plants, renewable energy generation sites, etc.
- The Lebanese Government should:
  - Speed up with the extraction of gas discovered in the Lebanese sea
  - Create a support fund for energy-intensive industries
  - Encourage and adopt the use of alternative energy
- Lebanese Industries should: enhance wastewater treatment and its reuse within the production process
- Use ecological and high-tech machineries to reduce water and energy use

Mr. Nasser Nasrallah
President
Ibrahim Abdel Aal Foundation for Sustainable Development

The Role of Civil Society

The role of civil society began to take shape after the set-up of the Earth Summit in Rio in 1992, to evolve constantly afterwards, thus expanding its horizon among most of the active institutions of civil society, especially those that are not-for-profit. Sustainable development and its economic, social, and environmental dimensions have become the talk of all those concerned.

I argue that in order for a civil society to play its role effectively, it must raise the common issues of concern to most people, away from any political influence or ambition or profit.

In the same vein, the civil society has to work on the dissemination of an enlightened and effective culture, which relates to the issues raised, in order to mobilize the potentials and have them act as a pressure group to influence the authorities and the governmental organizations at the national and global level; consequently, enabling the civil society to practice and apply whatever it aspires for.

The civil society and the affiliated institutions must exercise a leading, prominent and transparent role. Thereupon, they can win the

* The original text is in Arabic

confidence of the people as a prelude to push them to stand by and defend their rights.

The work of the civil society must be national, regional, and global.

Furthermore, the civil society should be a role model for cooperation, solidarity, and keeping away from corruption and selfishness. In addition, its active volunteers have to welcome all other effective sectors in the community; especially the municipalities, non-governmental organizations, associations, academics, free professions and labor unions, amongst others.

The Ibrahim Abdel Aal Foundation, which assumes a leading and significant role in the civil society, is committed to Sustainable Development. Thus I shall highlight its main concerns:

1. The right of the people to sustainable and clean water
2. Securing sewage treatment
3. Protecting water from pollution, which remains the most dangerous threat to our water
4. Rational use of water
5. Disseminating a culture of water-governance in order to avoid wastage
6. Focusing on collaboration with schools to spread the water culture among students, namely through direct communication and workshops, in coordination with the Ministry of Education and school administrations
7. Keeping-up with water legislations along with expressing relevant views. Conjointly communicating with the officials concerned for the good of society because we believe in integrating with the state and not the contrary
8. Publicizing and disseminating a culture of sustainable development

9. Working on adapting an integral water management
10. Raising awareness with regards to the dangers resulting from the abundant flow of water, caused by climate change worldwide due to thermal emissions
11. Cooperating with the civil society organizations and urging them to increase coordination among each other, to be able to play a pioneering role in raising awareness and furnishing guidance at all levels

I hope that Lebanon can overcome its current crises the soonest, so we can translate these ideas into actions, for the benefit of the Lebanese who have extremely suffered and still suffer from disregard and negligence of their public affairs.

Closing Session & Recommendations

Dr. Safa Baydoun
Research Center for Environment and Development Escwa
Beirut Arab University, Lebanon

Dr. Talal Darwish
Center for Remote Sensing Beirut Arab University, Lebanon
National Council for Scientific Research, Lebanon

Concluding remarks and recommendations

I. Introduction

Lebanon is increasingly heading towards water scarcity. Today, a good share of the Lebanese population and inhabitants don't have access to clean water. Yet, it is still inappropriately managed and wasted while most of the nation pays too much for potable drinking water. The UN defines scarcity as “the point at which the aggregate impact of all users impinges on the supply or quality of water under prevailing institutional arrangements to the extent that the demand by all sectors, including the environment, cannot be satisfied fully”. A simpler explanation is furnished by the European Commission which defines water scarcity as “a situation where there is insufficient water to satisfy basic needs”. In arid and semiarid regions, like most of Arabic countries, water scarcity is largely driven by droughts, climate variability, economic development and population growth. Although Lebanon enjoys relatively favorable cumulative water availability, the water

resources of the country have been facing enormous anthropogenic and natural pressures leading towards water scarcity unless rapid and effective measures are implemented.

II. This report reflects the concepts and sessions deliberations of the Rafik Hariri Foundation-UNESCO Conference on Water Scarcity held in Beirut on December 14-16, 2015. The conference addressed water scarcity in Lebanon and ways of accounting for future challenges. It discussed both the physical and economic levels of water scarcity and need for urgent coping actions, locally and nationally, at river basin and watershed levels. It stressed that rapid population growth, growing food and water demands, the expansion of economic activities, climate change and lack of sustainable water management practices form the major challenges facing Lebanese water resources. Further, the recent influx of Syrian refugees has added extra tremendous strains on food and water needs in the country, particularly exacerbating the pressures in rural areas where the major share of refugees is hosted.

The conference shed light on the significant declines in water tables and increased contamination levels in aquifers and salt water intrusion into groundwater along coastal areas. Speakers argued that off-shore exploitation of submarine springs along the Lebanese coastline to face future challenges couldn't be considered feasible due to technical challenges, high cost, flow and quality variability, and sensitivity to littoral pumping.

The presentations and debates stressed the unprecedented changes in climate over decades and millennia, which were stated in the Fifth International Panel (AR5) on Climate Change (IPCC) Report (2014). Alarming projected decrease by over 25% in precipitation and 25% increase in evaporation are projected for the Arab world by the end of the century. The net effect will be a major reduction in available water resources exacerbating current water challenges. Downscaled predictions for Lebanon indicate an increase in temperature of 3.5^{o}C - 5^{o}C, a

decrease in rainfall by 25%- 45% , an increase in number of hot summer days (Tmax> 35^{o}C), and tropical nights (Tmin> 25^{o}C), prolonged drought period, increased intensity and frequency of extreme events, and yearly net loss of 450 Mm^3 of water availability by 2090.

The current Third National Communication on Climate Change focuses on economic costs of climate change and cost of reduction in water supply. Information is insufficient to describe other potential costs of the degradation in water quality and changes in precipitation patterns. A challenge remains to establish a link between future climate projections and business sectors, several environmental and socio-economic features at local and regional levels. Rural communities and more particularly poor small farmers, who are largely based on weather-sensitive agricultural systems, are the first to suffer of climate change impact.

The speakers speculated that as climate change warms the atmosphere, the hydrologic cycle and the associated process are altered. In addition to the decrease in water availability and increase in the occurrence and frequency of droughts, climate change can influence water quality, decrease snow cover and residence time and cause a shift of snow elevation from 1500 m to 1900 m. Changes to the amount, timing, form, and intensity of precipitation will continue at various degrees to impact the flow of water as well as water quality in different watersheds in the country, with Bekaa-Hermel being the most vulnerable.

In assessing the determinants of vulnerability to water scarcity, as a necessary tool to induce the formulation of policies and measures to manage susceptibility under current and anticipated future conditions, two interrelated physical/natural and anthropogenic aspects of vulnerability were addressed. The physical/natural aspect was associated to the direct reliance of Lebanon on precipitation while climate models are projecting an increased frequency of dry years, seasonal, pronounced

inter-annual variability and over exploitation of groundwater. Whereas, anthropogenic aspects were linked to water inefficiency in the agricultural sector, losses in water networks, increased pressure on groundwater resources, flat rate tariff policy, limited water storage, lack of wastewater treatment and reuse.

As the most vulnerable sector to water scarcity and climate change, agriculture was stressed as the core of any successful adaptation and mitigation strategy that is needed to be consistent with safeguarding food security, rural livelihoods and agricultural system sustainability. Estimates of the Ministry of Agriculture indicate decreases in crop production, increases in associated costs and emphasized burden to the poorer of more vulnerable regions of the country such as Bekaa-Hermel, where water is the single most important and limiting factor of socioeconomic development. Ministry efforts are geared towards improving irrigation efficiency of existing and planned irrigation schemes, shifting to drip and precision systems could improve efficiency, though large investment would be needed. The implementation of government plans for the development of the irrigation sector and irrigated areas were stressed as crucial to enhance agricultural water productivity, optimize on-farm irrigation techniques, promote the management of small scheme network, introduce drought resistant crops and adjust planting dates and location.

The conference stressed that the development of policy and legal frameworks for an integrated national planning and management decisions of the interconnection between water, food, and energy can have crucial implications on the security of these vital resources. Consequently, coherent institutionalization of shared governance and financial governmental coordination of water-food-water nexus become essential to achieve Lebanese development goals.

During the conference, it was raised that although the overall water use in Lebanese industry is relatively small, it is very important to

consider wastewater treatment and industrial water management initiatives as a critical component that can actually provide cost-effective solutions to water use efficiency. Typically water in industry is used in manufacturing process, cooling water, and feed water to boiler systems for steam generation. Although there is a growing awareness of the strategic importance of water for industry, there is a limited number of industries in Lebanon that manage their waste water through well designed and efficient systems. In rare cases where wastewater treatment is attempted, it is usually sub-optimal and costly in terms of manpower, energy and technology needs. Thus, the use of renewable energy, creation of green industrial cities and turning to new technological innovation should enhance water efficiency and reuse not only in industry but also in other sectors taking into account the impact of treated water on health, quality of soil, agricultural and manufactured products.

As the responsibility for managing water and water services was found dispersed across multiple institutions which rarely coordinate among themselves, there is an urgent need to improve water governance and enhance administrative coordination between associated governmental functions and various multisectoral regional and international projects. The conference highlighted the necessity to adopt an integrated approach for water resources management (IWRM) to address threats posed to inefficient use of water resources taking into account a broad spectrum of social, economic, and ecological factors through political commitment and partnerships involving individual citizens, governmental and non-governmental organizations.

The conference stressed the fundamental role civil society can play in developing the nature and dynamics of water resource management tools to ensure optimal sustainable balances of water use. This involves raising awareness among policy-makers and the general public to the importance of water, human rights to water and sanitation, water conservation, protection from pollution and many other aspects.

Further, the conference found that since artificially low prices and heavy subsidies to water services were the key causes of inefficiency, overuse, excessive pollution and degradation, it is crucial to develop and implement water pricing schemes that meet acceptability, economic efficiency, cost recovery, and equity. Such schemes can cover the *cost* of inspection, rehabilitating and upgrading of water *networks through a cost*-effective manner which, in turn, should minimize leakages and wasting. Thus, flat fees should be replaced by a tariff structure based on a fixed charge for individual basic needs and incremental charges relative to usage level. The structure is to be applied to water supply systems in both private and public sectors.

During the conference, a holistic National Plan, comprised of four major actions, was discussed focusing on:

i. Establishment of a Water Board of dedicated administrative and technical body selected from the public and private sectors, responsible for managing all aspects of the water sector and maintaining well coordinated operations at all administrative levels and between various stakeholders
ii. Profiling watersheds and river basins to identify priority watersheds and river basins for implementation of IWRM and assess groundwater vulnerability in water stressed areas, and improve water infrastructure and storage
iii. Enhancement of safe water supply to water-stressed communities through suitable financing, tariffs, and incentives that reflect the full cost of providing safe water equitably
iv. Strengthening existing human resources capabilities and capacities in the water sector.

The conference stressed the need to develop a Water Scarcity and Drought Preparedness Plan as a key enabling measure in strengthening the resilience of social, economic and ecosystems in Lebanon. The proposed plan is based on three levels of water scarcity: Scarcity of

accountability for achieving sustainable outcomes; Scarcity of organizational capacity; and Scarcity of physical resources. The plan was formulated of five components including:

i. Institutional coordination and cooperation to achieve concerted actions
ii. Development of a National Strategy to Overcome Water Scarcity
iii. Establishment of a National Monitoring Network
iv. Support research on recharge mechanisms
v. Development of legal basis for rationalizing water use.

The conference stressed as well that water is at the core of sustainable development and is critical for socio-economic development, healthy ecosystems and for human welfare. Therefore, "Water and Sanitation" was adopted as Goal Six (SDG6) in the set of 17 goals of the new sustainable development agenda (SDGs) to end poverty, protect the planet, and ensure prosperity for all**.** Access to safe drinking water and sanitation was stressed as crucial for poverty eradication, education, and gender equality, reduction of child mortality, improved maternal health, combating major water-borne diseases and achieving environmental sustainability. These issues are inherently intertwined with water, as this crucial resource is a vehicle for diseases, and water scarcity brings additional burden on socioeconomic inequalities. Thus, the conference concluded that water security is implicitly central for reaching all SDGs and not only SDG6.

Furtherstill, The conference emphasized a set of elements deemed necessary through the development of the "National Development Plan" for Lebanon. These elements include:

i. Development of national coordination among governmental institutions, ideally under independent government body or the Cabinet

ii. Mapping of stakeholders per goal/target/indicator of the national plan
iii. Designation of a lead institution/goal/target/indicator
iv. Consultation with stakeholders and civil society including all public sectors
v. Exchange and share of Data
vi. Funding for core concerns and capacity development of government staff to improve monitoring quality

In accordance with Lebanon national priorities and circumstances, the Roadmap for the elaboration of National Development Plan integrating indivisible set of seven strategic objectives was launched in 2015. With the expectations to be completed in 2016, the plan is focused on national priorities of economic, social and environmental goals and their interlinkages in achieving sustainable development in all its dimensions. The plan includes consultation process with concerned partners (ministries, municipalities and unions of municipalities, private sector, civil society, the academic sector).

The main message of the Rafik Hariri Foundation-UNESCO Conference on Water Scarcity, held in Beirut 14-16 December 2015, is multifold:

i. Lebanon is already leading to a water scarcity that will be worsened if sustainable water management and climate change policies are not urgently implemented
ii. Multi-dimensional, water scarcity can be addressed through policy, institutional reforms, education, research and innovation, and public participation
iii. Management of water scarcity is only possible if a strategic political decision for institutional reforms is seriously and urgently adopted, including water governance, establishment of a Water Board of dedicated administrative and technical body selected from the public and private sectors, and the generation

and sharing of reliable data on water availability and behavior. This Board maintains well-coordinated operations at all administrative levels and amongst various stakeholders

iv. Increasing water efficiency and productivity in agriculture and industry; resource protection by a more effective management of industrial wastewater through regulation, investment, and innovation; increasing strategic water storage capacity

v. Development of policy and legal frameworks for an integrated national planning and management decisions of the interconnection between water, food, and energy

vi. Development of water scarcity and drought preparedness national plan

vii. Development of monitoring and evaluation systems based indicators on water related governance issues

Comparative Study on Water Governance in Lebanon, Tunisia and Jordan

Water Scarcity and Institutional Frameworks

Patricia Haydamous, Rana El Hajj and Nadim Farajalla

Climate Change and Environment

Issam Fares Institute for Public Policy and International Affairs

American University of Beirut

I. Introduction

Different regions in the world face high risks to water scarcity and drought, and the Middle East North Africa (MENA) region tops the chart in this regard, where the residing population forms five per cent of the world's population but is supplied with only one per cent of the world's fresh water (Rached & Brooks, 2010). The MENA countries are considered to be arid and semi-arid where the region's average annual rainfall reaches 166mm(Al-Ansari, et al. 2014). The estimated effects of climate change on the region will cause further severe shortages in the different water resources (Al-Ansari, 2013). Figure 1 and Figure 2 show the variability of precipitation and variability of aridity across the MENA. Most of the MENA countries have very low precipitation with the exception of the areas along the Mediterranean rim. As such the MENA region is facing a high risk of stability and sustainability due to water scarcity, and this might hinder further economic development and growth.

Rainfall within the MENA region itself is quite variable in as much as socio-economic characteristics and demographics vary (Rached & Brooks, 2010). Moreover, the MENA countries are at different stages of water scarcity preparedness due to their physical water and governance system differences. As such this study aims at providing a better identification of good governance of water scarcity by comparing water governance in three selected countries: Lebanon, Tunisia, and Jordan.

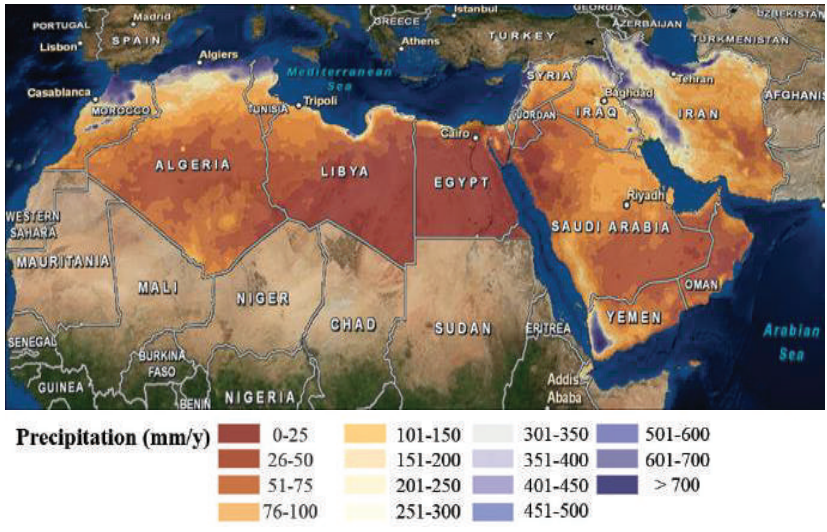


Figure 1: Precipitation Distribution in the MENA (source: futurewater.eu)

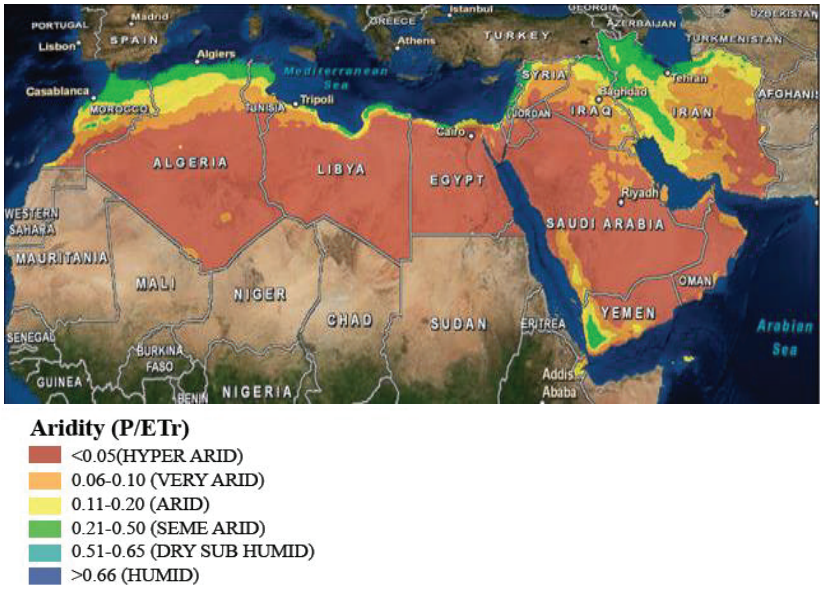


Figure 2: Aridity in the MENA (source: futurewater.eu)

The methodology followed is a comparative study of the three selected countries, which represent major hydro-climates of the MENA but are similar geographically (various micro-climates, physiography,

population, economy, socially, etc.). These three countries are at different stages of water scarcity and have similar yet different water governance systems. As such they can form a platform for the exchange of experiences in water governance from which other countries in the region may benefit.

II. Water scarcity

Water scarcity is a state with several dimensions that can be based on physical or socio-economic/political conditions. Physical conditions are comprised of the natural inexistence or insufficiency of water due to the nature of the land, its geographic region, its droughts and heat waves incidents, or even an imbalance in the ratio of population size to water availability. However, socio-economic/political conditions are the derivatives of insufficient funds, poor planning, and an unstructured political framework. Either way, water scarcity is a condition that needs to be addressed as it hinders further economic growth and it is a condition that will worsen with the increase in population size and the impacts of climate change.

Water scarcity is one of the main obstacles facing the world in the 21st century. As the world population is on the rise and climate change is taking its toll on weather cycles, water cycles and water bodies, extra pressure is mounting on water resources and consequently water security of nations. On-ground, this translates into around thirty five percent of the world population currently suffering from “severe water stress”, and having 65 percent of water bodies facing moderate to high degradation pressures (Dinar & Basin, 2013).

Water availability issues are not only linked to the natural and physical aspects, but also to other reasons related to the management, supply and distribution of such resources. As such, when looking at water scarcity there is a need to refer to three dimensions “quantity, quality and institutional capacity”; therefore, water scarcity can be the

product of a physical lack of water and the inadequate governance of the water resources (Emtairah et al., 2005).

In order to measure water scarcity, several indices have been developed, ranging from very basic and simple indices into more complex and multi-dimensional indices (White, 2014). The earliest developed indicator is the Falkenmark indicator known as the water stress index which tests the available renewable water per person per year and identifies 1000m^3/year/capita as the threshold limit to a water scarce country(Falkenmark, Lundqvist, & Widstrand, 1989). This indicator was the first developed index and has been criticized for not including all the related components of water scarcity such as flexibility in demand of water and other associated risks (White, 2014). Another indicator is the criticality ratio which compares the national demand to the national water availability and is calculated as the total annual withdrawals divided by the available water resources, thus giving the flexibility of having different water demands across different countries. Although this index relaxed one component of water scarcity, which is an estimated demand per person common to all like the case of the Falkenmark, there were still other assumed factors that were missing from the index. The International Water Management Institute (IWMI) developed a water scarcity indicator that distinguishes between physical and economical water scarcities by including the different water infrastructures according to their respective consumption use; for example, the use of desalinated water for irrigation. This still fell short of achieving an all-inclusive index. A much more elaborated method of measuring water scarcity, developed by Sullivan et al (2003), is the "water poverty index" which accounts for "(1) the level of access to water; (2) water quantity, quality, and variability; (3) water used for domestic, food and productive purposes; (4) capacity for water management; and (5) environmental aspects" (Sullivan et al. 2003). However this method has proven the hardest to calculate on large-scale areas and is better suited for local studies.

The development of the indices has proven the difficulty in quantifying water scarcity; however, defining the variables of the indices helped more clearly identify the risks associated with water scarcity. Looking at the water poverty index in particular, factors that affect the scarcity variables could be at the same time the risks to water resources. A report produced by the Stockholm International Water Institute (SIWI) and United Nations Environment Programme (UNEP) identified some of these risks as drought occurrences, water quality which affect the quantity of water, institutional and managerial capacities for water governance affecting water management, political and regulatory, cross boundary water conflicts related to water accessibility and local communities and stakeholders (Emtairah et al., 2005).

III. Water in Lebanon, Jordan, and Tunisia

The climate and the geography of the three countries differ, reflecting this in the spatial and temporal distribution of their water resources. Such difference is part of the reason for conducting this comparative study in that it allows for the assessment of governments' response to scarcity, given the differences in resource distribution at hand.

Tunisia is located on the Mediterranean, the northern African border; it has a Mediterranean climate in the north with a relatively high amount of precipitation, and a desert climate in the south with an increase in aridity. Tunisia's water resources are unequally distributed across the country where 81% of the water resources are located in the north, 11% in the center and 8% in the south (Louati & Bucknall, 2010). Moreover, due to the salty nature of the land, groundwater tends to be saline, and requires further treatment to become potable.

Lebanon is located on the eastern Mediterranean and enjoys a mostly Mediterranean climate. Lebanon is classified as a semi-arid country but receives a relatively high amount of precipitation; a

significant portion of which is in the form of snow which allows for the recharge of its groundwater.

On the other hand, Jordan is located close to the Mediterranean but has a mostly desert climate, classifying it on average as a very arid land. Jordan's principle water sources are transboundary with the headwaters outside the country's borders making it totally dependent on external sources and their management by others.

In terms of water availability, Tunisia rates highest with available renewable water of 4.8 billion cubic meters, Lebanon follows with 2.7 billion cubic meters, and Jordan with the lowest renewable resource at 0.78 billion cubic meters. This translates to different per capita availability, according to the Falkenmark index, taking into consideration the distribution of the water on the population whereby Lebanon ranks first at 962m^3/capita/year followed by Tunisia at 451 m^3/capita/year and Jordan at 146m^3/capita/year.

Surface and groundwater are both utilized in the three countries but in different ratios. Groundwater represents 18.59% of Lebanon's water resources with 81 % supplied from streams and rivers. Tunisia withdraws 61.13% of its freshwater from groundwater using nearly 2300 wells operated by the national agencies for water supply. Jordan's main groundwater resources are nonrenewable water aquifers, and in total groundwater represent 40% of total withdrawals.

In order to expand water supply, conventional and nonconventional water sources have been tapped. Use of treated wastewater and desalination top the latter while the former is mostly represented by surface storage. Lebanon has two constructed dams only, with a combined capacity of 235Million Cubic Meter (mn. $m^{3)}$, and representing only 53m^3 per capita capacity. It also has seven wastewater treatment plants with very little of their effluent used as a water source. Tunisia has been greatly expanding its supply through nonconventional

methods whereby it has 106 treatment plants producing 236mn. m^3 augmented by 19.7mn. m^3 from desalination. "Since the 1970s Tunisia has been formally re-using treated wastewater in agriculture and now has one of the world's highest rates of re-use"(Louati & Bucknall, 2010). Moreover Tunisia has 30 constructed dams with a per capita capacity of 237.1 m^3. Jordan on the other hand has also implemented desalination projects producing 50mn. m^3, 24 wastewater plants expanding supply by 98mn. m^3, and has constructed 30 dams with a per capita capacity of 43m^3. These figures are summarized in Table 2.

Table 2: Countries facts and figures

		Tunisia ("SEMIDE," n.d.)	**Lebanon** (Ministry of Energy and Water, 2010)	**Jordan** (Ministry of Water and Irrigation, 2013)
Population		~11 million	~4.5 million	~6.5 million
Area		163,610 km^2	10,452 km^2	89,342 km^2
Natural resources	Groundwater	2.1 Billion m^3	0.5 Billion m^3	0.275 Billion m^3
	Surface water	2.7 Billion m^3	2.2 Billion m^3	0.475 Billion m^3
	Total available renewable	4.8 Billion m^3	2.7 Billion m^3	0.78 billion m^3
Artificial Surface Storage	Number of Dams	30	2	30
	Dams Capacity per capita("UN-Water: KWIP,".)(UNDP, 2013)	237.1 m^3	53 m^3	43 m^3
Groundwater sources	Wells*	~2300	~269	>3000
Nonconventional Sources	Desalinated Water	29.7 million m^3	-	50 million m^3
	Treated Wastewater	296 million m^3	N/A	98 million m^3
	Waste water treatment plants	106	7	24

The three countries are facing different types of water scarcities, whether physical or economical/managerial. The end result being that the per capita water availabilities fall below the 1000m^3 threshold. Risks to the water resources faced by these countries are; the natural variability in its occurrence; its nature as a shared resource internally and across boundaries; water pollution and climate change. A higher risk is the governance of the water sectors in the Arab nations; the present status of water supply in Arab countries is the direct result of their water governance system.

IV. Water Governance in selected countries

Water governance is a combination of political, social, economic and administrative systems integrated to effectively manage and develop water resources and deliver water services to various segments of a society (Rogers & Hall, 2003). These components are the organizations that form the institutional structure, the laws on which these institutions are built and their resulting policies. Traditionally, water governance institutions in the MENA have been more oriented towards large-scale supply projects, and are highly centralized (Rached & Brooks, 2010). As such public involvement is rare when it comes to decision making.

Institutions and organizations form an important part of water governance and include the public/national institutions, the semi-private or semi-independent institutions that provide the service of supplying water, and other NGOs and local communities such as water user's associations(De Stefano et al., 2014). Accordingly these institutions can be grouped as (1) policy making institutions with the executive power to manage and develop the sector, (2) the operational institutions that deal with the water supply, and (3) the local community institutions with the

ability to voice demand side problems. The process of decision-making is another critical element of water governance that needs to be highlighted, particularly within the organizational structure and the policymaking.

However, as explained by De Stefano et al. (2014), "there is no routine prescription or standard for a 'good' organizational arrangement based simply on structural considerations, such as the existence (or not) of a given agency or a specific distribution of responsibilities among the existing organizations"(De Stefano et al., 2014). Accordingly, the institutional structure of water governance under water scarcity in the three selected countries will be compared. A proposed framework will look at the institutional structure of the three countries, including policies, laws and organizational structures, and assess the different levels of preparedness based on the different risks that are addressed by the governing body in their policies and the resulting project implementations.

1. Tunisia

a. Organizations

Tunisia's water governance follows a mostly centralized system despite the fact that in 1986 the government adopted a national decentralization strategy (EU - SWIM, 2014). The Ministry of Agriculture, Hydraulic Resources and Fishing (MAHR), is responsible for carrying out the different policies and legislative reforms required to promote the two sectors. The ministry supports the development of the agriculture sector, by identifying suitable ways of mobilizing and protecting national resources, especially that water is not evenly distributed across the country. Thus, it is responsible for accomplishing infrastructure works, aimed at the maintenance of farmland and the

conservation of the used resources in order to obtain continuous agricultural development. Among the identified bodies within the ministry is the Office of Planning and Hydraulic Balance, which is responsible for coordinating with the different water stakeholders. It reports directly to the minister and is responsible for developing national plans. Other notable departments within the ministry include the General Directorate of Water Resources, the General Directorate of Dams and Hydraulic Works, the Bureau of Inventory and Hydraulic Research, the General Directorate of Rural Engineering and Water Exploitation, and the Regional Agricultural Development Commissions that are in direct contact with 24 agricultural development groups that represent the ministry on a regional level, and form the communal associations.

The MAHR also oversees the work of SONEDE, which is the National Water Operating and Distributing Company, the government body operating and managing water supply infrastructure. SONEDE was created in 1968, with the mission of managing supply of potable water to most regions of the country, except for rural areas that fall under the responsibility of the Ministry of Agriculture, through the General Directorate of Rural Engineering and Water Exploitation. The Ministry of Agriculture also follows up on irrigation plans and proper water usage in agriculture.

The Ministry of Environment and Sustainable Development provides environmental protection and nature preservation policies; it also conducts routine water quality tests. Under its supervision/control are the National Agency for Environmental Protection ANPE and the National Office of Sanitation ONAS. The ANPE deals with pollution and environmental degradation, and monitors wastewater discharge, whereas ONAS on the other hand operates and manages the wastewater networks.

The Ministry of Health, as well as its sub department the National Agriculture Observatory, is responsible for setting standards and permit

conditions. The National Institute of Meteorology (INM), within the Ministry of Transportation, is responsible for reporting meteorological changes, thus identifying drought incidents for better preparedness. The Ministry of Equipment- Housing and Land management ensures, under its Department of Urban Water, proper infrastructure and building codes for water connections. Lastly, the Environmental Hygiene and Environmental protection, within the Ministry of Economy and Finance, ensures proper budget flow going to the water sector. In rural areas, the management of irrigation and potable water is directed by users associations where the number of water users associations (WUA) was 980 for irrigation and 1260 for potable water systems (EU - SWIM, 2014). The institutions are represented in Figure 3.

Coordination between involved organizations, under the supervision of MAHR, is through periodic meetings to follow up on plans and decisions regarding water management and water resources allocations. They also hold meetings during extreme weather conditions. In addition, the Office of Planning and Hydraulic Balance is responsible for coordinating with all the concerned organizations in water planning (Cedare, 2014; OECD, 2014b; Tunis International Center for Environmental Technologies, 2006).

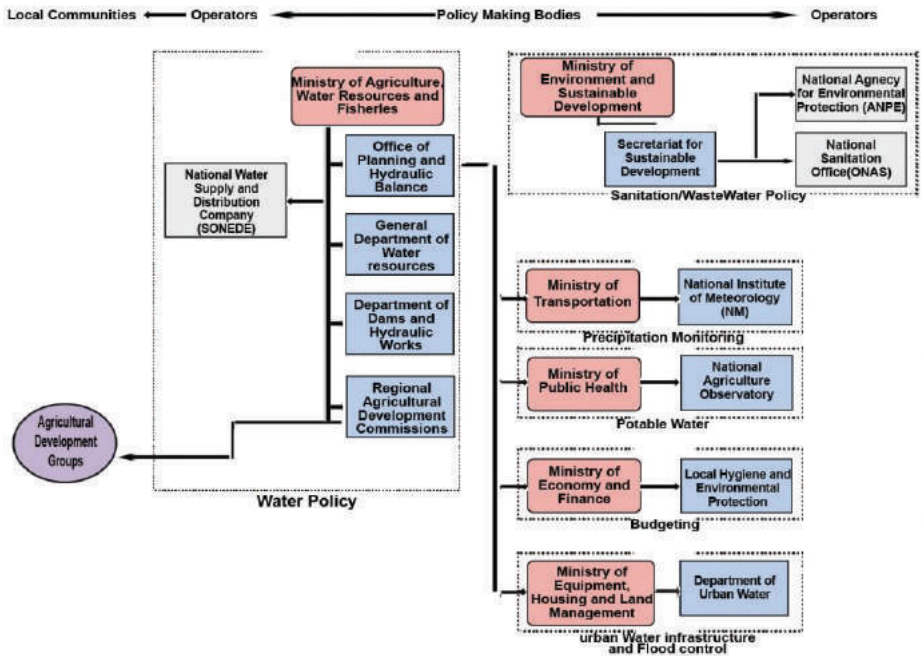


Figure 3: Water Governance in Tunisia

b. Plans and Laws

Tunisia has experienced several droughts resulting in a high economic cost which drove the country to react more aggressively in securing water supply (OECD, 2014b). Moreover, due to the uneven distribution of water resources, one of Tunisia's major concerns has been the plan to convey water to the more urbanized areas. As such, Tunisia's most important plans include a national water strategy, a mobilization and conveyance strategy, implementation of an integrated water resources management system, and a drought management plan(EU - SWIM, 2014).

The Tunisian national water strategy for allocating water focuses on three main elements: (1) demand side management in order to preserve the water resource, ensure economic efficiency and protect social equity, (2) follow integrated water resource management to regulate

groundwater extraction under drought, groundwater recharge, the use of brackish and treated water; (3) protection of resources and the environment by the reinforcing and improving water storage, reducing pollution, and conducting regular monitoring and cost evaluations. This strategy was first developed for the years 1990 to 2000 and then has been updated for the years 2001-2010, and 2011-2016. The IWRM strategy, conducted in 1995 and divided between medium and long-term plans, was developed by the Ministry of Environment for sustainable management of water resources.

Tunisia's drought management plan, which was initiated in 1999, includes three stages, the announcement, a warning system, and implementation of actions (OECD, 2014a). The drought management plan in Tunisia has been enacted and is at an evaluation stage. Initial findings of the evaluation indicate that the various stakeholders are still lacking the proper tools for coordination(OECD, 2014a). The most recent plan is the national water strategy for 2050 aiming at a more holistic approach to the water sector (EU - SWIM, 2014).

Another important tool of water governance includes the laws that shape the work of the institutions. Tunisia's first water decree was issued in 1885. The involvement of the government in water governance was further confirmed in decrees issued in 1933 and 1936 (EU - SWIM, 2014). These were all replaced by the water code in 1975 which has since undergone several amendments (CEDARE, 2014). Current Tunisian water laws, as compiled in the 2014 CEDARE study, include laws for allocation of water, water quality standards, municipal water supply and water sanitation, laws concerning irrigation and drainage, and lastly laws related to extreme events. Table 2 summarizes the activities associated with the various water laws.

Table 3. Water Laws of Tunisia as recorded in the CEDARE report

Activity	Governing Laws/Regulations
Water allocations	• National Water Council. Decree No. 407/2010 dated March 9, 2010
Water quality and National drinking water standards	• Law 82-66 of August 6, 1982 on standardization quality • NT 09 14 • *Law 75-16 of March 31,1975 (Water Code, as amended and supplemented by Law 87-35 of July 6, 1987 and Law of 88-94 of August 2, 1988)
Municipal water supply and Sanitation	• Law 93-41 of April 19, 1993 on ONAS in change of the law to create ONAS August 3, 1974.
Industrial effluent standards	• Decree 85-56 of January 2, 1985 on the terms of discharges into the receiving environment, changed, in 1991. • Decree 2005-1991 of July 11, 2005 defining the study of environmental impact (ANPE)
Irrigation and drainage	• Law 30/2000 on the development of agricultural land within PPI
Extreme events	• Law 75-16 of March 31, 1975 (Water Code), as amended and supplemented by Law 87-35 of July 6, 1987 and Law 88-94 of August 2, 1988

2. Jordan:

a. Organizations:

Water governance in Jordan is highly centralized with the Ministry of Water and Irrigation (MWI). Established in 1988, it is responsible for managing the sector that includes water supply, wastewater and all related projects and plans. Moreover, the ministry is responsible for drawing up new policies and strategies, also carrying out all the necessary data collection and archiving. Within its seven directorates, the MWI has units for internal monitoring and water security and protection such as, the Project Management Unit, the Jordan Valley Authority, established in 1977 to deal with water for irrigation and the distribution of water, and the Jordan Water Authority, established in 1984, to hold the responsibility of water and sewage networks. The latter two are semi-independent entities that report directly to the MWI, though their work sometimes overlaps. It is important to note that the MWI was established to control the water management more efficiently as a result of disputes between the two entities. Moreover, a Performance Management Unit within the Ministry of Water and Irrigation was established with the role of monitoring and auditing work related to public private partnerships (EU - SWIM, 2014). Together these entities form the central role of water management in Jordan. The ministry also works on ensuring efficient irrigation and water use in agriculture. Two entities, the National Water Advisory Council and the Royal Water Commission, both under the king's patronage, act as advisory and consulting bodies to water governance.

Other ministries are also involved in other aspects of water management. Among which, the Ministry of Environment which controls the water quality, the Ministry of Planning and International Cooperation and the Ministry of Finance, both work on budgeting and acquiring grants and aid for water projects, and the Ministry of Public Health for quality control of potable water (OECD, 2014b). The

National Department of Statistics and the National Meteorological Department also play a role in keeping record of water demand and use and in predicting meteorological events.

As such, the water governance has most of its balance within the executive agencies in the government. Even the private companies that work on the operation of the executed plans report directly to the ministry. There are local committees such as water users associations (WAU) and 22 other associations, mostly located in the Jordan Valley. However, they do not play a major role in the governance of the water sector. The Jordanian water governance organization chart is shown in Figure 4.

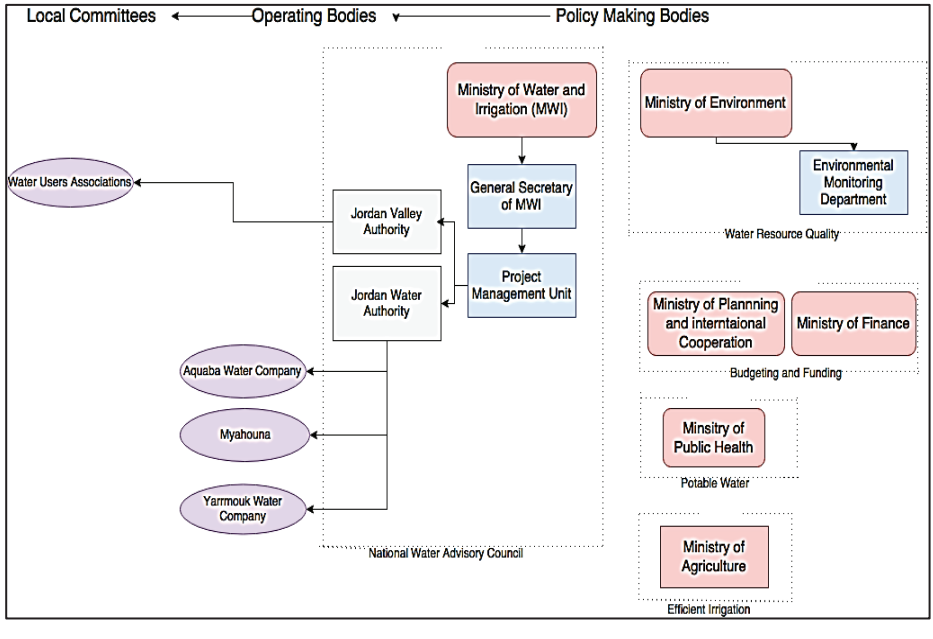


Figure 4. Water Governance in Jordan

b. Plans, Strategies and Laws

In order to tackle the foreseen water shortage, Jordan has set several strategies, policies, and laws including the National Water

Master Plan in 1994 and its update in 2011, the Water Strategy 2008-2022(OECD, 2014b).

The Master Plan addressed the key challenges facing the water sector, such as demand management, socio-economic and environmental considerations as well as transboundary issues. The Master Plan is currently under revision in order to include improved data collection and depict the findings from the application of different models(EU - SWIM, 2014).

Jordan's most recent water strategy spans over 14 years and consists of several pillars. The strategy aims at having "adequate, safe and secure drinking water supply"; better management of all water resources and their sustainable use; and aims to expand supply to adapt to population and economic growth. The strategy also focuses on the need to shift into demand management rather than only increasing supply side. It also stresses on the importance of reducing groundwater exploitation. More importantly, one of the pillars in the strategy, is the development of an outline for a more integrated approach to the sustainable management of the water resources(Royal Commission for Water, 2008).

The strategy also sets out the needed tools to achieve such goals including institutional reform, an applied reduction of groundwater abstraction, and the implementation of the Disi and Red Sea- Dead Sea conveyance projects. The Water Strategy 2008-2022 sets a reform process up to the year 2022 in order to improve the institutional framework including the setting up of a National Water Council which has already been accomplished(Royal Commission for Water, 2008).

In terms of water legislation, the Jordanian water legislation followed until 1988 an Ottoman code. The establishment of the Ministry of Water and Irrigation enriched the water laws in Jordan and provided the institutional frameworks and along with them came the restructuring

and establishments of other relevant institutions(EU - SWIM, 2014). The main law ruling the water resources is the 1988 “Water Authority Law number 18” that also presents the plan for best wastewater management.

Jordan is also initiating a national drought action plan. It is still in its preparatory phase; so still needs several enhancements, such as having a stronger role for the Ministry of Environment, also the need to include all relevant stakeholders such as the Meteorology Department, etc.(OECD, 2014b).

3. Lebanon

a. Organizations:

Lebanon’s water governance structure is centralized within the Ministry of Energy and Water that is responsible for producing plans, strategies, and water policies. It holds the executive power on water management. The ministry has two general directorates, the General Directorate of Hydraulic and Energy Resources, which is responsible for the plans and policies of national water strategies, and the General Directorate of Exploitation, which oversees the work of the four water establishments that deal with the operation and management of water supply across the country. The General Directorate of Exploitation also oversees the work of the Litani River Authority, a semi-independent institution that manages the Litani River basin (Ministry of Energy and Water, 2010).

The role of the Ministry of Agriculture in water governance falls within its responsibility to conduct projects related to water supply and water storage for agriculture within the Green Plan and the Department of Rural Development; the ministry is also responsible for developing and encouraging water saving irrigation schemes. In addition, the Ministry of Agriculture oversees the work of the Lebanese Agricultural

Research Institute (LARI) that operates weather stations, and uses the information to assist farmers in preparations for different weather incidents. The Ministry of Environment is mandated to regulate all activities that might harm the environment including pollution reduction plans. It is also involved in raising awareness for the protection of water resources.

Other ministries involved in water management include the Ministry of Public Health, which is responsible for the quality of potable water, and the Ministry of Economy and Trade, which deals with the consumer side potable water quality, mainly bottled water. The Ministry of Finance allocates national budgets and budgets for ministries and the relevant projects. The Council for Development and Reconstruction (CDR) complements and overlaps with the work of Ministry of Finance regarding grant mobilization for projects related to water (and other sectors).

Sanitation and wastewater collection body, which used to be under the responsibility of the municipalities under the ministry of interior and municipalities, has been moved to the Ministry of Energy and Water under Law 221 (EU - SWIM, 2014). Other governance structures include the inter-parliamentary committee of public work, water and energy. An ad hoc water council was temporarily formed in 2014, from representatives of the aforementioned ministries, to discuss urgent matters related to the drought of that year. Water governance of the Lebanese water structure is presented in Figure 5.

Lebanon's water governance system lacks proper tools that will mobilize the work of the different institutions in a coherent manner. A study, conducted by Farajalla et al (2015) investigated the mandates of stakeholders of the water sector in Lebanon. It showed an overlap in the responsibilities across the different institutions with a strong overlap in planning and project implementation (Farajalla et al., 2015).

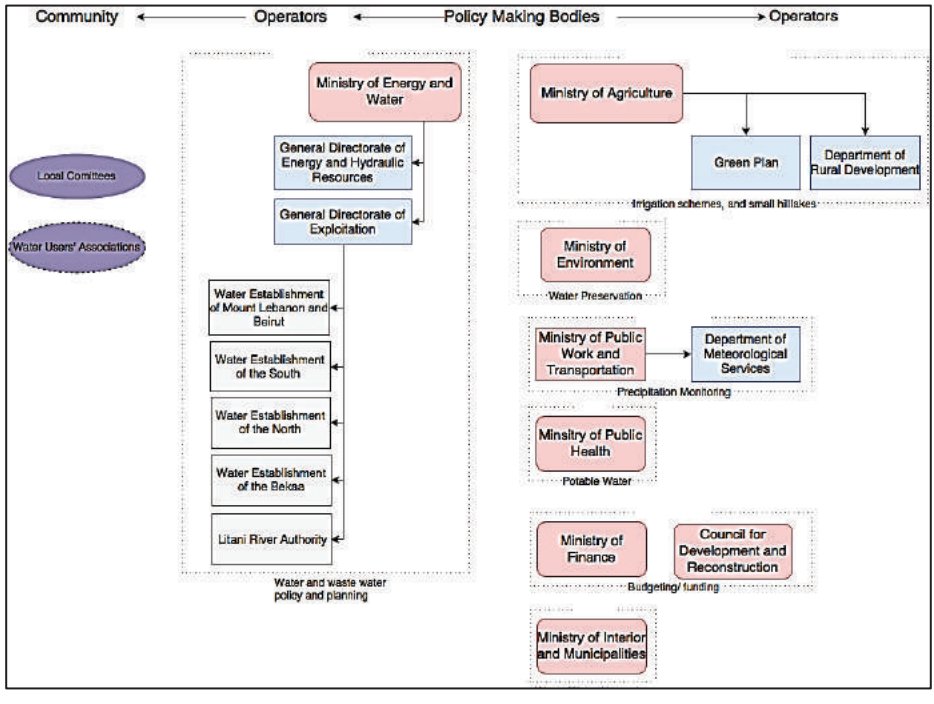


Figure 5: Water Governance in Lebanon

b. Plans and laws:

The water sector in Lebanon is governed by Law 221/2000, which was adopted in year 2000, but with no implementation decrees (Government of Lebanon, 2000). The law specifies the structure and roles for water governance; mainly it includes the division of roles among the institutions. The most important of which is decentralizing water distribution among the water establishments. An inter-ministerial committee representing the Ministry of Energy and Water, Ministry of Finance, Ministry of Justice and Ministry of the Environment, is currently studying a "water code" and its application in Lebanon. The code, though written out, still requires amendments before it can be adopted. It requires the endorsement of its decrees before it may be

implemented (Machayekhi, Kalinowsy, & Valfrey, 2014). The effort concerning the water code has been ongoing since the year 2005. It aims at addressing water management and institutional governance, and is directed towards developing sustainable management of the country's water resources with consideration given to climate change (EU - SWIM, 2014).

The most recent plan for the water sector is the National Water Sector Strategy that covers the period 2010 - 2020 (Ministry of Energy and Water, 2010). The plan focuses on the high risks facing the water sector in Lebanon, which as expressed, are the infrastructure problems and regulatory problems in applying the recently updated Law 221. In terms of infrastructure, the plan includes the need to upgrade and rehabilitate all water networks, give more independence to the water establishments and expand the surface water storage capacity in the country. Moreover, there is a big focus on the need to enhance capacities of the ministry. However, the ministry has not yet drafted a drought management plan or even a drought awareness plan. Other relevant plans include the Agriculture Strategy, that tackles the agriculture warning systems for drought management and highlights irrigation expansion projects. In addition, the Ministry of Environment has required that all projects undergo environmental impact assessments in order, in part, to protect water resources.

V. Analysis

5.1 Governance Structures

The institutional framework for water governance in Lebanon is currently highly centralized with very limited "official" interconnection with other ministries and governmental institutions that are directly or indirectly involved with the water sector. There is a clear demarcation between the Ministry of Energy and Water and the Ministry of

Agriculture overseeing the sector that consumes the most amount of water in the country.

By contrast the Tunisian institutional setup is more integrated or inclusive in that the major user of water, agricultural sector, is overseen by the same ministry managing water resources. Further, the Office of Planning and Hydraulic Balance is directly linked to four ministries that are considered key stakeholders in the water sector. This integration allows for better coordination, on paper and to a great extent in reality, and more justifiable if not equitable distribution of water resources.

Jordan lies somewhere in between the two extremes in that irrigation is overseen by the ministry managing water resources; however the connection to the Ministry of Agriculture which sets up the general development strategy in the sector is not apparent or official.

The Tunisian set up is a more integrated and decentralized system where water resources management is approached in manner that differentiates between urban and rural communities and their dominant needs, potable and flood control in the former versus irrigation in the latter, while at the same time balancing the respective needs.

In comparison, the Lebanese organizational structure is not integrated. There are two core, yet very much separate, institutions (MOEW and MOA) that interface, often indirectly, with more fringe institutions. This set up does not benefit from any complementarity of or support in tasks and policy generation, thereby emphasizing the fragmentation of decision and policy making.

The Jordanian system is similar to the Lebanese but with one major advantage – the presence of a National Water Advisory Council. This council enables the generation of well-coordinated policies and reduces duplication in efforts that are common in the fragmented

Lebanese system. It also has an advantage of the Tunisian system in its direct association with the head of state.

5.2 Plans, Policies and Laws

The laws and policies of all three countries reflect their current water management standing and practice and the evolution of legislation. Jordan has revamped its Ottoman-based laws and Lebanon has partially completed this task. Tunisian law represents an evolution of laws set up during the French colonial era.

Jordan does not have a universal water code; however, Lebanon is finalizing its own and Tunisia is already implementing it. In another aspect that reflects their relatively advanced water management systems, Tunisia and Jordan are currently addressing the incorporation of advanced institutional and management systems while Lebanon is focusing more on taking its water management system to the next level, a more decentralized system by empowering the four Water Establishments. This requires the development of new regulations and refinement and/or implementation of existing ones.

Strategies formulated by all countries are quite similar. All aim to incorporate integrated water resources management into their practice. Further, there is clear shift, but to varying degrees, towards demand management rather than focusing on ensuring water supply. Another common aspect of the country water strategies is the drive to limit and control groundwater exploitation. All three countries recognize this as one of the highest strategic risks to their water resources and their sustainability.

Climate change is an important cross cutting issue that is not well reflected in the policies put forward by the three countries. Lebanon has addressed, but not in depth, the issue of climate change from the perspective of the need for increased surface storage. Tunisia and Jordan

on the other hand have not directly dealt with climate change in their strategies; however, they have tackled one significant aspect – drought. Tunisian initiated its drought management plan in 1999 and Jordan has just initiated its own. Lebanon is lagging behind with no drought management plan even being considered.

The communication and institutional integration, across the different stakeholders, plays an important role in the success of the work, whereby Tunisia's institutions hold regular meetings to share information and data, and to evaluate the current status of all plans, strategies and projects. In Jordan and Lebanon, the coordination efforts and data sharing across the different involved bodies are not clearly defined.

VI. Conclusions and Recommendations:

Comparing water governance in the three countries it becomes apparent that there is not one common system that is used to manage the water system across the countries. The method of governance and the distribution of the roles and responsibilities among the different organizations are based on the need of each country and its general governance system. For Tunisia and Jordan, their main ministries are both strongly connected to the agriculture sector, and irrigation, whereas in Lebanon's case, the ministry's responsibilities are divided among the water and energy sectors with no official link to agriculture. However, when it comes to the operation and monitoring of water supply networks, Lebanon, with its four water establishments, has proven to have a wider decentralized system, as opposed to Tunisia with one organization, and Jordan with two. The similarity across the three countries is that all have a single ministry that is at the center of policy making and developing national water strategies.

The history of the water governance systems has been greatly influential in the success of the system's efficiency in managing the

water sector. In this sense, the Tunisian system has been working since the latter part of the last century on setting the ground for different tracks within its strategies with regular updates. The Jordanian experience is more recent but still has succeeded in establishing well-rooted strategies for the country. In Lebanon, the reform of 2010 is still awaiting the amendments and decrees, thereby delaying plans and strategic implementations.

The different approaches by the three countries in managing their water resources show that there is an evolution in practice towards integrated management. The following may be summarized as "lessons learned":

- Integrated water resources management will result in a more successful resource management system
- Inclusiveness of all stakeholders, especially those that utilize water most, would ensure that water resources are managed better and more sustainably
- Coordination between various institutions (governmental and nongovernmental) is critical for the efficient management of water resources
- Decentralization in water management would ensure more flexibility and better monitoring

Thus, by mobilizing the different institutions and utilizing their capacities; also by ensuring timely and comprehensive coordination, integrated water management plans can succeed.

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1. حق الناس في مياه مستدامة ونظيفة
2. تأمين معالجة الصرف الصحي
3. حماية المياه من التلوّث، لأنّه الأخطر على مياهنا
4. ترشيد استعمال المياه
5. نشر ثقافة التعامل مع المياه لمنع هدرها
6. التركيز على العمل المشترك في نشر الثقافة المائية وغيرها، مع الطلاب في المدارس عن طريق التواصل معهم وعقد حلقات مع ذوي الخبرة بالتنسيق مع وزارة التربية وإدارات المدارس
7. مواكبة التشريعات المتعلّقة بالمياه وإبداء الرأي فيها، والتواصل مع المسؤولين المعنيين لما فيه خير المجتمع لأننا نؤمن بالتكامل مع الدولة وليس العكس.
8. نشر وتعميم ثقافة التنمية المستدامة
9. العمل على اعتماد الإدارة المتكاملة للمياه
10. التوعية من المخاطر الناتجة عن غزارة وتدفق المياه بعدما أصبحنا اليوم أمام التغيير المناخي المسيطر على العالم جراء الإنبعاثات الحرارية
11. التعاون مع مؤسسات المجتمع المدني وحثّها على زيادة التنسيق فيما بينها، كي تتمكّن من أن تلعب دورا" رائدا" في التوعية والترشيد على جميع الأصعدة.

إني آمل أن يتمكّن لبنان من تجاوز أزماته الحالية في أقرب فرصة ممكنة، كي نعمل على تحقيق هذه الأفكار والتوجهات لصالح اللبنانيين الذين عانوا كثيرا"، وما يزالون، من التقصير والإهمال في شؤونهم العامة

أ. ناصر نصر الله
رئيس
مؤسسة إبراهيم عبد العال للتنمية المستدامة

دور المجتمع المدني

بدأ دور المجتمع المدني يتبلور بعد انعقاد قمة الأرض في الريو عام 1992، ومن ثمّ أخذ يتطوّر باستمرار ويتوسّع أفقه عند معظم العاملين في المؤسسات لدى المجتمع المدني خصوصا"، التي لا تهدف إلى الربح. وأصبح الحديث عن التنمية المستدامة وأبعادها الاقتصاديّة، والاجتماعيّة والبيئيّة عند جميع المهتمين.

ولكي يتمكّن المجتمع المدني من لعب دوره بصورة فعّالة، أرى أن عليه طرح القضايا المشتركة التي تهمّ معظم الناس بعيدا" عن أي نفوذ أو طموح سياسي أو ربحي.

كما عليه أن يعمل على نشر ثقافة واعية ومؤثّرة تتعلّق بالقضايا التي يطرحها، كي يتمكّن من حشد الطاقات حولها من أجل التأثير في تحرّك الدولة والمنظمات الحكومية وطنيا"، وعالميا"، وكي يتمكّن من تطبيق وتنفيذ ما يطمح إليه.

إنّ المجتمع المدني والمؤسسات العاملة ضمنه يجب أن يمارسوا دورا" رياديا" ورئيسيا" وشفافا" كي يتمكنوا من كسب ثقة الناس تمهيدا" لدفعهم إلى الوقوف بجانب حقوقهم والدفاع عنها. كما يجب أن يكون عمل المجتمع المدني وطنيا" وإقليميا" وعالميا".

وعليه أن يكون نموذجا" يحتذا به لجهة التعاون والتضامن والابتعاد عن الفساد والأنانيات. وعلى العاملين المتطوّعين قبول كلّ القطاعات الفعالة الموازية في المجتمع، لا سيّما البلديات والمنظمات غير الحكوميّة، والجمعيات والأكاديميين، وجميع نقابات المهن الحرّة والعمّالية وغيرها.

إنّني انطلاقا" من مؤسسة إبراهيم عبد العال للتنمية المستدامة، التي لها دور ريادي ومهم في المجتمع المدني، سأعطي الأولية للعناوين الآتية:-

الجلسة الخامسة

بالشكر الخبراء في هذه الورشة الذين أتوا من داخل وخارج لبنان، وأيضاً الجهات التي تعاونّا معها لإنجاح هذا المؤتمر؛ وزارة الطاقة والمياه؛ وزارة البيئة؛ وزارة الزراعة؛ رئاسة مجلس الوزراء؛ مجلس الوطني للبحوث العلمية؛ منظمة الأسكوا؛ منظمة الفاو؛ معهد عصام فارس في الجامعة الأميركية في بيروت؛ الجامعة اليسوعية؛ جامعة TEXAS A&M؛ جامعة بيروت العربية؛ جامعة رفيق الحريري؛ جمعية الصناعيين اللبنانيين؛ ومؤسسة ابراهيم عبد العال. وبالطبع، الشكر موصول إلى شريكنا في هذا المؤتمر، مؤسسة رفيق الحريري، بشخص المديرة العامة السيدة سلوى السنيورة بعاصيري على كل الجهود المبذولة لأنجاح هذا العمل. آملا أن تثمر جهودنا جميعاً بما في خير لبنان، وموارده المائية، وبيئته الطبيعية.

مـن هنـا، إن البرنـامج الهيـدرولوجي الـدولي يسـاهم بـالأدوات والأسـاليب المتعـددة التخصصـات، والسليمة بيئياً، ومبتكرة النهج، من خلال الاستفادة من التقدم في علوم المياه، فضلا عن بناء الكفاءات لمواجهة التحديات ضمن التحديات المائية العالمية التي نواجهها اليوم.

الحضور الكريم،

إنطلاقاً مما تقدم، وإيماناً بأهمية دعم السلطات والشركاء على الساحة الوطنية في كافة برامج المنظمة، ولاسيما برامج العلوم الطبيعية، قام مكتب اليونسكو في بيروت بالعمل على تطوير فكرة مؤتمر وطني حول **"التعامل مع ندرة المياه"**. نظراً لأهمية هذا الموضوع، ولكونه حلقة مهمة للوصول الى خطة وطنية للتأهب لندرة المياه. فبدأ العمل مع الشريك، مؤسسة رفيق الحريري، ومن ثم سوياً مع الجهات الداعمة لكي نتوصل الى نتائج عملية وتشاركية، آخذين بعين الإعتبار الخبرات الموجودة، والتجارب الناجحة في لبنان والعالم، والأهم إلى جمع أكبر عدد من اللاعبين الأساسيين في لبنان من قطاع عام، وخاص، واكاديميا، ومجتمع مدني، ومنظمات إقليمية ودولية.

من هنا، سيسلط مؤتمرنا الضوء على:-

- التحديات المرتبطة بندرة المياه
- المياه وتغير المناخ، والسياسات حسب القطاعات
- حوكمة المياه
- لبنان وأهداف التنمية المستدامة
- ومعالجة التحديات.

فعلى الرغم من أن موضوع المياه شائك، ومتشعب، إلا أننا حاولنا ان نتناوله من زوايا أساسية لكي نستكمل الجهود المبذولة على صعيد السياسات، والخطوات العملية، ولترجمتها الى واقع ملموس من اقتراحات، وخطوات واضحة في إتجاه وضع خطة وطنية للتأهب لندرة المياه. وهذا بالطبع سيكون تحت مظلة الوزارات المعنية؛ من وزارة الطاقة والمياه، ووزارة البيئة، ووزارة الزراعة.

وهكذا، نتمنى أن نستفيد جميعاً من نقاشات اليومين المقبلين، في مكتب اليونسكو في بيروت. وإنشاءالله نتمكن من إرساء الأسس للخطة الوطنية للتأهب لندرة المياه، وتكون ال2016 سنة لترجمة هذه الخطة الى مبادرات وطنية تساهم في التصدي للتحدي المتمثل في تغير المناخ، وبشكل خاص إدارة المياه والاستعداد للمخاطر.

في الختام، أود أن اتوجه بالشكر الجزيل لمعالي وزير الزراعة، الأستاذ أكرم شهيب على رعايته وحضوره لهذا النشاط، لما يمثل من أهمية على الصعيد الوطني. كما أود أن أخص

وضمن هذه المساهمات، تدمج اليونسكو عدسة النوع الإجتماعي من خلال جميع البرامج، لأن تمكين المرأة هو مغيّر لقواعد اللعبة من أجل مساعدة المجتمعات على التصدي للتحدي المتمثل في تغير المناخ، بدءاً من إدارة المياه والاستعداد للمخاطر. هذا بالإضافة الى التركيز بوجه خاص على أفريقيا، باعتبارها واحدة من المناطق الأكثر تضررا من تغير المناخ.

الحضور الكريم،

إن مصيرنا ملتزم بمصير مواردنا المائية. ولبناءالمستقبل الذي نريده، نحن بحاجة إلى السعي من أجل الأمن المائي من خلال تعزيز مساهمات العلوم والابتكار. فمنظمة اليونسكو تدعم هذه العملية، وكذلك القيام بأي تحرك أساسي لتعزيز الأمن المائي من أجل التنمية المستدامة.

واستناداً إلى أولويات واحتياجات الدول الأعضاء، التي تم تحديدها في اجتماع نيروبي، يركز البرنامج الهيدرولوجي الدولي على ستة مجالات لمساعدة الدول الأعضاء في مسعاها لإدارة أفضل، ومياه آمنة، وضمان القدرات البشرية، والمؤسسية الضرورية. وهذه المجالات هي:-

- الكوارث ذات الصلة بالمياه،والتغييرات الهيدرولوجية
- المياه الجوفية في بيئة متغيرة
- معالجة ندرة وجودة المياه
- المياه والمستوطنات البشرية في المستقبل
- الهيدرولوجيا، ووئام الهندسة من أجل عالم مستدام
- التعليم في مجال المياه، مفتاح الى الأمن المائي.

من أجل تحقيق هذه الخطة الاستراتيجية، سوف يتم التركيز على:-

- تعبئة التعاون الدولي لتحسين المعرفة والابتكار لمواجهة التحديات الأمنية للمياه
- تعزيز الترابط بين سياسات العلوم للوصول إلى الأمن المائي على المستويات المحلية، والوطنية، والإقليمية، والعالمية
- التركيز على تطوير القدرات المؤسساتية، والبشرية للأمن المائي والاستدامة.

إن دور السلوك البشري، والمعتقدات الثقافية والمواقف حول المياه، والبحوث الاجتماعية والاقتصادية لفهم وتطوير أدوات للتكيف بشكل أفضل مع تغير توفر المياه، هي بعض القضايا التي يجب معالجتها.

الحضور الكريم،

تتعرض موارد المياه بشكل متزايد لضغوطات شديدة من أثر تغير المناخ، وعوامل عالمية أخرى. فتغير المناخ يغيّر أنماط هطول الأمطار ورطوبة التربة، والرطوبة عامةً، وميزان الكتل الجليدية وتدفق الأنهر، كما يسبب أيضاً تغيرات في مصادر المياه الجوفية. في الوقت نفسه، ترتفع وتيرة، وحدّة الفيضانات أو حالات الجفاف. ومن المتوقع على مدى السنوات ال 40 المقبلة، أن ينتقل أسبوعياً ما يقارب ال800,000 شخص في جميع أنحاء العالم للعيش في المدن. وسوف يخلق هذا النمو السكاني والتوسع العمراني السريع المزيد من الضغوط على الموارد المائية، كما سيكون له تأثير هائل على البيئة الطبيعية.

إن تدهور البنية التحتية للمياه في أجزاء كثيرة من العالم، يؤثر أيضاً على الصحة العامة والبيئة. ونظراً لهذه التحديات، فالحاجة إلى إدارة المياه العذبة بشكل صحيح أمر ضروري. وينبغي أن تكون التنمية المستدامة للمياه في صميم جدول أعمال التنمية في مرحلة ما بعد 2015، وأن تكون الأهداف المتعلقة بالمياه محددة ومرتبطة بشكل واضح بالأهداف الإنمائية الأخرى. ومن هنا، تقوم منظمة اليونسكو بمساعدة الدول الأعضاء من أجل إدارة مستدامة للمياه من خلال تقديم توجيهات للسياسات العامة، ونشر التجارب الناجحة، وبناء القدرات، والتشبيك، والمناصرة.

وفي شكل موازي، فإن المجتمع الدولي لديه فرصة تاريخية هذا العام لاعتماد جدول جديد لأعمال التنمية المستدامة، والتوصل إلى اتفاق عالمي بشأن تغير المناخ. فعام 2015 هو عام للعمل على الصعيد العالمي لبناء المستقبل الذي نريده للجميع. وقد كان لمنظمة اليونسكو مساهمة فعالة من خلال مجموعة غنية من المبادرات:-

- فقطاع التربية يقوم بعمل مهم في التثقيف بشأن تغير المناخ في سياق التعليم من أجل التنمية المستدامة، وذلك عقب المؤتمر الناجح في اليابان في تشرين الثاني الماضي
- ويعمل قطاع الاتصالات والمعلومات مع الصحافة ووسائل الإعلام لتعزيز الوعي العام حول تغير المناخ
- ويشارك قطاع العلوم الطبيعية بشكل كامل بشأن تغير المناخ - حول القضايا المتعلقة بالمياه، والتنوع البيولوجي، ومحميات المحيط الحيوي، والحد من مخاطر الكوارث، وفي مجال الطاقة المتجددة، وفي سياسات العلوم والمعارف التقليدية
- قطاع العلوم الاجتماعية والإنسانية - ولا سيما من خلال برنامج إدارة التحول الاجتماعي - يسهم في وضع جدول أعمال شامل للاستدامة، كمتابعة للتقرير العالمي للعلوم الاجتماعية 2013 بشأن التغير البيئي العالمي
- قطاع الثقافة وحشد الدعم لمواقع التراث العالمي، ولمديريها للتعامل مع تغير المناخ.

أ. جورج عواد
مسؤول البرامج الوطنية للعلوم والاتصالات
اليونسكو

يسعدني أن أرحب بكم اليوم في افتتاح المؤتمر الوطني حول **"التعامل مع ندرة المياه"**، كما يسرني أن انقل اليكم تحيات د. حمد الهمامي، مدير مكتب اليونسكو الإقليمي في بيروت، واعتذاره عن عدم الحضور بسبب سفر طارئ، وهو يتمنى لمؤتمرنا النجاح والتوفيق.

الحضور الكريم،

إن المياه العذبة هي المورد الرئيسي لصحة الإنسان، والازدهار، والأمن. وهي ضرورية للقضاء على الفقر، وللمساواة بين الجنسين، وللأمن الغذائي، وللحفاظ على النظم الإيكولوجية.

ومع ذلك، إن أعداداً كبيرة من الناس (بالمليارات) في جميع أنحاء العالم تواجه تحديات خطيرة بشأن المياه العذبة؛ من ندرة المياه، والنوعية الرديئة، ونقص المرافق الصحية، الى كوارث ذات الصلة بالمياه، مثل الفيضانات والجفاف. فحوالي 80٪ من سكان العالم يعيشون في مناطق تعاني تهديدات كبيرة للأمن المائي.

أعلنت الجمعية العامة للأمم المتحدة في يوليو 2010 أن الحصول على المياه النظيفة، والصرف الصحي هو حق من حقوق الإنسان. لكن لا يزال عدم الحصول على نوعية جيدة وكمية كافية من مياه الشرب أحد أكبر المشاكل الصحية للإنسان على الصعيد العالمي. وعلى الرغم من انه تم التوصّل الى تحقيق الهدف الإنمائي للألفية حول توفّر المياه عام 2010، الا ان أكثر من 600 مليون شخص لا يزالون يفتقرون إلى إمكانية الحصول على مياه الشرب الآمنة، مع أكثر من نسبة 40٪ يعيشون في صحراء جنوب أفريقيا. ومن غير المرجّح ان يتم التوصل الى تحقيق الهدف الإنمائي للألفية حول الصرف الصحي، اذ ان حوالي ال2.5 مليار شخص في البلدان النامية لا يحصلون على مرافق الصرف الصحي المحسنة. والأكثر تضرراً هم سكان الأرياف الفقراء.

إنّ التحديات كبيرة، والحد من الاستهلاك المفرط للمياه العذبة بات أمراً ملحاً، يحتاج إلى سياسات وخطط ومشاريع وإجراءات وعمل. وإذا كان مسموحاً أو مطلوباً استغلال " مجاري" المياه الجوفية من خلال آبار سحب عند سفوح سلسلة جبال لبنان الغربية القريبة من الساحل، فإن الحاجة ملحة لوضع حد للاستغلال المفرط لـ " خزانات" مياهنا الجوفية، والحاجة ملحة أيضاً لسياسة حصاد رشيد لمياهنا الصحية، والحد من هدرها وأضرار تدفقها نحو البحر، سواءً بالبرك أو السدود الأمنة في المواقع الأمنة وبالمواصفات الضامنة للأمان.

مجدداً، نتطلّع إلى الاستفادة من خبراتكم واقتراحاتكم التي ننتظرها من مؤتمرنا هذا بغرض تطوير خططنا في وزارة الزراعة، وبهدف وضع خطة وطنية قابلة للتنفيذ، وأيضاً للتعامل مع ندرة المياه وذلك في زمن تغير المناخ المقلق، وفي زمن الشح وندرة السياسيين الهاجسين بالوطن وناسه، ووفرة معطّلي الحلول، ومضيّعي فرص التسويات، ومعرقلي المبادرات الإيجابية الضامنة لسلامة الوطن والمواطنين وانتاجهم واقتصادهم ومستلزمات حياتهم ومستلزمات بقاء وطننا وأمن لبناننا، في منطقة ملتهبة تحوّلت ميدان حروب وقتل أعمى.

آمنّا بالتسوية، ونؤمن بها من أجل الوطن وناسه، لكن مضيعي الفرص تلاقوا من 14 آذار ومن 8 آذار في العمل على إجهاض التسوية وعلى إفشال المبادرة الإيجابية.

أمنيتنا أن يلتقوا، ليس على رفض تسوية لانتخاب رئيس يؤمن الخروج من زمن التعطيل القاتل إلى زمن التلاقي، بل للعمل على ما يؤمن مصلحة الوطن ومصالح المواطنين.

تلاقوا على العرقلة. عساهم يستفيقون، عساهم يلتقون لابعاد الكأس المر ولإبعاد الحريق عن لبنان.

شكراً للخبراء والمتخصصين المؤتمرين، فأنتم تبحثون أمراً حياتيّاً وحيويّاً.

شكراً لمؤسسة رفيق الحريري ومكتب اليونسكوفي بيروت، فأنتم تسعون إلى تخطيط مبني على علم، وتسعون إلى عمل.

آن الأوان للإتجاه نحو ما بات يسمّى "الزراعة الذكية" القادرة على التأقلم. ولأن الأوان قد آن، فإن وزارة الزراعة لحظت في استراتيجيتها للسنوات الخمس 2015- -2019 ، أولوية مواجهة تحدي ندرة المياه وتحدي تغير المناخ.

ومن أجل مواجهة فاعلة لهذين التحديين، بدأنا العمل على إجراءات ضامنة لسياسة زراعية تقوم على تطوير طرق انتاجنا الزراعي، لتكون زراعتنا قادرة على التأقلم مع تغير المناخ وقادرة على التأقلم مع ندرة المياه وقادرة على المساهمة في أمن غذائي، في ظل الخلل الكبير بين الانتاج والاستهلاك وبين التصدير والاستراد.

وفي إطارالمواجهة، بدأنا التشجيع على اعتماد "الزراعة الحافظة" التي تخفض نسبة استهلاك الزراعة للمياه، والتي هي بحدود 55 بالمئة من المياه العذبة، كي توفر أيضاً تكاليف الحراثة وتؤمن كمّاً من الأعلاف.

ومع الزراعة الحافظة، نتابع الإرشاد والتوجيه للزراعات البعلية، كما للزراعات النوعية التي لا تحتاج إلى الكثير من المياه. ونولي اهتماما كبيراً لاعتماد الري بالتقنيات الموفرة للمياه، إذ لا يجوز استمرار الري التقليدي بالجر.

ولتأمين حاجات الزراعة للمياه، اعتمدنا سياسة إنشاء البرك التلّية، والتشجيع على انتشارها، لتساهم الزراعة في حصاد المتساقطات وتخفيف الهدر.

وكي لا يستمر الاعتماد على خزانات المياه الجوفية، خصوصاً في السهول، بدأنا عملياً، للري الزراعي المدروس والآمن، الاستفادة من مياه الصرف الصحي بعد معالجتها، بعد أن نجحت تجربة معالجة مياه الصرف الصحي في أبلح البقاعية، وبعد إنشاء بركة لتخزين المياه المعالجة واستخدامها في ري البساتين.

إنّها تجربة واعدة وتشكل نموذجاً يؤمّن :

أولاً: ري البساتين بمياه مراقبة ومناسبة.

ثانياً: التخفيف من تلوث مجرى الليطاني، الذي تحول مصباً لمياه الصرف المنزلي والصناعي، من منبعه إلى بحيرة القرعون، فتحول من شريان حياة إلى نهر ينازع ويكاد يتحول نهراً ميتاً، في ظل غياب انجاز محطات تكرير الصرف الصحي أو عدم تشغيل المنجز منها، وفي ظل غياب تنفيذ الخطط والدراسات والمشاريع المزمنة والكثيرة، كما في ظل ما يرمى في مجرى النهر وروافده من نفايات صناعية وزراعية ومنزلية، صلبة وسائلة. ونأمل، بتعميم تجربة أبلح، أن نساهم في إعادة الحياة إلى مياهنا السطحية ومجاريها وخزاناتها.

أ. أكرم شهيب
وزير الزراعة
وزارة الزراعة

تدل الأرقام بأن معدل الأمطار غير مستقر ويتنقل بين الشح والوفرة. فهو ساحلاً، على سبيل المثال، بين 800 و 900 ملم في السنة، علماً أنّه راوح بين 370 ملم في عام 2008 و770 ملم في العام 2013، وعادت النسبة إلى معدلها في العام الماضي لتنخفض مجدداً هذه السنة. فما سجل حتى الأمس في معظم المناطق لا يتعدى نصف المعدل السنوي بهذا التاريخ.

ندرك جميعاً أنّ حجم الهدر يتصل بمعدلات الأمطار، وبما تحمله المجاري السطحية من مياه إلى البحر وما تحمله معها من تربة أرض باتت عرضة للجرف بعد أن تعرّت نتيجة التخلّي عن الزراعة في المرتفعات.

إنّ الأرقام المتداولة تنبئ بأنّنا في دائرة الخطرسيّما في زمن تغير المناخ، الذي بتنا نلمس مفاعيله في كل الفصول، في السيول وفي انحسار الثلج وفي انحسار المطر وفي انحسار سياسات المواجهة على المستوى الوطني. من هنا يكتسب مؤتمرنا أهمية استثنائية، ونتطلع إلى نتائج تمهد لخطط علمية مدروسة لإدارة المياه ومواجهة تغير المناخ ومفاعيله المائية، علّها تخرجنا من دائرة الخطر إلى الاستخدام الرشيد لثروتنا المائية التي تحتاج إلى إدارة علمية وسياسة رشيدة.

الصديقات والأصدقاء

لسنا بمنأى في الزراعة عن الخطر، ولسنا بمنأى عن الممارسات الخاطئة والهدر. أقولها بوضوح:

إنّ طرق انتاجنا الزراعي لم تعد مقبولة، واستمرار انتاجنا الزراعي هو رهن بقدرة الزراعة على التأقلم مع تغير المناخ، ورهن بقدرة الزراعة على التأقلم مع ندرة المياه العذبة.

بما يقتضيه ذلك كله من حوكمة رشيدة، ومن اعتماد سياسات مستدامة، وادخال الاصلاحات الضرورية في التشريعات والمؤسسات، وانتهاج الآليات الملائمة، والتحفيز على القيام بمزيد من الابحاث والتعاون العلمي، كما ونشر التوعية سيما عبر التربية ومناهجها.

أيها الحضور الكريم،

يقيني ان الكوكبة المميزة من المؤتمرين ستتناول محاور المؤتمر بالعمق، وستثري موضوعاته بالأحدث من معارفها والاشمل في مقارباتها، فالشكر لهم فرداً فرداً ولجميع المرجعيات والمؤسسات المشاركة ، والشكر مستحق لمكتب اليونسكو في بيروت ممثّلاً بالأستاذ جورج عواد ولمعالي وزير الزراعة الأستاذ أكرم شهيب الذي أولى موضوع المؤتمر كل رعاية واهتمام.

دول عربية، حيث لا يتجاوز نصيب الفرد العربي من المياه العذبة المتجددة نسبة 6% مما يتمتع به نظيره عالمياً، وذلك طبعاً على حساب أمنه الغذائي والصحي والاجتماعي والاقتصادي. واذا كان لنا ان نخص لبنان تحديداً بتوصيف لوضعه المائي، يمكن لنا الاستعانة بالأرقام الصادرة عن "معهد الموارد العالمية" التي تشير الى ان مستوى الاجهاد المائي في لبنان مرتفع جداً بحيث يعادل 4.75 من اصل خمس نقاط مما يجعله، بحسب التقديرات المستشرفة عالمياً للعام 2020، في المرتبة 16 من بين 167 دولة، متراجعاً بذلك عن المرتبة 18 التي كان يحتلها في العام 2010.

اذا كان هذا هو الواقع راهناً، فماذا ستكون الامور عليه بحدود العام 2050، حيث من المتوقع ان يصل عدد سكان المنطقة العربية الى 634 مليون نسمة، اي ما يقارب ضعف ارقام اليوم، فتتعاظم بالتالي مخاطر قصور المياه المتجددة عن تلبية الحاجة ويصبح الخوف من ازدياد الضغط على مخزون المياه العذبة مبرراً اذا ما استمرت وتيرة استخدامات المياه على ما هي عليه الان، مما يهدد الامن الغذائي والصحي، كما وامدادات الطاقة، ويؤدي استطراداً الى تردي الاوضاع الاقتصادية والاجتماعية والانسانية.

حضرات السيدات والسادة،

تدركون جيداً أن مستوى ندرة المياه يقاس عادة بحجم الحصة السنوية المتاحة للفرد من الموارد المائية المتجددة، والتي تشير شتى الاحصاءات الى انها آخذة بالتناقص بشكل دراماتيكي في معظم بلدان العالم، وتحديداً في بلدان المنطقة العربية، وذلك نتيجة التمادي في استنزافها، وبكميات تتجاوز معدلات تجددها طبيعياً، وذلك يعود في معظمه الى الزيادة السكانية، وتبدل نمط العيش، والتوسع غير المتبصر في استخدام المياه في الزراعة والطاقة والصناعة، علماً أن من بين التحديات الكبرى التي أفضت الى ندرة المياه هو تغير المناخ، الذي أدّى الى مزيد من تراجع المتساقطات والى مزيد من ارتفاع معدلات التبخر وصولاً الى عجز المياه السطحية عن تلبية الحاجات المتزايدة.

تحدّ عوّض عنه بتحد جديد تمثل بتفاقم استغلال المياه الجوفية، الذي رافقه تسرب المياه المالحة والملوثة الى المياه الجوفية دون التفات للمخاطر المرافقة والتي أخذت تهدد الأمن البشري، متمثلاً بالأمن المائي والغذائي والطاقوي، باعتبار أنها جميعاً ترتبط ارتباطاً تفاعلياً في ما بينها، كما ترتبط مع حالة الاستقرار الاجتماعي والسياسي أو عدمه. وهذا ما بات يستوجب وبإلحاح اعتماد مقاربة شاملة في معالجة ندرة المياه، لا تكون فقط بالبحث عن مصادر جديدة للمياه بل بما هو أجدى وأفعل، أي عبر ترشيد استخدام الموارد المائية وتعزيز انتاجيتها.

بمعنى آخر هناك حاجة لتحول استراتيجي من ثقافة تقوم على ضخ استثمارات هائلة لزيادة امدادات المياه، الى أخرى تزاوج بينها وبين تحسين ادارة المياه ورفع كفاءتها وترشيد الاستهلاك، اضافة الى التصدي لمفاعيل تغير المناخ الناشئ عن التلوث والانبعاث الحراري،

أ. سلوى السنيورة بعاصيري
المديرة العامة
مؤسسة رفيق الحريري

التزاماً بالرسالة التي آمن بها الرئيس المؤسس الشهيد رفيق الحريري، والتي تقضي بواجب الانخراط فكراً ودراسة، جهداً وعملاً، شراكة ودعماً، في إطار كل ما من شأنه أي يخدم القضايا الوطنية ويلبي مستلزمات التنمية والتحديث والتطوير،

تجاوبت مؤسسة رفيق الحريري مع مبادرة مكتب اليونسكو في بيروت الى عقد مؤتمر اليوم، وتعاونا سوية من أجل تحقيقه مع مروحة واسعة من المرجعيات الرسمية والعامة، والفعاليات المختصة والمعنية، والخبراء المحليين والدوليين، علّ تضافر الجهود في مقاربة مسألة ندرة المياه وتنسيق الرؤى بشأن معالجة تداعياتها، يفضي الى وضع استراتيجيات وسياسات وبرامج عمل تكون أكثر فعالية واستدامة.

أيها الحضور الكريم،

قد يكون من المفيد التذكير بداية ان الامم المتحدة كانت قد أدركت باكراً المخاطر التي تهدد البشرية اذا ما استمر أناسها في التعاطي مع مسألة المياه وما يرتبط بها بذات النمط والوتيرة. فكان أن أطلقت في العام 1993 يوماً عالمياً للمياه بغية نشر الوعي بضرورة التعامل مع الامر من منظور رؤيوي واستشرافي وعلى أسس التخطيط السليم والمستنير، وجعلت من الثاني والعشرين من شهر آذار من كل عام تاريخاً مكرساً لطرح أحد اوجه مسألة المياه، للتفكر بها والتصدي لها، كان آخرها في العام 2015 بعنوان "المياه والتنمية المستدامة"، وسيكون بعنوان "المياه وفرص العمل" للعام 2016، و "مياه الصرف" للعام 2017، و "اجعل الطبيعة مصدر الحل لمعضلة المياه" للعام 2018.

من البديهي ملاحظة أن هذه العناوين تتقاطع في غاياتها والاهداف مع ما ورد في تقرير البنك الدولي الصادر في العام 2013، والذي توقع أن يعاني بحدود 2.8 بليون نسمة من تداعيات ندرة المياه بحدود العام 2025، وأيضاً مع ما ورد من احصاءات برنامج الامم المتحدة للتنمية التي تشير الى ان سبعة من أصل الدول العشرة الاكثر معاناة من شح المياه عالمياً، هي

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مع
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البريد الإلكتروني:
rhf@rafichariri-foundation.org

الموقع الإلكتروني:
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