Facing the Water Crisis in Lebanon*
An Urgent Need for Sustainable Development

Introduction

Water has become the subject of an urgent need for the planet's sustainable development in light of the overall changes which we've been witnessing since four decades. Those changes are predominantly man's responsibility, resulting from mismanagement, and abusive exploitation of natural resources through a consumption loop that multiplies year by year. This poses the threat of depleting such resources, and a gradual inability to meet human demand in light of the global population growth which will reach 9 billion people in the near future.

Water is the most important, and the largest renewable resource on Earth. It is fundamental to the sustainability of human life. Hence it has become the most alarming problem to citizens and officials alike in all countries, given the big challenges, present and future, to meet a growing demand. This is all the more true in view of its close interlinks with food security and social stability on the one hand, and with different energy types on the other hand, in what regards production and investment.

Lebanon, like Turkey, is a real reservoir of water in the Middle East, compared to its geographical neighbors. Over the past twenty years, water resources have become a limiting factor for the future development of our country, and the subject of a fierce competition among users, public authorities, and local authorities, let alone the conflicts over international rivers (Jordan River Basin: Al-Hasbani and Al-Wazzani; Southern Al-Kabir River: Assi river…). This situation is attributed to the global changes that hit the Mediterranean region, moving it from a tempered to a semi-desert climate, in addition to the "peculiarities of the Middle East" in terms of unsustainable management of natural resources, and crumbling infrastructure in a degraded environment. The coastal states on the South Eastern Mediterranean, including Lebanon, have peculiarities which resulted in forming a barrier to the development of infrastructure and its management. However, Lebanon has been a pioneer since 1998 in adopting integrated water

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resources management (GIRE- Gestion Intégrée des Ressources en Eau) so as to bring radical solutions to the water sector. Unfortunately, it remained ink on paper because of the unwillingness of public authorities, a proof of their inability to solve technical and developmental problems. This failure to take in a timely way the appropriate decisions that benefit public good, is allowing the emergence of new players on the national scene, while we do not know for whose benefit they are working!? This phenomenon increases and exudes an array of interests which have impaired the ability of the executive decision-making process to solve fundamental problems (for example, the waste problem). Other countries such as Jordan, which has less water resources, Tunisia, and others, were inspired by Lebanon to apply the concept of integrated water resources management and achieved success in that area.

It is certain, that meeting the demand of water resources is closely linked to two basic factors that affect the sustainability of their exploitation, namely:

a- Natural phenomena resulting from global changes that generally affect the climate

This factor is represented by the amount of precipitation (rain and snow) which varies from year to year. We have noted its low rate in recent years, which is what we will further present as the 'Water Balance'.

b- A man-made factor:

This relates to pollution, deterioration of the environment, excessive groundwater depletion, encroachment on the watercourses' surface, logging, fires, and thus desertification and soil erosion, etc. In addition, there are the following considerations:

- Water distribution poses everyday problems: Cuts, leaks in the networks, etc.
- Large loss of water flowing into the Mediterranean each year; lack of dams and lakes for surface water storage; aquifer recharge does not exist...
- Water pollution is on the rise by accidental or intentional contamination.
- Responsibilities are distributed among several parties: There are more than ten public bodies (ministries, councils and public institutions, etc.) for water that share the responsibility of its management.
- Knowledge is fragmented, and capacity not enough: There is a lack of integrated information systems to allow for the identification of resources and their uses.
- Poor management of water demand and lack of effective networks in all sectors of investment in this vital resource: Public authorities suffer from structural weaknesses and from a lack of human, organizational, and financial resources as well.

• Unused non-conventional water: Re-use of wastewater (REU) is virtually non-existent; marine springs and gray water.

• Unjustifiable excesses in over-pumping from aquifers, and in energy consumption as well, resulting in ground water overuse, pollution, seawater intrusion, and salinity.

• Incompetent management of subscribers: Inability to improve the level of service, unfair tariff system, non-payment by citizens of their water subscription bills and other utility services in many areas, water shortage compensated by supply from tanker trucks, which are not subject to minimum public health standards.

• Budget deficit: Problem of network coverage, irregularities of all kinds, in addition to incomplete and outdated case files.

• The transformation of rivers into garbage dumps; and man-made embankments of all kinds hinder the natural flow of water.

Moreover, the Lebanese have become in recent years aware of the climate change actually happening in the Mediterranean region, and its effects on the availability and use of water, energy, and food. This change plays a big role in the provision of resources, and it affects food prices. This is due to the increasing demand of water connections due to population growth, as well as to the Syrian refugees who have been estimated at about 1.5 million scattered throughout the Lebanese territory since the outbreak of the conflict in Syria.

Water in Lebanon and its close relation with climate change

a) Water Balance in Lebanon: The global climate changes:

We can assert that Lebanon has a Mediterranean climate characterized by abundant rainfall in winter (January to April), and by drought that continues through the final months of the year. The average rainfall is 800mm approx. between 600 mm and 900 mm on the coast, 1,400mm on the highlands, down to 400 mm in the east, and below 200 mm in the northeast. Rainfall at 2,000m and above contributes in maintaining the continuous flow of water sources during drought, and their increasing abundance in the period from January to May (75% of the annual flow), before getting to a lower than normal level of 16 % during June/July, and 9% in the last five months from August to December. However, the rainfall rate regresses as the winter season become shorter with the impact of global warming, whose signs have been experienced in the Mediterranean basin for some time.

Water issues have recently become of great importance in Lebanon due to water being a limited resource, and to the fact that the dry period extends for more than seven

months a year. Lack of water, and wastage thereof in the Mediterranean Sea, have become key elements that lead to the impairment of the country's development and of its economic growth. The total renewable water reserves inside Lebanese territory can be summed up at about 2.7 billion m^3.

Water issues in Lebanon are closely related to the climate issue. The impact of climate change in recent years has not been strong enough to make the officials feel concerned of its threats. In addition, water management is closely related to both the precipitation period and the drought season. If precipitation is not stored in the winter period and during the snowmelt, it'll not be possible to meet the growing demand for water in the drought period. The table below clarifies the picture.

The third report of the Expert Group of the Intergovernmental Panel on Climate Change, which was published in 2008, predicted a trend of temperature rise in the region (or what is known as global warming) in the range of 2° C - 4° C. This case reflects negatively on Lebanon, especially in terms of precipitation and snow inventory. The duration of the rainy season, which was between 80 and 90 days, will be reduced to 40-50 days at most. The disastrous consequences for our country would relate to ensuring underground water storage, which depends heavily on snowmelt.

The Lebanese situation was transposed into a model termed "Lebanon's Case" within a cooperation project between the Mediterranean Network of Basin Organizations and Professor Jean Jouzel, Vice-Chair of the Intergovernmental Panel on Climate Change. The results are described below:

	Basic conditions	**Global warming 2°C**	**Global warming 4°C**
Snowmelt Water	1,200 million m3	700 million m3	350 million m3
Total amount of renewable water	2,700 million m3	2,200 million m3	1,850 million m3

Results associated with usage problems (sectorial use of drinking water / irrigation / cross-border water)

In addition, the snow front, which touched an altitude of 800 meters above sea level in the 1970s, is now located between 1,200-1,300 m. With regard to the weather in the Lebanese coastal cities, the semi-desert climate which, for example, is experienced in the

city of Beirut has become similar to that of the city of Alexandria in Egypt. This means that a southward lowering of the climate axis had gradually begun to consolidate at our end.

This sad situation shows that water scarcity now threatens citizens in Lebanon. As experts and technocrats, we wanted to put Lebanon on a Year 2030 orbit by applying a proactive plan focused on integrated water management along what was done by the developed countries such as France, while taking into account both the vertical axis and the horizontal axis. Unfortunately, in Lebanon a water culture and a policy of sustainable development have not been adopted or supported in practice, due to lack of political will to do so. If nothing is done in the short or medium term then human, economic, and social development in our country will be in great danger.

This phenomenon generates consequences in relation to the sectoral use of resources, e.g for drinking, irrigation and transboundary uses.

Hence it is necessary to look at the Water Balance in Lebanon.

b) Some of the basic data for formulating a water demand policy:

The number of Lebanon's resident population in the official statistics for 2005 was estimated at about 4.8 million people, with an annual population growth rate estimated at 2.7%. With these estimates, a population growth of about 8 million is foreseen by 2030, including tourists. As for the total demand for water for drinking and industrial purposes, the criteria adopted by the Lebanese authorities and World Bank reports estimate it at 300 liters per person per day. With regard to the demand for irrigation water, the irrigated area in the year 2010 is estimated at about 110,000 hectares (ha) as per FAO and Ministry of Agriculture statistics. In addition, the area expected to be irrigated until the year 2030 is 280,000 hectares, with a view to ensuring food security.

Unfortunately, the irrigated area in Lebanon depends on surface irrigation at a rate of 75%, and the remaining area which relies on drip irrigation does not exceed 10%, while the rest depends on sprinklers especially in the Bekaa Valley (10%). Therefore, irrigation depletes about 80% of Lebanese renewable resources. Accordingly, the priority in the plan that has been developed is to extend the drip irrigation concept to cover the total irrigated area in Lebanon.

The usage rate will be 6,000 m^3/ha/year by 2020, instead of 10,000 m^3/ha/year for 2015, therefore reducing the waste of renewable resources similarly to what is experienced by developed nations.

Based on these data, authorities have calculated the Water Balance in Lebanon for all the sectors, which continues to be non-sustainable; and they have also set a demand management scenarios for 2015 and 2030 as shown below:

Year 2015

Irrigation: 1,100 million m^3 (existing irrigation of 10,000 m^3 / ha ratios)
Industry: 150 million m^3
Drinking water: 501 million m^3 (waste of about 48% in water networks)
Total: 1.75 billion m^3 / year

If we managed in **2030** to improve irrigation systems through drip irrigation in the framework of a sustainable management, the Water Balance becomes as follows:

Irrigation: 1,680 million m^3
Industry: 300 million m^3
Drinking water: 1,000 million m^3 (waste of about 48% within water networks)
Total: 3,000 billion m^3 / year

This total would result from not improving the quality of drinking water networks and would have as a consequence a big water deficit in Lebanon, because it exceeds the total renewable water resources (2.7 billion m3 per year). We conclude that improving the quality of drinking water networks, in addition to surface storage, are part of the priorities of the plan to reduce the wastage of water. Despite the multiplicity of water sources and surface storage, a water deficit is actually the case, due to the loss of around 1.2 billion m3 / year in the sea. This is accentuated by a multifaceted crisis with shortages and rationing prevailing throughout the year, leading to increased demand for water (namely drinking water, domestic water use, and irrigation, as a result of social development and the doubling of the population, in addition to changed habits and social traditions, and the presence of refugees).

If the Lebanon's Water Balance were to be projected for a period of 30 years starting from the year 2010, the calculation would look as follows:

Annual aggregate demand (2015) of all usage sectors is around 1.7 billion m3 / year. This demand would exceed the threshold of 2 billion m3 / year in 2020, and would reach 3 billion m3 / year in 2030.

c) As regards the general and global changes, the constraints affecting water resources include:

- Population growth in Lebanon: 4.5 million in 2010, plus the growth rate of the Lebanese, put the population figure at about 8 million in 2040, in addition to the presence of Syrian refugees whose number was estimated at 1.5 million in 2014. Moreover, it is not known how long this new situation will persist together with its impact on the Water Balance in terms of deficit. The additional consumption pressure was not there when the plan was developed, let alone that greenhouse effect implications are on the rise.

- The limited renewable resources, which are estimated at 2.7 million m^3 / year, will be further reduced by global warming as indicated above, in view of the cycle of draught years having moved from one every ten years on average to one every two years.

- Water wastage: 1.2 billion m^3 / year that flow into the Mediterranean.

- Lack of surface water storage facilities: Dams, mountain lakes, and basins, in addition to the lack of quality water systems.

- Since Lebanon's independence, groundwater formed the main source of water storage and investment (excessive pumping, seawater seepage, declining water table ...) instead of being a strategic reserve for use during periods of drought. Random drilling away from security forces' eyes adds to the problem... As for food security, it is currently provided, as Lebanon imports fruit and vegetables from water-poor countries, which manage that resource rather well, such as Jordan and Saudi Arabia.

- Mediterranean climate: Semi-dry climate.

- Average temperature rise (2°C - 4°C).

- Increased intensity of rainfall, but in small amounts (80 to 90 days: 50 to 60 days).

- Extreme and exceptional events (drought, desertification and floods): They became more frequent and more intense.

- Not to mention the political, financial, and bureaucratic obstacles, especially that the expropriation of lands takes a long time to complete and authorities do not take the issue of water seriously enough. The question asked by the citizen is: If plans by experts and technocrats, as well as the comprehensive program, have not been taken in consideration, then how the water deficit would be overcome, and how a sustained demand management would be achieved? (drinking and irrigation water networks). In light of Lebanon suffering until today from the decline in the efficiency of transport infrastructure and from an insufficiency in surface water storage (dams,

mountain lakes, basins ...), and from a lack of projects to feed the aquifers (natural and artificial) and low use (or non-use) of traditional water.

In view of this situation, the administration sought to adopt a national and modern plan in order to take advantage of renewable water in Lebanon, as part of the integrated management concept, by associating the public, private, civil, and municipal sectors with the State institutions, the objective being to ensure water management in Lebanon for the year 2050 that achieves social and food safety for the Lebanese people. It was the first time in Lebanon that a comprehensive vision of the "Water Resources Situation in Lebanon" was done on the basis of integrated water resources management for reservoirs, rivers, lakes and aquifers. The Cabinet approved the plan and Parliament ratified it in 2003. It has been updated since 2008 by the Mediterranean Component of the EU Water Initiative, then in 2010 where it became known as "The National Water Sector Strategy." From this point on, this strategy was to form one of the big leverages of the work meant to achieve the food and social security of citizens.

We can summarize the headlines of the 10-year Strategy plan and the National Strategy for the water sector as follows:

- Providing additional water resources through dams and lake projects and aquifer recharge
- Drinking water projects (supply lines, reservoirs, networks, dams and mountain lakes)
- Irrigation water projects (including new irrigation projects and modernization of existing projects)
- Wastewater projects (sewers and treatment plant projects)
- Riverbeds adjustment projects (for protection from the dangers of flooding)
- Seawater springs and graywater exploitation
- Electrical and energy-related projects.

This plan won the approval of major international institutions like the World Bank, the European Union, the European Bank, the Mediterranean Network of Basin Organizations (MENBO), and the Global Water Partnership-Mediterranean (GWP-med). It was the first time in Lebanon that an integrated and comprehensive plan for water projects across the whole Lebanese territory was set, in accordance with the needs and demand, and under the organization of a totally new institution for water management.

The challenges of water demand management: irrigation, management, drinking water and industry

The demand for irrigation water:

Since the year 2000, two scenarios were presented to the country's policymakers. The first is based on the case of "pressure on water resources", that is, to maintain the status quo and its implications on Lebanon and its people. The other on "sustainable water management" through the promotion and consolidation of the concept of integrated water resources management to meet the country's demand in case its politicians will have the will to adopt it.

The achievement of sustainable water resources management in Lebanon also requires greater attention to improving water efficiency; it should take initial actions in the agricultural sector, being the main consumer of water in Lebanon. It should be noted that about 1 billion cubic meters of water have been allocated to the agricultural sector in 2015, representing 80% of the total renewable water in Lebanon.

This requires rationalizing the use of irrigation water by applying modern irrigation techniques (drip or sprinkle), as well as using new water bodies (conventional and non-conventional water) such as recycling the used water, extracting water from springs, and refining gray water in order to meet the demand for water.

Pressure on water resources from the irrigation sector: 10,000 m^3 / ha

	2010	**2040**
Irrigated areas	100,000 hectares	280,000 hectares
Total consumption / year	1,000 million m^3	1,000 million m^3

Scenario of sustainable management of water resources: 6,000 m^3 / ha

	2010	**2040**
Irrigated areas	100,000 hectares	280,000 hectares
Total consumption / year	600 million m^3	1,680 million m^3
Provide water / year	400 million m^3	1,120 million m^3

Scenario of pressure on water resources from the drinking water sector: year 2010

Population	**5 million**	
The efficiency of water networks	50%	70%
Total demand for water / year	650 million m^3	520 million m^3

Water savings: 130 million m3 / year: year 2040

Population	**8 million**	
The efficiency of water networks	50%	90%
Total demand for water / year	1,200 million m^3	720 million m^3

Water savings: 480 million m3 / year

A road map for officials to meet the water challenges

There is no doubt that there are a number of water challenges for the public authorities.. These challenges serve as general principles that should be taken into consideration. They are represented by:

1. "Integrated water resources management":

This challenge to move towards integrated water management requires work to achieve a balance between water supply and demand in order to meet the growing needs for this resource in all aspects of its use, with the need to preserve the natural aquatic environment systems. This allows for the development of regions and contributes to the achievement of sustainable development. The basic principles of integrated water resources management are:

- Fresh water is essential to life.
- Water management requires concerted efforts and cooperation among consumers, planners and policy makers; namely water policies.
- Women's role in water conservation and management is essential.
- The role of schools, universities, civil society and the media in the publication and dissemination of awareness of the water culture.
- Water is an economic commodity that has strategic value, due to its economic importance.
- Water management requires the use of modern technologies in all their operating aspects to control leakage and reduce waste by using non-conventional water wherever possible.

Lebanon made a qualitative step by moving from the introduction of the concept of integrated water resources management within its recognized borders to the level of integrated basin-wide water resources management. The latter is defined as: "A process of coordination to preserve, manage, and develop land, water and related resources in various sectors within a given river basin, in order to maximize the economic and social benefits derived from water resources in an equitable manner while preserving and, where appropriate, restoring freshwater ecosystems".

Integrated water management at the basin level is:

- Change, so that the perspective of basin level becomes of increased importance in resolving local and global changes, especially that climate change happens through the hydraulic cycle. This affects water availability and quality, with direct impacts on the basin, which include an increase in the number and severity of floods and droughts, environmental flows, sewerage and drainage, hydropower, and navigation.

- Therefore, climate change is the key challenge for water management. This makes the integrated management at the basin level the best approach. It even gets more important from an all-sectors coordination viewpoint because it is consistent with the goals of sustainable development. The study and the implementation of climate change adaptation strategies need be done on this basis.

- Easier management of water-related disasters, and environmental impacts mitigation.

- Actual fulfillment of the three pillars for achieving sustainable development, namely economic efficiency, social justice, and environmental sustainability.

- Easier set-up of an information system at the basin-wide level, connected to all water monitoring devices to collect and update the necessary information, to be used as a means to support decision-making for proper planning in order to develop reliable water strategies and policies which are to be monitored periodically and updated when necessary, while taking climate change into account.

- Decentralization in decision-making and involvement of stakeholders at the basin-wide level in the formulation of policies and strategies.

- Planning at this level facilitates the assessment of the situation and the

implementation of projects, resulting in a more successful achievement of desired benefits that reflects on all sectors (drinking water, irrigation, agriculture, generation of hydropower, industry, tourism, shipping, transport, fish farming and other ... etc.).

This is the first challenge that will be put forth by responsible public authorities. It is primarily an affirmation of exercising good governance, enacting the Water Law, setting up the Information and Training Center on Water, and defining an action plan for integrated water management in our country. It is a fundamental condition for the effective management of water in Lebanon. Improving the management of water resources for sustainable development is reflected by:

- Political will: The willingness to apply the appropriate reforms in the field of water management, in terms of institutional reform and the application of integrated water management practices.

- Securing financial support from donor funds: The partnership between the public and private sectors (PPP).

- Governance: Issuance of the Water Law, Administrative Reform, Information and Training Center on Water.

2. "The protection and management of water resources":

It is the second challenge and is about developing strong and sustainable coordination mechanisms for the establishment of water infrastructure in order to reduce, in a first stage, the waste of water that goes into the Mediterranean Sea which is estimated at nearly 1.2 billion m^3 / year. In parallel to this initiative, there is work to be done on increasing the effectiveness of supply systems of drinking water, and on reducing the leakage rate within the water networks which is estimated at about 48%, so as to improve efficiency. That's why surface storage, estimated at 850 million m^3 per year (dams, mountain lakes ...), has been duly noted in addition to replenishing the natural and artificial aquifers to meet the need for drinking water management in Lebanon for the next 50 years.

3. "Encourage the use of New Water Mass":

This concerns conventional and non-conventional water resources. It entails the water reuse, marine water springs, and greywater re-use. This is the third challenge facing the public authorities in order to ensure better management of demand in the coming years.

In addition, the option of exploiting marine water springs must be taken into consideration. For Lebanon, the exploitation of non-conventional resources allows for compensating part of the projected water deficit for the year 2040 through the mobilization of 565 million m^3 of new water mass. With respect to seawater desalination, the project requires investment in high energy cost as of 2040; and this process must be conducted at a low energy cost of carbon in order to become a real option for sustainable development.

4. "Ensure Quality Management of water resources":

It is the fourth key challenge for public authorities. The growing water demand combined to the effects of pollution are a threat to public health. The protection of available water resources, quality control, as well as the application of the "Polluter Pays" principle are key components of the legislation and implementation of laws in this area.

5. "Encourage the establishment of a database":

It is the fifth challenge for the public authorities. This initiative could lead to the creation of an information/data base about the quality and quantity of water that is still to this day scattered among various ministries and bodies. We managed only this year to advance with this purpose through the establishment of the Information and Training Center for Water Sciences, a regional project deriving from Lebanon's initiative, which was approved by the Union for the Mediterranean within the "Regional project Towards a Mediterranean Water Knowledge Platform" (April 7 2014). The French Development Agency funded the feasibility study carried out by the International Office for Water (Office International de l'Eau); it is more urgently needed than ever. For this, the Mediterranean Network of Basin Organizations (MENBO), the Euro-Mediterranean system of information on water sciences, in addition to the Global Water Partnership-Mediterranean (GWP-Med), can leverage efforts in order to secure the necessary follow-up. This Center aims to increase knowledge on the water sector and control of the water transmission lines from the source to the beneficiaries, in addition to quality control, the exchange of information and experiences, and the promotion and training for workers in this sector. The creation and operation of the Center will be an important step for our country because it will enhance the data and know-how necessary to assess, control, and take decisions on water management. Other benefits will be in the training of all our managers, engineers, and technicians, and at all levels, so that they acquire the latest state-of-the-art knowledge and science skills needed to address the water problems of both the public and private sectors, at the national and sub-regional Mediterranean levels.

6. "Cleaning the Mediterranean":

It is the sixth challenge for the public authorities. It is to be pointed out that access to sewage treatment in Lebanon is suffering a significant decline compared with drinking water.

In spite of our country currently having six wastewater treatment plants (treatment at the secondary level), they are not yet in operation because not connected to sewage networks. The majority of this water is collected and discharged at the municipal level without treatment, and is left to pour into the rivers and streams, and to seep down to groundwater level (through bottomless or open wells); the same goes for the waters of coastal swimming facilities. It should be noted that much of the wastewater flowing into rivers is unfortunately used in irrigation. Communicable diseases spread through water as a result, such as typhoid, dysentery, and diarrhea. There are municipalities and municipal federations that have taken several measures to improve the operation of wastewater collection and treatment, thanks to assistance from international donors and NGOs. A number of sewage treatment plants varying between large and small were built in different regions; they have been able to reduce their pollution levels and allowed to re-use refined wastewater for irrigation purposes.

Neglect and chaos that characterized the design of stations without the necessary equipment, in addition to the lack of responsibilities distributed among the various responsible public bodies, are the most prominent reason for this situation. These matters should be emphasized in the Wastewater Master Plan of the country. This non-conventional water can secure a large quantity for use in irrigation, and thus reduce the use of surface and ground water resources. We offer this challenge as a priority plan of action that could be achieved in cooperation with international organizations. It's also beneficial to contract with local authorities of the areas along the coast to take over the tasks of cleaning, monitoring, and protecting their respective coast, along the successful French experience in this regard. Thus, they could revive the coastal tourism sector to its past dynamism. In this context, it is important to strengthen cooperation among all the basin countries for the transfer and exchange of technology and institutions.

7. "Strengthening the partnership between the public and private sectors (PPP)":

It is the seventh challenge. In fact, it is a lever for development in the field of water management, and represents a tool for solidarity between users and administrators. It also requires a strong and sustained political will to launch projects (that otherwise

linger in drawers of governmental departments) on BOT (Build-Operate-Transfer), DBOT (Design-Build-Operate-Transfer), or on franchising/concessions, leasing, and other basis. It should be noted that those responsible for the management of the water sector have completed a draft law on the partnership between the public and private sectors in 2003 for the management of docks, storage facilities of all types, treatment plants and power generation. It was passed to the Cabinet for approval and follow-up for ultimately enacting it. Then they conducted workshops at the Presidency of the Council of Ministers with the participation of several responsible parties, Ministries, councils and public institutions to inform them about the draft law. However, the draft law remained in the drawers and has not been issued to this day.

8. "Shared and transboundary water resources":

It's the eighth challenge for the public authorities. The problem cannot be solved in isolation from other states because it shows in a very sharp and particular way in the countries of the region where water resources are naturally limited. This is the reason why these resources can be a means to promote peace in the Middle East on the basis of the United Nations Convention through the application of the concept of equitable and fair sharing, and acceptable usage between states. We must give a serious chance for cooperation and water diplomacy to do their work, in order to maintain the available water (i.e. existing) in a good quality for future generations. This can also be the case by learning how to share water, which in turn should be taught to people, for them to know how to live together in an atmosphere of trust and respect and shared prosperity. Lebanon has positive achievements in sharing common waters according to the United Nations Convention of 1997, those relating to the Southern Al-Kabir River and the Assi River through the establishment of two dams with a hydroelectric power generating station on the latter. The project of constructing a dam on the southern Al-Kabir River is currently stalled due to the situation on the Lebanese-Syrian border. As for the Ibl al-Saqi dam project on the basin of the Hasbani River, and the Jordan River, Lebanon has been able to confirm its national right in international forums. It aims primarily to maintain Lebanon's share of the Hasbani River water and the use of these Lebanese water resources to meet the growing water needs brought about by population growth and the economic development of the project area from the present up to the year 2050.

9. "Reforming the water sector legislation":

The ninth challenge is the development of the legislation and systems pertinent to the water sector in Lebanon, which must be subject to an updating work in line with

the present status and modern developments. Law 221, issued in the year 2000, stipulated the reorganization of the water sector. In accordance to it, water affairs were attached to the Ministry of Energy and Water, besides the water institutions already under its supervision from the earlier merger of the independent twenty-one water companies. However, this move needs to be complemented by issuing regulatory decrees relative to the application of these laws, in order for it to proceed to execution.

10. "Achieving sustainable development is related to the integrated management of water resources":

This is the tenth challenge for public authorities. There is no doubt that the issue of sustainable development is closely related to integrated water management. For the latter's application leads to the achievement of sustainable development through working on the implementation of vital projects which have implications and dimensions at the economic, social, and environmental levels. This would be achieved if the right balance is set among those projects, and work to develop other relevant sectors would be determined by the national strategy in line with available capacities and the current circumstances. This would drive progress in the water sector, and therefore in the energy sector, thus reflecting positively on production in many domains. It should also be accompanied by the development of national legislation relevant to regional and international cooperation on transboundary water resources, for the purpose of environmental and natural resource protection, and to establish a culture of peace.

11. "The use of modern technology": Innovation to adapt to modern requirements:

That's the eleventh challenge for public authorities. The determination of international basins with precision requires the use of geographic information systems and the use of tools to support decision-making on a priority stage of project planning for the transboundary basins.

Reliance must be made on models such as Modflow, Arc Hydro, and WEAP (modeling) and integrated information systems, so that experts strengthen the amount of information and data belonging to the river basins, in order to be informed of resources and their usages for the purpose of identifying shared basins, and reducing the possibility of conflicts arising between states in matters of exploitation rights.

12. "The application of Pact of Paris (Cop21)":

The twelfth and final challenge came to being after Lebanon signed the pact of Paris during Cop21 at the end of 2015, which was a very important event. Lebanon participated through an official delegation and signed the pact, which led to drawing a roadmap for Lebanon to move forward in the implementation of the concept of integrated water management at the basin level. This pact emphasizes the importance of adaptation at the basin level through a joint, participatory, integrated and sustainable management of water resources, to reduce the effects of climate change on the health and safety of the population, in addition to economic development and environmental preservation. The importance of this pact lies in the attention given to the protection of ecosystems related to water, in addition to cooperation, coordination, exchange of information, dialogue, consultation, prevention of conflicts among stakeholders, and promoting the implementation of adaptation and benefit-sharing measures taken at the basin level.

It should be noted that Lebanon, through its presidency of the Mediterranean Network of Basin Organizations almost two years ago, played a major role in the drafting of this pact.

The essence of these challenges is that integrated water management is a comprehensive and holistic view of the water sector, where the water quantity, quality, and distribution method ought to be balanced. Attention should also be paid to water resources planning and management in the long run for both urban and rural development, and reaching sustainable development.

It can be said that there are two components for the integrated management of water, one vertical and one horizontal:

a) The vertical one is represented by technical projects highlighted by the ten-year plan and the national strategy for the water sector.

b) The horizontal one is represented by:

- The role of women, the role of education by schools and universities, the role of the media, the role of civil society, the role of research centers.

- The legislative process: Here, the administration played its role in drafting a modern law for water with the support of the French State. Moreover, a law of partnership between the public and private sectors was prepared and filed before the Presidency of the Council of Ministers in 2005, but it has not been issued yet.

- Stimulating awareness and motivating officials through the organisation of scientific seminars, conferences, and workshops at home and abroad.

- Water impact on the environment and public health.

However, these two components depend on the approval of the country's political authorities. Although the administrative authorities performed their role, the non-adoption of these legislations and the lack of securing funds for executing the projects was the biggest impediment to the implementation of the national plan which is based on modern concepts.

Conclusion

The implementation of the ten-year plan and the national strategy for the water sector in the context of the integrated water management concept could lead to a state of stability on the water level in terms of food security and the needs for drinking water. The Water Balance in Lebanon will achieve positive values until the year 2025. As of that year (2025), there will be a need to include preliminary work procedures to update the strategic plan.

In addition to that, the exploitation of available and renewable water, starting from the source, is no more sufficient to meet the needs of the population during the dry seasons. In addition, the excessive consumption of underground water by the public and private sectors can cause many problems.

This new practice by the administration bore first fruit in the emerging countries. Moreover, it will inevitably be successful in our country as well. Is there in Lebanon a plan for cooperation in infrastructure development between local communities and the State? What are its different facets? Who are the officials who are calling for playing down the partnership between the public and private sectors in Lebanon? The cooperation between the public and private sectors, with the support of the local community as well as the Government, may form a new mechanism that could be followed in order to improve service and performance. It is an experience that has known successes in several countries; so let us work and act together at this level.

As for all the leaders in Lebanon, the most prominent challenge is to engage in a holistic process based on strong will to establish a water policy aimed to achieve, together, a coordinated progress in order to protect water resources. Promoting the

integrated management of basins is essential to achieve the goals of the national plan and secure the financial means needed to support the implementation of sustainable infrastructure projects. Further, it'll be up to investors and donors to judge the targeted benefit of this strategic plan, which aims to strengthen the bonds of solidarity among citizens around the slogan: "Together for a better case for water in Lebanon."

In conclusion, "Water Culture" relies much on the role of national education, whether in schools or at universities, to spread out. Further, it would be a way to promote peace in the Middle East. We must give cooperation a serious chance in order to ensure and maintain water security.

That can also be through learning how to share water, which in turn we need to teach to people so that they acquire the awareness of how to live together in an atmosphere of trust, respect and shared prosperity.

We conclude with the words of Danton:

"After bread, education is the first need of people" ("Après le pain, l'éducation est le premier besoin d'un peuple."), and this is what we aspire to in Lebanon.