WATER MANAGEMENT
AND
DIPLOMACY IN THE MENA REGION

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FOREWORD

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Since the dawn of time, most human activities have relied on water as a vital resource that is inseperable from any form of life. Nowadays, the social and economical development of nations depends from the availability of this resource in terms of quantity and quality. This certitude is a particularity of the of the Near East countries, very well known to have a growing population, with a rate exceeding 2.8%, but have only the tiniest percentage of available drinking water I the world. Here, the mean amount of water per inhabitant is below 1000 m^3 per year, whereas the world average reaches some 7000m^3 per year.

This important natural resource figures now on the diplomatic agenda of the governments of Lebanon, Syria, Jordan, Palestine, Israel, Egypt and Turkey. Water has thus become a source of cross-border and, therefore inter-states stakes, particularly centered on the main rivers: the Jordan, the Orontes, the Nahr el Kebir, the Tigris, the Euphrates and the Nile.

A number of challenges will have to be taken up in order to guarantee the equitable use of water resources for the population of the South East of the Mediterranean basin. There are four critical thresholds to be crossed and which are essential to the implementation of the Millennium Development Goals.

We must first take up the challenge of water policies and, in particular, those involving drinking water, agriculture and sanitation, by adopting innovative techniques within the framework of integrated management, whilst ensuring protection from socio-economic impacts.
The pricing war will have to be won, as will that of the decentralization of services within the framework of Public Private Partnership (PPP), not to forget the unprivileged social classes.

The third challenge is that of good governance. This is a necessary condition for the efficient management of a resource. Good governance means active awareness amongst the population and their participation with various NGO’s and government leaders in the Near East. This concept is appliedin Lebanon through the implementation of the water code, the European water framework directives (WFD) and the United Nations Convention (1997) which concerns the equitable sharing of non-navigable international rivers.

The fourth major challenge resides in the application of the Millennium Goals, which basically mean that we must, by the year 2015, have r3educed by half the number of inhabitants across the Globe that does not have access to water and sanitation.

The “**Land of Cedars**” and water is the title of an adventure story that goes back to the drawn of time and Biblical quotations. Since olden times, the Lebanese have rationally managed their water resources. However, demographic growth, social and economic changes lead to a new situation in the 20th century. In an increasingly spoilt environment, water in Lebanon became a rare resource and a limiting factor for the country development.

The Lebanese administration is currently undertaking an ambitious programme that continuously defines policies, directions and expectations within the water sector and for which the stakes and dead-lines are becoming increasingly urgent.

Within the organization framework of the Lebanese water sector, a ten-year strategy that plans the construction of some thirty dams and hillside lakes which should store a yearly average of 850 million m^3 of water that will be distributed in the periods of drought, was proposed. Moreover, the plan includes the creation of a wastewater collection network with the relative treatment plants spread throughout the Lebanese territory.
This treated water will be recycled for irrigation or for the artificial replenishment of coastal aquifer.

Along with the ten year strategic technical plan, the institutional framework of the laws 221, 241 (2000) and 337 (2002) which initiated a new water policy in Lebanon lead to the creation of four new Autonomous Water Boards which will take over the management, operations and maintenance of drinking water supplies, sewage collection and irrigation networks within their respective operational areas. The Ministry of Energy and Water ensures the environmental preservation of the watercourses and the strategic plans for a sustainable management of all of the country’s water resources. A close work with the technical personnel of foreign Institutions such as the French Development Agency (AFD), the World Bank, the European Union through its EU water Initiative programme, the Rhone Alpes regional Council and the USAID will be needed. A geographical Information System (GIS) for all of the water resources in Lebanon will be set up.

The Administration started a major action oriented towards the private Public Partnership (PPP) in the water sector. A new management contract was signed between a Frecnch operation and the water Authority of Tripoli which lead to a positive result in terms of the improvement of the utility performances.

At the regional level, Lebanon is faced with an extremely serious problem linked to the water shortage and if its tragic consequences due to the geopolitical issues in the Middle East, it is urgent that we increase our efforts in attempting to find a means by which to eradicate this threat. The problem of water and possible solutions cannot be isolated from other issues such us the geopolitics of the Middle East, but must be included within a global development plan that involves regional hydrodiplomatic cooperation for the equitable sharing of this resource.

In the MENA region, water must form a bond between people. This vital natural resource must become a cause for “peace”, appeasement and reconciliation. The only alternative that remains open of this region is to find a way of dealing with the problems related to this rare resource, based on cooperation and on the technical and economic criteria concerning resources, availabilities, current and future needs, within the framework of integrated management and equitable sharing.

“**Water Culture**” must be the means by which to cultivate peace in the Middle East. We must give cooperation approach a serious boost if we wish to maintain peace. In learning to share water, the populations will also get to know each other and learn to live together in a climate of confidence, respect and prosperity.

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CHAPTER I

INTEGRATED WATER RESOURCES MANAGEMENT IN THE MEDITERRANEAN BASIN (IWRM)

I – Introduction

Many countries around the world confront challenges related to water resources, in the frame of their fight for sustainable economic and social development. The increasing demand of water resources, the degradation of its quality as well as the bad management of natural resources cause the water to be much more vulnerable and limited.

This fact is becoming more obvious in the Mediterranean region where the sectoral approaches of the water management are always present in a number of countries and are unable to meet the contemporary needs for a sustainable management. The region is in need for a general master plan and a future strategy that takes into account the climate change issue and its negative impact on the water cycle and integrates technical, environmental, social and economical parameters.

In this context, the need for an integrated approach is currently crucial to supply the future generations with fresh water in sufficient quantity and to preserve the environment and the ecosystem in the Mediterranean basin. .

During the Earth Summit in Rio de Janeiro (1992) and within the scope of the Agenda 21, chapter 18, paragraph 18.6: the term "Integrated Water Resources Management" (IWRM) was defined as the following:

"**The holistic management of drinking water as a finite and vulnerable resource, and the integration of sectoral water plans and programmes within the framework of national economic and social policy, are of absolute importance for action in the 1990s and beyond**"

For this purpose, the process launched to adopt the IWRM by the international and governmental agencies initially aimed at helping countries in their efforts exerted to treat the water-related issues in an effective and sustainable way.

The "Global Water Partnership" (GWP) has defined the IWRM as: "**A process to promote the development and the management of water resources, lands and other related resources, in order to maximize the economic and social welfare resulting from the equitable means without compromising the sustainability of indispensable ecosystems**".

These two definitions lead us to distinguish among three fundamental mainstays of IWRM which are:

- Set up an environment that promotes policies and appropriate regulations.
- Implement an Institutional Framework
- Organize the Management Instruments that should be applied by the institutions.

II – Water management in the Mediterranean basin

The political and social environment prevailing in the Mediterranean region is considered as representative of the relationship between the North and the South East to the other parts of the planet, due to the climate diversity resources and socio-economic development. This region represents a ideal context for the application of world vision, mainly regarding the water resource status and management suggested during the Rio summit in 1992, Rio + 5 at Johannesburg (1997) and the Global Water Forum in Mexico City in 2006.

The creation of a database comprehending the technical characteristics on water resources in the region as well as the socio-economic criteria of the countries located in the Mediterranean basin is a necessary task to launch the IWRM process.

It is worth mentioning that the application of such process in the Mediterranean region was conducted by several international institutions such as: Global Water Partnership (GWP), European Union Water Initiative (EUWI) and the Euro-Mediterranean water information system (EMWIS).

In the following section a review of the important elements in relation to the water resources status in the Mediterranean region as well as the challenges of the future development are presented.

II – 1 – Demography

The increase of the population constitutes the dominant factor of the economical, social and environmental development in the Mediterranean region. The population of the Mediterranean countries that counted 246 million inhabitants in 1960 will reach in 2025 approximately 550 millions.

This demographic status, combined with the intensive urbanization, underlines the concentration of population and their activities essentially in costal regions. Moreover, in the majority of the Mediterranean countries more than 80 %of the population is supplied with drinking water, but this percentage decreases to 60 %in rural southern regions. The access to sanitation on the southeastern shore reveals an important backwardness to drinking water in serving supply system.

The countries localized on this shore of the Mediterranean basin are also facing an increasing degradation for the remaining natural resources. The water stress constitutes a threat for the food security of the populations and binds their economical developments particularly for poor countries located in arid and semi-arid rural areas.

II – 2 Climate in the Mediterranean basin

The principal climate characteristics that prevail in the Mediterranean basin are:

- Sunshine
- Drought periods
- Winter relatively mild
- Abundance of precipitations in winter along the coast
- Snow on high mountains
- Marine wind current

In general, the climate is humid in the coast, more contrasted on high mountains in the North and in the plains of the occidental and continental Europe. The aridity exists in the south, where desert extends till the sea in Libya. These diversified relieves resulted in an arid or semi-arid climate that governs more than 40 % of the basin and widely present in Africa and Middle East as well as in many regions in Spain and Anatolia. The different climate zones of the Mediterranean basin are presented in figure 1.

The annual average precipitation levels are extremely different; starting with few centimeters on the shore of Syrtes, in Libya to reach more than 4 meters over the most watered summits on the western Balkan (max. 4.64 meter over Montenegro). The rain records of the basin shows that the input of precipitations are unequally distributed since 2/3 of the total annual average of 1100 km^3, are concentrated over 1/5 of the surface of the basin. France, Turkey and Italy are the three Mediterranean countries which receive half of this volume. Italy is the most watered state (with 300 km^3) while the countries of the African littoral don't receive more than 13 %of this volume. These precipitations intensified in winter season of 50 to 100 days per year and present usually a torrential condition. The high irregularity factors of the precipitation flow causes grounds erosion as well as natural catastrophes such as landslide. The precipitation widely varies according to the following range of years:

- One year out of three is identified as being "dry" and two years out of three present an intensity under the recorded average.
- A decennial year characterized as "dry" with precipitations that fall mainly over 2/3 of the recorded averages of nine out of ten years.

These aforementioned climate parameters related to the Mediterranean basin shows that the weakness and irregularity of precipitations are the main cause of the high irrigation water consumption volume in the region.

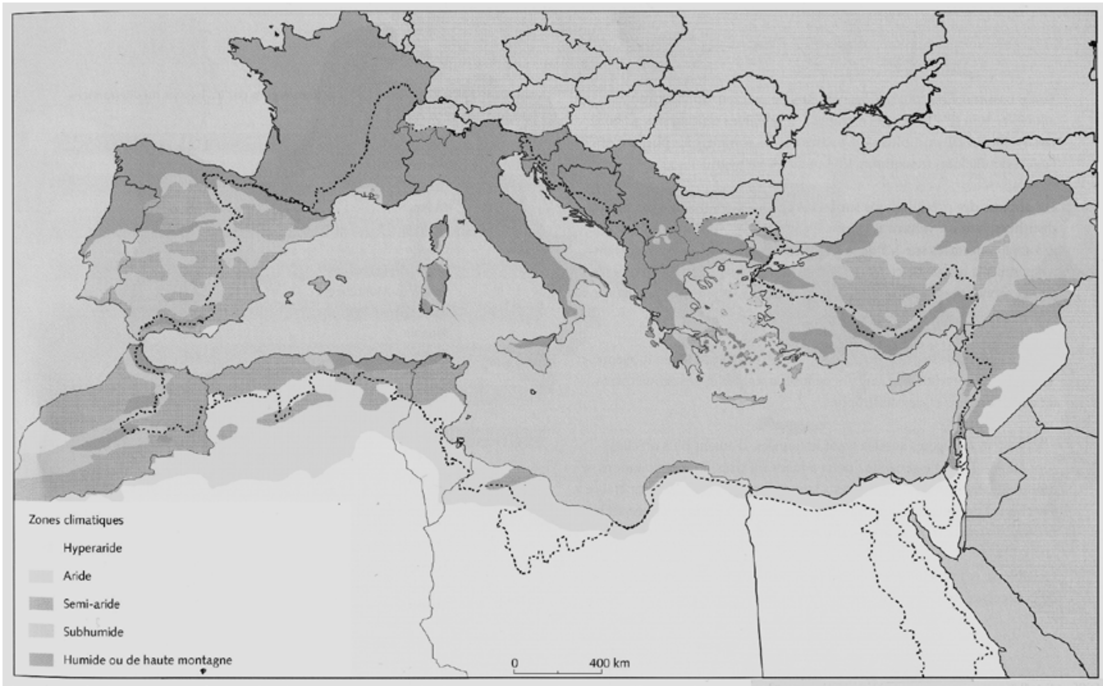

Figure 1: different climatic zones in the Mediterranean basin

The annual average volumes of precipitations and flows for each country (per km³) are presented in table 1 and 2.

The annual average flow collected by the watercourses and the aquifers are spread between 2 meters and less than 10 mm of precipitation, or 2 millions m^3 and less than 10000 m³ per km². The northern chain of mountains, starting from the Pyrenees till the Taurus, receive the most abundant flows and reach a maximum at the Alp and the western of the peninsula of the Balkan, from the Dalmatie till Albany. The average of inputs can be found on the eastern shore countries in semi-arid regions, while the volume of low precipitations are located in the arid regions at the South of the basin. Theses cumulated inputs that reach 517 km³ per year are unequally distributed since ¾ of the total volume are only produced over 1/3 of the basin. The basins of Po and Rhone receive 20 %of the total flows. This repartition influences the river basins renewable water resources of each country.

Country	Volume in km³
Spain	112
France	123
Italy	296
Malta	0.16
Slovenia	6.5
Croatia	26.5
Bosnia Herzegovina	22
Serbia & Montenegro	22

Country	Volume in km³
Spain	28
France	64
Italy	182.5
Malta	0.05
Slovenia	4.20
Croatia	18
Bosnia Herzegovina	14
Serbia & Montenegro	16

Macedonia	18
Albania	42.7
Greece	113.4
Cyprus	4.4
Turkey	137.6
Syria	13.5
Lebanon	8.2
Israel	3
West Bank	1.4
Gaza	0.1
Egypt	12
Libya	10
Tunisia	33
Algeria	68.5
Morocco	21

Table 1: annual average volumes of precipitations per country

Macedonia	5.4
Albania	26.9
Greece	58
Cyprus	0.78
Turkey	66
Syria	5
Lebanon	4.8
Israel	0.63
West Bank	0.57
Gaza	0.8
Egypt	12
Libya	10
Tunisia	3.7
Algeria	12
Morocco	5

Table 2: annual average volumes of flows per country

II – 3 Surface and flow of Mediterranean river basins

We distinguish two forms of the Mediterranean basin surface:

- Basin of variable geometry with two variations:

a. The area of the whole basin, added to the entire Nile basin reaches 4562480 km².
b. The area of the conventional basin, with the part of the Nile basin localized only in Egypt, reaches 1836480 km² and is distributed as following:
- North (Europe) 949 531 km²
- South (Africa) 661 864 km²
- East (Middle East) 225 025 km²

- Basin of parceled type having several forms:

a. Six river basins which extend over 50 000 km²: **Nile, Rhone**, **Ebro, Po, Moulouya, Evros - Ergene**.
b. Eleven basins of more than 10 000 km²
c. Many small river basins of less than 10000 km²

As to the outflow, the watercourses can be classified as the following:

a. An average outflow for three rivers of more than 1000 m^3 per second: Nile in Assouan, Rhone and Po.
b. The outflow of ten other rivers varying between 100 and 1000 m³ per second: **Adige, Axios – Vadar, Ceyhan, Drin, Ebro, Goksu, Neretva, Seyhan, Strymon, Tiber.**

The most important Mediterranean rivers (with an average outflow > 10 km³ per year) are presented in table 3:

Name	Length (km)	Catchment basin area (km²)	Natural outflow average	
			m^3/s	km³/year
Nile (entire) (el-Bahr)	6 617	2 870 000	2 660	84
Rhone	812	98 845	1 940	61.2
Po	676	70 090	1 480	46.7
Drin + Buna	151	19 582	680	21.4
Ebro	930	86 000	593	18.7
Neretva	210	12 750	377	11.9

Table 3: characteristics of Mediterranean rivers of important outflow

The majority of the Mediterranean sub-basins hydrographic boundaries rarely coincide with the political borders of countries. Thus, the water balance of the basin nations should comprehend the water transboundary flows coming from a neighboring country added to those existing in the national territories of each country. This is the case of Switzerland which supplies France and Italy, Bulgaria an upstream country supply, Macedonia and Greece, and massively from countries of the upper Nile basin to Egypt. The inputs of non coastal countries to the Mediterranean Basin reach about 110 km³/year (including the Nile) and this supplementary discharge increase the internal flows at a rate of 20 per cent.

In the Middle East, the Jordan River (42 500 km²) which empties into the Dead Sea is considered as closed basin and is shared out by five countries: Lebanon, Syria, Palestine, Jordan and Israel. The Jordan River will be subject to a special study within the context of the peace process in the Middle East. The watercourses and aquifers which naturally flow into the Mediterranean Sea discharge an average flow of around 470 km³/year among which 40 km³/year are underground flows with strong inequality between the north and the south (85% throughout the northern shore of Europe and Turkey and 15% on the southern and eastern shore). It is worth to mention that a significant part of the Mediterranean watercourse natural outflows does not reach the sea because of its overuse. This is the case of countries like Spain, Tunisia as well as Egypt where the Nile outflow discharges in the sea was reduced by six of its initial volume. Loss of fresh water flows discharged in the Mediterranean Sea is evaluated of more than 15 per cent of the total watercourses outflow.

II – 4 Hydrogeological structures of aquifers

The most spread aquifers of the Mediterranean basin are of three types:
1 – Karstic carbonated aquifers: exist in all along the Mediterranean basin and particularly are developed in Diranic Alps (Slovenia) where the Karst region is on the basis of their denomination. They represent unequally large and regulating reservoirs that feed also many littoral and brackish underground water sources due to its mixture with sea water. This is the case of Hamate sources in Lebanon that are subject to a “MEDITATE" research program financed by the European Union. The depth of water table and the random access by drilling make the direct utilization quite of these aquifers difficult.

2 – Alluvial aquifers: located in the valleys and deltas of main rivers, strongly linked to surface watercourses. The most extending ones are those of the Po plain in Italy and the Nile valley and delta in Egypt. They comprehend deep captive water table and can be easily reached and overexploited.

3 – Aquifers of sedimentary formations: Are initially located on the coastal plains and wide basins extended on the southeastern side (Libya and Egypt) as well as in the deserts. These aquifers contain deep water table provided with considerable reserves but not renewable (fossil water) and relatively independent of the surface water.

The flows of these aquifers vary as the following:

- With 20 l/s per km^2 (> 630 mm/year) in the mountain chains, such as the Alp and the Diranic karstic calcareous plateau.
- With less than 0.1 l/s per km^2 for a year of average precipitation in the arid plains of the southeastern region.

The total volume of the Mediterranean aquifers natural supply is estimated at 150 km^3 / year. They are unequally distributed since 4/5 of their volume is located in Europe and the remaining quantity is distributed among the southeastern basin area.

II – 5 Renewable and exploitable resources

The renewable water resources of each country are calculated by the addition of internal resources (being surface or groundwater) and of external resources originating in neighboring countries from transboundary rivers or aquifers. The volume of these resources is unequally distributed among the basin regions and presents for a year of average precipitations the following:

- 480 km^3 / year in the north (Europe)
- 78 km^3 / year in the south (Africa)
- 82.6 km^3 / year in the east (Middle East)

Italy, France, Greece and Turkey are the four countries which receive the highest level of precipitations in the basin. They cumulate 407 km^3/ year which constitute 2/3 of the renewable resources total volume. The poorest countries as Cyprus, Malta, Libya and the Palestinian Territories do not anymore calculate their water resources in billions of m^3/year anymore but in millions.

Moreover, internal and external flows are highly different and show indicators of the independence of water resources (refer to table 4). Being abundant or not, this natural resource is just partially “available” and “exploitable”. The sharing among countries whether they are providers of water in upstream river or receivers in downstream river are fixed according to the technical, economical, environmental and geopolitical criteria.

The indicator of countries water independence all around the Mediterranean basin (table 4) shows the rareness of the resource and the compensation through water transfers from other regions with better provision, for instance, in Spain from the Tage river, Israel from the Jordan River and Libya that extract more than 60 % of its water resources from pumped fossil ground aquifers in the desert (Non-sustainable resources).

The comparison between the resources of a country and its population reveals the indicator of richness and poorness in water of the territory. The actual average water quantity of the whole Mediterranean basin is considered as 1400 m^3 /year per inhabitant. This indicator determines the reference water level widely accepted by the international agencies and which are classified under three categories:

1 – Water scarcity **$i<500$ m^3/year**
2 – Water shortage or water stress **$500<i<1000$ m^3/year**
3 – Acceptable minimum amount **$i = 1000$ m^3 /year**

The practical application of this classification shows that for 250 million inhabitants of the Mediterranean basin, 74 million will suffer from "Water stress" and 48 millions from "water scarcity"; regardless the other local seriously difficult conditions to be managed in some countries.

Table 4 shows the indicator of water resources independence in the Mediterranean basin countries.

	Internal resources km^3	**External resources km^3**	**Indicator of independence %**
Spain	28	0.35	99
France	64	8.5	88
Italy	182.5	8.8	95
Malta	0.05	0	100
Slovenia	4.21	0	100
Croatia	18	13.65	56
Bosnia – Herzegovina	14	0	100
Serbia & Montenegro	16	0	100
Macedonia	5.42	1	84
Albania	26.9	14.8	64.5
Greece	58	16.25	78
Cyprus	0.78	0	100
Turkey	66	3.45	95
Syria	5	0.96	84
Lebanon	4.8	0	100
Israel	0.63	0.38	62
West Bank	0.57	0	100
Gaza	0.046	0.01	82
Egypt	0.8	55.5	1.4
Libya	0.7	0	100
Tunisia	3.7	0.32	92
Algeria	12	0.03	99.7
Morocco	5	0	100

Table 4: Indicator of water resources independence per country

Strong disparity appears in the Mediterranean basin where the indicator on the average of consumable resources per inhabitant varies of less than 10m³ / year for Gaza and Malta and more than 10000 m³ / year in Croatia and Bosnia. The average volumes per sub-region present a great difference in m³ / year: 2254 m³ / year in the north, 1339 m³ / year in the east and 572 m³ / year in the south.

II – 6 Water demands by sector of use

The total annual volume of water use for all the consumption sectors in the Mediterranean basin is estimated to be about 200 billions of m³. This quantity translates that water for irrigation is considered to be the main consumption sector in almost all the basin countries, and then comes after the domestic demands to meet the needs of the population's growth and the industries connected to the public networks. Thus, the great quantity of water used in every country depends on the population's growth and the irrigation schemes development. This is the case of Egypt and Italy which are classified as the "most irrigating" countries since they cumulate together a water volume of of 115 km³ annually, over the half of the exploited total amount. According to the "Blue Plan", water demands in every sector of use are distributed as following:

- Community /drinking Water	37.9 km³ / year (13 per cent)
- Irrigation	181 km³ / year (63 per cent)
- Industries	32.4 km³ / year (11 per cent)
- Power (cooling)	37.9 km³ / year (13 per cent)

The demand of water in the power sector for the cooling of nuclear plants is predominant in France.

Based on the importance of the irrigation in the region and especially of Egypt an Italy, the repartition of water demands in the Mediterranean Basin is quite equilibrated and distributed as the following:

- 90 km³ / year in the north
- 82 km³ / year in the south
- 29 km³ / year in the east

a- Irrigated surfaces

Irrigated surfaces in the Mediterranean basin were developed in the 20th century. They almost doubled between 1950 and 2000, and their total surface reached currently 12.5 million hectares distributed as following:

- 6.5 million hectares in the north
- 1.6 million hectares in the east
- 4.4 million hectares in the south

However, these irrigated surfaces occupy various parts of cultivated lands with the following rates:

- Less than 10 % in the South (Tunisia, Algeria and Morocco)
- 100 %in Egypt (represents by its own an extreme case)
- 20 %representing the average of the whole basin or "dry" cultivations. It occupies large areas mostly concentrated in the valleys of the greatest rivers (Nile, Ebro, Po, Rhone, Oronte) and coastal plains.

The irrigated surfaces gather different watering methods such as gravity irrigation by submersion, sprinklers and dripping.

The irrigation methods using sprinklers and dripping are deemed much more economical since they reduce the quantities of water used per year, which varies between 10000 and 20000 m³ per ha for gravity and submersion comparing to 7000 m³ and 6000 m³ per ha for sprinklers and drip irrigation. The irrigation percentage of cultivated lands per country and the quantity of water used are presented in table 5:

Country	**Irrigated cultivated lands %**	**Quantity of water used (km³ / year)**
Spain	24	11.9
France	20	1.8
Italy	24	20
Malta	-	0.007
Slovenia	1	
Croatia	-	-
Bosnia – Herzegovina	-	-
Serbia & Montenegro		0.2
Macedonia	9	1.4
Albania	34	1.0
Greece	37	7.6
Cyprus	40	0.24
Turkey	17	7.6
Syria	30	3.2
Lebanon	29	0.9
Israel	46	1.2
West Bank	-	0.08
Gaza	-	0.08
Egypt	100	60.7
Libya	22	1.6
Tunisia	8	1.9
Algeria	7	1.1
Morocco	10	1.7

Table 5: percentage of irrigated areas and quantity of used water per country

b- Urban demands of drinking water

The statistics made by the "Bleu Plan" in the year 2000 reveal that 2/3 of the populations living in the Mediterranean regions are town people. The Mediterranean basin counts more than 200 cities assembling more than one hundred thousand inhabitants among whom 23 towns of more than one million inhabitants.

The supply of the urban populations with drinking water, for an amount going between 50 and 250 liters daily per inhabitant, constitutes a considerable part of water resource to be managed with care. Recent studies shows that 35 cities located in the Mediterranean basin require an amount exceeding 100 000 m^3 daily out of which three urban agglomerations require a water quantity of approximately more than one million m^3 daily. For all the other Mediterranean cities, a total amount of 50 million m^3 is daily required in order to meet the demands of water for the domestic sector.

Efficiencies in the distribution networks require a fast rehabilitation since 30 to 50 %of the distributed drinking water is wasted because of leaks. In the south, the rates of service supplied to inhabitants is really low and weakly covered where about 5 million people are deprived from the access to drinking water of good quality.

Improving sanitation as well as waste water treatment requires the elaboration of a general management plan to satisfy the objective of the EU Water Framework Directive (WFD) mainly for the Mediterranean countries that have integrated the policy of good neighborhood with Europe.

c- Indicators of exploitation

The indicator of exploitation of a basin that interprets the relation among the quantity of water used in all the sectors and the available natural resources show the diversity of the actual water utilizations in the Mediterranean basin. This indicator varies with less than 1 %in Bosnia, Croatia and Slovenia to 200 %in Libya under the effect of the excessive utilization of the local resources.

The presumption of local tensions becomes stronger when the indicator exceeds 50 %. When the indicator is close and even exceeds 100 per cent, water status will become critical indicating the presence of a general scarcity. In order to encounter such a stress status, the applicable solutions enter either within the frame of hydrodiplomacy of transboundary basins or from a non renewable management of water resources such as the project of the Artificial Great River in Libya.

Seeking for the use of non conventional resources, like desalination or waste water reuse constitutes adequate solutions for the countries that do not have natural resources. In addition, an indicator surpassing 100 %may interpret the reuse of the same resources after treatment.

Table 6 shows in percentage the indicators of utilization of water resources in every country.

Country	**Indicators related to resources %**	
	Natural	**Exploitable**
Spain	64	84
France	23	42
Italy	22	38
Malta	50	162
Slovenia	0.7	1.5
Croatia	0.6	2
Bosnia – Herzegovina	0.7	1.4
Serbia & Montenegro	5	10
Macedonia	29	60
Albania	3.4	10
Greece	11.7	29
Cyprus	38	55
Turkey	16	28
Syria	65	96
Lebanon	27	80
Israel	112	120
West Bank	23	25
Gaza	232	260
Egypt	89	96
Libya	200	233
Tunisia	57	69
Algeria	24	41
Morocco	38	56

Table 6: indicator of utilization of water resources per country or city

Indicators for countries and cities such as Cyprus, Malta, Spain, Jordan, Israel, Gaza and Libya shows that these nations should implement a better strategy of their demands management and launch a global awareness campaign for water economy. They should rely at the meantime on their non conventional resources and on water importation from other Mediterranean countries leaving aside their non renewable resources.

II – 7 Excessive utilization of the aquifers

The intensive utilization of groundwater aquifers in many Mediterranean countries has caused several problems related to the environment which resulted in:

- Disequilibrium comparing to the average of natural supply, leading to the reduction of the water tables level (till 100 meters, or more in some cases).
- Intrusion of salted water into the coastal aquifers causing saline pollution which can hardly be reversible.
- Undesirable impacts on the flows of springs and rivers causing drought and also over the aquatic ecosystems.

This status of aquifers overuse leads to a negative impact and non sustainable development of water resources management in the Mediterranean basin.
The proportions of the total water quantities inserted under the context of excessive utilization of non renewable groundwater resources define an indicator of non sustainable water production in many Mediterranean countries (Table 7).

Country	**Indicator %**
Libya	84
Algeria	34
Malta	31
Gaza	23
Tunisia	22
Cyprus	12
Israel	11
Spain	2
Egypt	1

Table 7: indicator of non sustainable water production per country

This table shows a relatively high indicator for Libya (84 per cent) mainly because of the creation and utilization of the Artificial Great River which water resources arise from fossil non renewable aquifers located in the desert.

II – 8 Environmental risks

The pressures that harm and downgrade the qualities of numerous Mediterranean watercourses have various natures and origins as:

- Shortage of urban waste water treatment, industrial and mining waste rejection.
- Polluted water inflow in aquifers by the excess of intensive agricultural fertilizers (nitrate fertilizers, pesticides).
- Lakes and reservoirs affected by eutrophication spread all over the basin area.

These pressures downgrade the resource quality as well as the aquatic fauna and flora and as a result influence the water economical value due to the treatment level required for satisfying the WHO standards.

In addition to these pressures, the impact of climatic change over the Mediterranean basin should be considered as a hight priorites issue. It has recently resulted to drought period and at least in fifty floods each one of them has counted for a lot of victims.

II – 9 Challenges of the water governance and management

In the Mediterranean countries and all along the years, the development of water management depended on the particular needs of each water sector and neglecting the integrated balance of the whole demands.

This sectorial management approach as well as the lack of coordination and cooperation among the different institutions assigned to the utilization of this resource contributes in the water governance and management crisis in the Mediterranean basin.

In this context, the primordial preoccupation of countries located in the southeastern Mediterranean basin is to draw up the conceptual frame of a good governance of resources as well as the necessary means for the application of the integrated management of this sector. This plan aims to promote a balanced situation between the demands and the available resources in these countries.

Then, the implementation process of IWRM does not constitute a finished product but a dynamic process that should be adapted to the level of each water basin in consideration to the technical, social and economical characteristics relevant to each situation.

In fact, it is a process of equilibrium bringing a number of means, tools and methods to ensure the development and the management of water resources with a priority goal to realize food security and water sustainability. The implementation of such innovated concept will incite the political authorities to join their efforts in order to ensure its success.

Moreover, the comprehension of users of the necessity to change the water management approach as well as the manner on the basis of which the institutions will enhance this change constitutes a prerequisite for the application of IWRM.

The preparation of such synergy levels is not easy at all. The most realistic approach will probably be to develop progressively the synergies for each of the phases with clear objective and demonstrative advantages.

II – 10 Principle of Dublin

The international conference on drinking water held in 1992 in Dublin has constituted the vehicle for the practical implementation of the “Fundamental Principles for Water” that recognize the close correlations between the economic, social and environmental security. These principles are the following:

a- Drinking water is a finite and vulnerable resource essential to sustain life, development and environment

“Since water sustains life, effective management of water resources demands a holistic approach, linking social and economical development with the protection of natural ecosystems. Effective management links land and water uses with the whole water basin catchment or groundwater aquifer”.

Water is crucial to all life aspects that guaranty the good quality, development and the socio economic welfare.

The overpopulation, increasing demands, pollution and degradation of the quality and quantity of water resources make drinking water much more vulnerable and delicate.

On the other hand, drinking water is a finite resource with natural limits among which the global volume is related to the water cycle.

Human alterations can not be significant, despite the initiatives launched such as non conventional water resources and desalination. Consequently, water management should be implemented using a global approach with integrating policies for the maintaining of resources and ecosystems as well as social and economical development.

The concept of effective water management will allow the establishment of equilibrium between the utilization of resources for survival, the development and the protection of resources as well as the maintaining of their functions and their characteristics. In addition, the water management should establish the link between the upstream and downstream users, which means that dialogue, settlement of conflicts and hydrodiplomacy are substantial to meet the needs of the two users in order to maintain an equitable water sharing.

b- Water Development and management should be based on a participatory approach involving users, planners and policy-makers

“The participatory approach involves raising awareness among policy-makers and the general public about the importance of water as a resource in order to ensure its sustainability”.

This approach means that “the decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and the implementation of water projects”.

The fragmented framework of water management currently in force in many Mediterranean countries does not meet the correlations of different sectors identified in Dublin. Nowadays, most professionals manage water, frequently on sectoral basis, without coordination or collaboration with users of the environmental community in their administrative boundaries.

Moreover, the most affected and concerned stakeholders are the users who do not participate in the decision process. The participation of all the concerned actors in decision makings allows attaining an agreement and guaranteeing the transparency as well as the democracy in application of decisions and administration plans.

These actors may be: organization belonging to the private sector, professionals, academics, local groups, Non Governmental Organization (NGO) and individuals; they can participate in all the phases of the public opinion starting from data gathering, consultation, participation, planning, implementation, process and valuation of results.

c- Women play a central role in the provision, management and safeguarding of water

This capital role of women as water users and guardians of social and natural environment has been rarely reflected in the institutional agreements for the development and management of water resources.

In the Mediterranean basin, the approval and the implementation of this principle needs positive policies that meet the specific requirements of women and the disposition of the means to participate in all the levels particularly in rural communities.

d- Water has an economic value in all its competing uses and should be recognized as an economic good

Within the frame of such principle, it is vital to admit first the fundamental right of all the human beings to have access to water and to be provided with water for reasonable price.

The failure of the past to admit the economic value of water caused the occurrence of waste in the utilizations of this resource. Water management being an economical good constitutes a significant manner to realize an effective and equitable use and to encourage the preservation and protection of water resources. The economic value of water was not recognized mainly in the south Mediterranean regions because this resource was and is still considered in many countries to be a free good. Thus, water as same as the air, is a public possession but the utilization and management of such public possession require however some investments and fees; in consequence, its value comprehend an economic and intrinsic component.

- The economic component depends on the user and the manner through which the water is consumed, including the value to the water direct users, profits of reuse, the net profits of indirect users and the water contribution in the fulfillment of social objectives.
- The intrinsic component includes the values of non use such as the existence, nature, cultural and social values.

This approach indicates that the entire cost recovery is basically referred to the economic value and cannot include all the other aspects of its intrinsic value; however, the entire cost recovery should be the aim of practice of all water utilization.

The definition of the water entire cost recommends that the consumers will be billed for the rendering of water services, mainly the impounding, treatment, distribution, and also waste water collection and their treatment. This process does not deprive the governments from presenting social transparent allocations targeted towards poor and vulnerable people in order to recognize the social value of water. The tariff policies should as well consider the communities and individuals with limited financial revenues.

This consideration will allow to have a minimum provision that meets their needs while encouraging in a way the participation of users to make decisions.

Such approach of assessment will encourage the investments for infrastructure development and the private sector participation in cooperation with the public sector for ensuring revenues to cover the operation and maintenance fees.

II – 11 Process of Integration

The integration process of IWRM in a given country takes into account the whole water cycle and its interaction with the socio-economic context. This concept defines a sustainable and optimal utilization of the resource in all the sector of utilization. This integration process requires a global approach that admits the interdependence of three principal domains: environment, social stability and economic development.

Since the water management in the Mediterranean region is based on surface and groundwater distribution systems, it becomes primordial that the management strategy integrates simultaneously the technical, institutional and socio economic aspects in order to harmonize the demands of water with the renewable natural resources.
More specifically, the integration concept of policies on water management could be estimated according to two aspects: horizontal (transversal integration) and vertical (sub-sectoral integration).

a- Horizontal integration

This aspect concerns the integration of national policies in different management sectors such as: coordination, mutual coherence and compatibility of objectives in all water sectors (agriculture, industry, domestic, ecosystems, etc..)

In consequence, the water policies should be integrated in the economy as well as in sectoral policies.

Horizontal integration requires a review of all the sectoral goals with those of sustainable water management. The strategies of development pertaining to different sectors should be assessed in terms of potential impacts (socio-economic and environmental) concerning water resources and such assessments should be taken into consideration during the planning and the definition of the priorities related to development projects. Consequently, the concept of water resources management should foresee the transversal information exchange and the coordination procedures between the different administrative entities for the valuation of projects compared to their implications on the social environment. It is primordial as well to apply some mechanism of assessment and continuous revision of strategies in order to ensure their progressive re-adaptation in a given context.

b- Vertical integration

The vertical integration lays on the sub-sectoral approach and suggests a detailed application and close coordination among the different sectors of uses. Some logistic ways as well as tools of management should be invested to attain such operation, they are:

- Economic instruments
- New legislation and regulations
- Institutional role
- Technology tools

The mechanism of application of these two models of integration constitutes the "integrated model of water resources" representing by itself the water cycle sustainable management in all its constituents: precipitations, fresh and saline water, surface water, groundwater aquifers and evapotranspiration. The whole cycle should be globally managed according to the particularities and implications using all the available tools and methods presented above.

Accordingly, IWRM plays a greater role in protecting the ecosystems and considers drinking water, coastal and marine environment as an integral part of the concept. Then, although the concept and the principles of integrated water management are common, the strategies and the tools could remarkably vary with respect to each country in the Mediterranean region.

The practice of this approach should be adapted to each country or region according to their physical and environmental characteristics and their institutional and administrative systems with regard to the different economic, social and cultural conditions. The European Union Water Framework Directive (WFD) focused to harmonize the different approaches of IWRM in the countries of the community. It constitutes a new legislation and regulations for the application of the integration concept. The principles of the Water Framework Directive are stated in details in the following paragraph.

III – European Union Water Framework Directive (EU-WFD)

The directives of 2000/60/CE, commonly known under Water Framework Directive, came into effect on the 22nd of December 2000. It represents a remarkable trace of the harmonization of IWRM application and the sustainable utilization of water resources in Europe. Water Framework Directive requires the member states to take all the necessary measures in order to attain the environmental objective for the "good status" of the whole surface and groundwater in Europe till 2015. However, the required specific actions for the realization of this objective fall within the competence of the member states authorities on both national and regional level of hydrographic basin.

The implementation of the Water Framework Directive involves a great range of stakeholders like individual consumers of the big consumption sectors, for instance agriculture and industry. One should not forget the activities that lean on the indirect use of water such as: water and seaside activities, treatment, distribution, water reuse, operation and maintenance companies.

It involves also scientists, ecologists, municipalities, non governmental organizations and competent authorities for lands and water use planning and management on local, national and regional levels.

The main characteristic of this text which determines all the other elements of the directive is the use of the hydrographic basins as a basic unit of all planning and water resources management actions. The Water Framework Directive recognizes that the water follows the physical and hydrologic limits of the basins, but not the political and administrative borders.

The specified benefits directly related to the implementation of the Water Framework Directive are the following:

- Improvement of the ecological quality of the watercourses (including groundwater, transboundary and coastal waters in Europe.

- Growth of the biological diversity for a better management of species situated in the aquatic and humid zones

- Sustainable management and water use

- Reduction of water pollution

- Floods mitigation and droughts management

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- Management costs reduction due to the adoption of effective water policies.

The regulatory text of the Water Framework Directive determines the "major tasks" to implement planning and integrated management of national and international hydrographic basins in Europe. A brief summary of WFD is presented herein after.

Article 3 requires the establishment of a hydrographic district as a fundamental unit of the application and the coordination of the directive provisions. The following actions should be applied:

- All the basins and all the coastal waters should be attributed to a hydrographic district. The management of this district shall be ensured by a competent authority.
- An international hydrologic district shall be constituted for a hydropolitical basin which extends over the territories of more than one member State.

- The concerned member State shall watch over the implementation of a coordination mechanism for the international hydrographic district management

Article 4 defines the environmental objectives on surface and ground waters, including highly modified waters. The definition of the objectives presents the context in which the main themes of water management will be identified. This article treats specifically the “masses of artificial waters” and “highly modified” for which it defines the “good ecological potential” and a good “chemical state of surface waters”.

Article 5 stipulates that the characteristics of each hydrographic district should be analyzed with regard to the surface and ground waters. A study of environmental incidence of the human activities is required for each district. The member States shall undertake an economical analysis on water uses for each hydrographic district.

Article 6 imposes the establishment of a record concerning the protected zones in every hydrographic district. This issue is related to the conservation of habitats and species as well as protected zones for the distribution of drinking water. This complementary phase of the characteristics relevant to the hydrologic district contributes in the identification of these districts zones particularly affected by human activities and which require new approaches of specific management.

The identification and the protection of the water masses used for drinking water catchment infrastructure stated in article 7. The necessary treatment degree for the water allocated to the human consumption shall satisfy the exigencies of the directive for drinking water.
Article 8 binds the member States to prepare control programs in order to draft a coherent and complete table on the water status in every hydrographic district. Three types of control are required: monitoring control, operational control and inquiry control. Some additional controls are required for the protected zones such as habitat, species protection and drinking water catchments.

Articles 9 and 11 treat the themes related to the economical analysis and water management. They suggest the application of the recuperation costs principle incurred by the water services in the development of the pricing policies. It also includes the costs related to the protection of the environment and the water resources.

Article 11 binds the member States to set up for the year 2009 a program of measures for every hydrologic district, comprehending the fundamental measures and additional measures required for the realization of the objective of “good status” and the way to preserve it.

- The “fundamental” measures consist of observing the minimal requirements in order to reach the “good status”. These requirements concern the directives for all the sectors of water use.
- The “additional” measures concern the recreation area and also the rehabilitation of humid zones.

Articles 10 and 16 define the control mechanism of all the pollutants and the discharges in the surface waters. The global quantity of a pollutant and its concentration should be regularly controlled. It also covers the specific priority control of some high risk pollutants, with the reduction and the progressive or total discharges suppression of dangerous emission substances.

Article 13 imposes on all the member states to watch over a management plan for each hydrographic basin entirely situated on their territory. When the basin extends over many states, the concerned member States should coordinate their action in order to produce a specific management plan for the international hydrographic basin. In the absence of such a plan, every member State shall develop its own one covering at least the international hydrographic basin situated in its territory.

Article 14 tackles the themes on information and consultation of the public. This article states the general obligation of the member States "to encourage the active participation of all the concerned parties in the implementation of the present directive …". The member States are as well bound to publish and submit the observations of the public within six months as a minimum period. The due date is expected in December 2006. The users as well as the NGO and the stakeholders involved in the protection of the environment were invited to participate in the development and the application of a joint strategy for the WFD implementation. This strategy constitutes a courage and comprehensive approach which will contribute to the effective implementation of this directive.

The calendar of the "Good Practices" for the implementation of the WFD is presented in table 8.

Due date	**Actions**
End 2003	The Water Framework Directive adapted to the national legislations Identification of hydrographic districts.
End 2004	Pressures, incidences, analysis of economic uses
End 2006	Operational programs supervision
End 2006	Public consultancy on the management plans elements of the hydrographic basins.
End 2009	Published plans on hydrographic basins management.
End 2010	Incentive tariff policies and costs recovery
End 2012	Operational measures programs
End 2015	Realized environmental objectives

Table 8: Agenda for the implementation of the Water Framework Directive

The Water Framework Directive was ratified by the end of 2003 and adapted as national law for member states defines series of tasks to be carried out with respect to many final and strict due dates in order to meet the final objective of "good water status".

CHAPTER II

HYDRODIPLOMACY FOR SUSTAINABLE DEVELOPMENT

I – Pressures on water resources

Since the early 20th century, water resources have been considered as the core of the political, scientific and humanitarian topics in the world. The management of the population water needs in the world as well as food security becomes a complicated problem to resolve especially that the quality of the resource and the quantity availability became day after day very precious on earth. Nowadays, 1.5 billion persons do not have access to drinking water and 5500 children die every year of infections related to contaminated water. According to the United Nations Agencies, about 2.4 billion persons will suffer in 2025 from water shortage necessary for survival and conflictual situation among nations started to arise because of inequitable sharing of transboundary watercourses between riparian states.

A scale for water level evaluation of different nations in the world has been identified by FAO, whereas a quantity of 1700 m^3/person/year being a satisfying situation and less than 1000 m^3/person / year is qualified as “Water Scarcity”.

The application of the FAO scale on the available resources volume for the planet shows that highly sensitive water issues are arising in the demand management of several nations such as:

- In 1950 six countries had suffered from “Water scarcity”
- In 2000, the situation becomes much more critical: 19 countries suffered from “water scarcity”. These countries mainly located in the MENA region counted about 160 million inhabitants. Another 11 countries whose population is estimated at 270 million inhabitants are actually under a situation of “Water Stress”.

The projection for the year 2050 shows a more complicated situation since 2.3 billions people will face “Water Stress” while 1.7 billions fall within the scope of “Water Scarcity”.
This shortage of drinking water in the world will be linked to many causes that act on the available resources of the planet and which are:

- Demographic growth.
- Food security.
- Climate change and environmental degradation.
- Difficult access to the resource in the regions of arid climate.
- Inequitable division of transboundary water between riparian nations.
- Non sustainable management of the resource.

With a growing population in the countries located on the southeastern coasts of the Mediterranean basin added to a food policy based on a non sustainable management of the demand for irrigation, the conflicts on transboundary watercourse between reparian states will intensify more and more especially in the Middle East. This situation leads us to distinguish three approaches in the management of the international watercourses which are:

a- Management with financial compensation

This concept concerns the countries that have avoided political tensions and military provocations resulting from the inequitable sharing and the unreasonable use of international water resources by the riparian States. Thus, a financial compensation mechanism should immediately be implemented for these nations concerning the water quantities, unequally distributed without a mutual consensus between the states.

b- Management with regional cooperation

It concerns the nations that rely on regional cooperation framework (treaties and bilateral or multilateral conventions) with the aim of ensuring their domestic water needs and food security and enhance an economic development policy while preserving the international basin ecosystems.

c- Management with security concept

This management method involves the countries which consider that their strategic security depend on the access to water resources and the security of its supply. In this scope, water needs could be considered as tools for territorial expansion.

The diagnostic of these three management concepts will lead us to propose a pragmatic approach for the utilization of the international watercourses. This will consist in treating the socio-economic aspects of the resources by relying on the regional geopolitical facts.

This alternative suggests linking the water resources to the international basin economic development. The objective will be to look for solutions that may enable us to reach an agreement based on an equitable and reasonable sharing of the resource. This concept enhances political stability and establishes an atmosphere of mutual confidence between riparian watercourse States.

II – Cooperation for the development of nations

In the presence of conflicting situations, an independent mediator assistance may enhance the prevailing of a positive climate for communication between the watercourse nations. The mediator may work on establishing a consensus in the settlement of technical problems and overpass then the specific challenges of each country such as:

- Difference in culture
- Difference in political and economic development levels
- Variability of the institutional capacities from one country to another

In the scope of the negotiation process among the watercourse States, each of the concerned country fixes its strategic positions according to its economic interests.

The experience shows that the weakness and imperfections in the water resource management on national level are usually concealed by strong political positions which arise from the absence of consensus between the different political entities. Thus, decision making becomes more centralized and delayed because of the evidence of a weak governmental system.

Some states in the Middle East that experienced during the 20th century the passage from the rule of a colonial regime to an independent government, these countries are still under the impact of the international water agreements adopted by the former regime. The international organizations like the United Nations and European Union have undertaken several hydrodiplomatic attempts in order to direct countries towards a concept of cooperation. This action was taken in order to encounter the water shortages in their countries based on the principles provided in the United Nation Convention for International Watercourses and the European Union Water Framework Directive.

The water resource management depends from several technical and economical parameters related to the volume of used water compared to the available quantity, the quality of the resource, the financial revenue, the protection of watercourses ecosystems and the waste water treatment and reuse. The identification of the parameters allows us to attain the following classification:

a. Country of limited revenue with abundant water resources.

b. Country of limited revenue with limited water potential.

c. Country of high revenue with abundant water resources.

d. Country of high revenue with limited water potential.

It is well known that the most vulnerable category is countries of limited revenue and limited water potential. It is worth to mention that in the majority of cases, transboundary watercourses often cross countries belonging to all the classification categories mentioned above. In this case, it is crucial to motivate underprivileged states in order to benefit from a regional cooperation and take advantage of the socio-economic plans conducted on regional scale by the United Nations and the European Union for the safeguard of their food security. The hydro-diplomatic process becomes closely related to the management system by regional cooperation between states that share the same basin.

A promising example for litigations resulting from the international watercourses is the sharing water protocol systems in South African Development Community" (SADC). This arrangement focuses on international successful initiatives in the domain of water management according to the concept of the regional economic cooperation.

This positive situation reached on the level of SADC relies on the confidence atmosphere that accompanied the negotiations between the concerned parties.

Such a positive environment in the negotiations is only encountered when the negotiating parties deals from equal position on the basis of the legislative texts recognized by water international authorities. In this case, the international donor agencies may transform inequitable sharing by increasing the financial capacity of development, in the underprivileged country.

The agreement conducted in 1995 by the governments of Cambodia, Laos, Thailand and Vietnam on the "Mekong River" and sustainable development cooperation is considered as a successful experience based on the consolidation of mutual confidence between the negotiating parties of these countries.

It is also the case of the dynamic process created by the International community to encourage the cooperation among the riparian states that share the Nile River and enhance as well the development of large infrastructures on this basin with the support of the international donators.

The watercourse States are in need for technical assistance from the international agencies which have a main role to play in the training of a core of specialists in the domain of conflict resolutions. The training of negotiators in the technical and legal disciplines related to natural resources is essential for the elaboration of treaties on sharing, management and development of the international watercourses.

This subject defined as hydrodiplomacy comprehends all these essential components listed above. The definition of hydrodiplomacy and its mechanism of application is related to the benefits of cooperation on the international watercourses which constitute a priority item for transboundary watercourse negotiation. Therefore, it is necessary to take into consideration the nature of the river and its role in the environment, the investments mobilized for the socio-economic development of the basin, as well as the regional political context of the watercourse.

The Lebanese experience in the negotiations of international watercourses was taken as reference in the formulation of this section as well as other regional conflicts. This concept was applied in the scope of the Orontes river, Nahr el Kebir and Hasbani-Wazzani basin (tributary of the Jordan River) negotiations and have reached perfect results in the cooperation between the riparian watercourse States.

This experience shows that the cooperation on the international rivers can bring many benefits such as:

- Environmental sustainability.

- Public health and food security of the watercourse nations.
- Economic productivity of nations which can be extended beyond the watercourse and enhance their development in different domains (commerce, agriculture, energy, industry, transportation, tourism….).

- Integration and regional cooperation.

Hydrodiplomacy should define a framework for this cooperation by specifying the following points:

- What are the benefits of a regional cooperation for a given basin?

- Why are these benefits important for the development of a nation?

- When the benefits could take place?

- How can these benefits be enhanced and shared?

The interpretation of these points permits the identification of a classification by level of benefit resulting from the cooperation between the watercourse States. The classification may help in:

- Exploring the dynamics of cooperation for each level of benefit.

- Exploring the dynamics between the different levels of benefit.

- Comprehending and working in order to reach a more effective cooperation.

- Ensuring the sustainable development of international watercourse.

Table 1 presents the benefits with the challenges to overcome as well as the opportunities of cooperation classified according to their priorities. This procedure allows reaching mutual success of “win – win” situation for the riparian countries that shared the same international watercourse.

Benefits	Challenges	Opportunities
Level 1: Benefits to the river	Limited management of water resources: degradation of the basin water quality, biodiversity and humid zones.	Improvement of the watercourse resource, conservation of soils and biodiversity.
Level 2: Benefits to the river	Optimal management of the basin water resources.	Improvement of the agricultural and hydroelectric energy production. Management of floods. Preservation of the environment and the water quality.
Level 3: Investment Costs	Strained diplomatic relations on regional level and negative impact on the economic development of the basin.	Change of the diplomatic relations towards the regional cooperation. Reduction of risks conflict and military expenses in favor of the economic development, food security and the energy self-sufficiency.
Level 4: Benefits beyond the river	Regional fragmentation	Integration of markets and commercial infrastructures on the regional level.

Table 1: four levels of cooperation on the international watercourses

Hydrodiplomacy is based on the application of this new concept of regional cooperation that creates dynamics of transboundary basin economic development. For that reason, the watercourse Riparian States would be highly motivated to be considered by the international instances as “catalysts for peace”. Thus, these nations will take advantage of the financing programs designated to the development of the basin economic sectors.

The process presented above based on the levels of benefits as well as the opportunities of cooperation enhance the sustainable development of international watercourses. This concept relies on the essential economic and hydrodiplomatic components in order to resolve political conflicts and implement sustainable peace among the watercourse riparian States. The level of cooperation, the motivations and catalysts are detailed herein.

Level 1: **Increase of environmental benefits**

The motivations of level -1- deal with the improvement of the watercourses flows management, flood mitigation as well as drought problems. The responsibility of the watercourse States shall also deal with the preservation of the basin from all kinds of contaminations in order to ensure the sustainability of the ecosystem. The intervention of international agencies and “catalysts” States is essential for the environmental diagnostic of the watercourse. In addition, the implementation of an awareness campaign and the launching of an education component oriented towards public administrations, municipalities and endusers will be essential for the prevention of the basin water quality.

Level 2: **Increase of direct economic benefits**
The motivations of level -2- deal with the recognition of economic growth of the basin, investment and job opportunities arising therefore. The role of the international organizations and “catalysts” countries is to motivate the main economic development stakeholders of the watercourse States in order to identify the investments in the fields of water resources, energy, food industry…

Level 3: **Increase of benefits associated to the political stability**
The improvement of the hydrodiplomatic relations leads to the application of sustainable peace between the watercourse States. The political stability helps in reaching equitable water sharing between the populations. The role of catalysts is to create hydrodiplomatic initiatives on regional stage in order to conclude permanent agreements among the riparian basins countries.

Level 4: **Increase of indirect economic benefits**
The indirect economic benefits are due to the success and gains following the cooperation concept implementation between nations sharing the same international watercourse. The integrated analysis of the basin economy broadens the business opportunities by the private sector involvement as well as the civil society in the development of the basin.

III – Strategy formulation of hydrodiplomatic negotiation

The strategies of hydrodiplomatic negotiation on international watercourses shall be developed on national level for each riparian country. Governments should consider in priority, the assessment of “the risk of potential conflict” level in case of direct or indirect water use without advanced consultation with the watercourse States. Moreover, the levels of benefits should be evaluated for and beyond the basin in case of the adoption of a regional cooperation strategy.

The formulation of a national negotiation strategy represents an opportunity for the major national institutions, concerned by the development of transboundary basin in order to treat the subjects such as:

- Multiple utilizations of the water resources.

- Potential conflicts between the watercourse States.

- Permanence of aquatic ecosystems of the basin.

The final objective will consist on the creation of a “transboundary Basin Organization” or an "International Commission of River Basin” that will guide the efforts of the planning and management of the water course in a climate of cooperation and coordination. This concept of transboundary cooperation-coordination can create synergy for the economic development among the watercourse States and enhance the benefits beyond the watercourses. It would be useful to remind the existence of 263 trans-boundary basins in the world that:

- cover 45 % of the earth surface
- affect 40 % of the world population
- count approximately 80 % of the total watercourse discharges
- cross the political borders of 147 nations

These basins are shared out over the following continents:

- Africa	: 59
- Asia	: 52
- Europe	: 73
- Latin America	: 61
- North America	: 17
- Oceania	: 1

The complexity of their management can not tolerate simplistic, immediate and non planned solutions because they can give rise to political and military conflicts between the riparian countries. An early cooperation between the watercourse States can prevent the potential conflicts.

The implementation of a national strategy within the frame of hydrodiplomatic negotiations has to gather all stakeholders to the negotiations process between the watercourse nations and generate formal links for the application of the framework agreement between the states. In order to give rise to political supports for the application of the framework agreement, it is useful that the strategy may demonstrate to which point the changes could contribute in the benefits of the basin. The experience shows that the creation of the "River Basin Organization" encourages the implementation of the agreement. This organism will ensure the total management of the basin including the preservation of the watercourses ecosystem. This action shall be supported by the governments of every Watercourse State in order to ensure the transfer of the agreement into a national legislation for each country. This process is necessary to reinforce the national consent on the concept of cooperation between the states. The main characteristics of this type of organism are the following:

- Capacity to apply the framework agreement according to the concept of "equitable sharing" and "reasonable utilization" of water resources between the riparian States. The implementation mechanism will be applied to all the domains (technical, socio-economic) with a large participation of the concerned parties.
- Capacity to acquire competences for the basin management on administrative, technical and financial level.
- Possibility to withhold rights, obtain subsidies and loans for the development of the basin.
- Decisions making and efficient solutions for the important and recurrent problems such as: floods, drought, food scarcity, lands degradation, accidental pollution…etc. the solutions shall be approved by all the involved parties.
- Application of efficient information systems between the watercourse States with an accessible database with the aim to have access to the results of the hydrological measurement, the analysis of the basin water quality, the hydroelectric production with a preliminary annual program for every country.
- Preparation of research programs on themes concerning the resources, socio-economic and cultural aspects of the basin.
- Organization of national and regional forums on water in order to share knowledge and to present research programs on the basin.

III – 1 Definition of the national strategic objectives

The development of a national hydrodiplomatic strategy should include the following components:

- Definition of the objectives and the way through which they can be pursued.
- Delimitation of a series of possibilities adapted to different contingences.
- Implementation of long term vision objectives.
- Capture of opportunities in order to establish a sustainable agreement.

Each country must define its roles and responsibilities before launching the negotiations process. This procedure depends on the particular situation and decisional structure of the concerned government, bearing in mind that the implementation mechanisms should be rapidly set up. The first priority is to establish a negotiation commission preferably sustained by an interdepartmental administration committee composed of qualified professionals. The major parties to be included in the formulation of the national strategy are:

- Ministries and institutions involved in the decision making and the planning for national development such as: foreign affairs, justice and territorial planning entities.
- Ministries and institutions concerned by the sectors related to water such as: agriculture, environment, energy, health, industry, transportation, fishing and tourism.
- Local communities, organizations and collectivities being part of the basin.
- Financial organisms of the private sector, water authorities, associated agencies and organisms.
- Groups of sectorial interests such as farmers, cultivators and fishermen.
- Non governmental organizations
- Research institutes including universities.

III – 2 Negotiation instruments

An expert team shall be constituted for the set up and the application of the national strategy. In addition, a "negotiation commission" relevant to the water problems should envolve many highly qualified experts in their fields of activities. The following profiles are requested:

a. Technical profile

- Expert in integrated water resources management
- Expert in hydrology and geology
- Expert in environmental science and quality of resource
- Expert in hydraulic infrastructure

b. Judicial profile

- Experimented consultant in the interpretation and comprehension of judicial documents such as: treaties and conventions of the United Nations and European Union on water and environment.

c. Diplomatic profile

- Experimented diplomat in the domains of conflicts resolutions and crises management.

These experts should be able to undertake the national strategy in the frame of a common agreement between the watercourse States. This objective seems to be very important for the assessment of the interests pertaining to a riparian State, its commitments and legitimacy towards any proposed agreement with the intent to enhance the sustainable development of the basin.

d. Profile of the head of the negotiation delegation

The head negotiator should possess a wide experience in the following fields:

- Water management and environmental science, conflicts resolutions and crises management.
- Administrative responsibility of different major positions at the top of the management hierarchy with large communication skills.
- Involvement in international initiatives for the improvement of the water resources management.
- Large vision concerning the world great stakes with a good national reputation and integrity.

The head negotiator should also have good command of the following faculties:

- Attentive hearing with courtesy
- Attention paid to future opportunities without stating the previous problems and conflicts
- Realism in what may be accomplished according to the institutional, socio-economic and political context.
- Reliability with a constructive thought, clear and realistic targets.
- Optimism, patience and compromising spirit.
- Long term vision and imagination
- Intuition in the identification of positions and alliances.
- Good organization (logistically and institutionally) and preparation of continuous and assessment activities.
- Facility in adaptation to strategic data changes and international alliances to avail profit from new opportunities.
- Guaranty of a wide base of support and commitment on the national political level.

e. Negotiation delegation

The negotiation delegation should ensure the follow up and assessment of the negotiation process in coordination with the interministerial administration committee. The following criteria are to be taken into consideration:

- Define the assessment indicators while the negotiations move forward.
- Establish landmarks and bring in the national strategy implementation mechanisms in order to guarantee its sustainability.
- Verify the implementation process of the suggested agenda along with the national road map.
- Measure and evaluate short, medium and long term impacts and ensure that the proposed actions contribute effectively in the applicability of the national strategy objectives.

The criteria of success of this delegation are the following:

- **Efficiency**: It is the conversion of implemented means into results. It is important to know to which extent the results would be the consequences of the exerted efforts, how the invested resources could be converted into opportunities, and if the same result could have been obtained by a better way.

- **Effectiveness**: It is the degree of the results effectiveness in attaining the declared objectives. It is necessary to consider to what extent the implemented means have reached the desired objectives and if this happened on basis of the process results and the road program.

- **Impact**: It is the way of transforming the national strategy objectives into goals to be achieved and realized. The delegation should measure the impact of a proposed agreement on the basin population.

- **Pertinence**: It is the degree of evolution through which the negotiation process and proposed agreement describes the results and the goals with regard to the basin national and regional development.

- **Sustainability** : Finally, it is necessary to define the positive effects of the agreement that should continue with time.

III – 3 Criteria for successful negotiation

Within the procedures of transboundary watercourse strategic negotiation, several elements shall be taken into consideration in order to reach clear, practical and sustainable commitments. The mediators should try hard with the concerned parties to reach an equitable and egalitarian treatment.
These elements are directly associated to a common strategic vision along with a compromising and cooperative spirit. They are founded on a national consensus and an unconditional political support in order to reach the best alternative way for a successful negotiation.

In this new concept, we withhold seven priority criteria used in the preparation of the strategic negotiation:

a- Alternatives

These are the possibilities of strategic choice held by each party in the absence of a proposed agreement:

* Definition of the strategic choices priorities
* Definition of the methods for strategic axis improvement
* Presentation of a withdrawal plan in the absence of an agreement
*Evaluation of the speaker's position in case of agreement or disagreement.

b- Interests

As much as the agreement satisfies the interests of the parties, it will have better chances to reach a deal. It is also important to analyze its own interests, those of the others, their positions, hopes and fears. The mediator should reply on his personnel contact and charisma and try to dominate the negotiations. It is useful to the chief negotiators to talk about his country own interests in order to encourage other partners in the negotiation to do as such.

c- Options

The parties involved in the negotiation process can reach an agreement through many possibilities. The options are or could be put "on table". The ideal agreement consists of integrating the best options if the purpose is to use the potential and mutual gain in a given situation.

It is necessary for the mediator to create multiple options for the mutual gain of the riparian countries. If the negotiation process shows that interests of the parties do not converge with the mediator ideas, at this point there is no need to continue on the same strategic track. It is better to go for another option and define a new decision making process.

d- Legitimacy

It is the appropriate decision to abide to an equitable agreement permitting to the involved parties to consider themselves as treated in a just and equitable manner. The process should be based on benchmarks, criteria and principles guaranteeing the desire of each party to adopt the concept of cooperation. It should as well find an applicable range of standards and particularly those that permit to convince the other party.

e- Commitments

The commitments can be verbal or mentioned in the content of the declaration concerning what each party may or may not do. They can be declared during the negotiations or included in minutes confirming the agreement at the end of the negotiations.
They shall be practical, sustainable and easily comprehended for those who will apply them. In addition, these commitments should formulate the following priorities:

* Definition of a typical agreement at the end of the negotiations
* Formulation of the extent authority that the mediator could practice.
* Evaluation of the extent authority and the decision power of the other parties.

The head negotiator can define the commitment of the different parties by instituting the following phases:

- Examination of the negotiators points of view
- Creation of new options for the different negotiation delegations
- Publication of a statement on the bilateral and multilateral recommendations.
- Proposition of several drafts agreement attempts to be presented to the delegations
- Promulgation of a firm agreement ready to be signed by the delegations.

f- Communication

This process depends on the degree of mutual understanding and the effectiveness of the discussion. The communication will be much more accessible and easy, if the logistic means invested in the negotiations are well operated; in this case the parties will have a better understanding even in case of disagreement. The plan related to the development of the meeting should include the following points:

- Objective of the meeting
- Suggestions and statements
- Participants to the negotiations
- Development of the process
- Methods to open the meeting
- Outlined agenda
- Responsibilities of each member of the group
- Basic rules to be applied

The preparation of the dialogue plan is essential for the good development of the negotiations. This should include the following points:

- Listen / ask questions
- Discuss / gather information
- State the problems of communication
- Foresee eventual steps to be considered and avoid problems by improving the communication
- Propose the hypothesis for analysis

Some confidential or parallel communication networks shall exist in order to mitigate the impact of eventual disagreements concerning one or many options.

g- Relations between the parties

The negotiations process involves persons and institutions. A strong and active relation among the members of the negotiations delegations may force them to better manage their differences. An appropriate transaction could help in the improvement of the parties capacity to work together, without hindering the negotiations. This should be implemented on the following bases:

- Consider the current relations and those to be improved
- Analyze the possible causes of the existing gaps
- Fix the specific steps to be followed in case of gaps in order to ameliorate the relations among the parties.

The relation among the members of the delegation should always be rational, and not governed by emotions but by reason and reliability. Each party shall be opened to persuasion. Should any party for some reasons refuse to continue with the process, this situation shall be taken into consideration and dialogue shall be maintained by grasping the suspended matters?

III – 4 Negotiation strategy and application of the national evaluation system

The interministerial committee gives confidential instructions to the chief negotiator based on national interests and of the future economic development of the concerned river basin. These interests are fixed by priority and comprehend a range of steps to be considered along the process. Interests are presented according to the previously established road maps with respect to the following criteria:

- All hydraulic infrastructure (dams, water treatment plants) and hydroelectric development related to different technical installations.
- Managing the demands in all the water sectors for the basin population and for the industry.
- Industrial clean development of the basin along with the energy production installation units and the planned dams.
- Rural development of the basin region.
- Development of the agricultural food industries.
- Creation of different jobs relevant to these developments
- Enhancement of tourist and navigation installations along the watercourse for environmental exploration intents.
- Preservation of the ecosystem and the water quality of the basin.
- Involvement of the private sectors in the basin development (banks, construction companies, hotels…) and the profitability of the financial operations of the concerned country.

The implementation of a common national strategy requires that the aforementioned criteria be subjected to an evaluation system on the basis of grades (between 0 and 100) and weighting factors (from 0 to 20). This evaluation system is useful for the priority options to be used by chief negotiators.

Each option in this negotiation strategy is graded between 0 and 100 and considered according to the needs of every nation. The official and confidential road map which will guide the head of the delegation includes on one hand the priorities and on the other hand the obtained scores and the limit of options that should not be surpassed. The main objective of this method is to implement the deal that would take place under the best conditions. Furthermore, the total confidential score of the best deal with respect to the road map should be > 60.

Several blocking possibilities will arise when a delegation of a riparian country involved in the negotiations present suggestions or initiatives that are not in the priority for another concerned state. This score system allows us to suggest many options before adopting a blocking position in order to face the strategy of the adversary. Thus, it shall be necessary to analyze as well the position and the interests of the countries involved in the negotiations in order to reach the best alternative to materialize a firm deal or agreement. If the negotiations process failed with the participating riparian States of the watercourse, a parallel agreement or side deal shall be considered with one of the countries that showed an eventual interest in the suggested option.

III – 5 Presentation of a road map example

Table 2 presents an example of a confidential road map prepared to guide the chief negotiator in imposing a choice of priority strategic options of its country.

Option A	Industrial development 1-Deterioration of the quality of water and air 2-Deterioration of the soils quality due to the polluted discharges 3-Non polluted industries	Grades 0 22 75
Option B	Hydroelectric installations 1-Non polluted energy production 2- Use of water stocked in dams for agricultural development 3- Development of infrastructures for domestic and industrial water sectors	Grades 55 60 70
Option C	Creation of jobs and investment 1-Construction companies 2-Banks 3-Workers	Grades 57 68 85
Total from A to C	• Minimum required grades for the favorable negotiations • Total obtained for each option or the average of the three options	60/100 /100

Table 2: example of the road map for a successful negotiation

IV – Legal aspect of transboundary watercourses management

Water laws have continuously evoluted towards a global development management concept of river basins within the hydro-geographic and socio-economic context. The EU Water Framework Directive (WFD) that concerns the integrated water resources management of river basins constitutes a new water code for Europe as well as for the Mediterranean countries already engaged in the neighborhood policy with this continent.
The main articles of the EU Water Framework Directive were adopted in the action plan suggested by Lebanon for the Paris II and III donor's conferences meeting in the scope of the EU neighborhood policy.

The application of Mediterranean component directed by Greece, has started the national dialogue on IWRM engaged in Lebanon during the Beirut water week event organized in December 2005.

An ideal administrative and legal system for IWRM should include a strong mechanism to resolve conflicts, with the objective to decrease tensions among water users located upstream and downstream of transboundary basins.

The southeastern Mediterranean region presents among other three examples of water international disputes, among which:

- Egypt, Sudan and Ethiopia on the Nile
- Israel, Jordan, Palestine, Syria and Lebanon over the Jordan River basin
- The development of Tigris and Euphrates system by Turkey and resulting conflicts with downstream countries as Iraq and Syria.

There are also in the Mediterranean basin many national debates concerning the transfer of water mass from humid to dry region for instance:

- The National Hydrological plan of Spain which aims to the diversion of Ebro River at 912 Km of its actual course in order to supply with water the regions located in the south of Spain subject to water stress.

- The diversion of Acheloos River in Greece from the occidental part of the nation to the eastern plain of Thessalie.

Confronted to the risk of several disputes transformed into adversaries' divergent demands and extremely complicated to resolve, water international law has developed principles implemented with high success between riparian nations, such as:

- Obligation not to "cause substantial harm"
- "Reasonable and equitable use of water"

The principal of non substantial harm, accepted by the states as an international standard of constraining nature, means that the parties which share a common basin are bound to cooperate in good faith. These countries should proceed to consultation for the water use,

as well as to avoid taking any unilateral action that may cause harm to the water supply to other parties.
These principals adopted in the United Nations Convention of 1997 on the protection and the uses of non Navigational international watercourses will be detailed in the following section.

IV – I United Nations Convention (1997)

The convention on Non-Navigational uses of International Watercourses was approved by the General Assembly of the United Nations on 21 May 1997 after twenty years of studies and negotiations by the member states in the Commission of International Law (CIL). The text classified under seven parts comprehends 37 articles and one annex:

- Part I: Introduction, articles 1 to 4
- Part II: General Principles, articles 5 to 10
- Part III: Planned Measures, articles 11 to 19
- Part IV: Protection, preservation and management, articles 20 to 26
- Part V: Harmful conditions and emergency situations, articles 27 to 28
- Part VI: Miscellaneous provisions, articles 29 to 37
- Part VII: Final clauses
- Annex: Arbitration

In part I of the text, the definition of the term "watercourses" constitute the main point of the convention. According to article 2, the definition of watercourses means "a system of surface water and groundwater constituting by virtue of their physical relationship a unitary whole…".

This definition draws the attention of states to the utilization of the term "International watercourses" which takes into account groundwaters being the greatest volume of freshwater on earth which are related or in interaction with surface waters. Then surface water pollution may contaminate the groundwaters and vice versa, such as groundwaters pumping can influence the discharge of surface waters. Then it is obvious that an aquifer, situated on the borders of two states, may influence the level of the water table in one of the defined states. This aquifer can as well alter the discharge of surface water of a watercourse in one of the states which is supplied also by the same ground water source.

Articles 3 and 4 define the relation between the convention and the agreements related to specific watercourses. Article 3 comprehending six paragraphs encourages the states sharing the same watercourse to harmonize the "basic provisions" of the convention with the bilateral or multilateral agreements previously adopted by the legislative bodies of the concerned states.
Article 3 provides as well the "consultation provision" between the watercourse states in the event that the states sharing a common watercourse are partners in the negotiations in order to reach an agreement related to the uses of watercourses. None of the provisions of the agreement shall make breach to the uses of the watercourse by other states without their express consent. This article also treats the case when a state estimates that the

watercourse it shares with other states shall be managed by the provisions of the convention. In this case, a riparian state which uses the watercourse shall consult “with a view to negotiate in good faith for the purpose of concluding a watercourse agreement or agreements.”

Article 4 named “parties to watercourse agreements” precise that every riparian State is entitled to participate in the negotiation and become a party to “any watercourse agreement that applies to the entire international watercourse, as well as to participate in any relevant consultations”.
Concerning the watercourse agreement that applies to a particular project or a particular use, a riparian State whose use of an international watercourse may be affected to a significant extent by the implementation of a particular project is entitled to participate in consultations on such an agreement “and where appropriate, in the negotiation thereof with a view to becoming a party thereto, to the extent that its use is thereby affected.”

Part II titled “General Principles” forms the essential elements of the Convention. Article 5 with subtitle “Equitable and reasonable utilization and participation” announces that watercourses States shall utilize an international watercourse in an equitable and reasonable manner vis-à-vis to the other riparian States, taking into account their concerned interest.
The equitable and reasonable use shall as well be compatible with the exigencies of adequate protection of the watercourse from pollution or other forms of degradation.

The basic idea that underlines the term of equitable participation is, in the event of watercourses States want to establish a regime of equitable and reasonable use, they shall cooperate with applying, individually or collectively, the positive measures related to international watercourses. Such term contributes in the awareness of riparian States towards such equitable use by protecting and preserving the ecosystems. The notion can be only applied through positive cooperation between the watercourse States. This article sets the main key stone of the law of international watercourse.

Article 6 lists in its paragraph 1 many factors of technical, economic, demographic and environmental nature relevant to equitable sharing of watercourse. Paragraph 3 suggests a “weight” to be given to each factor which is to be determined by its importance by comparison with that of other relevant factors.
In determining what is a “reasonable and equitable use”, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.

Article 7 titled “obligation not to cause significant harm” shall be considered closely connected to article 5 and 6.
It interpretation shows that riparian States shall take appropriated measures to prevent the causing of significant harm to another watercourse States. Article 7 indicates as well that all appropriate measures shall be taken to eliminate or mitigate such harm, and where appropriate, to discuss the question of compensation.

Then, article 8 of the convention imposes the general obligation to cooperate “in order to attain optimal utilization and adequate protection of an international watercourse”. This article calls the watercourse States “to consider the establishment of joint mechanisms or commissions “to facilitate cooperation on relevant measures among the States.

Article 9 bounds the watercourse States to exchange on regular basis readily available data and information”. These information and data shall particularly comprehend that of a hydrological, meteorological, hydrogeological and ecological nature and related to water quality.
Such exchange of information between the watercourse States is the only mean to be sure of an equitable utilization of a watercourse. A very close cooperation between States may be done, in the scope of a basin agency, joint commission, or via the establishment of a tribunal or a third party. This institutional cooperation is the best way to ensure the application of the provision of the equitable and reasonable use”.
From this concept we can deduce the importance of the watercourse States cooperation in order to establish a regime of an equitable and reasonable utilization as well as the effective participation of the whole international watercourse system.

Article 10 defines the relation between the utilizations of an international watercourse. It precise that “In the absence of agreement or custom to the contrary, no use of an international watercourse enjoys inherent priorities over other uses”. In the event of a conflict between uses of an international watercourse, it shall be resolved with reference to articles 5 to 7 with special regard being given to the requirements of vital human needs.

The part III of the Convention “Planned Measures” (article 11 to 19) presents a series of provisions on the measures to be followed when a watercourse State foresees the implementation of planned measures which may have significant adverse effect upon other international watercourse States. In this case, article 12 sets the right to the riparian States that it shall be provided with notification thereof and shall be presented to be accompanied by available technical data and information, including the results of any environmental impact assessment.

Article 13 specifies that a watercourse State providing a notification shall allow the notified States a period of six months within which to study and evaluate the possible effects of the planned measures and to communicate the findings to it. This period shall, at the request of a notified State for which the evaluation of the planned measures poses special difficulty, be extended for a period of six months.

Article 14 presents the obligation of the notifying State to cooperate with the notified States. This cooperation consists in providing the watercourse States all the additional data and information that is available and necessary for an accurate evaluation. In this article, the notifying State shall not implement or permit the implementation of the planned measures without the consent of the notified States.
According to article 15, the reply to notification shall be communicated as early as possible within the period applicable pursuant to article 13.

This reply shall be attached to a documented explanation if the implementation of the planned measures would be inconsistent with the provisions of articles 5 or 7.
Article 16 determines that in the absence of a reply to the notification and under article 13 and 15, the State may, subject to its obligations under articles 5 and 7, proceed with the implementation of the planned measures on the watercourse.

Article 17 foresees that the notifying State and the State making the communication shall enter into consultations and negotiations with a view to the planned measures in the event that the implementation measures inconsistent with the provisions of article 5 and 7.
The consultations shall be conducted on the basis that each State must in good faith and with a view to arriving at an equitable resolution of the situation.

Article 18 presents the procedures to be followed in the absence of notification and article 19 specifies the mechanism of implementation of planned measures in order to protect public health or public safety.
If the conflict is not resolved with the satisfaction of the interested States, the procedure relevant to the settlement of disputes provided in article 33 and the annex of arbitrage shall apply.

Part IV of the Convention (article 20 to 26) titled “Protection, preservation and management” presents the “environmental” provisions to be taken into consideration to preserve the ecosystem of the international watercourse as well as the mechanism of management and regulation, and the protection of installation relevant to different facilities in the watercourse States.
Article 20 defines the mechanism of “Protection and preservation of ecosystems” of international watercourses and stipulates that watercourse States shall apply this environmental exigencies.

This article 21 under “Preservation, reduction and control of pollution” defines in first the term “pollution” as any detrimental alteration in the composition or quality of the waters of an international watercourse with results directly or indirectly from human conduct” such as biological and socio-chemical pollutants.
This article indicates in addition that watercourse States shall, individually and, where appropriate, jointly, prevent, reduce and control the pollution of an international watercourse “that may cause significant harm” to other watercourse States or to “their environment, including harm to human health or safety”. Watercourse States shall consult with a view to arriving at mutually agreeable measures and methods, such as establishing lists of substances concerning their introduction into the waters of an international watercourse are to be prohibited, limited, investigated or monitored”.

Article 22 stipulates that Watercourse States shall take all measures necessary to prevent the introduction of species, alien or new into an international watercourse which may have effects detrimental to the ecosystem of the watercourse resulting in “significant harm” to other riparian States.

The article 23 treats “Protection and preservation” of the marine environment with reference to international rules and standards generally accepted for “marine environment and estuaries”.
The watercourse States shall enter into consultations concerning the management of an international course which may include the establishment of a joint management mechanism presented in article 24.
The management refers in particular to “planning the sustainable development and providing the implementation of any plans” adopted by the States as well as “promoting the utilization, protection and control” of the watercourse “in rational and optimal conditions”.

The regulation of watercourse mentioned in article 25 concerns the hydraulic works for the control of the flow such as the reinforcement and the increase in height of banks to prevent erosion, the alignment of the river basin etc… This article requires watercourse States to participate “on equitable basis” in the construction, maintenance or defrayal of the costs such as regulation works as they may have agreed to undertake.
Article 26 titled “installations” concerns the construction and the maintenance of hydraulic facilities that may cause accidently “harms” to the watercourse States. For instance this is the case of dams that necessitate a periodic maintenance for their good functions.

Part V titled “Harmful conditions and emergency situations” treats in its article 27 “Appropriate measures” to be taken for the prevention or the mitigation of conditions relevant to an international watercourse resulting from natural causes or human conduct that may be harmful for other watercourse States such as: flood or ice conditions, water-borne diseases, siltation, erosion…etc.

Article 28 deals with the emergency situations resulting from natural causes mentioned in article 27 or of human conduct such as industrial accidents. A watercourse State within whose territory an emergency originates shall in cooperation with potentially affected States and competent international organizations, immediately take “all practicable measures to prevent, mitigate and eliminate harmful effects of emergency”. A close cooperation between the watercourse States is recommended to face this situation.

Part VI under “Miscellaneous provisions” (article 29 to 33) concerns several problems that affect the watercourse States such as installations in time of armed conflict, indirect procedures of contact between States, protection of data and information vital to national defense or security and also the non-discrimination in granting to persons of watercourse States access to judicial or other procedures or a right to claim “compensation in respect of significant trans-boundary or continuous harm”.

Article 33 titled “Settlement of disputes” presents the judicial mechanism to be followed in the event of disputes between two or several parties concerning the integration and the application of the present Convention.

This article foresees as well that states becoming parties to this Convention submit the disputes to the International Court of Justice or arbitration according to the provisions targeted in the annex.

Part VII titled “Final clauses” presents in articles 34 and 35 the methods of ratification, notification, acceptation, approval or accession to the Convention. The annex constituted of 14 articles, defines the steps to be followed by the States that proceeded to arbitration in case of litigation.

V- **CONCLUSION**

This study provides some direction for negotiators involved in the issues of transboundary water management. The content of this chapter reveal a range of institutional developments aimed at increasing management effectiveness of international watercourses and negotiation skills of water diplomacy experts. The process of regional institution building described in the study requires a political environment built upon “mutual trust and goodwill” among the riparian countries. The international organizations along with NGO’s may help facilitating the implementation of such an environment through the creation of medium and long term supporting structures suitable for enhancing regional dialogues based on future cooperation on water as a “public sustainable resource”.

Such arrangements that could be implemented by these agencies should promote with national governments of riparian nations economic direct and indirect benefits of effective transboundary management. This approach requires a political sensitivity from the different upstream and downstream countries with regards to the implementation of the “equitable allocation of water” particularly in economically uneven riparian watercourse countries.

The principles related to “equitable sharing and reasonable use” should generate regional and international consensus among all stakeholders in order to achieve “the culture of peace” between riparian nations for the sake of the future generations.

CHAPTER III

WATER MANAGEMENT IN TURKEY

I – Generalities

Turkey is considered as the water castle of the Middle East region and disposes of 26 river basins among which the Tigris and Euphrates. These two watercourse constitute alone 1/3 of the surface water volume of the country and take rise in the oriental Turkish district of the Kurdistan region. The Euphrates which length is about 2700 km crosses Syria and Iraq whereas the Tigris of 1890 km long shares its borders with Syria and flow then in Iraq.

The downstream part of these two rivers forms the Mesopotamian region. It extends over a depth of 170 km and ends at Shat El Arab which joins up with the Arab Persian Gulf (figure 1).

Figure 1: Arab Persian Gulf and the region of Shat El Arab

The flow system of these two rivers is very similar the one to the other and presents three great characteristics:

- Strong irregularities during the year, decreasing to the half of the flows cumulated during three months starting from March till May.
- Floods mainly heavy in the alluvial plane of the Mesopotamia.

- Decrease of the flow from the upstream basin to downstream.
- The average flow of the Euphrates is measured as the following hydrographic stations:

  - Turkish Syrian border : 830 m^3/s
  - Iraq at the border line: 775 m^3/s
  - Iraq at Nassiriya: 458 m^3/s

During the wet period, the Euphrates flow can reach 5200 m^3/s and its annual water volume can widely vary in accordance with the rate of pluviometry and snowing in Turkey. The flow goes from 15 billion m^3 during the dry period to 58 billion m^3 during the wet period.

The hydrographic data on the Euphrates are shown in table 1:

Country	**Length km**	**Basin Surface km²**	**Basin Distribution in %**	**Inflow %**
Turkey	455	124320	28	98.6
Syria	675	75480	17	1.4
Iraq	1200	177600	40	0
Saudi Arabia	---	66600	15	0

Table 1: Hydrographic data of the Euphrates considering the inflow according to the water sources in the country of origin.

The Tigris takes it rise from the Taurus Mountains in the Oriental Turkish district and presents an average flow of:

- 1410 m^3/s downstream of Baghdad
- 218 m^3/s at Amara
- 78 m^3/s at Qalet Saleh in Mesopotamia.

The hydrographic characteristics of the Tigris as well as their tributaries are stated in table 2:

Country	**Length km**	**Basin surface km²**	**Basin distribution In %**	**Inflow %**	**Flow billion m³**
Turkey	400	45000	12	51	24
Syria	32	1000	0.2	0	---
Iraq	1418	292000	54	39	18.5
Iran	Tributaries	37000	34	10	4.73
Total Flow					**47.23**

Table 2: Hydrographic characteristics of the Tigris

The recognition studies effectuated in 1958 proposed the creation of three dams on the lowest part of the Euphrates and five dams on the Tigris. In addition, the Keban dam considered as the key infrastructure on the Euphrates was inaugurated in 1974. This reservoir currently produces 6 billion Kwh. The Karakaya dam located downstream Keban whose works started in 1976 and ended in 1987, produces 7.3 billion kWh. The works on the Ataturk dam accomplished in 1992 increased this electrical production to reach 8.9 billion Kwh.

II – GAP Project

The Turkish government has enhanced the development of big water resource infrastructures in the southeastern part of Anatolia known as the GAP project. This multi-sectorial project, which started in 1976, consists of developing the rural regions through hydroelectric production units and irrigation schemes.

The region of Anatolia is a semi arid region with an annual pluviometry varying between 470 and 830 mm during the dry period starting from May till October. Currently, the settings of dry cultivation such as wheat, chickpea and barely are common in this region. The transformation of "dry" to "irrigated" agriculture may multiply by 20 the farmers agricultural revenues. As a result the total agricultural production of Turkey may be doubled at the accomplishment of this project.

The master plan of the Anatolia region was realized by a consortium assembling the Turkish and the Japanese governments. Three scenarios were suggested:

- Scenario "A": takes into consideration the development of all the hydroelectric and agriculture potential of the region to be completed in 2005.
- Scenario "B", takes into account the development phases of all the hydroelectric and agriculture potential to be completed in 2010.
- Scenario "C", determined the priority to the rural development based on the social and economical impact study, designed to ameliorate the life conditions of the inhabitants.

The GAP project, implemented in the less developed zone in Turkey, covers eight provinces which count 10% of the total population of the country and constitute 41.5% of the totality of the Euphrates and Tigris basins. The total surface area of the project is 75358 km² among which 42.2% are cultivated schemes.

According to the census of 1990, the total population of the GAP region was estimated at 5.15 million inhabitants with an annual growth rate of 3.4 %. This region contributes with 4% of Turkey annual GDP, while with the development of this project the rate will vary between 10 and 15%.

The integrated development plan of the GAP project covers other related economic sectors such as industries, transportation networks and social infrastructures (figure 2).

It comprehends the construction of 22 dams and 19 hydroelectric plants with a total capacity of 7500 MW. Based on this project 27.3 billion kWh will be annually produced. It will ensure as well the irrigation of 1.7 billion hectares corresponding to 1/5 of the Turkish irrigated lands.

Table 3 indicates the Tigris and Euphrates flows before and after the execution of the GAP project.

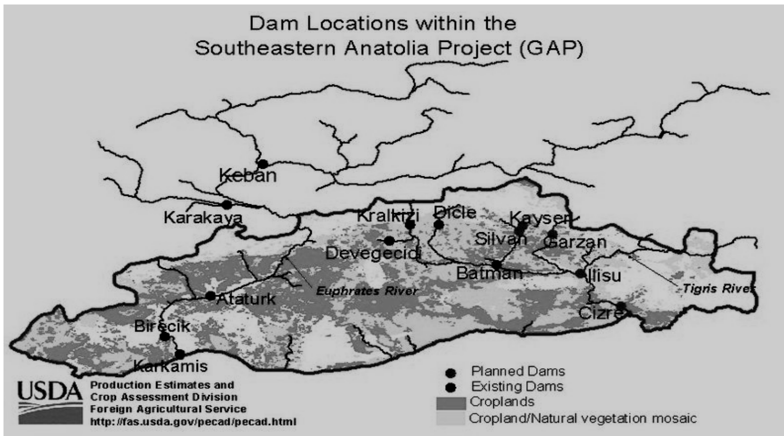


Figure 2: Localization of the dams in the framework of the GAP project.

1973 (million m^3/s)	**Euphrates**	**Tigris**	**Total**
Initial flow in Turkey	31430	18870	50300
Used volume in Turkey	1580	370	1950
Volume flowing in Syria	29850	18500	48350
Volume added in Syria	2050	-----	2050
Volume used in Syria	2100	-----	2100
Volume flowing in Irak	29800	18500	48300
Volume added in Irak	------	30700	30700
Volume used in Irak	12500	16500	29000
Flow moving to the Gulf	17300	32700	50000
2010			
Initial flow in Turkey	31430	18870	50300
Used volume in Turkey	8200	2500	10700
Volume flowing in Syria	23230	16370	39600
Volume added in Syria	2050	------	2050
Volume used in Syria	4700	------	4700
Volume flowing in Irak	20580	16370	36950
Volume added in Irak	15500	29500	45000
Volume used in Irak	------	30700	30700
Flow moving to the Gulf	5080	17570	22650

2040			
Initial flow in Turkey	31430	18870	50300
Used volume in Turkey	14500	8000	22500
Volume flowing in Syria	16930	10870	27800
Volume added in Syria	2050	------	2050
Volume used in Syria	5500	------	5500
Volume flowing in Irak	13480	10870	24350
Volume added in Irak	-------	30700	30700
Volume used in Irak	15500	31900	47400
Flow moving to the Gulf	2020	9670	765

Table 3: Flows of the Tigris and the Euphrates for 1973 – 2010 – 2040

It was mentioned that the number of active persons in this region will go from 1528000 persons in 1985 to 3324000 persons in 2005. The development of irrigated agriculture in the Southeastern region of Turkey has enhanced the expansion of the agricultural food industries. The financial incomes of this industrial development increased the GDP of this sector which passes from 16% to reach 37%

The important fluctuations of flows of these two rivers are presented in table 4.

	Country			
Period	**Turkey irrigation Electricity 1000 ha MW**	**Syria irrigation Electricity 1000 ha MW**	**Iraq irrigation**	**Total irrigation Electricity 1000 ha MW**
1920	30 E: 25 -------- T: 5	---------------------	600 E: 200 T: 400	630 E: 225 ---------------- T: 405
1950	70 E: 60 ---------- T: 10	30 E: 30	1400 E: 450 T: 950	1500 E: 540 T: 960
1970	160 10 E: 130 T: 30	200 E: 200	1200 E: 400 T: 800	1560 E: 730 10 T: 830
1985	200 3000 E: 150 T: 50	240 350 E: 240	2000 E: 800 T: 1200	2440 E: 1190 3350 T: 1250
1995	250 5400 E: 190 T: 60	280 350 E: 280	2600 E: 1000 T: 1200	3130 E: 1470 5750 T: 1660
2010	680 7500 E: 520 T: 160	320 350 E: 320	4000 E: 1300 T: 2700	5000 E: 1470 7850 T: 2860
2020	1140 8000 E: 820 T: 320	360 350 E: 360	4000 E: 1300 T: 2700	5500 E:8350 2480 T: 3020
2040	1800 8500 E: 1150 T: 650	400 350 E: 400	4000 E: 1300 T: 2700	6200 E:8850 2850 T: 3350

Table 4: Hydroelectric and agricultural Development in the basin of Shatt el Arab

III – Conflicts resulting from the management of the dams

The management of the water reservoirs in Turkey generated a lot of political tensions between the riparian watercourse States that share the Tigres and the Euphrates. The filling up of Keban and Tabka dams from the water of the Euphrates at the upstream Turkish basin and which occurred during the same period extending from spring 1974 to 1975 created tensions between Turkey and Syria that mutually accused each other of having diverted the water. On the 13th of January 1990, Turkey suspended the inflow of the Euphrates towards Syria and Irak in order to fill up the Ataturk dam considered to be the biggest reservoir on the Euphrates. This water interruption which lasted until 13 February 1990 caused serious political incidences between Syria and Turkey. Syria accused the Turkish government of wanting to use the water as a mean of pressure for political goals.

IV- New Orientations of the Turkish water policy

International analysts and experts involved in the water geopolitics of the Middle East think that behind the enormous GAP project there exist several national and regional Turkish goals. Figure 3 shows the irrigated surface area covered by the Ataturk dam within the frame of the GAP project.

The seizure of Turkey over the Euphrates water resources can transform the GAP project into an arm of pressure over Syria. In 1974, conflicts also emerged between Irak and Syria concerning the build up in the Euphrates watercourse of the Tabqa dam near the Iraqi borders.

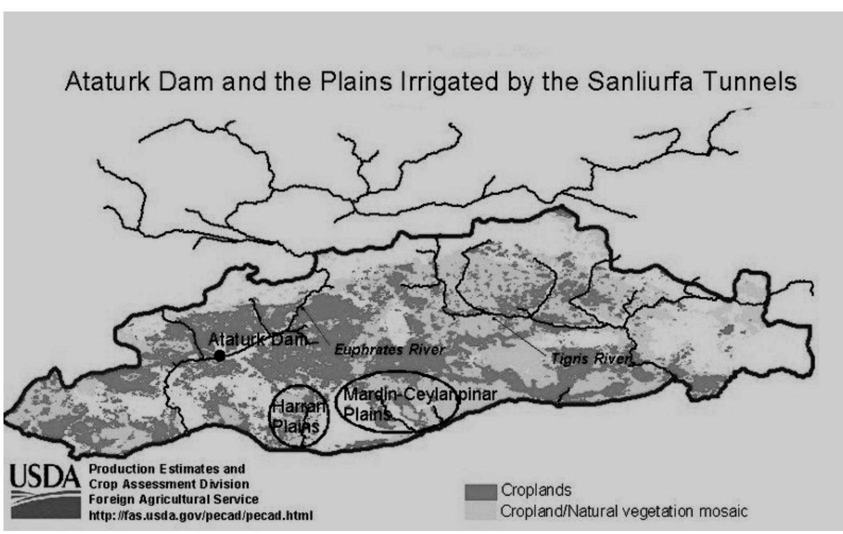


Figure 3: Installation of Ataturk Dam within the scope of the GAP program

For the international water experts, there is no doubt that the development of the GAP project launched in 1980 will have negative repercussions on the irrigation process adopted by the downstream countries like Syria and Iraq. In 1987, Syria and Turkey signed an agreement according to which Ankara undertakes to provide Damascus with a minimum water output of 500 m^3/s among which 58 % should be redistributed in Baghdad. These two countries have been encountered drastic water reductions related to the output of the river. Irak which is currently under international occupations, only a rate of 25 % remains for water usage out of the river output. The impact of this project concerning the reduction of the discharge output on the Syrian border shall be estimated at a rate varying between 30 to 40 % with a population increase between 1970 and 2001 evaluated to pass from 7 to 16 million inhabitants. According to the United Nations, Syria may witness water scarcity with the arrival of 2025, which means that it will dispose of less than 1000 m^3 of water per inhabitant and per year. Such situation will be disastrous for Syria since this country is intending to increase its irrigated surface lands from 900000 to 1.5 million hectares in 2015. Figure 3 shows the dams installations in the country of the Tigris and Euphrates basin.

Mumtaz Turfan, Director General of DSI in Turkey has recently declared that “the manner through which we treat the problem in our national basins could be enlarged on the international level”. Behind this declaration we can understand that:

- Turkish officials do not wish to apply the international conventions that govern the international watercourses sharing.
- Development of the GAP will integrate and open up a region where the population in its majority is Kurdish and represents 20 % of the national territorial area in spite of the decreasing of the shares accorded to the Arab countries. These volumes are estimated at 11 billion m^3 of the Euphrates and 6 billion m^3 of the Tigris.

In front of this tense climate and the American presence in the region, the Syrian Government asked for the recognition of the state of International River to the Euphrates and Tigris and requires a revision of the 1987 agreement since this latter no more corresponds to its needs. From its side, Turkey like Israel, which did not sign the UN Convention of 1997 concerning the use of the non-navigational international watercourses deprive Iraq and Syria from the possibility to refer to the UN judicial instance in this concern. It will be interesting to see if the new Iraqi regime, reinforced by the presence of the American army on its territories, will negotiate again these water agreements with the upstream Turkish riparian States which represents a loyal ally of the United States.

The analysis concerning the national strategic position of Turkey related to the water geopolitical problems in the region will allow us to summarize the criteria that Ankara is leaning on in order to reinforce its position in the Middle East.

a. Social and economic stability

- Water shall be considered as a precious source and a necessary element for the fight against poverty and famine.
- Agricultural development shall be ensured by mean of irrigation projects with a great concern on productivity and economic profitability.
- Strategic development should be undertaken for long term in order to ensure an optimal use of water resources.

b. Quantitative aspect

- Disposition of abundant strategic water reserves is essential to encounter the growing demands for the future.
- Important demographic growth will require future developments of irrigation schemes in order to ensure the food security in the country.

c. Technology transfer

- Build up of water infrastructures such as dams and reservoirs will provide to Turkey a large experience in such projects that could be technologically transferable to other countries in the region.
- Launch a policy pertaining to large works infrastructure.
- Render assistance to the Arab countries and mainly to Irak in the domain of water resource management. This will constitute a good contribution for its reconstruction.

d. Sustainable Development and proper energy

- Desire to promote the development of renewable energy such as hydropower in line with the commitments decided during the Summit of Johannesburg.
- Adoption of the World Bank policy which participates in financing the infrastructures designated to the development of the clean energy.
- Reinforcement of the economic development of the neighboring countries in terms of exporting the hydropower.

These aforementioned strategic criteria that govern the Turkish water policy have a direct implication on the delicate question of Transboundary Rivers Such As:

- Water is considered as vital and strategic resource for the economic development in the Middle East and Turkey will play a major role in the future especially with the implication of the global warning and the climate change on the water resources in the region.
- Sovereign right of every watercourse nation to use the available water in its territory.
- Equitable sharing and reasonable use of the water resources do not automatically lead to the distribution of water in equal parts among the countries.
- Life style can change from one country to another.
- Combination of the two rivers water potential, the Tigris and the Euphrates is sufficient to meet the needs of the three basin countries.

- “Benefits division" principle resulting from the economic cost of water between the riparian watercourse States should be respected.
- Transformation of the semi-arid and desert regions such as the GAP project into fertile lands shall constitute a priority goal for the Mediterranean basin countries.

V – International projects for exporting drinking water from Turkey

In 1978, Turkey started the preliminary design of a water exportation project through a transboundary pipeline named "The Pipeline of Peace”. The idea was to substitute the lack of water generated by the GAP project towards the downstream countries by an additional water the inflow volume deriving from Turkey. According to the Turkish version, this project aims at consolidating the principle of water regional cooperation will constitutes in the future a peace instrument for settling the conflicts between Israel and the Arab countries. The preliminary studies were effectuated by the Brown & Root Engineering and consisted of exporting excess waters from Ceyhan and Seyhan rivers through two pipelines directed towards the Middle East and the Arab Peninsula.

The western pipeline of the Ceyhan River (2700 km) may serve Syria, Jordan and Saudi Arabia with a flow of 40.5 m^3/s or 3.5 million m^3 per day, while the pipeline of Seyhan River (3900 km) may supply with water Syria, Jordan, Saudi Arabia, Kuwait, Bahrain, Qatar, Oman and the United Arab Emirates with a flow of 29 m^3/ s or 2.5 million m^3 per day. The cost of these two pipelines is estimated at 20 billion US Dollars. The transportation cost of one cubic meter of water will be 84 US cents for the western pipeline and 1.07 US $ for the eastern pipeline.

This infrastructure may drain fresh drinking water to 1.5 million persons and always according to the Turkish version; this project will ameliorate the economical situation of the bordering countries of Turkey, while reducing the political tensions with their arab neighbors. The construction period of these two pipelines will last for approximately 10 years and it shall overpass two major obstacles:

- The first concerning the internal demands of drinking water in Turkey during the years of dryness
- The second concerns the countries receiving the fresh water, which will be under the control of Turkey for their water supply to their population.

Another project of drinking water transportation is the surplus of the Manavgat River resource, near Antalaya, through tankers and plastic balloons.

A flow of 5.8 m^3/ s may be exported of this river out of a total of 250000 m^3 per day of treated water and 250000 m^3/ per day of non treated water.
These volumes will be exported from the catchment stations located on the sea coast. This project may serve 2000000 persons and with a construction cost of the pumping station estimated at 90 million US Dollars. This cost of water transportation towards the Eastern Mediterranean countries is 70 cents US Dollars per m^3.

VI – Conclusion

The repercussions on Syria are not limited to the quality aspects of water but also on the level of the resource quantity downstream the basin which will decrease 30% of the actual inflow volume. Such a situation may be disastrous, as long as its agricultural policy foresees an extension of the irrigated lands from 863000 to 1.4 million hectare from now till few years. Till now, Syria succeeded to obtain a commitment from Turkey which ensures an inflow of the Euphrates of 500 m^3/s against the Syrian political promises related to the control of the Kurdish activities of PKK (Labors Party of Kurdistan).

The impact on Irak is as well disastrous since this country won't receive more than 25% of the actual inflow in Iraq with the repercussions on the projects of agricultural development in this country.

The Turkish government refused the involvement of foreign investors in the development of the GAP and ensures all the financial cost of the project. Turkey's objectives are the following:

a- Control the water flow of the downstream watercourse countries mainly Syria and Iraq
b- Control social and economical development of the Arab watercourse downstream countries
c- Constitute a strategic weapon from the water infrastructure development projects
d- Stock the maximum amount of water in Dams for clean energy production and irrigation scheme rural developments.
e- Ensure the social and economical stability of the Kurdish region.
f- Facilitate the displacements of the Kurdish community to other regions of Turkey.
g- Ensure its role as a military and economical power in the region.
h- Implement the strategy of water transport towards neighboring countries aiming to consolidate the concept of the economic value of water.
i- Propose a development tools to the Arab countries peninsula through water transport
j- Propose to Syria the complementary needed water volume taken from the Golan Height by Israel and from Turkey through the Euphrates.

CHAPTER IV

JORDAN RIVER BASIN

I.1 - JORDAN RIVER'S GEOGRAPHY

I.1.1 - General

The Jordan River is a multinational river, the third largest perennial river in the Middle East, and receives most of its discharge from precipitation on the southern part of the Anti-Lebanon Range. It flows southwards for a total length of 228 km through Lebanon, Syria, Israel and Jordan along the bottom of a longitudinal graben known as the Rift valley, or Ghor, before emptying into the Dead Sea.

In the absence of irrigation extraction, the Jordan system delivers an average annual flow of 1.84 billion m^3 to the Dead Sea (Naff and Matson), equivalent to 2% of the annual flow of the Nile and 7% of the annual flow of the Euphrates.

The water flowing into the upper part of the Jordan River is derived principally from groundwater through a group of karstic springs located on the western and southern slopes of Mount Hermon (Jabel El Sheikh) which is covered with snow in winter. Three rivers constitute the main tributaries in the headwaters of the North Fork of the Jordan River: the Dan River, the Hasbani River and the Banias River. The quality of these rivers' waters is excellent, with salinity less than 15 to 20 mg of chlorine per liter. The flow in the lower reaches of the system is supplemented by springs, but much of their contribution is so saline that they degrade the quality of the river flow, to the extent of several thousand parts per million of total dissolved solids (TDS) at the Alenby Bridge near Jericho.

I.1.2 - The River Basin Hydrology and Water Resources

The watershed of the Jordan River, excluding its upper basin, is located in an arid to semi-arid region. There is a marked spatial variation in the distribution of precipitation over the catchment since the recharge area is confined to the mountainous areas of the Anti-Lebanon range, where the mean annual precipitation amounts to 1,400 mm. The climate in the lower reaches of the Jordan in the Rift valley is arid to hyper-arid, with an annual mean precipitation of less than 50 - 200 mm.

The principal tributary of the Jordan is the Yarmouk River, forming the border between Syria and Jordan for 40 km before becoming the border between Israel and Jordan in the

Yarmouk triangle. The lower reaches of the Jordan River border of the occupied West Bank to the west and Jordan to the east for a distance of about 80 km.

The total area of the Jordan River basin is 18,300 km^2 in total. The lower Jordan between Lake Tiberias and the Dead Sea has a catchment area of 1,050 km^2.

The Jordan River system can be classified on the basis of hydrology, hydro-geology and water use into three sections:

(1) The upper Jordan-headwaters, the Huleh valley and Lake Tiberias,

(2) The Yarmouk River and

(3) The lower Jordan (main stream and the Dead Sea)

I.1.2.1 - The Upper Jordan-Headwaters, the Huleh Valley and Lake Tiberias

The upper Jordan River system includes:

(a) The three major headwater streams, the Dan, Hasbani and Banias,

(b) The Huleh valley and

(c) Lake Tiberias.

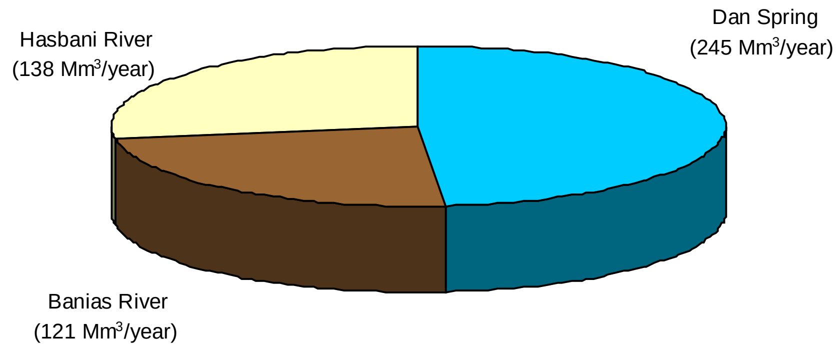
The largest of the springs is the Dan spring, which rises from Jurassic carbonate rocks and supplies a large and relatively steady flow that responds only slowly to rainfall events. The average discharge of the spring is 245 million m^3 per year varying from 173 million to 285 million m^3 (Naff and Matson, 1984). The Dan typically accounts for 50% of the discharge of the upper Jordan.

The Hasbani River, out of which 21 km are located within the Lebanese Territory, derives most of its discharge from two springs, the Wazzani and the Hasbani, the latter being a group of springs on the uppermost Hasbani. All of these springs rise from subsurface conduits in cavernous Cretaceous carbonate rocks. Their combined discharge averages 138 million m^3 per year (Naff and Matson, 1984), but the values vary over a greater range than those of the Dan spring; over a recent twenty-year period, the flow of the Hasbani varied from 52 million to 236 million m^3 per year. The Hasbani discharge responds much more rapidly to rainfall than does that of the Dan spring. The Litani River Authority (LRA) in Lebanon, who is in charge of hydrology and water measurements on all rivers, has conducted periodic measurements on the Hasbani and Wazzani springs and river. Detailed information regarding various aspects of the Hasbani River basin is presented in Part IV below.

The Banias River is fed primarily from Hermon springs that issue from the contact of Quaternary sediments over Jurassic limestone in the extreme Northeast of the Jordan valley. The average discharge of the Hermon springs is 121 million m^3 per year (Naff and Matson, 1984); during a recent twenty-year period, the flow varied from 63 million to 190 million m^3 per year.

The Dan spring, the largest of the sources of the upper Jordan, lies wholly within Israel, close to the border with Syria. The spring sources of the Hasbani lie entirely within Lebanon. The spring source of the Banias River is in Syria. These three streams unite 6 km inside Israel at about 70 m above sea level to form the upper Jordan River (Chart.1).

Chart.1 Upper Jordan Headwaters in an Average Year



The total annual discharge of the headwater rivers of the upper Jordan amount to 504 million m^3 (Naff and Matson, 1984), including precipitation that falls on the surface watershed.

Together the springs provide more water than can be accounted for as a result of rainfall over their immediate watersheds; thus, it is surmised that they represent the outflow of a large regional aquifer. In a typical year these karstic springs provide 50% of the discharge of the Jordan River; the rest is derived from surface run-off directly after the winter rainfalls. In dry years, spring outflow may make up as much as 70% of the flow of the upper Jordan.

After flowing inside the Huleh valley (formerly Lake Huleh), the flow of the upper Jordan is augmented by the flow of sub-lacustrine springs. Among the minor springs and seasonal watercourses contributing the flow of the upper Jordan, the most important is the Wadi Bareighit.

Beyond the Huleh valley, the North Fork of the Jordan falls 200 m to Lake Tiberias, which lies 210 m below sea level. The upper Jordan contributes an average of 660 million m^3 per year to the lake, or 40% of Israel's total identified renewable water resources. An additional 130 million m^3 per year enters the lake as winter run-off from various wadis and in the form of discharge from sublacustrine springs that contain high salinity.

Lake Tiberias characteristics are the following:

- ***Volume:*** 4 billion m^3, which is 6.5 times the annual inflow from the upper Jordan and 8 times the annual outflow.
- ***Water depth:*** 26 m on average, with a maximum of 43 m.
- ***Surface area:***170 k m^2
- ***Water losses by direct evaporation:*** 270 million m^3 per year
- ***Salinity***: variable between 260 mg and 400 mg of chlorine per liter
- ***Volume of water leaving the lake:*** 500 million m^3 per year via its outlet flowing south along the floor of the Dead Sea Rift for about 10 km to the confluence with the Yarmouk River.

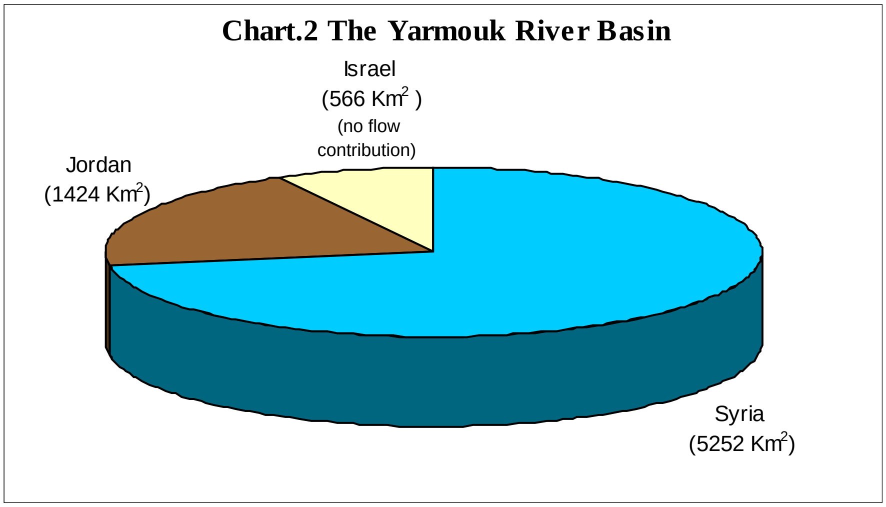
Characteristics of Lake Tiberias

No.	Designation	Value	Remarks
1	Volume	4 billion m^3	6.5 times the annual inflow from the upper Jordan and 8 times the annual outflow
2	Water depth	26 m on average 43 m maximum	
3	Surface area	170 k m^2	
4	Water losses by direct evaporation	270 million m^3 per year	
5	Salinity	260 - 400 mg of chlorine per liter	
6	Volume of water leaving the lake	500 million m^3 per year	via its outlet flowing south along the floor of the Dead Sea Rift for about 10 km to the confluence with the Yarmouk River

I.1.2.2 - The Yarmouk River

The headwaters of the Yarmouk River are located on the southeastern slopes of Mount Hermon in a complex of wadis developed in Quaternary volcanic rocks. The Yarmouk joins the Jordan River 10 km below Lake Tiberias where it contributes about 400 million m^3 per year, which is 65% of the total discharge of 607 million m^3 per year from the Jordan's East Bank. The flow in largely influenced by the rainfall pattern in the Mediterranean climate, indicating a maximum monthly discharge of 101 million m^3 in February and a minimum of 19 million m^3 in September.

On the 7,242 km^2 of the Yarmouk basin, 1,424 km^2 lie within Jordan and 5,252 km^2 within Syria; there is no flow contribution from the part of the valley where Israel is a riparian. The flow of the Yarmouk is derived from winter precipitation that averages 364 mm per year over the basin in addition to spring discharges from highly permeable zones in the lavas. Some further springs discharges may be channeled to the surface on wadi floors via solution pathways in the underlying limestone (Chart.2).



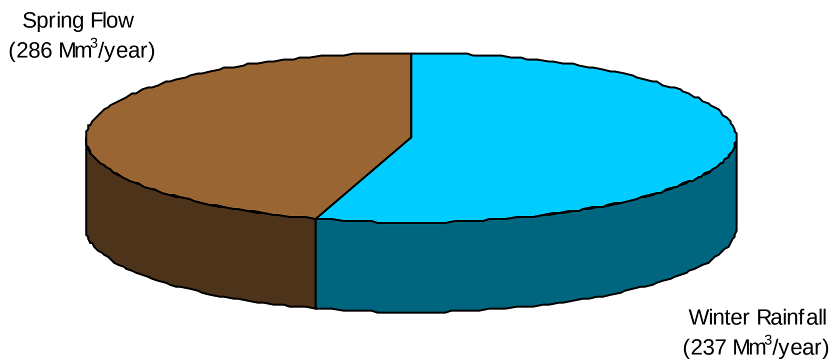
The salinity of the Yarmouk River is quite low, being between 280 and 480 mg of total dissolved solids per liter.

I.1.2.3 - The Lower Jordan River, the Main Stream and the Dead Sea

For the first 40 km south of its confluence with the Yarmouk the Jordan river forms the international boundary between Israel and Jordan; further south of that reach it abuts the West Bank. The Jordan here flows through the deepest portion of the Rift to enter the Dead Sea at 401 m below sea level, the lowest point on earth.

Runoff from winter rainfall within the valley is carried out to the Jordan River via steep, intermittent tributary wadis incised in the wall of the Jordan valley, primarily on the East Bank. This source represents an additional 523 million m^3 per year only 20% originates in Israel; 286 million m^3 is derived from perennial spring flow, while 237 million m^3 is provided by winter rainfall (Chart.3).

Chart.3 The Lower Jordan River



The Dead Sea characteristics are the following:

- ***Area:*** over 10,000 km^2;
- ***Surface elevation:*** 400 m below mean sea level;
- ***Catchment area:*** 40,000 km^2 including parts of Israel, Jordan and Syria;
- ***Shortest distance between the Dead Sea and the Mediterranean:*** 72 km
- ***Evaporation:*** 1,600 mm per year.

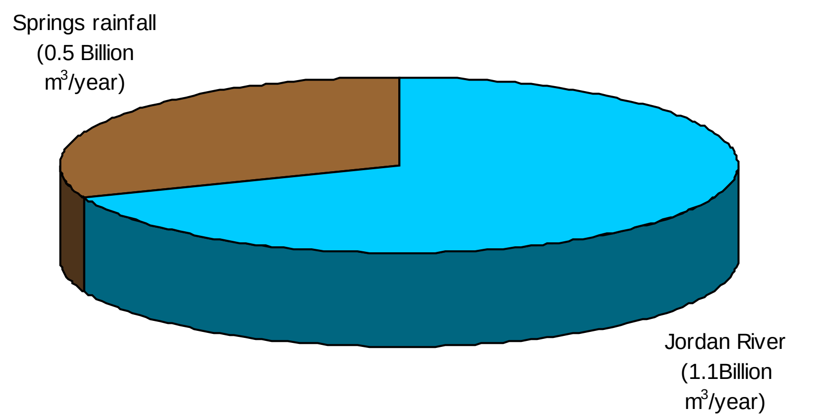
CHARACTERISTICS OF THE DEAD SEA

No.	Designation	Value	Remarks
1	Area	Over 10,000 km^2	
2	Surface elevation	400 m below mean sea level	
3	Catchment area	40,000 km^2	including parts of Israel, Jordan and Syria
4	Shortest distance between the Dead Sea and the Mediterranean	72 km	
5	Evaporation	1,600 mm per year	

The Dead Sea is a closed sea with no outlet except by evaporation. In the past the evaporation losses were replenished by an inflow of fresh water from the Jordan River and its tributaries, and other sources such as wadi floods, springs and rainfall. The mean volume of water flowing into the sea before 1930 was about 1.6 billion m^3 per year, of which1.1 billion m^3 were carried by the Jordan. Under these conditions, the sea had reached an equilibrium level at height around 393 m below sea level, with some seasonal and annual fluctuation due to variations in the amount of rainfall.

However, since the early 1950s, Israel and later Jordan have taken steps to utilize the fresh water flowing into the Dead Sea for intensified irrigation and other purposes, which has reduced the amount of water entering the sea by 1 billion m^3 per year. Consequently, the water level has declined in recent years to 403 m below sea level today, almost 10 m lower than its historical equilibrium level. The surface area of the Dead Sea and the volume evaporated from the surface vary only by a few percentage points between elevations from -402 to -390 m, while the water levels fluctuates considerably (Chart.4).

Chart.4 Inflow of Fresh Water to the Dead Sea



Water Flows in the Jordan River according to Naff and Matson

No.	Source	Country	Flows (Mm^3)		
			Inflows	Losses	Total
1	Headwaters a) Dan b) Hasbani c) Banias	 Israel Lebanon Syria	 245 138 121		
2	Jordan River at Huleh				504
3	Irrigation in Huleh valley	Israel		-100	
4	Local streams at Jisr Banat Yacub	Israel	140		
5	Flow at the entrance of Lake Tiberias				544
6	Inside Lake Tiberias a) Local springs b) Precipitation over the lake c) Sub-lacustrine springs	 Israel/Syria Israel Israel	 70 65 65		
7	Evaporation from Lake Tiberias	Israel		270	
8	Run-off in the lower Jordan River				474
9	Yarmouk River	Syria/Jordan	492		
10	Wadis and spring in the Ghor	Jordan/Israe l	505		1471
11	Total in the absence of irrigation				1841

Source: Smith (1966) as Revised from Main Plan and Hydrological Yearbook (1946-1960)

CHAPTER V

Water Management in Jordan

I- Water resources in Jordan

I-1-Climate and rainfall

The Jordanian kingdom is located in an arid and semi-arid climate zone with an area of 90 000 km2 and receives an average amount of precipitation less than 200 millimetres over 90% of the territory and more of its surface than the half of its surface the country receives less than 100 millimeters per year. The relief of Jordan plays a key role in the disparity and distribution of this water quantity. The total water volume that is received over to Jordanian territory is assessed at around 8.5 billion m3/year.

The Hashemite kingdom is positioned below the threshold in terms of resources scarcity water and is one of seven countries in the world with relevant position in terms of resources. Nearly 92% of rainwater evaporates and the remaining small precipitation fraction constitutes the total resource flows in terms of surface and underground water.

At present, the lack of water for all utilization sectors will increase with the population growth in the country and the increased demand for water which already exceeds the available resources. The kingdom population which counts for about 5 million will increase to 9.3 million in 2020. The amount of water allocated per capita in the kingdom is among the lowest in the world.

This volume estimated to be 249 m3/cap/year in 1993 drop to 163 m3/cap/year in 1999 and is expected to decline further to reach 109 m3/cap/year in 2020.

This imbalance between supply and demand for water in the kingdom led to block the economic and social development of the country which requires first to insure the resources sustainability and conservation.

II-Demand management

II-1-Renewable resources

Water resources in the kingdom come from conventional surface and groundwater and non conventional treated waste water reused for irrigation, especially in the Jordan Valley.

The renewable water resources are estimated at around 780 million m3 per year, including 275 Mm3/year groundwater and 505 Mm3/year of surface water. An estimated 140 Mm3/year are available from fossil aquifers. The brackish aquifers have not yet been fully explored but can be counted for around 50 Mm3/year. This quantity of water could be used after the process of desalination through reverse osmosis.

II-2-Wastewater

The wastewater is treated in nineteen stations devoted to this sector by using appropriate techniques in this field. The Ministry of Water and Irrigation (MWI) has carried out the expansion of the wastewater treatment stations, to improve the level of public health and to further protect the aquifers from pollution. In 2001, nearly 61 Mm3/year were indirectly reused for irrigation. It is estimated that the volume of treated wastewater to be reused for the irrigation sector is expected to reach 220 Mm3 in 2020. This represents a significant portion of the total volume of water for irrigation and should supplement the demand on renewable groundwater water resources.

II-3-economic value of water

The economic value of water for some new projects currently underway is expected to exceed $ 1 / m3, in addition to the costs of wastewater treatment, valued at $ 0.5 / m3.

The total costs of water supply and wastewater treatment for a volume of 150 litres / capita / day would exceed $ 82 / capita / year, or 4.8% in average disposable income per capita in the 2000.

This situation will be a considerable challenge for Jordan and further reduce the access to water disadvantaged category the people, unless the government adopts a plan for cross-subsidies.

Faced with this situation, it is expected that the wastewater volume will grow, with that of water used by municipal and industrial sectors in Jordan. This explains why the policy of wastewater management in this country, stipulates that treatment should aimed at least to the production of tributaries that can be reused in irrigation in accordance with the guidelines of WHO and FAO . The economic value of treated wastewater, reserved for irrigation must cover at least the operating costs and maintenance.

II-4-Municipal Water

In Jordan, the municipal water is used by the domestic, industrial, commercial sectors, as well as public institutions. These sectors are connected to public and municipalities which receive their water needs. These needs are a function of population growth, industrial development, urban concentration and rising incomes.

Although the water supply of municipalities has increased by 8.6% from 1993 to 2000 the consumption per capita consumption has registered a decline of 11.3%. This consumption which was estimated to be 150 litres / capita / day in 1993, reached 133 litres / capita / day in 2000. This situation has been caused by the increases in the Jordanian population, which rose during the same period from 3.99 million to 4.9 million.

II-5 - Concept of IWRM

Faced with this situation of water resources scarcity and the increasingly threatening danger of pollution, the Jordanian government adopted a management strategy of water resources based on national motivations for the implementation of IWRM and the concept of assessing the economic value of water according to the principle of "user-payer". In addition, other measures were adopted to promote the water policy such as ten-year strategy which emerged in 2000 and based on the following topics:

- Adopt the surface storage concept through the construction of dams in order to increase the amount of water used for consumption of drinking water and irrigation.
- Apply the technique of natural and artificial recharge of the aquifers.
- Maximizing the efficiency of the potable water networks by reducing the water from 50% to 30%.
- Encourage the reuse of treated water in the irrigation and municipal sector.
- Ensure the costs recovery through a tariff increase in rates which corresponds to the real value of water.
- Strengthen the public-private partnership in the management and distribution services for the capital Amman.

II -6 - Major water supply systems

Jordan depends mostly on groundwater for the domestic water supply pending the completion construction of the new al-Wehda dam built at the Jordanian-Syrian border on the Yarmouk.

The main supply systems provide water from the wells fields located at Azrak, Qatrana, Siwaya Hallabat in the governorate of Mafraq and Disi.

The additional quantities are pumped into the King Abdullah Canal and transported to the Zai processing station, then in the direction of Amman. The coverage degree of drinking water and sanitation is assessed at a rate of:

-95% of the Jordanian households who are connected to the drinking water distribution network.
- 55% of the households that have the access to sewerage facilities system.

The flow meters are installed for all users, on the domestic industrial and tourism water networks. They are an integral part of water connection. Also, the municipal water consumption is measured using flow meters at the main municipality and private property connections for water gardening. The connections and counters are the property of the Water Authority of Jordan (WAJ0.

The WAJ currently manage nearly 280 000 connections in the Greater Amman. These figures include all categories of users such as households, industrial facilities and other services in the capital.

The counters system of computers also applies to the water irrigation sector in the Jordan Valley, with the exception of the farmers situated in the southern part of the valley where private wells are the source of the water supply.

The management of irrigation r is provided by the Jordan Valley Authority (JVA) attached to WAJ and under the tutelage of the Ministry of water and Irrigation (MWI). It continues to this day, to be responsible for the policy development, decision-making, national planning, monitoring and studies of the water resources with the integration of the Geographic Information systems (GIS) and the national water database. The Water Authority of Jordan (WAJ) has delegated its supply activities to the private sector under a PPP contracts. The WAJ monitors the detail contract supply and is involved in several management contracts operations concluded with the private sector.

III-Strategic Development Projects

The Jordanian government has prepared five emergency programs to increase the water resources of the country. These water resources emerge either from the Jordan River its Yarmouk tributary, and Lake Tiberias, or the aquifers that are subjected to over pumping and did not replenish naturally fellow the required annual precipitation at high speed.

III-1 - Disi water project

Disi is a large water project that brings water from the transbourdery aquifer situaded between Saudi Arabia and southern Jordan at 350 km from the capital Amman. The Disi project constitutes a vast unexploited reservoir part of it rejected as the Jordanian side but already widely overused Saudi in the side to intensive irrigation. The IEM began the project in order to pump a volume of 100 million m3 of water per year from 65 wells and deliver the volume of water to the capital Amman through a 35 km canals supply. The estimated cost for this operation exceeds $ 650 million. The Jordanian government has asked for financial assistance from Libya and Iran to finance the project, but after months of talks, negotiations have only resulted in technical assistance offered by Libya. MWI experts have finally opted for a partnership with the private sector on the basis of BOT (Built-Operate and Transfer) over a period of 40 years with a financial package allocated as follows:

-Public sector contribution: $ 250 million.
-Private operator’s contribution: 400 million.

The impact on the environment showed that the operational life of this project is 50 years and the risk of dryness due to over pumping of this important fossil aquifer could cause very significant damage on the environment.

III-2-A-Wehda dam with Syria

The second infrastrictire project is to divert water from the Yarmouk River and proceed with the construction of the A-Wehda dam with a capacity of 225 million m3 on the basis of an agreement concluded between Syria and Jordan in 1987. This arrangement has aroused strong opposition from Israel, which feared that this structure could affect its water supply from the Yarmouk River. The peace treaty signed between the Jordanian government and the Jewish state in 1994 has resolved the situation in Israel by ensuring a share of 25 million m3 of water. This volume will be distributed as follows:

-12 Million m3 of water during the period that starting from May until October.
-13 Million m3 during the winter period between October and May.

According to the agreement signed between Syria and the Hashemite kingdom, the water and energy distribution will be programmed in the following manner:

- Jordan: 80% of the water volume and 20% of hydropower
- Syria: 20% of the water volume and 80% of hydropower

The financial cost of this project estimated at $ 200 million was provided from major donors which are the Arab Fund and development banks in the Gulf countries that covered 80% of the Dam Cost.. The remainder was covered by Syria and Jordan. It should be noted that the relations with Syria have improved following the meeting between His Majesty King Abdullah and the Syrian President Bashar al-Assad. The cooperation between the two countries is excellent in the hydrodiplomatic field and Syria diverts an annual water amount from the Yarmouk River to help Jordan overcome the problem of shortage during dry periods.

III-3-Joint project with Turkey

Hydrodiplomatic cooperation with Turkey is very positive, because of the Jordanian political orientation which occurred lately in the region between Turkey, Egypt, Jordan and Israel.

The idea of building peace pipelines from the two rivers Turkish Seyhan and Ceyhan was discussed between the two governments. This project was planed to ensure water supply to Jordan and Israel, but it was abandoned for the moment because of its high cost. Another project was presented to the Jordanian Government which consists of transporting water from Turkey by tankers through Israel. The economic studies undertaken by Jordan have shown that it is more feasible for the kingdom to desalinate water from the Red Sea.

III-4-Joint project with Iraq

There has been talk of draining water through a piping system from Irak to Jordan. This project has been freezed the fact that the country is currently suffering a water shortage because of the military occupation of its territory and the civil war.

III-5-Projects and Karak Maïan

The third project is to collect water from the region of Maïan and send it to the capital. This water resources which 50% of its volume is currently unused, is of a very good quality. The fourth project is located in Karak, towards the south.

III-6- Red Sea-Dead Sea Project

The fifth projects consists of using the water level difference and implement a canal between the Dead Sea and Red Sea and use desalinization process to fulfill the needs of the country. It is a unique project which requires a mobilization of funds but which it will be amortized by all the touristical activities and infrastructures to be built at the same time.

This project will raise hopes for saving the Dead Sea from dryness and the threat of disappearing this essential resource in the region of the Middle East.

The drying up of this sea is mainly due to the Jordan River waters diversion and other rivers side from Israel, Jordan and Syria.

The water of Lake Tiberiades is also diverted by the Israel, which currently draws 600 million m3 to irrigate inland areas to the coastal cities of Haifa and Tel Aviv. From the Jordanian side, the MWF has also pumped the Yarmouk River water causing a sharp drop in it flow contribute the Jordan River. The Syrians constructed several dams on the Yarmouk River and its tributaries and developed large irritation schemes in the basin catchment

During the years 1950, nearly 1 200 million m3 of water from the Jordan River and its main tributaries used to feed the Dead Sea. Nowadays at least 200 million m3 flow into this sea because of the lake. The irrigation water diversion at the Jordan River upstairs and the annual evapotranspiration led to the lowering of water which came down to more than 30 meters from 70 years to the present day. A study by computer simulation has provided that a total dryness of the sea will occurs within 50 years if the project Dead Sea-Red Sea is not executed.

Two alternatives were proposed in order to save the Sea from an ecological catastrophe and to avoid losing a World historical Heritage highly valuable and irreplaceable. The first is to transfer the waters of the Mediterranean Sea to the Dead Sea (MS-MS), the second concerns the transfer of the Red Sea to the Dead Sea (RS-DS). The second option was adopted after the Oslo accords and the signing of the peace treaty between Israel, Jordan and the Palestinian Authority. The World Bank has assured the financing of the feasibility studies for this project and may also contribute to the financial cost of its implementation.

The project is to drain water from the Red Sea to the Dead Sea through a pipeline canal system linked to an open channel. This facility will be designed to produce electricity using the 400 m level difference between the two seas. The energy produced will be designed in part to the desalination of water which will be used for the different water sector and for the restitution of the Dead Sea initial volume and initial water level.

CHAPTER VI

Water Management in Israel

I – Institutional aspects

The assessment and management of water resources in Israel is primarily assigned to the Ministry of Agriculture through the Water Commissioner Office. This office takes in charge the administration of water resources within the scope of the Israeli laws and includes the following prerogatives:

- Overall management of the system;
- Distribution to the consumers;
- Efficiency of utilization;
- Water supply development;

With regard to the water commissioner, many agencies undertake the monitoring, control and distribution functions. The primary agency is the Israeli Hydrologic Service that collects and keeps the water records in a data base system. .

The Israeli Hydrologic Service (IHS) controls and operates a network of 300 groundwater observation stations and 100 stream-flow stations of watercourse measurements. For each of these stations, the levels, discharges and water quality are registered. These inventories of measurements constitute a national data base that are annually computerized and published as year book reports.

The Hydrological Service also monitors and controls certain wells in the West Bank, especially those that supply the Israeli settlements. For the rest of the West Bank, the measurement data are gathered by the civil administration water authority and then submitted to the Hydrological Service for interpretation, processing and archiving in a central database.

In addition, two other institutions ensure in Israel the distribution and the management of water resource and report to the water commissioner:

- Mekorot Water Authority supply about 65% of the country's water.
- Tahal Water Authority which is in charge of the planning and designs organization of the sector.
- These two institutions collect and stock all the water measurement data that corresponds to their operational sectors and exchange their information with the Israeli Hydrological Service.

The Israeli Meteorological Service (IMS) keeps all the climatologic data of the country through a network of 400 stations of pluviometry, evaporation and climatology. All the recorded data, mainly the pluviometry and evaporation are essential for the preparation of the water balance general report and the demands according to the water resources availability.

The Israeli Geological Service (IGS), which is not directly involved in the data water measurement, keeps a geological inventory of all the wells, dams and aquifers. These data will be used as reference for the interpretation of the water needs in the different Israeli regions.

The Ministry of Health in Israel (MHI) is liable for the quality of the drinking water. This Ministry collects and registers all the data related to the quality of fresh water throughout the country. These data are provided by other agencies and institutions that are also involved in the control and distribution of the resource.

Research and development for the waste water collection and treatment are undertaken in the university research centers in coordination with local collectivities. The non-conventional water will lead to reduce the water demands in the agricultural sectors which consume more than 70% of the fresh water in Israel.

For this purpose, the National Rivers Agency (NRA) was created in 1993 in order to remedy to the watercourses degradation in Israel. This agency plays the role of coordination between the different entities in charge of the watercourse basin management. Moreover, it exerts considerable efforts for the regeneration and the rivers ecosystem rehabilitation.

II – Water resources in Israel

II – 1 Generalities

The volume of precipitations that the Israeli territories receive is estimated to be 5 billion m³ for an average year, among which 3.5 billions are irreversibly lost through evapotranspiration, leaving only 1.5 billions m³ per year to provide the ground and surface water of the country (Diagram 1).

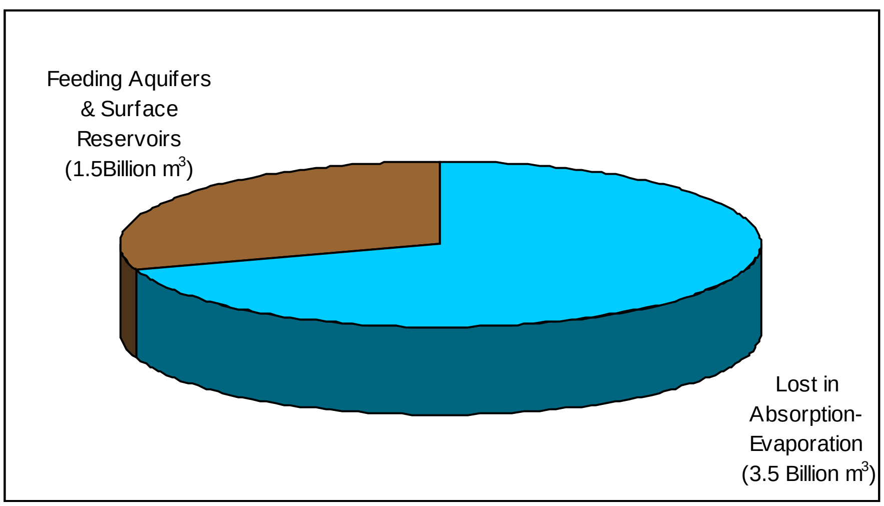


Diagram 1: water resources in Israel in an average year

The water resources characteristics in Israel can be summarized as follows:

- Rain falls only in winter with wide variability ranging from 25% of the annual average precipitation for a dry year to very high rates for the wet years.
- Most of the water resources are located at low elevation in the northern and central regions of the country. The water supply is related to high operation costs due to the pumping procedure.

Due to the important variations of the annual rainfall, groundwater aquifers are considered to be a more reliable potential resources then the surface water storage. Approximately 1/3 of Israel's hydraulic reserve comes from the surface water of the Jordan River. Groundwater, which constitutes the principal source of water supply for Israel, represents 2/3 of the national water consumption.

The aquifers arise from the limestone geological formations at a depth varying from 300 to 400 meters while the sandstone formations are located at a depth of 500 to 800 meters. The fossil aquifers which constitute the strategic water reserve of Israel are located at the most profound formations reaching a depth of 1000 meters and more (Diagram 2).

Another important resource, seeking to fulfill the additional water demand for the next ten years, comes from the non conventional water resources such as: brackish water, desalination of sea water, and the reuse of treated waste waters.

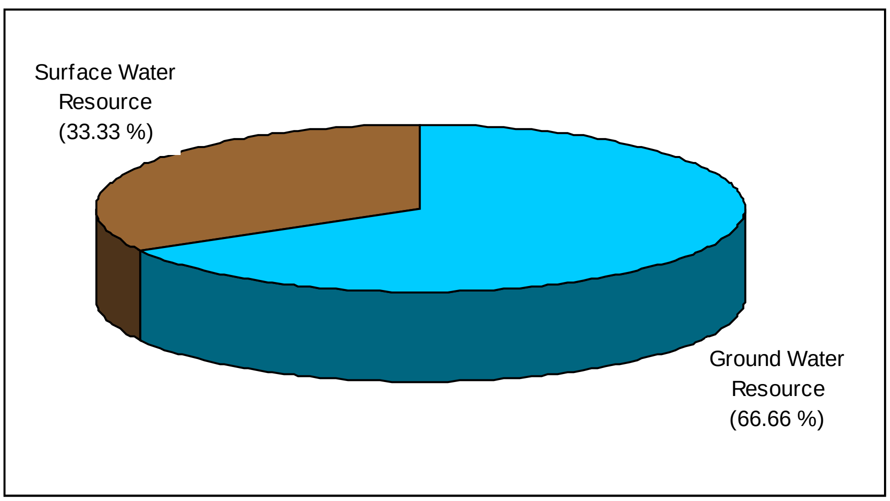


Diagram 2: Israel’s water Use

II – 2 Potential water resources

Precipitation over Israel varies considerably in time and place and directly influences the volume of renewable water resources. It is estimated that half of Israel's territorial area receives annual precipitations of less than 180 mm, while the precipitations on high mountains in North Israel (Golan, Lebanese occupied territories of Chebaa farms, reach 1000 mm and more. Although the renewable water resource accumulates in the North, water demand is intensified in the central and southern regions of the country.

The rainy season begins in October or November and ends up in April or May. For the rest of the year, precipitations are very low, with three or four dry months completely without rain. The aquifers are recharged exclusively in winter while the huge water demand for the irrigation sectors occurs during the summer season.

The total annual surface and groundwater discharge of Israel is estimated to be around 1.5 billion m^3. Lake Tiberiad, situated in the North of the country stocks effectively 0.5 billion m^3 per year, while the aquifers located on the coastal plains stock 1 billion m^3 per year.

III – 3 Surface water resources

Approximately one third of the potential fresh water used in Israel comes from the surface water arising from the Jordan River which is considered to be a completely closed watershed that ends in the Dead Sea.

Additional surface water is provided from streams located to the east and west of the country. Throughout the southern part of the country, the watercourses are practically inexistent. The Galilee region is the most humid region of Israel, since it receives more than 1000 mm of rain per year and streams and water sources are more numerous than those existing in all the other regions.

The Northern Harod River, a tributary of the Jordan River middle basin is replenished with abundant sources or ground flows, but its high salinity content make it practically not suitable for irrigation. Brackish water located in this region constitutes the major contamination source of the Jordan River middle basin. Nevertheless, the application of desalination method through "Reverse Osmosis" allows the recuperation of 50 million m^3 of fresh water per year.

The Yarqon River is a short watercourse situated on the coastal plain of Israel and is fed by several springs located in the western region. Its calibrated watershed basin is extended over an aquifer which is actually under exploitation with a high economical development potential.

The mountainous zones of Judea and Samaria, receive more than 500 mm of average annual rainfall, but the surface water in this region is not abundant. Permeable formations whose dip is oriented towards the western direction are very important for the recharge of aquifers that extend downstream the hydrogeographic basin.

II – 4 Groundwater resources

Groundwater resources extend in principle in the carbonated thick rocks aquifers related to the Cenomanien and Turonien formations. The total thickness varies between 600 and 700 m in the Central and Northern zones of Israel. The aquifers count for several hundred million m³ per year which represents a great part of the water supply in Israel.

The coastal plain is rich in water resources arising from wells and springs. More than 700 mm of precipitation per year, falls over the hills and the permeable formations dipping towards the west procures a good water reserve for the coastal plains. The aquifers extend over a depth varying between 80 and 120 meters. The groundwater pumping from the coastal aquifers amounts to 30% of the total volume of water supply in Israel.

A huge non renewable ground aquifer is located at a depth of 800 m under the desert of Neguev with an estimated water capacity of 70 billion m³. The salt content of this aquifer was found acceptable for irrigation purposes. The experts and economists in Israel requested in priority the utilization of this underground resource instead of conveying water over a long distance from the Jordan River northern basin.

II – 5 Non conventional water resources

The non conventional water in Israel is composed basically from the desalination of brakish water, sea water, and treated urban waste water. The potential contributions of non conventional water resources in meeting the water demands include the following alternatives:

- Treatment of the waste waters effluents of the Jordan river and occupied territories
- Increasing of the water reserves of Tiberiad Lake by creating artificial rains.
- Desalination of brakish water in the north of Tiberiad Lake.
- Desalination of the Sea water through Reverse Osmosis (R.O).

In Israel, the assessment of the general water master plan is a permanent process which is evaluated by considering all the water resources possibilities even the one that are not available for utilization yet. It also includes the recent researches developments relevant to the desalination techniques and waste water treatment and reuse.

II – 6 Water Consumption in Israel

All the renewable water resources were already being used in Israel which varies between 1.5 to 1.6 billion m³ per year. They are:

- Surface water from the upper part of the Jordan River
- Groundwater of limestone formations and the sandstone aquifers.

It is clear from Israel water balance that the demand has already exceeded the potential of renewable water resources by the late 1960s. The annual water consumption in Israel was 1.565 billion m³ in 1973, among which 1.18 billion m³ was estimated (75.4%) for the irrigation sector, 0.288 billion m³ (18.4%) for domestic use and 0.1 billion of m³ (6.2%) for the industry. It is also expected to provide till the year 2020, an additional volume of:

- 300 million m³ will be needed for the agriculture sector
- 400 million m³ for domestic use
- 200 million m³ for the industry.

Water consumption per inhabitant is estimated to be 537 m³ per year among which only 86 m³ per year for the domestic use. This volume is not so different from the other industrial countries, although it is the double of the amount used by Israel Arab neighbors.

III – Management and development of water resources in Israel

The principal countries “producers” of water in the Jordan River basin are: Jordan, Lebanon and Syria which are also Israel neighboring and riparian states.

After 1984, Israel has decided to undertake a program for the development of its water resources based on the ideas presented by Loudermilk in 1944. The application of this plan depended on two major factors that constituted a considerable importance in the initial development stage which are:

- Mobilization of capital financial investment for this new State.
- Urgent need to provide water supply for all the Jewish immigrants coming to the country.

Till 1965, and with the accomplishment of the National Water Carrier, there was a sufficient water resource to meet the socio-economic development of Israel and satisfy all the needs of the country. The Israeli government has continued in implementing new development plans in order to withhold other water resources, even if that was on the detriment of its Arabs neighboring states.

The year 1967 marked a turning point in the history of the “Water Wars” in the Middle East. Israel invaded the Arab territories in Gaza and the West Bank of the Jordan River as well as the Golan Heights in Syria and the Chebaa farms in Lebanon. This strategic plateau that dominates the North of Israel allows the control of the water sources at the upstream of the Jordan River Basin and regroups in its upper watershed the most abundant resources of this river.

At the beginning of the years 1980s, Israel started to encounter an increasing water demand in the urban and industrial economic sectors. This new situation required a drastic change in the resource utilization especially in the agriculture sector that consumed the three quarters of the total water volume available in the country. Unfortunately, very little changes have been carried out in the irrigation sector and the mismanagement of the water resources continued to be practiced by the Israeli administration especially in the landscaping sector that consumes huge amounts of water resources.

III – 1 Initial stage of the water resources planning

Israel relied on low cost alternative projects such as wells installations that permitted the irrigation of new lands over the coastal plain and in the North of Neguev desert.

During the period extending from 1950 to 1960, Israel improved the Jordan River upstream flow in the region of the Houle valley. The drainage improvement of this swampy depression caused a great relief for the Jewish rural settlers. The Houle valley is situated at the northern border of Israel and was a Lebanese owned marshy region where nobody could live there before 1950s.

The Houle depression use to encounter each year the winter floods resulting from the overflow of the upstream Jordan River basin and quickly evaporate without any productive use in the dry periods of the year. The settlers started the land drainage infrastructures by the mean of a series of canals connected to a main outflow discharge system in order to permanently control the water floods and aquifers levels in the Houle depression. The Jewish immigrants succeeded to turn the unused valley into a better fertile irrigated land with high agriculture production efficiencies.

The excessive utilization of water in the irrigation sector and the increase of drainage in the Houle valley led to a high salinity water content estimated to be around 400 mg/l that flows towards and out of the Tiberiad Lake.

III – 2 Medium and long term water resources planning

The main medium and long term planning concept developed by the Israeli administration was to integrate every hydraulic project in the national water distribution system. The major infrastructure projects were selected according to the criteria which allow a maximum investment per unit of water supplied. This planning approach permit to split the financial investment into many long term projects that had a regional rather than local significance. This concerns the development of the following infrastructures (table1 and figure 1):

1) Yarqon-Neguev was one of the first projects of the National Water Carrier (1955), which conducts water from springs and aquifers of the calibrated Yarqon watershed to the Neguev desert, situated in the south part of the country. This project provides the Israeli population with a water volume of 270 million m³ per year.

2) The Kishon – West Galilee was the first large size surface and groundwater project which carries a water volume of 85 million m³ per year, from the west of Galilee to the fertile Jezreel plain located in the semi-arid part of Israel. The water resources management of this project mainly leans on surface water during winter months and on groundwater during the driest months of the year in the summer.

3) The Beit She'an valley project located at 15 km in the South western region of the Tiberiad Lake. It uses high salinity water deriving from a local stream which is diluted with fresh water from Tiberiad Lake.

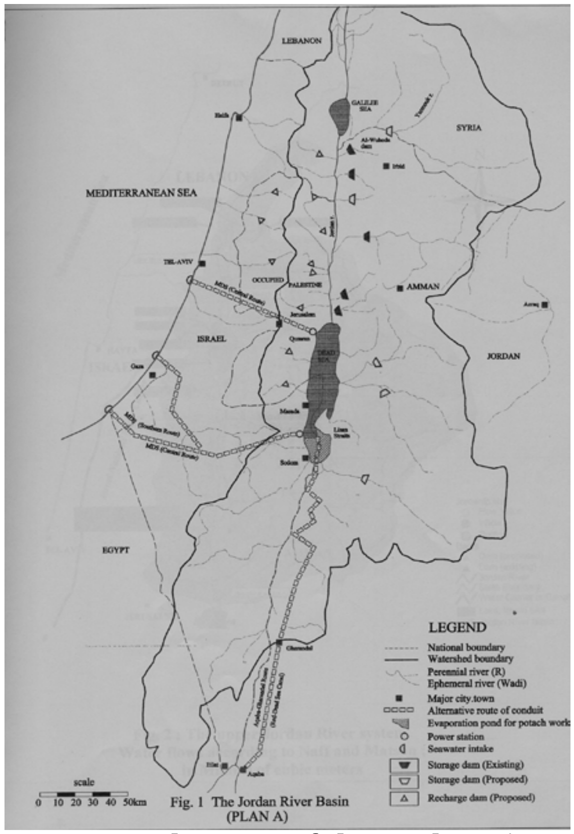


Figure 1: Development of the Jordan River projects in Israel

No	Project Designation	Description	Origin	Destination	Flow (Mm³ / year)
1	Yarqon Neguev	First projects of the national water carrier terminated in 1955	Sources and groundwater of the calibrated watershed of Yarqon river	Neguev Desert	270
2	Kishon-West Galilee	First joint project using at the same time surface and groundwater resources.	West of Galilee	Jezreel Plain	85
3	Valley of Beit She'an	Perennial salted watercourses diluted with fresh water deriving from the Tiberiad Lake.	15 km in the South West of Tiberiad Lake	Local Development	50

Table 1: Water resources development projects

III – 3 Integrated development phase: Israel national water master plan

The National Water Carrier is the biggest water resources project developed in Israel. It combines a huge aqueduct and canalization network which transmit water from the Jordan River to the Southern part of the country all along the costal plains regions.

In the early 1950, discussions were raised between the four riparian watercourse States of the Jordan River in an attempt to reach an agreement over its water sharing. In 1953, the negotiation resulted in a plan established by the United Nations known as the "Main Plan".

In 1955, after long negotiations between the riparian states, modifications were made on the initial plan by the American mediator Ambassador Eric Johnston and the new version referred to as the "Johnston Plan".

The potential utilization of the Jordan River water was totally estimated at 1.28 billion m³ per year (diagram 4), among which a percentage of 30% was reserved to Israel, 56% to Jordan and 10% to Syria and 3% to Lebanon. After many negotiations and consultations, the concerned states rejected the whole plan.

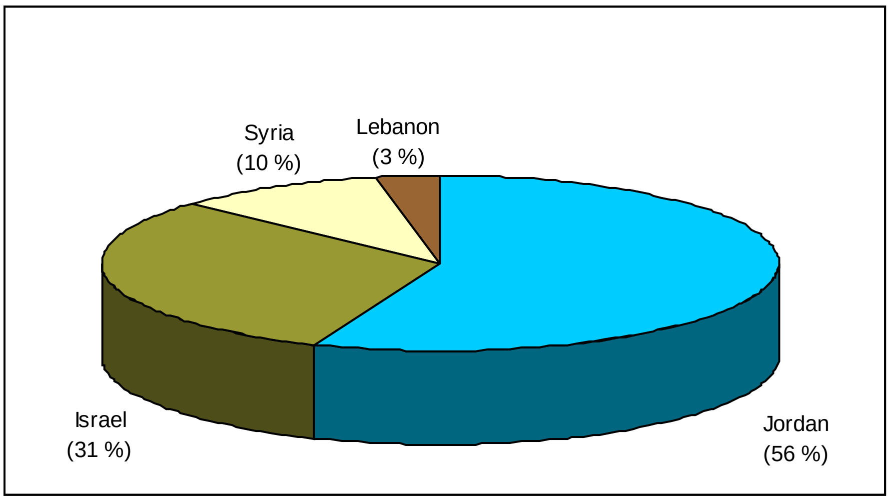


Diagram 3: Allocation of the Jordan River water among the riparian states. Johnston Plan: 1955

With the failure of the negotiations, Jordan and Israel decided at the same time to proceed with water projects situated entirely within their own territorial boundaries. Consequently, Israel continues in 1958 the construction of the National Water Carrier project. The main storage reservoir has its water supply starting point in Tiberiad Lake situated at 210 meters below sea level. From this location water is transmitted through a series of pumping and gravity canals to the distribution system in Yarqon - Neguev.

During the initial phase of the project, 180 millions m^3 per year of fresh water were transmitted to the Israeli population. In 1968, the capacity of output increased to reach a discharge volume of 360 million m^3 and finally reached an output flow capacity close to 500 million m^3 per year. Currently, the water national network links all the principal distribution canalizations and covers all water demands in the country, with the exception of some regions located in the southern desert of Neguev.

In total, this network currently distributes 1.4 billion m^3 per year which constitutes 90% of the water resources of Israel. The majority of the water supply derives from the Jordan River and its tributaries in addition to the calibrated watershed of the Yarqon River.

III – 4 Joint utilization and ground resources management

The principal aquifers of Israel are combined and integrated to the national water master plan. The utilization of groundwater is completely integrated to the output of surface water in a Joint operation with the artificial recharge of the aquifers. Taking into account the rarity of sites to stock surface water and the presence of arid climate with high potential of evaporation, a part of the aquifers was used as underground reservoir to stock the surplus of the watercourses discharge in winter by recharching them in the wells. .

III – 5 Water conservation

The annual total water distribution is approximately 1.75 billion m^3 in 1988, among which about 74% are used for irrigation, 19% for domestic use and 7% for the industrial sector. Approximately, 43% of cultivated lands or 185000 ha, are irrigated. The estimations indicate that Israel uses regularly 95% of its renewable water resources, including surface waters and groundwaters.

Currently, almost all the irrigation schemes in Israel are carried out through sprinkler, drip or surface watering system. The utilization of these new system increased the efficiently of irrigation and also the agricultural production.

At the beginning of the 1980s, Israel should have to face an increase of water demand in the urban economic and industrial sectors. Experiences and researches were made to start the reuse of treated urban waste waters as well as water desalination. This non conventional water system appeared to be a success but a very expensive solution. Its usage was at a first stage restricted to the Tourism sector but it was highly used later on because of the effort made to decrease the cost of fresh water production.

The Israeli government began the transfer of water from the agricultural sector that uses more than three quarter of the total water resources to the urban and industrial sectors and it was declared that the water granted for irrigation, for the year 1991, was reduced with 30% in comparison to the utilization rate of 1990.

III – 6 Territorial invasion policies of Israel and water resources of the West Bank

The estimated water capacity of Israel is mainly derived from the precipitation intensity which falls over the West Bank watershed and constitutes 1/3 of the total water resource of the country. The occupation of the West Bank in 1967 permitted a wider utilization of the water aquifer and prevented the Arab population from the development of new water infrastructures.

In the coastal areas, the recharge of the aquifer is developed intensively. At the same time, the Israeli inhabitants of the colonies in the West Bank pumped off the water from the aquifer preventing the Arab population from the use of their water shares.

It is primordial to note that the main part of Israel water resources comes from the Jordan River. The occupation of the Golan Heights in1967 by the Israeli state allow to control and manage the upper part of Jordan River, enabling Israel to block all the Arab attempts to turn the upstream watercourse . Almost half of the total supply of Israel water derives from the resources of Arab states located outside Israel borders before 1967.

III – 7 Hydraulic Balance in Israel

The water scarcity that the state of Israel is facing actually is mainly due to the absence of a sustainable and integrated water management policy. Efforts should be invested in order to balance the resources versus the demands especially if Israel is willing to integrate a peace process and restitute to the Arabs neighboring countries their occupied land in 1967. The three hydraulic scenarios that we propose for Israel (table 2 – 3 – 4) show that the development of the agricultural sector widely alter the water planning and management in this country. The deep analyses of these scenarios lead to the following conclusions:

- Water consumption for the agriculture sector exceeds 2 billion m^3/year till 2040.
- Negative balance of the water resources was recorded and estimated to be 1.9 billions m^3/year.
- Irrigated surface should be reduced from 185000 ha till 145000 ha for 2040.
- Irrigation water consumption should not exceed 1.4 billion m^3 for 2040.

Even with these new provisions that are proposed, Israel water balance shows negative values of its resources evaluated to be 880 million m^3. The hypothesis taken into account for implementing these water scenarios in Israel are the following:

Scenario I:

1. Population in 2000: 6 millions
2. Annual growth rate: 1.8%
3. Emigrants: 20000 per year
4. Irrigated surface area: 185000 ha
5. Water consumption per ha: 11500 m^3 /year
6. Domestic and industrial use per capita / day: 300 l/day in 2000 and 380 l/day in 2040

Scenario II:

1. Population in 2000: 6 millions
2. Annual growth rate: 1.8%
3. Emigrants: 10000 per year
4. Irrigated surface area: 185000 ha
5. Water consumption per ha: 11500 m^3 /year
6. Domestic and industrial use per capita / day: 300 l/day in 2000 and 380 l/day in 2040

Scenario III:

1. Population in 2000: 6 millions
2. Annual growth rate: 1.8%
3. Emigrants: 20000 per year
4. Irrigated surface area: 185000 ha in 2000 and 145000 ha in 2040 (reduction of the irrigated surface area of 1000 ha / year)
5. Water consumption per ha: 10000 m^3/ year
6. Domestic and industrial use per capita / day: 300 l/day in 2040

<table>
<tr><th colspan="3">Designation</th><th>2000</th><th>2005</th><th>2010</th><th>2015</th><th>2020</th></tr>
<tr><td colspan="3">Population ($x10^6$)</td><td>6.00</td><td>6.56</td><td>7.17</td><td>7.84</td><td>8.57</td></tr>
<tr><td colspan="3">Emigrants ($x10^6$)</td><td>0.00</td><td>0.10</td><td>0.22</td><td>0.34</td><td>0.48</td></tr>
<tr><td colspan="3">Total Population ($x10^6$)</td><td>6.00</td><td>6.66</td><td>7.39</td><td>8.18</td><td>9.05</td></tr>
<tr><td rowspan="4">Water needs</td><td rowspan="2">Domestic and industrial usage</td><td>(m^3/capita/year)</td><td>112.00</td><td>115.40</td><td>118.90</td><td>122.51</td><td>126.23</td></tr>
<tr><td>Total (Mm^3/year)</td><td>672.00</td><td>768.97</td><td>878.56</td><td>1002.40</td><td>1142.28</td></tr>
<tr><td rowspan="2">Agriculture</td><td>Surface (10^3 ha)</td><td>185</td><td>185</td><td>185</td><td>185</td><td>185</td></tr>
<tr><td>Total (Mm^3/year)</td><td>2127</td><td>2127</td><td>2127</td><td>2127</td><td>2127</td></tr>
<tr><td colspan="3">Total (Mm^3 / year)</td><td>2799</td><td>2896</td><td>3006</td><td>3129</td><td>3269</td></tr>
<tr><td rowspan="4">Water resource Mm^3/yea</td><td colspan="2">Surface water</td><td>1000</td><td>1000</td><td>1000</td><td>1000</td><td>1000</td></tr>
<tr><td colspan="2">Groundwater</td><td>500</td><td>500</td><td>500</td><td>500</td><td>500</td></tr>
<tr><td colspan="2">Non conventional water</td><td>570</td><td>570</td><td>570</td><td>570</td><td>570</td></tr>
<tr><td colspan="2">Total</td><td>2070</td><td>2070</td><td>2070</td><td>2070</td><td>2070</td></tr>
<tr><td colspan="3">Balance (Mm^3 / year)</td><td>- 729</td><td>- 826</td><td>- 936</td><td>- 059</td><td>- 1199</td></tr>
</table>

Table 2 – a: Scenario "I" on the water needs in Israel for the period 2000 – 2020

Designation			2020	2025	2030	2035	2040
Population (x10^6)			8.57	9.37	10.25	11.20	12.25
Emigrants (x10^6)			0.48	0.62	0.79	0.96	1.16
Total population (x10^6)			9.05	10.00	11.03	12.17	13.40
Water needs	Domestic and industrial usage	(m³/capita/year)	126.23	130.07	134.02	138.09	142.28
		Total (Mm³/year)	1142.28	1300.25	1478.62	1679.97	1.907.23
	Agriculture	Surface (10³ ha)	185	185	185	185	185
		Total (Mm³/year)	2127	2127	2127	2127	2127
Total (Mm³ / year)			3269	3427	3606	3807	4034
Water resource Mm³//year	Surface water		1000	1000	1000	1000	1000
	Groundwater		500	500	500	500	500
	Non conventional water		570	570	570	570	570
	Total		2070	2070	2070	2070	2070
Balance (Mm³/ year)			-1199	-1357	-1536	-1737	-1964

Table 2 – a: Scenario "I" on the water needs in Israel for the period 2020 – 2040

Designation			2000	2005	2010	2015	2020
Population (x10^6)			6.00	6.56	7.17	7.84	8.57
Emigrants (x10^6)			0.00	0.05	0.11	0.17	0.24
Total Population (x10^6)			6.00	6.61	7.28	8.01	8.81
Water needs	Domestic and industrial usage	(m³/capita/year)	112.00	112.00	112.00	112.00	112.00
		Total (Mm³ / year)	672.00	740.50	815.40	897.28	986.80
	Agriculture	Surface (10³ Ha)	185	185	185	185	185
		Total (Mm³ / year)	1850	1850	1850	1850	1850
Total (Mm³ / year)			2522	2590	2665	2747	2836
Water resource Mm³ / year	Surface water		1000	1000	1000	1000	1000
	Groundwater		500	500	500	500	500
	Non conventional water		570	570	570	570	570
	Total		2070	2070	2070	2070	2070
Balance (Mm³ / year)			-452	-520	-595	-677	-766

Table 3 – a: Scenario "II" on the water needs in Israel for the period 2000 – 2020

Designation			2020	2025	2030	2035	2040
Population ($x10^6$)			8.57	9.37	10.25	11.20	12.25
Emigrants ($x10^6$)			0.24	0.31	0.39	0.48	0.58
Total population ($x10^6$)			8.81	9.69	10.64	11.68	12.83
Water needs	Domestic and industrial usage	(m^3/capita/year)	112.00	112.00	112.00	112.00	112.00
		Total (Mm^3 /year)	986.80	1084.67	1191.67	1308.66	1436.56
	Agriculture	Surface (10^3 Ha)	185	185	185	185	185
		Total (Mm^3/ year)	1850	1850	1850	1850	1850
Total (Mm^3 / year)			2836	2934	3041	3158	3286
Water resource Mm^3 / year	Surface water		1000	1000	1000	1000	1000
	Groundwater		500	500	500	500	500
	Non conventional water		570	570	570	570	570
	Total		2070	2070	2070	2070	2070
Balance (Mm^3 / year)			-766	-864	-971	-1088	-1216

Table 3 – b: Scenario "II" on the water needs in Israel for the period 2020 – 2040

Designation			2000	2005	2010	2015	2020
Population ($x10^6$)			6.00	6.56	7.17	7.84	8.57
Emigrants ($x10^6$)			0.00	0.10	0.22	0.34	0.48
Total Population ($x10^6$)			6.00	6.66	7.39	8.18	9.05
Water needs	Domestic and industrial usage	(m^3/capita/year)	112.00	112.00	112.00	112.00	112.00
		Total (Mm^3/ year)	672.00	746.31	827.55	916.37	1013.47
	Agriculture	Surface (10^3 Ha)	185	180	175	170	165
		Total (Mm^3 / year)	1850	1800	1750	1700	1650
Total (Mm^3 / year)			2522	2546	2577	2616	2663
Water resource (Mm^3 / year)	Surface water		1000	1000	1000	1000	1000
	Groundwater		500	500	500	500	500
	Non conventional water		570	570	570	570	570
	Total		2070	2070	2070	2070	2070
Balance (Mm^3/ year)			-452	-476	-507	-546	-593

Table 4 – a: Scenario "III" on the water needs in Israel for the period 2000 – 2020

<table>
<tr><th colspan="3">Designation</th><th>2020</th><th>2025</th><th>2030</th><th>2035</th><th>2040</th></tr>
<tr><td colspan="3">Population (x10^6)</td><td>8.57</td><td>9.37</td><td>10.25</td><td>11.20</td><td>12.25</td></tr>
<tr><td colspan="3">Emigrants (x10^6)</td><td>0.48</td><td>0.62</td><td>0.79</td><td>0.96</td><td>1.16</td></tr>
<tr><td colspan="3">Total population (x10^6)</td><td>9.05</td><td>10.00</td><td>11.03</td><td>12.17</td><td>13.40</td></tr>
<tr><td rowspan="4">Water needs</td><td rowspan="2">Domestic and industrial usage</td><td>(m³/capita/year)</td><td>112.00</td><td>112.00</td><td>112.00</td><td>112.00</td><td>112.00</td></tr>
<tr><td>Total (Mm³ / year)</td><td>1013.47</td><td>1119.64</td><td>1235.71</td><td>1362.6</td><td>1501.3</td></tr>
<tr><td rowspan="2">Agriculture</td><td>Surface (10³ Ha)</td><td>165</td><td>160</td><td>155</td><td>150</td><td>145</td></tr>
<tr><td>Total (Mm³ / year)</td><td>1650</td><td>1600</td><td>1550</td><td>1500</td><td>1450</td></tr>
<tr><td colspan="3">Total (Mm³ / year)</td><td>2663</td><td>2719</td><td>2785</td><td>2862</td><td>2951</td></tr>
<tr><td rowspan="4">Water resource (Mm³ / year)</td><td colspan="2">Surface water</td><td>1000</td><td>1000</td><td>1000</td><td>1000</td><td>1000</td></tr>
<tr><td colspan="2">Groundwater</td><td>500</td><td>500</td><td>500</td><td>500</td><td>500</td></tr>
<tr><td colspan="2">Non conventional water</td><td>570</td><td>570</td><td>570</td><td>570</td><td>570</td></tr>
<tr><td colspan="2">Total</td><td>2070</td><td>2070</td><td>2070</td><td>2070</td><td>2070</td></tr>
<tr><td colspan="3">Balance (Mm³ / year)</td><td>-593</td><td>-649</td><td>-715</td><td>-792</td><td>-881</td></tr>
</table>

Table 4 – b: Scenario "III" on the water needs in Israel for the period 2020 – 2040

IV –Mediterranean Sea and the Dead Sea canal development

IV – 1 Hydrology of the Dead Sea

The climate of the Dead Sea watershed is characterized by an arid and hot zone located in its major part deep down the valley of the Jordan River, as well as another semi arid and Mediterranean climate zone located in the Golan Heights. The Dead Sea represents a basin of salt water whose total content of Sodium is estimated at 250000 mg/l (TDS). This sea is a closed lake with no outlet other than the evaporation of its water in the atmosphere which is likely to attain from 1500 to 1600 mm per year. Since the water resources in the Jordan River are very limited to satisfy the increasing demands in Israel, the water experts have proposed a new method of cogeneration that may permit the production of fresh water from the sea through the combination of hydroelectric power and desalination by reverse Osmosis. This project was conceived by using the difference in elevation of 400 m existing between the Mediterranean and the Dead Sea.

This project may produce an electric power of about 800 MW and 100 million m³ of fresh water per year, from the connection between both seas. All the riparian watercourse States, including the Palestinian Authority may beneficiate from this project. It was expected that this volume of water reaching 100 million m³ per year would be exclusively reserved to supply the Central Ghor Valley. This region is located in the valley that surrounds the Dead Sea, whose altitude extends from (-) 210 meters to (-) 400 meters below the sea level.

The execution of this project constitutes a new strategy in the technological development of the region enhancing the safeguard of the environment of the Dead Sea.

IV – 2 Technical characteristics of the project

Twenty seven alternatives were studied to define the layout of the tunnel that will connect the two seas. The alternative chosen in 1982 minimizes the cost of the capital investment and links Gaza to Ain Bokek by a tunnel of 80 km in length. However, this alternative that may cross Gaza was reconsidered for political reasons. Therefore, Israel has adopted a variety of alternatives that consists in moving the entrance of the tunnel far to the North for the purpose of securing it inside the Israeli territories.

The Israeli Ministry of Energy has recently shown a new interest in the project of pumping – stocking over the Dead Sea. This wide-spread project estimated at more than 2 billion US $ contains the following technical components:

- Upstream reservoir (Mediterranean Sea), located at level zero with an unlimited water reserve.
- Sea Water conveyor (tunnel), a canal and a conduit with a discharge of 200 m^3 / s.
- Large reservoir and a regulator discharge located at the exit of the sea water conveyor.
- Hydroelectric power plant that could produce an average power between 400 MGW and 800 MGW in peak hour and ensure a supply of 1.5 billion KWH. This "stock type" unit may allow to reverse the system and to obtain also the following functioning: pumping – stoking, upon demand.
- Downstream reservoir which is the Dead Sea with its actual water level situated at 420 meters under the sea level.
- Desalination plant through Reverse Osmosis using the hydroelectric power, comprising regulatory reservoirs for water distribution.

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The approach of this project will take in consideration the following facts:

- Development of the recent technological innovations of membranes for desalination through Reverse Osmosis. The purpose of this procedure is to reduce the energy consumption and generate fresh water.
- Recent developments of the political situation in the Middle East particularly in Iraq and the changes of alliances after the Gulf War have turned the IWRM on transboundary watercourses a much more acceptable issue than before.

IV – 3 Sharing and distribution approach

The Dead Sea is a common heritage of the watercourses States that share its basin according to the following portions:

- Israel's (300 km², 30%), Palestine and Jordan (700 km², 70%), watershed surface basin estimated to 300 Km^2 (30%)
- Palestine and Jordan watershed surface basin estimated to 700 Km^2 (70%)

These countries shall as well share their water resources deriving from the Dead Sea in an equitable way and should find a mean to divide the benefits of the project. The implementation of this project, comprehending the financing, construction, operation and maintenance, could be undertaken by an international consortium such as the World Bank.

IV – 4 Proposal of Jordan

In 1981, Jordan has proposed to link the Red Sea from Aqaba Gulf to the Dead Sea. This project is also based on the difference in altitude of 400 m for the production of hydro - electrical power. The Red Sea water will be taken out at a distance of 85 kilometers to the North from Gharandal to the Dead Sea producing an electrical power of 330 MW, at the rate of eight hours per day and according to the peak demands.

The experts' mission report of the United Nations published in 1983 indicated that the maximum water level of the Dead Sea which will reaches (–) 390 meters, will not produce an overflowing of the religious and archeological places, and may not activate earthquakes. This water level will reached the initial equilibrium level already existed before. The environmental impact assessment showed that this project does not produce harmful effects to the Dead Sea environment.

CHAPTER VII

Syrian Water Management
And hydraulic stakes of the Golan heights

I - Institutional aspects

The Ministry of Irrigation is in charge of dams, planning, research, operation and maintenance and water for irrigation and pollution control. The Directorate of Irrigation is involved in water resources studies and surveys, water legislation and sharing international waters. There are three other departments under the responsibility of the Ministry of Irrigation: the Euphrates Basin Development Authority, the Euphrates Basin Land Reclamation Authority and the General Company of Major Water Resources Studies.

The Ministry of Irrigation is also in charge of groundwater monitoring and the issuing of licenses for groundwater well drilling. In some areas with a high concentration of wells, such as parts of the Aleppo and Salamieh areas, the water table is dropping. The Ministry is exploring means of increasing the recharge of the shallow aquifers.

There are four other organizations involved in the water sector in Syria:

- the Ministry of Agriculture and Agrarian Reform, Directorate of Irrigation and Water Uses;
- the Ministry of Housing and Public services, Directorate of Water Supply and Waste Water;
- the State Planning Commission, Section: Irrigation and Agriculture Sector;
- the State Environmental Affairs Commission, Section: Water Environment Safety Sector.

II - water resources of Syria

II.1 - Climate

Syria's climate is Mediterranean with continental influence: cool rainy winters and warm dry summers, with relatively short spring and autumn seasons. Large parts of Syria are exposed to high variability in daily temperature. The maximum difference in daily temperature can be as high as 32°C in the interior and about 13°C in the coastal region. Total annual precipitation ranges from 100 to 150 mm in the north-west, 150 to 200 mm from the south towards the central and east-central areas, 300 to 600 mm in the plains and along the foothills in the west, and 800 to 1 000 mm along the coast, increasing to 1 400 mm in the mountains. The Average annual rainfall in the country is 252 mm giving 46.6 billion m^3.

II.2 - Surface Water Resources

There are 16 main rivers and tributaries in the country, of which 6 main international rivers:

- The Euphrates (Al Furat), which is Syria's the largest river. It comes from Turkey and flows to Iraq. Its total length is 2 330 km, of which 680 km are in Syria;
- The Afrin in the north-western part of the country, which comes from Turkey, crosses Syria and flows back to Turkey;
- The Orontes (El-Assi) in the western part of the country, which comes from Lebanon and flows into Turkey;
- The Yarmouk in the south-western part of the country with sources in Syria and Jordan and which forms the border between these two countries before flowing into the Jordan river;
- The El-Kebir with sources in Syria and Lebanon and which forms the border between them before flowing to the sea.
- The Tigris, which forms the border between Syria and Turkey in the extreme north-eastern part.

The natural average surface runoff to Syria from international rivers is estimated at 28.73 billion m^3 per year. If we include 15.75 billion m^3 of water entering with the Euphrates, as proposed by Turkey, and 0.43 billion m^3 of water entering with the Orontes, this total becomes 18.11 billion m^3 per year.

The Tigris, which is the second most important river in the country, borders the country to the east and has a mean annual flow of 18 billion m^3. Total natural average outflow from Syria is 31.975 billion m^3 per year, of which an agreement exists for 9.2 billion m^3, resulting in a total of actual external surface water resources for Syria of 17.91 billion m^3 per year (27.11 billion m^3 per year - 9.2 billion m^3 per year).

Although figures for water resources are very difficult to obtain due to the lack of reliable data, it can be estimated that water resources generated from rain falling within the country amount to 7 billion m^3 per year.

A breakdown of surface water entering, bordering and leaving the country is given in the following table 1.

Name of River	Inflow into Syria (Bm^3/year)			Outflow from Syria (Bm^3/year)		
	From	Natural	Actual	To	Natural	Agreement
Euphrates *	Turkey	26.29	15.75	Iraq	30	9
Tributaries of Euphrates	Turkey	1.74	1.74		-	
Afrin	Turkey	0.19	0.19	Turkey	0.25	
Orontes, El Kebir	Lebanon	0.51	0.43		1.2	
Yarmouk		-	-	Jordan	0.4	0.2
Baniyas		-	-	Israel	0.125	
Sub-Total		28.73	18.11		31.975	9.2
Bordering Tigris	50% of total	9	9			
Total	Inflow	**37.73**	**27.11**	Outflow	**31.975**	**9.2**

*: *Turkey has unilaterally promised to secure a minimum flow of 15.75 Bm3/year at its border with Syria*.

Table 1: Major rivers entering, bordering and leaving Syria

II.3 - Groundwater Resources

Groundwater recharge is about 4.2 billion m^3 per year, of which 2 billion m^3 per year discharges into rivers as spring water. Total groundwater inflow has been estimated at 1.35 billion m^3 per year out of which 1.2 billion m^3 from Turkey and 0.15 billion m^3 from Lebanon. Although not quantified, the amount of groundwater flowing into Jordan may be significant.

II.4 - Water Consumption in Syria

Total annual water withdrawal in Syria in 1993 was estimated at 14.41 billion m^3 per year, of which agricultural use accounted for 94%. The assessment of agricultural water use is based on the assumption that the maximum water requirement is about 13,450 m^3/ha per year.

II.5 - Non-Conventional Water Resources

The treatment of domestic wastewater is carried out mainly in the towns of Damascus, Aleppo, Homs and Salamieh. The total amount of treated wastewater was estimated at 0.37 billion m^3 per year in 1993, which represents 60% of the total produced volume of 0.61 billion m^3 per year. All treated wastewater is reused.

III - Water resources development and management in Syria

III.1 - International rivers and agreements

As far as the Euphrates river is concerned, Turkey unilaterally decided to secure a minimum flow of 500 m^3/s (15.75 billion m^3 per year) to enter Syria, although more has been demanded. According to an agreement between Syria and Iraq (1990), Syria agrees to share the Euphrates water with Iraq on a basis of 58% to Iraq and 42% to Syria. This sharing rate corresponds to a flow of 9 billion m^3 per year at the border with Iraq when using the figure of 15.75 billion m^3 per year from Turkey. Up to now, there has been no global agreement between the three countries concerning the Euphrates waters. An agreement was signed in 1955 between Syria and Jordan regarding the allocation of the water of the Yarmouk River, and was further revised in 1987. A recent agreement was concluded in 2002 between Lebanon and Syria on the Orontes river has led to a share of 80 million m^3 per year for Lebanon stocked in two dams and the remainder for Syria.

III.2 - Dams and lakes

There are 141 dams in Syria with a total storage capacity of 15.8 billion m^3. The largest dam is located at Al-Tabka on the Euphrates. It forms the Al-Assad Lake with a storage capacity of 11.2 billion m^3. Medium-sized dams include the Al-Rastan (225 million m^3), the Mouhardeh (50 million m^3) and the Taldo (15.5 million m^3). There are some 20 dams classified as small, the largest of which is the Dara'a, with a storage capacity of 15 million m^3. The majority of these dams are located near Homs and Hama.
Apart from the Al-Assad lake, there are five lakes in Syria, the largest being lake Jabboul near Aleppo with a surface area of about 239 km^2. Lake Qattineh near Homs is the main perennial lake in Syria.

III.3 - Irrigation and Drainage Development

In 1993, the cultivable land was estimated at 5.94 million ha, or 32% of the total area of the country. The cultivated land was estimated at 4.94 million ha, which is 83% of the cultivable area. Of this area, 4.27 million ha consisted of annual crops and 0.67 million ha consisted of permanent crops. About 62% of the cultivated area is located in the three northern governorates Aleppo, Al-Reqqa and Al-Hassakeh, representing only 33% of the total area of the country.
The total population is 14.6 million (1995), of which 48% is rural. Actual population growth is 3.3%. In 1993, agriculture employed around 22.5% of the total labor force, accounted for nearly 28% of GDP and 60% of non-oil exports.

Estimates on irrigation potential, based solely on soil resources, lead to a figure of around 5.9 million ha, which is roughly equal to the cultivable area. Considering the water resources available at present, irrigation potential is estimated at 1.25 million ha. The exact figure, however, depends on how Syria reaches agreements with neighboring countries on the sharing of river waters in the future.

In 1993, the total area equipped for irrigation was estimated at 1,013,273 ha, which is 81% of the above irrigation potential. Irrigation is mainly developed in the north-eastern part of the country and more than one-third of irrigated areas are located in the Al-Hassakeh governorate.

Surface irrigation is reported to be practiced on 981,273 ha. The predominant system of surface irrigation practiced is basin irrigation. Traditionally, irrigation in Syria has relied on flooding for cereals, furrow irrigation for vegetables and basin irrigation for fruit trees. Sprinkler irrigation is practiced on 30,000 ha, mostly in the Homs, Aleppo and Al-Hassakeh governorates. It has been developing on a wider scale recently, mainly because of groundwater scarcity, which has encouraged farmers to develop water-saving techniques, and because of equipment becoming available on the local market. Micro-irrigation is practiced on 2,000 ha.

In 1993 it was estimated that 60.2% of the area was irrigated from groundwater and 39.8% from surface water (gravity-fed or pumped from the rivers and lakes). The use of groundwater for irrigation has been expanding rapidly in the last five years because irrigation from groundwater is cheaper than irrigation by gravity. Since pumped water is free, the only investment expense required is the well and a suitable pump. Farmers obtain credit at preferential rates of interest to purchase fuel and imported pumps at subsidized prices. A second factor explaining the increase in irrigation from groundwater is the large number of farmers with small farm holdings. The latest available data estimate that over 75% of the farmers have holdings of less than 10 ha. On average, it is estimated that a household has 3.5 ha of irrigated land. Since most private farmers want secure and independent access to a supply of water, they often dig their own wells. In 1994, the total number of wells in the country was estimated at 122,276 of which 53,453 were not licensed.

Of the total area of 1,013,273 ha equipped for irrigation, 349,820 ha are involved in government irrigation projects and 78% of this land is also equipped for drainage. It is estimated that 105,000 ha of these government irrigated areas need rehabilitation.

There is a wide variation in cropping patterns in the irrigated areas, depending on the water resources available and the agro-climatological conditions. Strategic crops such as wheat and cotton are concentrated in the northern and eastern part of the country. More than 50% of the wheat and cotton produced comes from the Al-Hassakeh governorate, in the north-eastern part of the country. The production of winter vegetables is centered in the coastal region, while summer vegetables are produced mainly in the internal plains, especially in the central and southern regions. In 1993, of the total area equipped for irrigation of 1.01 million ha, about 0.12 million ha were planted with fruit trees and olives, while 0.89 million ha were used for annual crops. The cropping intensity for annual crops reached 121%, leading to a total cropped area of annual crops of about 1.08 million ha of which 0.19 million ha with double cropping (winter and summer), 0.49 million ha planted during the winter only and 0.21 million ha planted during the summer only.

The average yield for irrigated wheat was estimated at 4 tons/ha in 1993, varying between 2.5 and 5.2 tons/ha over the different governorates. The yield for rainfed wheat varied between 1.3 tons/ha for standard varieties and 2 tons/ha for high productivity varieties. The average yield of irrigated cotton was 3.1 tons/ha. Irrigated barley is mainly used as fodder crop with yields reaching 15 tons/ha.

The average cost of surface irrigation development varies between $US 3,800/ha for small, 6,600/ha for medium and 7,600/ha for large schemes. The average operation and maintenance cost varies between $US 60 and 85/ha per year for gravity and $US 155 and 238/ha per year for pumping. However, private farmers using water from government schemes pay only $US 26/ha per year. The current capital cost of installing 1 ha of micro-irrigation is estimated at $US 1,000 for locally manufactured equipment and $US 1,400 for imported equipment. There is no fee charged for irrigation water, only for operation and maintenance.

Drainage is mainly developed in the governorates bordering the Euphrates river. In the Al-Reqqa governorate, for instance, 62% of the irrigated area is drained. About 24% of the total drained area is power drained. The drainage systems are generally mixed systems of surface and subsurface drainage. In 1993, 60,000 ha of irrigated land were estimated to be affected by salinization. Some 5,000 ha in the Euphrates basin have been abandoned due to water logging and salinity problems. In the new irrigation scheme, open drainage systems have been installed on 90% of the irrigated land. Only a small area has been equipped with subsurface drains.

Unit costs for irrigation development have increased considerably in the last two decades and this is one of the reasons why since the 1970s attention has also been given to drainage and irrigation rehabilitation, mainly in the Euphrates valley where irrigation through pumping from the river has developed rapidly since the 1950s. Appreciable progress has been made in restoring large irrigated areas which went out of cultivation due to water logging and salinity especially in the lower and middle parts of the Euphrates valley. Table 2 presents the size of irrigation Government projects in Syria.

GOVERNMENT PROJECTS			
Size	**Criteria**	**Total area in ha**	**as % of total**
Large	20,000 ha	257,860	74
Medium		47,840	14
Small	<2,000 ha	44,220	12
Total		**349,820**	**100**

Table 2: Government projects in Syria

III.4 - Trends in Water Resources Management

The agriculture sector is a major source of income, foreign exchange and labor in Syria. The irrigated area produces over 50% of the total value of agricultural production on about 18.6% of the cultivated land. A large part of the wheat production, as well as all major industrial crops including cotton, tobacco and sugar beet are produced on irrigated farms. The development and utilization of water so far has been carried out on an ad hoc basis, mainly responding to various demands. The need to increase food production has resulted in the construction of dams for irrigating lands under their command; and attractive prices for food crops, particularly for wheat recently, have resulted in a rapid increase in wells and the over exploitation of groundwater. In addition, an increase in population and the proliferation of industries in major cities have contributed to further exploitation of the limited water resources.

Under the latest development plans, between 60 and 70% of public investment in agriculture was allocated to irrigation development, in particular for the construction of the Taqba dam and the establishment of the Assad reservoir.
Irrigated agriculture in the Damascus basin has to compete for both land and water with the residential and industrial expansion of the city. Irrigated agriculture has already been seriously reduced in the Damascus basin in recent decades.

Irrigation development to a large extent depends on how Syria reaches agreements with neighboring countries on the sharing of river waters (Turkey, Lebanon, Jordan and Iraq). Identifying and implementing policies, programs, projects and techniques to improve water use efficiency and to better control surface water and groundwater exploitation are important challenges facing Syrian policy-makers. Future projects have been planned by the government for the development of major schemes: 91,000 ha in the Euphrates basin, 150,000 ha in the Khabour (tributary of the Euphrates) basin with the construction of a reservoir north of Al-Hassakeh, 150,000 ha in the Tigris basin by pumping from the Tigris river and 72,000 ha in the Orontes basin (Al-Ghab). Table 3 presents the details of the water resources and use and table 4 presents the irrigation and drainage potential in Syria.

Renewable Water Resources		
Average precipitation	252	mm/yr
	46.6	Bm^3/yr
Internal renewable water resources	7.0	Bm^3/yr
Total (actual) renewable water resources	26.26	Bm^3/yr
Dependency ratio	80.3	%
Total (actual) renewable water resources per inhabitant	1,791	m^3/yr
Total dam capacity	15,800	Mm^3
Water Withdrawal		
- agricultural	13,600	Mm^3/yr
- domestic	530	Mm^3/yr
- industrial	280	Mm^3/yr
Total water withdrawal	14,410	Mm^3/yr
per inhabitant	1,017	m^3/yr
as % of total (actual) renewable water resources	54.9	%
Other water withdrawal	-	Mm^3/yr
Average groundwater depletion	1,820	Mm^3/yr
Wastewater - Non-Conventional Water Sources		
Wastewater:		
- produced wastewater	610	Mm^3/yr
- treated wastewater	370	Mm^3/yr
- reused treated wastewater	370	Mm^3/yr
Desalinated water	-	Mm^3/yr

Table 3: water resource and use in Syria

Irrigation Potential	1,250,000	Ha
Irrigation		
- surface Irrigation	981,237	Ha
- sprinkler irrigation	30,000	Ha
- micro-irrigation	2,000	Ha
% of area irrigated from groundwater	60.2	%
% of area irrigated from surface water	39.8	%
% of area irrigated from non-conventional sources	0.0	%
Total Irrigation	**1,013,273**	**Ha**
- as % of cultivated area	21	%
- increase over last 10 years 1983-93	75	%
Irrigated Crops		
Total irrigated grain production	2,400,000	Tons
as % of total grain production	45	%
Drainage – Environment		
Drained area	273,030	Ha
as % of cultivated area	6	%

Table 4: Irrigation and drainage schemes in Syria

IV – Geographic Localization of the Golan Heights

The Golan Height plateau is surrounded by five countries which are Lebanon, Syria, Palestine, Israel and Jordan. It is situated in the southwestern angle of Syria within the district of Qunaytra and extends to the northern side towards Mount Hermon (Djebel-Al-Cheikh) to reach the border line between Syria and Lebanon. The geological formation from the west side extend towards the Syrio-African fault situated at 2814 m and constitute the natural line with Palestine represented by the downstream basin of the Jordan River which reaches lake Tiberiad at the level 212 m under the sea.
From the south, the Golan Heights reaches the Yarmouk River, being the principal tributary of the Jordan River and draws the border line between Syria and Jordan till the Himme region. From the East side, the plateau reaches Al Rakkad Valley which forms the administrative limits between the districts of Deraa and Rif Damascus.

The surface area of the Golan is 1860 km² among which 1250 km² became in 1967 under the Israeli occupation, including the following regions:

- The lands located in the outskirts of Houle swamps and Tiberiad Lake, with a 100 km² surface area considered before 1967 as a demilitarized zones.

- The Chebaa Farms, which constitutes the Lebanese territories still under occupation by Israel with a surface area of about 62 km².

This plateau is divided into three distinguished parts:

- Mount Hermon (Djebel-Al-Cheikh) which is a gigantic calcareous massif with an altitude of 2814 m.

- Qunaytra zone situated in the north of the Golan Height which constitutes a volcanic region with magmatic rocks such as lava and ash originated from the fourth geological period. This region forms a chain of hills known as Tell – Abou Al Nada (1204 m), Tell Akkacha and Tell Al-Faras and crossed by several watercourses which are:

- Wadis Al – Rakkad from the east

- Jordan River basin from the west

- Southern region of the Golan (Al – Zwieh) constitutes a zone rich in water resources that feeds the Jordan River with the Yarmouk watercourse and Al Rakkad spring.

- Bteiha valley, located in the northeastern part of Tiberiad Lake where many seasonal watercourses emerge such as: Wadi Al – Safa, Dalie and Cheikh Ali.

- El – Al plains, Fig, Kfar Hareb and Scovia.

The population of the Golan region counts actually around 30500 inhabitants (according to the census of 1994) mainly comprehending Syrian druzes population holding actuality the Israelis passports. They are mostly farmers working in the cultivation of citrus fruits and cattle breeding. Part of these population are employees in the Jewish communities while the Israelis live in 32 agricultural cooperatives and develop the cultivation of vegetables, cereals, cotton and administrate the farms for dairy and wine production.

V- Historical background

After the World War I (1914 – 1918), the Golan Heights formed a part of the regions falling under the French mandate. The establishment of the State of Israel in 1948 motivates the Israelis government to create cooperative agricultural farms near the Syrian borders intending to dominate the Golan Heights in order to control the Jordan River and canalize its water to its territories. The Israeli strategic development vision shows clearly that the core of the conflict with the Arab countries is concentrated on two objectives; the land and the water resources.

In 1950 a brutal fight started between Syria and Israel due to the drying up of the Houle swamps and the diversion of the Jordan River for the irrigation of lands. The Israeli activities in the upstream basin of the Jordan River aim clearly towards the imposition of a peace agreement with Syria that could give an advantage to Israel in the water sharing of the Jordan River.

The declaration of the Israeli Prime Minister, Ben Gorion, has confirmed these facts by stating that "the Jewish were fighting a combat for water against the control of this resource by the Arabs and that the existence of the Jewish people in Palestine depends on the results consequences of such a fight".
Between 1964 and 1965, Israel has launched a series of military aggressions against the water infrastructures under realization in Syria, Palestine and Lebanon, leading to the arrest of all these projects.

In 1967, Israel launched an attack against all the Arab states and occupied Sinai, Gaza, west bank and the Golan Heights. Its initial objective aimed at dominating the Arab water resources in the Golan and the neighboring regions. Some researchers tend to thing that Israel is much more interested in controlling the water resources in the Golan than in the strategic military site of the plateau. Figure 1 shows the geographic position of the Golan Plateau.

After the 1987 war, this region fell under the Israeli military administration, and many colonies were settled in the area. Syria tried to recuperate this region during its war with Israel in 1973, but it failed. Since then, the United Nations forces have constituted a buffer zone between the two armies. In 1981, Israel annexed the Golan Heights applying thereon the Israeli civil code over the region. The Syrian Government has always refused to recognize the "fait accompli" of the Hebrew State in this region.
In 1991, the peace negotiations between Israel and Syria started again but directly failed. Israel has offered to withdraw during a period of 4 years, while Syria was demanding such retrieve to be done during 18 months. None of both parties wanted to compromise and in 1996, Israel suspended all negotiations after several attacks of fundamentalist Islamic groups against Israel.

Figure I: geographic position of Golan Heights

VI – Evaluation of the water resources in Golan

The strategic importance of the Golan Heights for the State of Israel clearly comprehends the fresh water resources that have a great economic importance and impact on the development of the country.

The annual precipitation and snow volumes are estimated at approximately 1.05 billion m³. The major precipitations are produced between October and May, and the snow between January and March. A great part of this water volume evaporates due to the nature of the ground, the volcanic rocks and the weak permeability of the soil. The evaporation rate of the water constitutes approximately 50% of the annual total precipitations volume and 20% infiltrates in the aquifers and only 30% constitutes the runoff water which flows and forms the rivers and lakes of the region.

The total volume of infiltrated water is estimated to be 200 million m³ and recharges the aquifers forming an important water reservoir. The average of the total volume of runoff water is 350 millions m³ per year. The majority of Golan sources are adjacent to Mount Hermon, known for its huge water reservoir.

Number	Resources	Liters per second
1	Bait Jinn	1900
2	Al waywani	1900
3	As Saar	120
4	Al Fawar	53
5	Aassayadeh	250
6	Al Burjiyat	150
7	Balsam al Minieh	300
8	Addub	90
9	Annakelleh	260
10	Adardara	60
11	Alfajra	50
12	Al Baloua	100
13	Haibanieh	100
14	Abared	328
15	Hilss Alf Awali	60
16	Assanaber	75
17	Ashallaleh	56
18	Tahounet El Qaasabeh	110
19	Alhimmeh Alkabriteyeh	850

Table I: most important sources of the plateau with their outputs

Other secondary 60 sources with an annual runoff volume of 92 million m³ per year as a minimum are present in the occupied Golan Heights in addition to Alhimeh hot water source which is located at 120 m under the sea level and becomes a spa for cure and treatment.

VII – Economic particularities and sources distribution

Before the 1950s, the agriculture constituted the major income source in the region. This sector provided 65% of the active population with job opportunities over an agricultural surface area covering 40000 ha. Cereals, vegetables, rice and fruits constituted the most important cultivation. Factories were restricted to the agricultural production whereas the tools and machines fabricated on site were used for the development of the sector.

The privileged situation of the Golan located on trunk roads linking different regions encouraged between 1948 and 1967 the trade with the other regions of the country. After the war, this region was developed to deal with the industries of agricultural machines, transformation of construction material, cereals grinding and oil trade.

CHAPTER VIII

WATER MANAGEMENT IN PALESTINE

I-Water resources in Palestine

Water is scarce in Palestine and its quality is getting worse. This resource has become a problem in the occupied territories, as a result of actions and Israeli abuses that prevent the Palestinian Authority of ensuring its control and its management. The distribution of this resource which is provided by the Israeli administration does not meet the principle of "equitable shoring and reasonable use" advocated by the UN Convention of 1997.

Thus the shortage of water in Palestine has become a major cause of the injustice feeling developed by the Arab population of the occupied territories. The total control of the Jewish state on water sources in Palestine deprives the citizens of their basic right to fulfill their needs for drinking water and irrigation. It is important to note that about 40% of the water used by Israel comes from the Jordan River and Lake Tiberiad. It should also be noted that the remaining 60% comes from three major aquifers located in the West Bank (30 to 40%) and in Gaza (20%). Table 1 shows the historic water resources right in Palestine with reference to the Palestinian Water Authority.

Historic water resources in Palestine								
Resources	**Run off Mm^3**	**Total utilization**	**Palestinian water management**			**Israeli water management**		
			Volume Mm^3	**total utilization%**	**Recharge %**	**Volume Mm^3**	**total utilization%**	**Recharge %**
Ground water	1454	1503	251	17	17	1252	83	86
Jordan	965	870	0	0	0	860	100	90
Streaming	215	197	20	10	9	177	90	82
Total	**2634**	**1570**	**271**	**11**	**10**	**2299**	**89**	**87**

Table 1 : historic water resources in Palestine with reference to the Palestine Water Authority

In the West Bank, the Mekorot company which control and manage the water sources in this territory, distributes each year 110 million m^3 to 1.5 million Palestinians and 30 million m^3 to 140 000 Jewish settlers while 460 million m^3 are diverted to Israel.

Since the Six Days war in 1967, water resources in Palestine were placed under the control of the Tsahal and its management was provided by the Israeli government. At that time, Israeli officials issued a military order "No: 158," prohibiting anyone to implement or hold water installations without obtaining prior authorization from the military command. This ordinance regulates all areas that are related to water, namely, extraction, exploitation and distribution management. The Arab residents were then banned from digging new wells, while Jewish settlements were allowed without restriction. According to the World Bank, 90% of the water generated from the West Bank is used for the benefit of Israel, the Palestinians use the remaining 10%, and hence the water experts realize the big differences in consumption between Israelis and Palestinians. The volumes allocated for drinking water is 375 m^3/cap/year in Israel and 115 m^3/cap/year in Gaza and the West Bank. Figure 1 shows the volume of pumping water from wells in the Palestinian West Bank territory.

Fig:1: pompage de l'eau des puits palestiniens en Cisjordanie selon l'Autorité palestinienne de l'eau

II-Oslo II Agreement

The Taba agreement signed on the 28 th of September 1995 which is also named as Oslo II, defines the conditions and timing of the enforcement autonomy for the majority of the Palestinians. The agreement provides for the West Bank division into three zones, A, B and C, and precise in Appendix 1, Annex 3, Article 40 that Israel recognizes the Palestinian rights to water in the West Bank, but postpone this subject to final negotiations. In the meantime, the management of this resource continues to be provided by the Israeli administration. It is highly likely that the negotiations postponement on water is linked to groundwater resources which are located in Area C in the West Bank. The Israeli government so far ensures a complete control of the occupied area mainly by Jewish settlements and draws 1/3 of its drinking water demands from the three major aquifers in this region, namely:

- The first starts from the Palestinian area of Hebron and expand in Israel until the Mediterranean coast;

- The second is located at the Arab city of DJenine and extends until reashing the Israeli region of Mount Gilboa;
- The third which is called "Eastern aquifer", is located in the Jordan Valley and stretches to the border with Jordan.

Figure 1: pumping water from wells in the West Bank with the reference to the Palestinian water Authority.
• Total number of wells: 325
• Total pumping water volume: 65.46 mm^3/an

The Israeli control of the water resources in Palestine has created an imbalanced situation not only between the Jewish state and the Palestinian Authority, but also inside the territories (Area C) between the Palestinians and Jewish settlers. Several recent studies show that 1.5 million Palestinians in the West Bank would benefit only of 17% of the water volume of the three aquifers of the region and receive only 115 m^3/cap/year, while the annual extraction volume of groundwater is assessed to 650 million m^3 of water per year.

III- Gaza Strip

The situation in the Gaza Strip is not better than the West Bank in terms of quantity and quality of the resource. The estimated presence of 5 000 Jewish settlers in Gaza absorb 17% of total water consumption in the region. This situation has been aggravated by drilling inclined wells in the water aquifer and that from the Israeli territory. This transfer of water from aquifers in Israel has increased tension between Palestinians and the Jewish settlers especially as the region demand management is exacerbated by the chronic water scare situation whose annual deficit amounted to 80 million m3 Water per year.

The hydraulic situation of the Gaza strip be coming very complex due to the following situation:

- Over one million people lives on an area of 360 km2 with an annual growth rate exceeding 3%
- Water resources is very scare with a constantly exceeding demand
- Deteriorated water quality due to the absence of wastewater treatment plant and over pumping in the aquifer which generates sea water intensive
- Only a volume of 50 million m^3/year replenish the water aquifer
- Israeli settlers build duties on the water stream in order to divert the water from Gaza.
- Lack of sanitation systems, sewage lines and waste water treatment plants pollution from the industry which is discharge and directly in the sea. This situation shows the critical water management in the Gaza Strip in terms of quality and resources availability to fulfill the demands of all the sectors quantity.

In terms of quality the over-exploitation of groundwater in Gaza has led to the intrusion of sea water in the aquifer. The current salinity of water is estimated at 4 000 mg / l, while the international standards set a maximum limit of 250 mg / l. the same situation apply for the nitrate quantity in Gaza water which exceed 600 mg / l, while the European Union directives allow a maximum of 50 mg / l (fig 2).

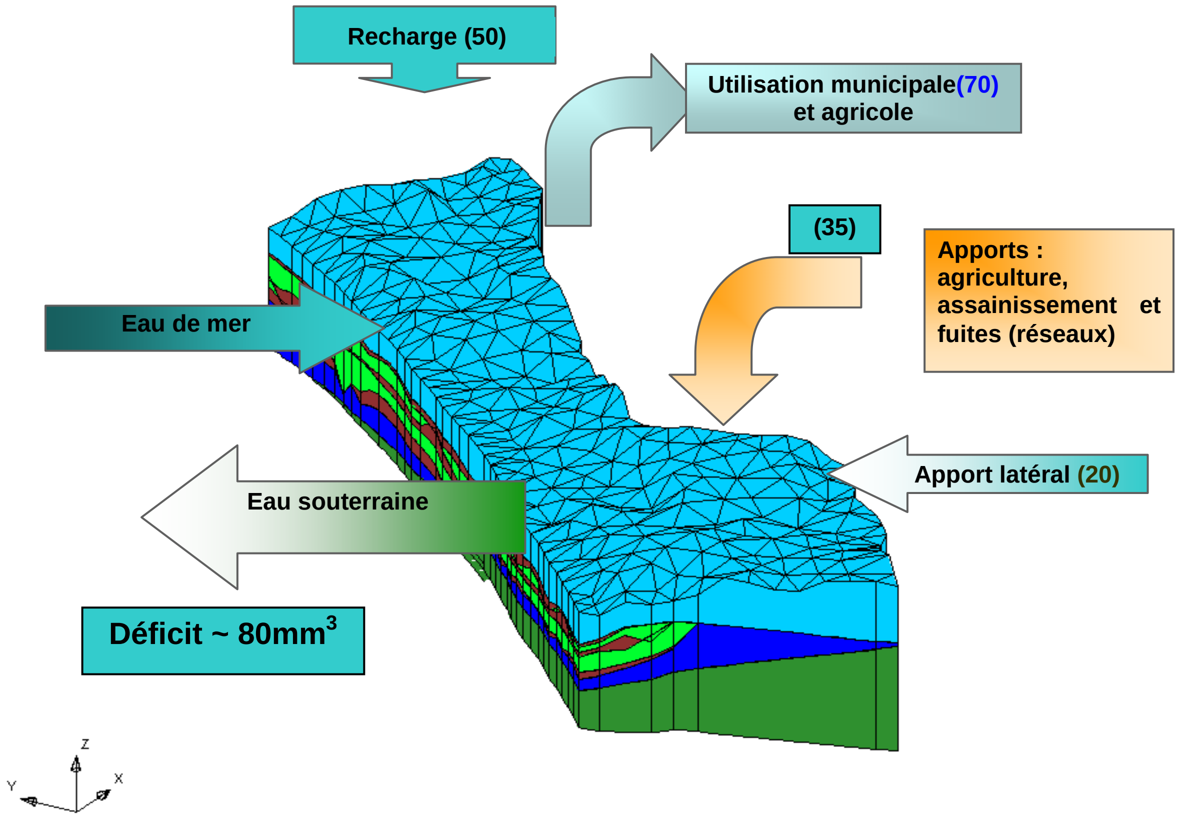


Figure 2 : situation critique de l'eau dans la bande de Gaza en termes de qualité et de quantité

The Palestinian Authority which actually control the water in Gaza must take measures to:
- Limit the over-pumping that threatens the water quality which is already polluted with a high is already salinity rate;
- Improve the sanitation and sewage treatment network and encourage the reuse of water;
-Limit the misuse of fertilizers and pesticides;
- Replace the traditional irrigation methods which are inappropriate for the good water management and which also accentuate the salinity and the soil sterilization;
-Rehabilitate the drinking water network in order systems to reduce the losses that exceed 50%.

IV- World Bank projects

In 1996, a World Bank report noted that the situation in Gaza was "more worrying than anywhere in the world." The water tariff rates charged by Mekerot are not structured in an equitable way. This company charges the Israelis a tariff equivalent to 0.7 cents per m3 for domestic use and $ 0.16 for irrigation, while the Palestinians are paying $ 1.0 the m3 for all the utilization sectors.

In conclusion, whether in Gaza or the West Bank, the Palestinians water resources are among the lowest in the world. They are inadequate for drinking water and irrigation purposes. The Palestinian agricultural sector represents 15% of Gross National Product and employs 1 / 5 of the active population. The land occupation for the agricultural sector accounts for 6% of arable land under irrigation and water consumption constitutes 70% of available resources. This situation fosters a great waste of available resources to the detriment of drinking water which is highly needed to meet the needs of the Palestinian population.

That is why the World Bank calls for an effort from the Palestinian Authority to reorient the economy towards the industry. It should be noted that the industrial sector contributes with the construction sector for 25% of GDP using only 13% of water resources.

CHAPTER IX

WATER RESOURCES IN LEBANON

I – Water resources in Lebanon

I – 1 Topographical relief and precipitations

Lebanon, with a total surface of 10452 km² is located at the eastern coast of the Mediterranean sea and extends all along 210 km at the coast and 50 km inside the Lebanese territories. It has common borders from the north and the east with Syria and from the south with Israel and the occupied Palestinian territories.

Administratively, Lebanon is divided into six districts or provinces. As to the topographical side, it can be divided into four parallel parts heading from the West to the East:

- Coastal and narrow flat belt all along the sea.
- Mount Lebanon assembly line with maximum height of 3000 m.
- Valley of Bekaa with an altitude of 900 m over sea level
- Anti Lebanon assembly line going in height to 2800 m to the east.

In Lebanon, the climate is typically Mediterranean. It is characterized by strong precipitations during winter followed by a dry period with high humidity during the remaining seven months of the year. However, the influence of the sea, the particularities of the topography and the presence of the Syrian desert in the North create a variation of microclimate inside the country with contrast of the distribution of both temperature and precipitations.

The annual average temperature is 20 ºC prevailing over the coast (varying between 13ºC in winter and 27 ºC in summer), 16 ºC in the Bekaa valley (between 5 ºC in winter and 26 ºC in summer), and less than 10 ºC on high altitude over the mountains (between 0 ºC in winter and 18 ºC in summer).

The annual precipitation average is estimated to be about 800 mm, varying between 600 and 900 mm along the coast and 1400 mm over the mountains. It decreases to 400 mm in eastern regions and less than 200 mm in the northeastern regions of the country.

Over 2000 m of altitude, the essential precipitations are snow and can help in giving rise to good outputs for 2000 water sources during the dry periods. Precipitations are produced in 80 or 90 days of the year, mainly between October and April. Approximately, 75 % of the total volume of the surface flow took place during five months, extending from January till May, 16 % of June and July and only 9% for the remaining five months from August till December.

I – 2 Water balance in Lebanon

The water cycle in Lebanon, for an average precipitation year, can be resumed as the following: (Table 1)

No.	Designation	Flows (Mm³)		
		Inputs	**Outputs**	**Total**
1	Total annual precipitations	8200		
2	Natural evaporation and transpiration		4100	
3	Losses in groundwater towards neighboring countries		300	
4	Losses in surface waters in towards neighboring countries		648	
5	Sea spring sources		385	
6	Total renewable waters			2700
6.1	Ground water			567
6.2	Surface waters			2200

Tableau 1: water balance in Lebanon

Approximately, one billion m³ of this volume of water flow comes from more than 2000 sources, with unitary average flow of 10 to 15 l/s. Such volume is assessed out of the perpetual flow of 17 watercourses being part of 40 principal river basins flowing in the country.

While the global water annual volume empties in the sea and a part of it goes towards the neighboring countries, groundwater faces major difficulties for their control, because of the geological karstic conditions. Water resources in use in Lebanon are estimated to be around 1,5 billion m³ per year distributed among domestic, irrigation, municipal and industrial sectors of the country with an increasing annual demands that will generate starting 2015 an enormous water balance deficit.

The most important watercourses in Lebanon derive from the Litani that constitutes only about 28 % of the total surface flows of the country.

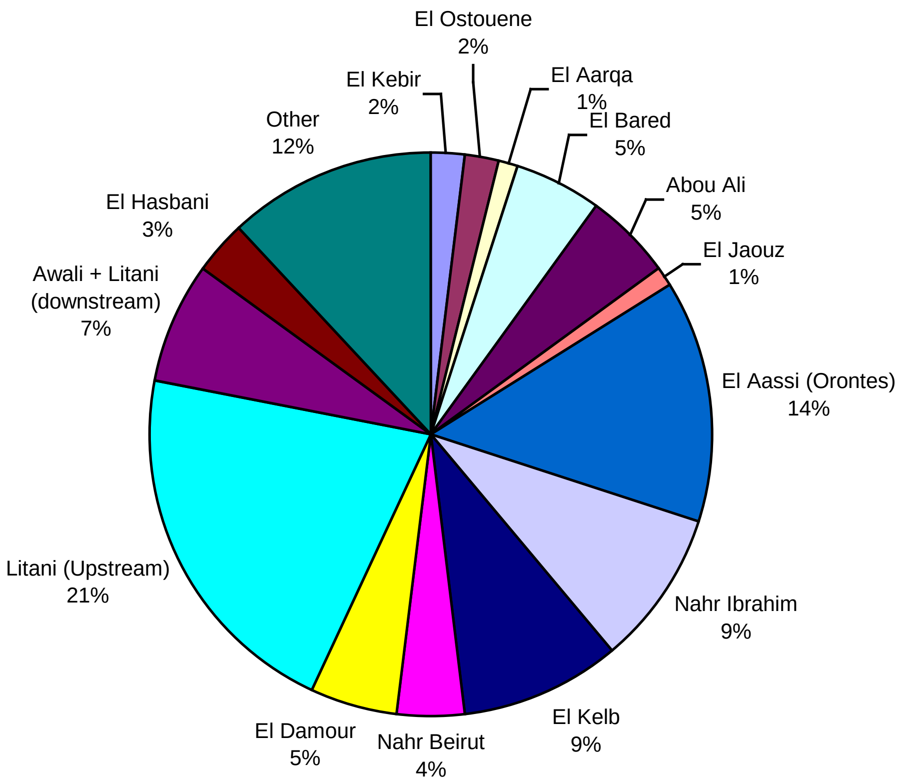


Table 2: total division of the main rivers of the country

The annual total volume of ground water in Lebanon is estimated at 567 Mm³ whereas the flow in dry period (July till October) in the different Lebanese basins is evaluated around 141 Mm³. The repartition of this volume on the national aquifers is presented in table 3.

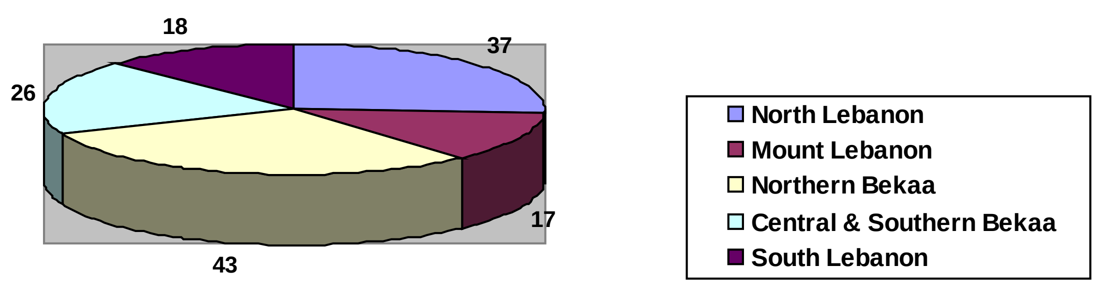


Table 3: repartition of the ground water in dry period

The hydrographic system of the country shows three international watercourses:

- El Assi watercourse (Orontus), situated in the north of the Bekka Valley. It flows towards Syria to the northeast of the country to end up in Turkey.
- Hasbani watercourse situated in the south east; the Hasbani which flows towards Palestine and Israel constitutes a tributary of the Jordan River.
- Nahr El Kebir watercourse in the north which constitutes the border line between Syria and Lebanon. Nahr EL Kebir empties then in the Mediterranean Sea.

These three transboundary basins were subject to a strategic study in this book in the scope of the negotiations with the reparian States.
The hydraulic resources of Lebanon show that the country owns a favorable situation in what concerns the cumulative flows, but the constraints of its utilization come from their limited availability during the five months dry season of the year that go from June till October (JJASO) and the Karstic geological complicated nature of the country.

II – Water Demand in Lebanon

II – 1 Population

The official study which is the most reliable to estimate the Lebanese population was undertaken by the Ministry of Interior (electoral lists) and by the Ministry of Social Affairs with the participation of the UNDP and UNRWA. These sources indicate that the current population counts 4.8 million inhabitants, with an average annual growth rate of 2.5 %.
The distribution of the Lebanese population as well as the Palestinian refugees in different regions of the country is presented as the following:

- North region 1000000 inhabitants
- Beirut & Mount Lebanon 2300000 inhabitants
- South Lebanon 670000 inhabitants
- Bekaa 580000 inhabitants

II – 2 Drinking water demand

The studies done by the Ministry of Energy and Water showed a link between the drinking water needs and the social, economical and cultural levels of the country. As a follow up of several inquiries related to this subject, the General Directorate of Hydraulic and Electric Resources (GDHER) considered that the daily needs per inhabitant are 200 l/day / person with an added water rate of 3.5 % while taking into account the big consumers and municipal use.

It is worth to mention that the efficiency of the drinking water networks is evaluated to 70 %. The calculation of these technical settings allow to present the final daily value of water needs per inhabitant which corresponds to 230 liters.

The studies of the GDHER showed that the annual drinking water country demands are about 500 Mm³. The necessary volume to meet the demands of the consumers during the dry period of the year, meaning July, August, September and October (JASO) reaches 250 Mm³. In percentage, they are stated as the following:

- North region 22 %
- Beirut & Mount Lebanon 46 %
- South Lebanon 16 %
- Bekaa 16 %

Table 4 presents the annual and seasonal consumption in the different water sectors of use.

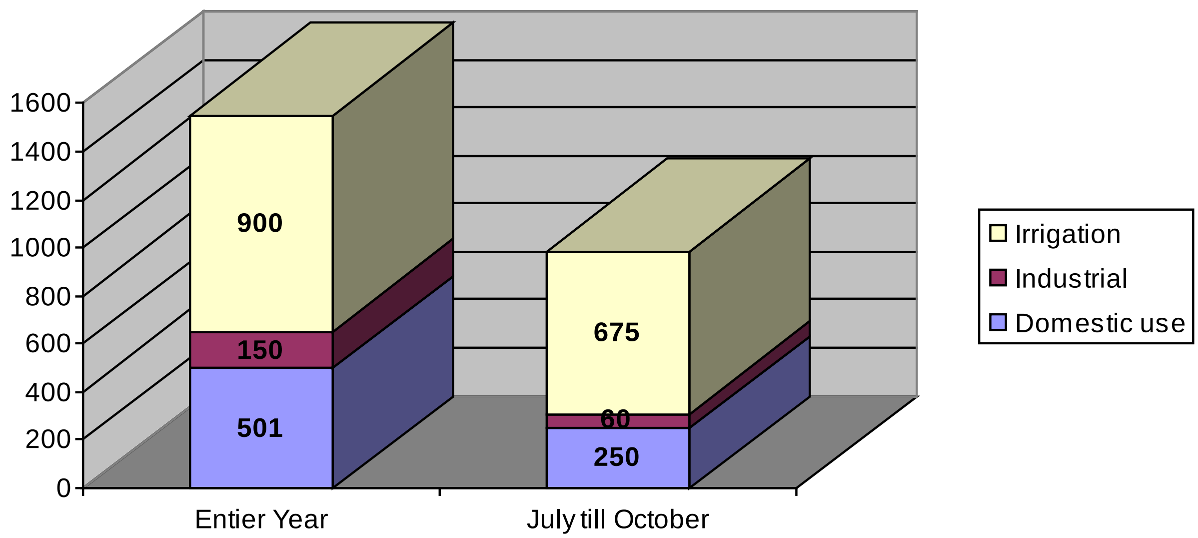


Table 4: annual and seasonal consumption in different water sectors of use

Table 5 shows the volume of water demand in the different Lebanese departments for the dry period (July – October)

Departments	Domestic Use (Mm³)	Industrial Use (Mm³)	Irrigation (Mm³)	Total (Mm³)
North Lebanon	53	13	150	**216**
Mount Lebanon and Beirut	127	30	78	**235**
Bekaa Nord	15	4	135	**154**
Central Bekaa & South	17	4	153	**174**
South Lebanon	38	9	159	**206**
Total	**250**	**60**	**675**	**985**

Table 5: seasonal demand of water in the different Lebanese departments

These values presented above show a high demand for irrigation in the rural zones of the country such as the departments of the North, South and Bekaa while the demand for domestic use is concentrated in the region of Mount Lebanon and Beirut (refer to table 6)

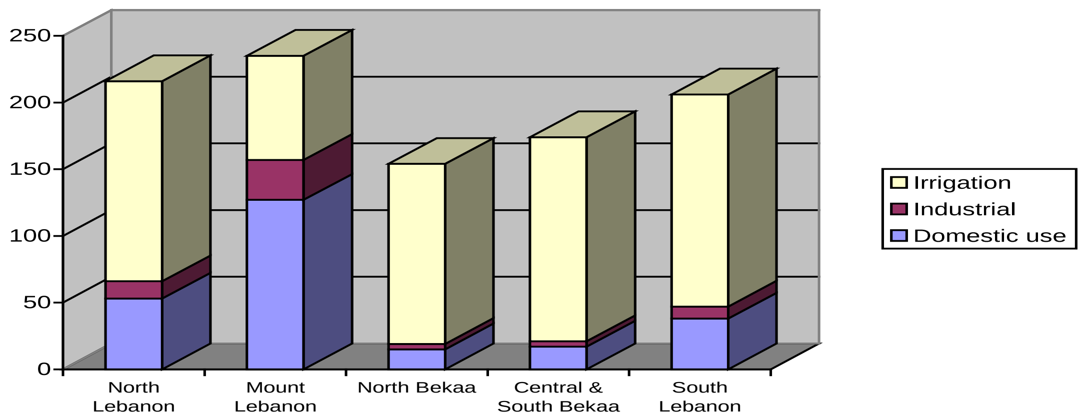


Table 6: seasonal water demand for the sectors of use in the different Lebanese departments

Concerning the consumption of the Lebanese industrial sector, a rate of 30% over the whole drinking water volume will be adopted as proposed by the World Bank.

II – 3 Water demand for irrigation

In the year 2004, the FAO and the Ministry of Agriculture (MoA) in Lebanon published a detailed study about the irrigated areas which were estimated about 100000 ha. These irrigated surface areas are dispersed in the following districts:

- North Lebanon 30000 ha
- Beirut & Mount Lebanon 10700 ha
- South Lebanon 21000 ha
- Bekaa 40000 ha

The FAO study has presented the figures concerning the yearly water need per hectare which varies between 6000 and 10300 m^3 at the head of the network. This variation depends in general on the cultivated species but more specifically from the irrigation methods, status of networks and climate of the country.

II – 4 Hydraulic balance in Lebanon

A detailed study of the hydraulic balance in Lebanon calculated starting from the year 2000 for a projection of 40 years and taking into account all the water sectors of use, is presented in the tables 7a and 7b. The settings and hypothesis of calculation used in the present study are the following:

1. Population in 2000 : 4.5 million
2. Annual growth rate: 2.7 %
3. Irrigated surface: 10000 ha in 2000 and 280000 ha in 2040
4. Water consumption per ha: 10000 m³/ year in the year 2000; 8000 m³/year starting 2015; 6000 m³/ year for 2020 – 2040
5. Domestic and industrial use per person/ day: 300 Liters
6. Mobilized water resources: 1.5 billion m³/ year in 2000, 2.1 billion m³/ year in 2015 and 2.7 billion m³ /year in 2040.

Id.	**Designation**			**2000**	**2005**	**2010**	**2015**	**2020**
A.1	Population ($x10^6$)			4,5	5,14	5,87	6,71	7,67
A.2	Water Demands	Domestic & industrial Use	(m³/person/year)	114,48	116,79	119,14	114,48	116,79
			Total (Mm³/year)	672,43	783,73	913,46	672,43	783,73
		Agriculture	Surface ($x10^3$ Ha)	145	160	190	145	160
			Total (Mm³/year)	1450	1280	1140	1450	1280
	General Total (Mm³/year)			1495	1801	2122	2063	2053
B	Water Resources (Mm³/yea	Surface water		1200	1500	1600	1720	1720
		Ground water		500	500	500	500	500
		Total		1700	1800	2100	2220	2220
C	Balance (Mm³/year)			+0,005	-100	-322	+37	+167

Table7-a : global chart of the hydraulic balance of Lebanon for the period 2000 – 2020

Id.	**Designation**			**2020**	**2025**	**2030**	**2035**	**2040**
A.1	Population ($x10^6$)			7,67	8,76	10,01	11,43	13,06
A.2	Water Demands	Domestic & industrial Use	(m³/person/year)	119,14	121,54	123,99	126,49	129,05
			Total (Mm³/an)	913,46	1000	1240	1446	1685
		Agriculture	Surface ($x10^3$ Ha)	190	212	235	257	280
			Total (Mm³/year)	1140	1272	1410	1542	1680
	General Total (Mm³/year)			2053	2272	2650	2988	3365
B	Water Resources (Mm³/year)	Surface water		1720	1840	1960	2080	2200
		Ground water		500	500	500	500	500
		Total		2220	2340	2460	2580	2700
C	Balance (Mm³/an)			+167	+68	-190	-400	-665

Table7-b: global chart of the hydraulic balance of Lebanon for the period 2020-2040

II – 5 Global assessments of water demands

The study of Lebanon hydraulic balance presented in table 7 leads to the following conclusions:

- The annual water total demand (2005) for all the sectors of use is assessed to 1.8 billion m^3/ year. This demand exceeds the value of 2 billion m^3/ year in 2010 and attains 3.4 billion m^3/ year in 2040.

Two scenarios are detained and directly linked to the total volume of renewable water resources and to the demand of different sectors of use; they are the following:

a. Scenario of “Water Stress”

The non implementation of the decennial strategic plan (2000 – 2010) suggested by the General Directorate of Hydraulic and Electrical Resources leads the country to a serious situation concerning the demand of watrer for food security and for drinking water. The difference as of 2005 between the demands and the renewable resources is equal to 100 Mm^3/ year to attain 665 Mm^3/ year in 2040. This situation, accompanied with the unsustainable water management will be disastrous for the country. The conditions taken into consideration in the calculation hypothesis will be applied mainly in water consumption for irrigation. In the event that these exigencies are not satisfactory, the difference between the needs and the resources can reach 1.7 billion m^3/ year in 2040.

b. Scenario of sustainable water resource management

The implementation of the decennial strategic plan (2000 – 2010) within the concept of IWRM leads to a situation of water stability for the sectors of: food security, domestic water and industrial demands. The hydraulic balance in Lebanon registers positive values till 2025.

Starting from this year (2025), the consideration of the priority actions to update the strategic plan will be necessary. These actions concern:

- Geological investigation and hydrological study for the dam and lake sites considered as “difficult” and which should be reconsidered for the completion of the surface water stock.
- Reuse of treated waste water for the artificial costal aquifer recharge and for the irrigation and municipal sector. The volume is estimated to be around 300 Mm^3/year.
- Improvement of the drinking water distribution networks efficiency to reach 90%.
- Introduction of drip and sprinkler systems in irrigation networks.
- Use of non conventional resources particularly the marine fresh water sources (sea water spring) as well as the desalination of the sea water.

For 2040, this annual demand for all the sectors of utilization can surpass 3.4 billion m^3/ year.

III – Decennial strategic plan 2000 – 2010

The objective of the decennial strategic plan established by the General Directorate of Hydraulic and Electric Resource (GDHER) is to ensure the water volume necessary to meet the demands of population in all the sectors of use. It constitutes an Integrated Water Resource Plan (IWRP) for Lebanon and covers major technical hydraulic infrastructure projects which are essential for the economic development of the country. The decennial strategic plan is based on the following themes:

- Ensure additional water resources (dams, lakes, recharge of aquifers, sea fresh water springs, desalinations,…)
- Establish drinking water projects (Distribution network and efficiency, Public Private Partnership involvements,...)
- Foresee different irrigation projects (Ensuring food security, network efficiency…)
- Ensure waste water collecting projects and treatment plants (water reuse for irrigation, municipal sectorial use and artificial recharge of aquifers…).
- Consider infrastructures for flood mitigation, rectification and alignment of rivers beds.

III – 1 Ensure additional water resources

The demands increase of the in the sectors of drinking water, irrigation, municipal and industrial use led Lebanon to confront a water deficit experienced more and more in the urban cities located mainly at the Lebanese coast and in mount Lebanon as well as in the rural regions in the south, the Bekaa Valley and the north of the country.
In addition, the utilization of available and renewable water from the springs is no more enough to meet the population needs during the drought seasons. Moreover, the intensive use of ground water by the public and private sectors caused many problems as:

- Decrease of the sources flow volume impeding the use of water for domestic consumption and irrigation.
- Reduction of ground water in the aquifers of the Bekaa plaine.
- Intrusion of sea water into the coastal aquifers and then increase of their salinity.

Therefore, it is necessary to stock in dams and hill lakes the surface water generated from the precipitation of the winter season that will be then used during the period of water shortage. The execution of these reservoirs for the surface water stokage should be preceded by:

- Preparation and establishment of detailed geological and hydro-geological maps.
- Control of the ground water level
- Protection of the aquifers and the water sources.

In addition, it is necessary to study the possibilities of natural ground water recharge in order to reduce the intrusion of sea water, and examine the alternative of the artificial recharge of aquifers.
These studies should be completed with the economical feasibility studies and the environmental impact assessment in order to abide with the financial donor agencies. These dams are presentation table 8.

Chabrouh dam was the first project already executed of the decennial strategy. The construction of this hydraulic infrastructure started in August 2002 and the accomplishment of the works were planned to be achieved in 2006. Unfortunately, the military events occurring in July 2006 have caused the delay of this project to the 3 October 2007.
In the following paragraph, the general background concerning this hydraulic project is presented.

- **Situation of Chabrouh dam**
  The project is located in Faraya (region of Kesrouan) at 40 Km at the North eastern side of Beirut. The population of this area has highly increased during the latest twenty years, which caused an excessive demand in drinking water, mainly during the period of water shortage.
  Chabrouh dam through its capacity of 8 million cubic meters can fulfill the deficit in drinking water, till 2025, in the Kesrouane region as well as a part of the Metn region. This new hydraulic infrastructure contributes in the integrated water resources management of Mount Lebanon regions and Beirut City.

- **Technical description**
  The site of the dam was chosen in a zone exempted of active fault with good geological formation and layers that ensure the stability of the foundations and water tightness of the reservoir.
  The structure is a riprap rockfill dam with a capacity of 8 Mm3 masked at the upstream side with a bituminous concrete diaphragm. The technical characteristics of this infrastructure are the following:

- Crest elevation	1618 m
- Crest length	470 m
- Crest width	10m
- Lake surface	0.46 Km^2
- Maximum height	63 m
- Maximum width at the base	200 m
- Upper and lower slope	1,7 h/1 v
- Volume of riprap	1800000 m^3
- Surface of the upstream diaphragm	30750 m^2

- **Annexed works**

- Spillway
  The drainage spillway is located on the right bed. It is a discharging circular well of 52m height with an 11.20 m diameter as a discharging threshold. It guarantees the discharge of ten thousands year return flood of 180 m^3 per second located at an altitude of 1615 m. The flood flow is conducted to the basin of Wadi Chabrouh through a tunnel (Derivation gallery) of 4.6m diameter.
- Intake Tower
  The water intake tower is a circular well located on the right bed of a height of 50m. It includes four intake levels. This work is connected to the water treatment station through a pipe of 800 mm of diameter and 450 m of length.

- Water catchment at Nabaa El Laban
  The source of Nabaa El Laban is considered to be the main water catchment for the filling up of Chabrouh Dam through canalization and tunneling hydraulic system. It is situated in Kfarzebyan at 5200 m away from the dam location with an annual flow estimated to be around 48 Mm^3. This source emerges at level 1634 m and usually discharges at Nahr el Kalb in the Mediterranean Sea. The location of Nabaa el Laban at 21 m above the normal level of the reservoir allows through the hydraulic canalization system a replenishment of the dam by gravity.
  The system is constituted from the following infrastructures:
- Water catchment from the outlet of Nabaa El Laban guaranteeing a volume of 1.5 m^3/s to Chabrouh.
- Water conduit system of 5190 m length and 1000 mm diameter crosses a vertical well of 60 m depth, a tunnel of 660 m length and 3 m diameter. This system is connected to a discharge outlet work ensuring the restitution of the water from Nabaa El Laban to the reservoir. The annual discharged water volume from this source during a 2 months period (April and May) is estimated to be around 6 Mm^3 while the remaining 2 Mm^3 is generated from the dam basin watershed.
- Treatment plant
  A drinking water treatment station, located at 150 m downstream of the dam deliver to the Kesrouan water network; a capacity of 60000 m^3 /day. This plant operates in conformity with the WHO water quality directives.

- **Environmental impact assessment**

The environmental impact study of Chabrouh dam has taken into consideration all the criteria adopted by the international organizations.
The study shows that the construction of this hydraulic infrastructure does not present any negative impact on the environment. It does not affect any transfer of population in the region and the choice of quarries sites located over the mountains heights and their utilization does not cause any harm to the natural scenery.

- **Served regions**

The water stoked in the dam foresees, during the dry season (June to October), the distribution of 60000 m^3/ day of drinking water to the districts of Kesrouane, Ftouh and Metn. This project as well as the distribution networks that the WE of Beirut and Mount Lebanon should implement constitutes a priority for the development of these districts till the year 2025. The priority objectives of this infrastructure are resumed as the following:

- Reduce as much as possible the water deficits in particularly during the dry season.
- Stop the pumping that is actually prevalent for the drinking water distribution and its high electrical costs. The financial cash flow generated from the reduction of the corresponding wasted energy will be invested on the efficiency improvement of the networks.
- Preserve the ground water that constitutes the strategic reserves of the country resources.
- Face the claims that announce that our surface water is uselessly discharged in the Mediterranean Sea.

Starting the year 2002, Chabrouh dam was the only implemented project of the 10 year strategic plan among 27 other projects. The GDHER was able to plan and deign all these dam projects on the Lebanese territory but only four of them (Baquata, Kaysamani, Younin, Assi) have been tendered for construction but unfortunately not ratified by the political authorities.
In 2005, the GDHER started with the Assi (Orontus) derivation dam in the district of Hermel but the work has been stopped in July 2006 because of the Israeli air plane strike on the construction site. With these 27 dams, Lebanon could have stocked a volume of about 900 Mm3 of fresh water which could constitute a major economical and financial development tool for the upgrading the Lebanese service sectors. Also, this amount of water would have been useful to fulfill the demand for fresh water until 2040 and the food security for the Lebanese people.

Table 8 presents the major dam projects of the 10 year strategic plan prepared by the GDHER.

Site Designation	**North Lebanon**	**Mount Lebanon**	**North Bekaa**	**Central and Southern Bekaa**	**South Lebanon**	**Total**
1 – Existing dams						
Qaraoun				220		220
2 – Suggested dams						
Noura el Tahta	70					
Qarqaf	20					
Bared	40					
Iaal	10					
El Mseilha	10					
Dar Beachtar	55					
Chabrouh		8				
Janneh		30				
Boqaata		7				
Aazzounieh		4				
Damour		60				
Aassi			37			
Younine			7			
Massa			8			
Ibl Es Saqi					50	
Bisri					120	
Khardaleh					120	120
Total	**205**	**109**	**52**	**220**	**290**	**875**

Table 8: suggested major dams according to the decennial strategic plan

IV – Drinking water projects

Before the 1960s, few regions in Lebanon beneficiated from the commodities of drinking water. During the 1960s, the Lebanese government has undertaken a plan of large scale to install distribution networks for drinking water with the intent to ensure this resource in all the regions of the country. The criteria adopted at this period for the daily drinking and domestic water needs were 100 liters per day and per inhabitant. Also, the life duration as well as the dimensioning of the networks was calculated for duration of 25 years.

Starting from the 1990s, these installations become decayed and their capacities could not meet the needs of the population which experienced many migrations because of the war or due to the urban expansion of the main cities in the country.
During this period, the major efforts were exerted by the MEW and CDR to rehabilitate the drinking water networks and the annexed installations, reinforce their capacities, or even, find new water resources in order to fill the increase of the daily demand. The purpose of this approach was to ensure the continuous water supply to the Lebanese population. Thus, the actual tendency of the Lebanese Government is to:

- Rehabilitate the drinking water distribution network and ensure this resource to the cities and villages that are not provided with this service.
- Ameliorate the conditions of the services, starting from the resources and the infrastructures.
- Improve the efficiency of the drinking water distribution networks
- Reinforce the partnership with the private sector in the management of this utilities.

V – Collection and treatment of waste water

The process of optimization regarding the implementation of waste water treatment plants in Lebanon represents a complicated task to be solved on the bases of technical and economical criteria. In fact, the adequate alternative to be adapted should be based on a compromise between the following objectives and the constraints:

- Best protection of the environment
- Reuse of treated waste water for irrigation and artificial recharge of aquifers in the coastal regions.
- Budget constraints concerning the investments, operation and maintenance.

Thus, it is necessary for Lebanon that the technical planning scheme would be based in its extent on the principal calibrated watersheds and not on the sub basins or joint basins. This approach is directly related to the mountainous topography and the uncontrolled demographic development which complicate more and more the process of decision.
Under these conditions, the following actions should be taken:

- Optimization of the treatment plants investment, operation and maintenance costs proportionally to its capacity by equivalent inhabitant.

- Reduction of the pumping and lifting stations.
- Reduction of the treatment plants number with the advantages that this procures on the maintenance level and the sludge treatment management.

This approach will allow an optimal utilization of water reuse for municipal and irrigation development schemes and to quickly absorb and increasing discharges due to the demographic development of urban cities in Lebanon.
In 1993, the Lebanese Government delegated to the MEW and CDR the launching of a wide program in the waste water treatment sector in order to supply the needs of environmental protection and public health.
The 10 year strategic plan went through the actual situation of the waste water construction program treatment plant in Lebanon in order to show the advance studies and works stage as well as the priorities to be applied in the legislative, administrative, technical and financial domains.

The scheme plan for waste water treatment in Lebanon (2000), foresees with regard to the increasing demographic development surrounding the cities, the construction of 20 priority plants as a beginning, to meet the waste water collection and treatment of 75% to 80% of the Lebanese population.
With regard to the rare lands on the Lebanese coast and their high price in m² near the cities, the optimal use of the area should be a permanent concern of the responsible designers. These experts suggested that the conventional treatment plants (Activated sludge) which require big surfaces (0.1 to 0.3 m² per inhabitant) according to the size and performance of treatment, shall be replaced by the compacted plants with technical performances.
The development of high performance compact technologies for the residuary water treatment such as biological reactors of fixed cultivation or biological filtration are very suitable for the coastal zones. For instance, a biological infiltration system with a land occupation of 0.4 to 0.006 m2 par person used for a city of 2 million inhabitants, can be placed on a land of only 40000 m² or under the natural ground. Table 9 presents values of land use comparison between a classical installation and a compacted plant.

Filtration type	**Necessary surfaces per inhabitant**
Conventional treatment, secondary stage, activated sludge.	0.1 to 0.3 m²
Biological filtration treatment, secondary stage.	0.04 to 0.06 m²

Table 9: land use for waste water treatment plants.

The major treatment plants that have been programmed for implementation in each district of Lebanon are presented in the following paragraphs. The technical terms related to the used systems are stated as the following:

- P.D.= Primary decantation
- A.S.= Activated sludge
- A.S.W.C.= Activated sludge of weak charge
- LA = Lagooning
- B.F.= Biological filter

V – 1 Department of North Lebanon

In the department of North Lebanon, the expected inhabitant number for the year 2020 is about 1900000. Therefore, the execution of five treatment plants (table 10) will ensure the treatment of waste water of 74% of the population.

plants	Districts	Population in 2020	Finance	Cost in M$-M€	in function	Treatment type	Actual stage
Michmich	Akkar	54000	Italian Protocol	4.2 M$	2009	P.D + A.S	Preparation of the tender file
Tripoli	Tripoli	1289000	European Bank of Investment	100M€	2008	P.D + A.S	completed Work
Chekka	Batroun	75000	French protocol	11 M€	2006	A.S.W.C	Completed work
Batroun	Batroun	16000	French protocol	7M€	2006	A.S.W.C	Work in process
Bakhoun	Dinnie	-----	Italian Protocol	13M€		P.D.+A.S.	Preparation of the tender file
Total		1400000					

Table 10: current situation of the treatment plants in North Lebanon

The MEW have foreseen the collection and the treatment of waste water of Koura, Zgharta, Minye and a part of Dinniye districts through the treatment plant located in Tripoli. This approach was suggested in order to preserve the quality of ground water that supplies the city from the Habb source aquifer. Thus, any pollution infiltrating in the ground water in the regions of Koura, Zgharta, Minie and Dinnye will affect inescapably the supply of drinking water in Tripoli. This would be produced, for instance, when a treatment plant of waste water of the upstream region breaks down for any technical reasons.

Unfortunately, the municipality of Tripoli has accepted the construction of the treatment plant, exclusively for the residuary waters of Tripoli, Mina, Beddaoui and Kalamoun, without taking in account as it was mentioned previously in the design, the collection of waste water resulting from the upstream districts. It is important to mention that in 2006, the French Agency of Development has launched the study and construction of residuary water collection and treatment plant situated in the region of Koura. As to the 14 treatment plants of Becharre district, planned within the global waste water framework, the MEW considered that it would be necessary to reexamine the locations of these plants and reduce their number in a way to mitigate the costs of expropriation, construction, operation and maintenance by preserving the touristic site of the Saints Valley (Kadisha).

V – 2 Department of Mount Lebanon

Table 11 shows the principle plants of Byblos, Kesrouan and Chouf districts. The region of Metn will be taken in charge by the plant of Dora located in the eastern suburbs of Beirut.

Plants	Districts	Populations year 2020	Finance	Cost M$ - M€	Put in service	Treatment type	Actual level
Byblos	Jbeil	40000	French Protocol	8.8 M€	2009	A.S. + B.F.	Works in process
Chloumass	Jbeil	8000	----	1.52 M$		P.D.+A.S.	Accomplished studies
Kartaba	Jbeil	9000	Italian Protocol	1.635 M$		P.D.+A.S.	Preparation of the tender file
Yanouth	Jbeil	7000	----	1.3 M$		P.D.+A.S.	Accomplished studies
Ghalboun	Jbeil	10000	----	1.55 M$		P.D.+A.S.	Accomplished studies
Kesrouan	Kesrouan	346000	----	40.3 M$	2010	P.D.+A.S.	Adopt B.F.
Hrajel	Kesrouan	---	Italian Protocol	3.1 M$		B.F., Compact, secondary	Preparation of offers invitations
Rass Abi Youness	Chouf	65000	French Protocol	13 M$	2010	P.D. + B.F.	Tendered works
Mazraat Chouf	Chouf	6000	Italian Protocol		2010	LA.	Preparation of the tender file

Table 11: current situation of the treatment plants in Mount Lebanon

Concerning the plant of Kesrouan located in Tabarja, it is important to clarify that the cancellation of financing was the result of the population and Municipality refusal to establish the installations in the specified place. This situation engendered the following consequences:

a. Prevention of population from taking advantage of the waste water treatment of the concerned region.
b. Continuous discharge of waste water in the hydro geographical basin and watercourse of the districts.
c. Pollution of ground waters from the continuous discharge of waste water in wells located in the region.

Consequently, the MEW deemed necessary the adoption of biological filtration process, reducing in a way the surface of the plant, thus replacing Tabarja station by two compacted underground treatment installations located at Zouk and Fidar prevent the occurrence of olfactory damages. The economy realized through this alternative would be estimated to 10 million dollars.

For the Tabarja option, the necessary surface for the plant construction is estimated to 180000 m², (80000 m² expropriations of lands, 100000 m² backfilled in the sea), while for the second option, the necessary lands would be respectively of 17000 m² and 8000 m² for Zouk and Fidar plants. The cost of Tabarja conventional type plant is estimated to US $ 64 million while the cost of the second alternative will be approximately US$ 54 million. For these reasons the MEW has recommended the Donor Agencies to use the biological filtration treatment type, or all other non classic filtration system especially in coastal cities.

Concerning the waste water treatment plant of Hrajel, the MEW has recommended not to build it at this location but to circulate directly the waste waters towards the Zouk plant. The reason is that it any break down will occur in Hrajel plant, the waste water discharge would be a source of pollution of Jeita and Kashkoush aquifers which constitute the major source of drinking water for Beirut City.

Moreover, the four treatment plants intended to be implemented in the Jbeil mountain area could be gathered in one plant in Kartaba, in order to limit the costs of construction, operation and maintenance.

Concerning the planned projects in the Metn area, the main collector situated along the Beirut River watercourse should be executed, permitting in a way, the recuperation of all the residuary waters of the Beirut River watershed and conducted towards the treatment plants expected in Dora.
The Union of the Chouf municipalities Al Souyjani has agreed for the construction of 9 treatment plants in the region which are actually under an environmental impact assessment study.

V – 3 Greater Beirut
Two treatment plants have been identified for Beirut city and the suburbs (Table 12). They will cover a total number of inhabitants estimated at 3562000, which constitute 40 % of the total Lebanese population for the year 2020.
The first plant, located in Ghadir, was designed for the prefiltration treatment only. Currently, its transformation with a filtration system reaching the secondary stage is in process.
For the second plant which will be located in Dora has been designed to be a compacted underground system, of biological filtration type.

Plants	**Districts**	**Populations year 2020**	**Finance**	**Cost M$ - M€**	**Put in service**	**Treatment type**	**Actual level**
Dora	Beirut	2 340000	By the assigned enterprise	48 M$	2000	B.F.	Preparation of tender document.
Ghadir	Beirut	1 222000	German Protocol	50.7 M$	2006	Secondary 2009	Preparation of tender document.

Table 12: current situation of the treatment plants in Greater Beirut

V – 4 Department of south Lebanon

Three plants were designed for this department (table 13). They are localized in three main cities of the South: Saida, Tyr and Nabatiye. For the treatment plant of Saida, the tender took place for a primary filtration system but it was reconsidered for a secondary treatment.

Plants	**Districts**	**Populations year 2020**	**Finance**	**Cost M$ - M€**	**Put in service**	**Treatment type**	**Actual level**
Sidon	Saida	215000	Japanese Protocol	10 M$	2005	Pretreatment	Change the treatment in D.P. + B. F.
Tyr	Sour	280000	Finance in process	35 M$	-	P.D. + A.S	Accomplished offers invitations
Nabatiye	Nabatiye	79000	French Protocol	8.5 M€	2005	A.S.W.C.	Attributed contract

Table 13: current situation of the treatment plants in the south

V5 – Department of the Bekaa

This region will be provided with seven plants which shall have the capacity to treat the wastes of about 450 thousand inhabitants in 2020. In addition to the program planned in table 14, the Islamic Bank for the Development will finance the majority of the plants for the West Bekaa according to the established framework. Recently the GDHER supported the decision of the USAID to finance three plants situated upstream of the Litani watershed.

Plants	District	Population year 2020	Finance	Cost M$ - M€	Put in service	Treatment type	Actual level
Zahle	Zahle	203000	Italian Protocol	18 M$		P.D. + A.S.W.C	Technical Assessment
Anjar	Zahle	30000	Italian Protocol		-	P.D. + A.S	Under study
Baalbeck	Baalbeck	126000	World Bank	5.59 M$	2004	A.S.W.C	Completed woks
Laboue	Baalbeck	60000	World Bank	3.6 M$		A.S.W.C	Preparation of the booklet of conditions
Yammoune	Baalbeck	10000	Lebanese State	0.9M$		P.D. + A.S.	
Hermel	Hermel		Italian Protocol	2.13 M$		A.S.W.C.	Under study
Qaraoun	Qaraoun	29000	Italian Protocol		2005	A.S.W.C.	Under study

Table 14: current situation of the treatment plants in the Bekaa region

The priorities and proposals presented by the GDHER 10 year strategic plan

- **Administrative priorities**

- Water Establishments should assume their responsibilities as a control authority in the operation and maintenance of these plants or to charge this task to the private sector.
- Environmental studies shall be controlled by the Ministry of Environment (MoE). This ministry should work hard to ensure the application of these directives that rule the allowed limits of the treated waters quality before their discharge in the sea or in watercourses.
- Foreign finances and protocols granted by the donating countries, should be administrated by the Council of Development and Reconstruction, in coordination with the MEW and MoE
- Infrastructure related to the secondary and tertiary residuary water networks collection shall be assumed by the municipalities, upon agreement with the MEW, in order to be integrated in the general strategic plan already implemented.
- Infrastructure related to the main collector of the Metn region should be executed within short periods, along the Beirut River, in a way to allow the recuperation of all the watershed wastewaters and drain them into the treatment plant located in Dora.

- **Technical priorities**

- Reconsider the distribution of the waste waters treatment plants in order to decrease their numbers, their relevant construction costs, operation and maintenance. This is the case of the 14 plants of Becharre, 14 plants of Byblos and the 19 plants of Chouf and those of the

South. The MEW claims that the location of these plants would be reconsidered in a manner that preserves the environment.

- Adopt the biological filtration procedure in the treatment plants situated on the coast in order to reduce the land occupation. This system shall be followed by UV disinfection before it discharges through the sea outlet, or the artificial recharge in the aquifer.
- Adopt the tertiary treatment system, with the UV disinfection system, in the internal rural regions of the country and especially for the treatment plants situated in Litani River Basin. The purpose of this treatment is to preserve river basin ecosystems.
- Accelerate the implementation works of the treatment plant situated in the transboundary basins of the Orontus and the Jordan River (Hasbani – Wazzani).

VI – Irrigation Projects

In 1993, it was considered that 54.3% of the lands were irrigated by surface waters and 45.7 % by the underground waters. The use of ground waters for irrigation has increased during these past years, due to the postponement of dams and hill lakes construction expected within the strategic decennial plan. This situation has incited every farmer to confront the water demand through the increase of private wells.

The irrigation schemes developed in the 1970 by the public sector are made of many large scale projects and 50 medium and small ones. Most of these irrigation schemes were rehabilitated by a loan from the World Bank and also by the yearly budget of the GDHER. Tables 15 and 16 show the essential characteristics of the surface areas to be irrigated.

Moreover, it is worth to mention that the agricultural private sector continues its development with a wide and dynamic expansion, essentially based on the underground water wells.

Supply	**Projects Number**	**Surface (Ha)**	**Cost M$**	**Accomplishment Degree**
Yammouneh	1	4500	7.52	100
Akkar El Bared	1	1450	2.90	100
Dannyeh	1	3850	7.30	100
Qasmieh Ras El Ain	1	3600	8.00	100
South Bekaa Phase 1	1	2000	15.40	100
Sub total Big projects	5	15400	41.12	100
North package: N1	2	2240	2.60	100
North package: N2	3	1250	5.44	100
North package: N3	5	4680	7.82	100
South/ Mount Lebanon package:	7	11656	4.90	100
Subtotal Small and middle projects	17	11656	20.76	100
Global Total	22	27056	6188	100

Table 15: rehabilitation and updating of irrigation project in Lebanon
(IBRD Loan 3769 – LE)

Project	**Geographic Zone**	**Surface Ha**	**Water needs Mm^3/ year**
Akkar plain	North Lebanon	9000	63
Plateau of Koura-Zgharta	North Lebanon	6790	41
Qaa-Hermel plain	North Bekaa	6000	42
Central plain of Bekaa	Center of Bekaa	4920	31
South Bekaa plain	South Bekaa	20080	121
Hasbani watershed	South Lebanon	5300	35
Irrigation of the West watershed: -carrier 800 (High edge 800 – 400m) -carrier Anane-Nabatiyeh Intermediate edge 600 – 300 m) - Pilot project of Saida-Jezzine - Perimeter of the Khardale dam (Intermediate edge 500 – 200m) - Extension of 2nd phase of Qasmieh Ras El Ain project (Coastal edge 100 – 200m)	South Lebanon	14700 3500 1200 9000 2000	90 (1) 24 (2) 8 59 16
Subtotal		30400	197
General Total		**82490**	**530**

Table 16: irrigation projects prospected in the decennial strategic plan

In the frame of the decennial strategic plan, the MEW focuses on the updating of new irrigation projects, mainly on the following rivers:

- Litani: Irrigation scheme of 30000 ha situated in the Bekaa and in South Lebanon.
- Hasbani – Wazzani: Irrigation scheme of 6000 ha situated in South Lebanon. This transboundary watercourse forms a tributary of the Jordan River.
- Orontus: Irrigation scheme of 7000 ha situated in North Bekaa in Hermel and Kaa. This transbourdary watercourse takes its source from Lebanon, crosses Syria and flows in the Mediterranean Sea in Turkey.
- Nahr el Kebir : Irrigation scheme of 10000 ha situated in Akkar in North Lebanon. This transboundary watercourse constitutes the northern border between Lebanon and Syria.

VII – Flood mitigation and alignment of rivers beds

The purpose of these projects is to protect the watercourses beds from floods. These regions are principally situated near the Litani, Orontus and Nahr El Kebir rivers. The GDHER has launched wide projects for river beds alignment with the aim to ensure the protection to the inhabitants from floods.

VIII – Financial requirements

The financial requirements needed for the period of 2000 – 2009 to execute the projects of the decennial strategic plan are presented in table 17

Sectors	**Budget Million US $**	**Distribution**
a-Ensure additional water resources	787	59%
b- Drinking water projects	133	10%
c- Irrigation schemes	83	6%
d- Wastewater treatment	213	16%
e- Flood mitigation and alignment of rivers beds	43	3%
f- Electrical equipments	23	2%
g- Miscellaneous	50	4%
Total	1333	100%

Table 17: financial investments of the decennial strategic plan

The investment program of the GDHER was adopted by the government and the Lebanese Parliament as law programs with an allocated budget over a ten-year period of time (2000 – 2010).

The projects identification of dams relevant to the strategic plan are stated in the following tables (18 – 19 – 20 – 21 – 22)

Dam Designation	**Purpose**	**Capacity in million m³**	**Cost in Billion of L.P.**	
			Study	**Execution**
Bisri	Drinking water and irrigation	120		300
Study				
Execution				300
Different and non included				
Total amount				300

DW = Drinking Water IRR = Irrigation

Table 18: dam projects in Lebanon designated for the region of Great Beirut

Dam Designation	**Purpose**	**Capacity in million m³**	**Cost in Billion of L.P.**	
			Study	**Execution**
Noura El-Tahta/ Naher El Kebir	IRR	60	1.5	40
Qarqaf/ Wadi Jamous	IRR	30	2.25	30
Al-Bared/ Al-Bared Source	DW	35	3	60
Qamoua	IRR & Tourism	1		12
Aidamoun	IRR	0.3		4.5
Rehabilitation of hill lakes of Kawachira	IRR	0.35	0.1	1.2
Brisa	IRR & DW	0.9		15
Iaal	IRR & DW	10	2	30
Bcharre	IRR & DW		2,65	
Dar Beachtar	IRR & DW	55	1	100
Kfifane	DW	1.5	1.25	18
Tannourine	IRR & DW		1.25	18
Study			15	
Execution				328.7
Other & non included				6.3
Total amount			15	335

DW = Drinking Water IRR = Irrigation

Table 19: dam projects in north Lebanon

Dam Designation	Purpose	Capacity in million m³	Cost in Billion of L.P.	
			Study	Execution
Aqoura / Majdal	IRR & DW	2	1.5	20
Afqa	IRR & DW	2.5	1.5	20
Janneh	IRR & DW	30	5	60
CHabrouh	DW	11	0.75	90
Mayrouba	IRR & DW	18	3	4.5
Beqa'ata	DW	6.5	3	50
Habash/ Zaarour Lake	DW	0.55	0.75	15
Qaisamani Lake	DW	0.55		14
Azouniye Lake	IRR & DW	8	3	120
Damour	IRR & DW	40	4	
Study			22.5	
Execution				329
Others & non included			2.5	11
Total Amount			25	340

DW = Drinking Water IRR = Irrigation

Table 20: dam projects in Mount Lebanon region

Dam Designation	Purpose	Capacity in million m³	Cost in Billion of L.P.	
			Study	Execution
Yammouneh	IRR	1.2		6
Younine	IRR	25	2	40
Assi	IRR & DW	25	2.5	40
Massa	IRR	8	1.5	15
Study			7	
Execution				101
Others & non included				4
Total Amount			7	105

DW = Drinking Water IRR = Irrigation

Table 21: dam projects in the Bekaa region

Dam Designation	Purpose	Capacity in million m³	Cost in Billion of L.P.	
			Study	Execution
Azibe Lake		0.6	0.75	15
Lebaa/Jensnaya Lake		0.8	1	15
Kfar Souna Lake		1.1	0.75	8
Kfar Syr Lake		8	3	20
Khardale Dam		120	5	200
Study			10.5	
Execution				258
Others & non included			1.5	2
Total Amount			12	260

DW = Drinking Water IRR = Irrigation

Table 22: dam projects in the south region

IX – Characteristics of the Litani basin

The Litani River is the major national Lebanese watercourse that takes it rise from Baalbeck (source of Aalleik) at an altitude of 1000m. It crosses through the Bekaa plain to form after a bend in South Lebanon near the Beaufort castle and discharge in the Mediterranean Sea in Qasmieh near Tyr city. The surface of its watershed, evaluated to be 2175 Km², covers approximately 20% of the total surface of the Lebanese territory. Its annual average flow is estimated to be 700 Mm³ and passes through the national Lebanese territory. This river takes its importance and from the development of projects which are actually in operation or that shall be realized therein in the near future. The Litani projects will generate direct economic benefits to the rural societies of the Bekaa and South Lebanon. Before stating the present situation and prospects of the Litani future, it is necessary to recall that the great merit for the development of

this national project goes back in 1958 to the engineers Alfred Naccache, Ibrahim Abdel Al, Selim Lahoud and Cheikh Maurice Gemayel. These well known Engineers and planners have grasped all the importance of this river for the socio-economic future of Lebanon.
In 1952, the Lebanese Government at the time of the mandate of President Camille Chamoun, called for an American commission representing the Bureau of Reclamation, one of the prominent authorities of the United States of Interior specialized in waters and dams, in order to establish an exhaustive and global study of this basin. This commission arrived to Lebanon in 1952, at the same time with the Johnston mission which was sent to the region, by the United States Government in order to draw the base lines for the sharing of the Jordan River sharing among riparian states.

In 1954, The U.S mission of the "Bureau of Reclamation" published its six volumes report entitled "Integrated Management of the Litani Basin" and present it to the Lebanese Government.
The major lines of this document concern the following themes:

- **Irrigation sector:**

The construction of Qaraoun and Khardale dams designated for the irrigation of a surface evaluated around 21000 ha in the Bekka and 31500 ha in the South.

- **Drinking water sector:**

The construction of Bisri dam planned to supply Beirut city with water.

- **Hydroelectric production**

The creation of six hydroelectric units with a potential of 170 Megawatts.

The report of the U.S Bureau of Reclamation motivated the Lebanese government to create on the 14^{th} of August 1954 the Litani River Authority (LRA). The official decree of the LRA implementation stated that an independent office should be created with the objective of executing irrigation, drainage, drinking water and energy projects, in the framework of a global management plan for the Lebanese water resources.

It is important to notice that since 1954, the policy followed by the LRA, was to start the execution of the hydroelectric plants with the intent to finance from the power production, the irrigation and drinking water supply. On the basis of this approach the Lebanese officials at that time, believed that they were able to ensure the necessary financing of the major development phases of the LRA project. In 1970s, the development works of the LRA were completely blocked because of the wars that started in Lebanon and mainly during the Israeli occupation of the South.
Another important launching of the projects started in 1993 with the development of a strategic five-year plan initiated by Dr. Fadi Comair, chairman of LRA.

This plan focused on several major strategic orientations:

- Development of about 57000 ha irrigation schemes located in the Bekaa (25000 ha) and South Lebanon (32000 ha) including the rehabilitation of the Qaraoun dam.
- Rehabilitation of hydroelectric production plants.
- Design of Bisri dam designated for the distribution of drinking water to Beirut city.
- Design of Khardale dam for the irrigation schemes in South Lebanon.

- Vision on the institutional reform.
- Administrative recovery plan and modernization of the LRA departments.

The LRA five-year plan was presented to two official delegations of the World Bank who visited Lebanon in 1993. Following these visits, the chairman of the Board Dr. Fadi Comair mandated by the Minister of Agriculture (MoA) Dr. Adel Cortas, visited in 1994 the World Bank in Washington for the negotiation of a loan agreement out of which 15 million US$ were allocated to rehabilitate the LRA irrigation projects.

In 1996 the rehabilitation of the Kasmieh and West Bekaa projects started and also the LRA five-year plan was submitted to Mr. Nabih Berri the Speaker of the Parliament who requested from the Gulf countries during an official visit the complementary financing of the South Lebanon irrigation projects.

X – Natural and hydraulic characteristics of the river

The Litani River comprehends four sub basins located among Bekaa Valley, Mount Lebanon, Anti Lebanon, the hills of Djebel Amel and the middle region of the basin. Table 23 presents the designation as well the geographic localization of the sub basins of the River.

No.	**Designation**	**Altitude over sea level (m)**		**Remarks**
		Inferior Limit	**Superior Limit**	
1	The Bekaa Valley	700	900	
2	Mount Lebanon and Anti Lebanon	1000	2000	The sources are mainly situated between the altitudes 1000 and 2000 m
3	Hills of Djebel Amel	700	1600	
4	Middle Region of Litani	300	1000	The sources are mainly situated between the altitudes 300 and 600 m

Tableau 23: sub-basins of the Litani River

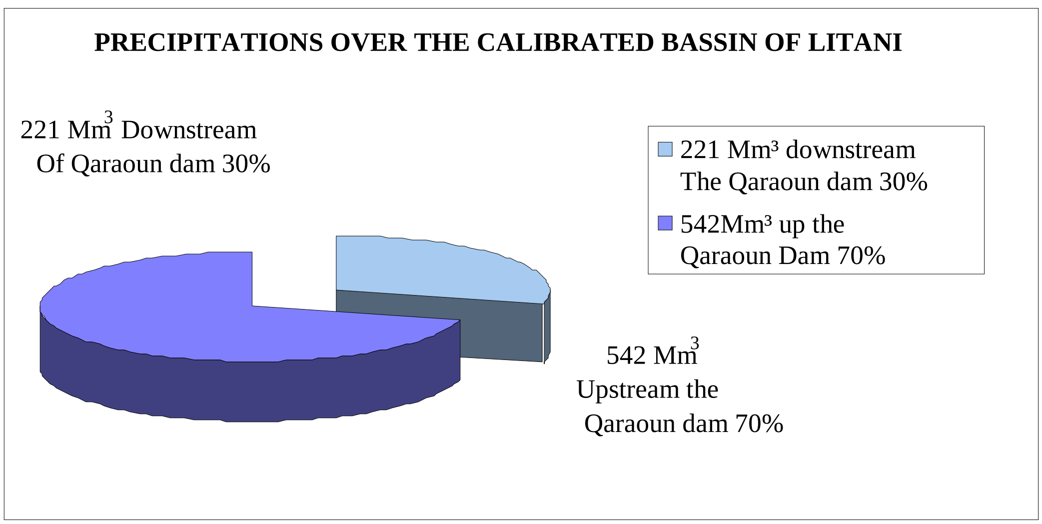
The principal tributaries of the watercoiurse are respectively situated in the region of Bekaa and South Lebanon. Their characteristics are given in table 24.

No.	Location	Designation
1	Upstream Qaraoun Dam	Berdaouni River, Jair, Hafir, Chtaura, Riachi, Faregh, Ghzeil and the source of Khoraizat
2	Downstream Qaraoun Dam	Chita River, the sources of Ain Zarqa, Bergez, Qella, Meidana, Wadi Houjeir, Ghandourieh, Wadi Zeirqon, source of Alman
3	Upstream to the watercourse Delta	Abundant sources

Table 24: principal tributaries of the Litani River

X-1 Assessment of the Litani water resource

After the process of natural evaporation, the total volume of precipitations over the Litani watershed is generate about 764 million m³ splitted between 542 million m³ upstream and 221 million m³ downstream the Qaraoun dam. The total runoff of the watercourse is 946 million m³ which constitute 30% of the total flow volume of all the national rivers in Lebanon. A water capacity of 70 million m³ is considered to be derived from the lateral calibrated Litani watersheds situated in the western mountains.



a- Available water volumes in storage dams

The water volumes that will be available in the storage dams for the agricultural development projects of the LRA and those concerning the drinking water distributed are evaluated to be 467 Mm³. The details are summarized in table 25.

№	Designation	Status	Capacity (Mm³)	
			Usable	Total
1	Qaraoun Dam	Available	160	220
2	Khardali Dam	Suggested	85	128
3	Bisri Dam	Suggested	106	128
Total			**351**	**476**

T Table 25: available water volume in the storage dams

b- Ground Water

The ground water total capacity available in the Litani watercourse is evaluated to be 125 Mm^3 per year. This quantity is located in five aquifers among which three are situated in the Bekaa Valley and the remaining quantity in the coastal plain of the south. The details on available ground waters are presented in table 26.

№	**Designation**	**Aquifers number**	**Capacity in (Mm^3)**
1	Bekaa Valley	3	75
2	Southeastern Coastal plain	2	50
Total			**125**

Table 26: ground water in the Litani watercourse

c- Water sources

The total capacity of the basin water sources is about 65 Mm^3 per year. The Ain Zarqa source evaluated to be 30 Mm^3/year and situated in the South Bekaa region is the heaviest in volume and constitutes approximately half of the total available resources out of the storage reservoirs and ground waters (table 27).

№	**Designation**	**Capacity (Mm^3)**
1	Source of Zarqa	30
2	Jezzine Tunnel	10
3	Sources on the Litani watercourse	20
4	Alman	5
Total		**65**

Table 27: water sources of the Litani Basin

d- Total volume of available resources

Considering the usable quantity of stored water in the dams estimated to be 351 Mm^3/year, the total volume of resources available in the Litani basin reaches approximately 541 Mm^3/ year. This volume can reach the value of 670 Mm^3 if the water reserves of the dams are taken into account. Table 28 presents the total volume of available resources in the Litani watercourse.

№	**Designation**	**Capacity (Mm^3)**
1	Storage Dams of surface water	351
2	Ground water	125
3	Water sources	65
Total		**541**

Table 28: total volume of available resources

XI – Litani Basin master plans

XI – 1 Hydroelectric plan

The power supply comes from Qaraoun dam connected downstream to a sequences of derivation galleries, tunnels and penstocks made for the production of hydroelectric power. The construction of this dam and three energy production units were totally achieved in 1968. These hydroelectric plants have an installation capacity of 295MGW and produce a clean energy estimated to be in a range of 700 millions to one billion per year.

XI – 2 Master plans for drinking water, irrigation and industry

During the period of 1955 and 1969, many design phases were implemented to develop the irrigation sector of the Bekaa: southwestern region and South Lebanon. Moreover, the drinking water and industrial supply of the zone extending from the North of Awali to Beirut has been planned including the one related to South Lebanon.
The promulgation of the decree number 14522 dated 10/05/1970 determined the shares of water resources for irrigation, domestic and industrial uses for the regions situated from the Damascus road to the southern border. This approach concerns the western mountain watershed located from the edge of 800 m till the sea.

a- Agricultural Lands and irrigation

The planned irrigation development schemes in the Litani basin cover about 58000 hectares. These surfaces are divided between the Bekaa region and south Lebanon. The Qasmieh project is the only irrigation scheme in South Lebanon currently in operation and comprehends 4000 hectares of irrigated lands.

The irrigation scheme of the Bekaa valley that covers 25000 hectares is situated in the upstream of Qaraoun dam till the village of Terbol in Central Bekaa.

In this region, 37 villages may beneficiate from the direct and indirect benefits of the Bekaa irrigation project. They are distributed between the districts of Western Bekaa and Zahle with a population of 383000 inhabitants.

The master plan of the LRA indicates that the total area that could be irrigated in South Lebanon is estimated to be around 75300 hectares. The irrigation schemes that present a positive economical impact and could be equipped with efficient techniques are reduced to 52000 hectares among which a surface area of 5000 hectares is already irrigated. By taking into account the water share that may be allocated to South Lebanon, it was decided that only 33000 hectares shall be covered with the water resources deriving from the Litani Basin.

The number of villages beneficiaries of the irrigation project in South Lebanon are 227 villages situated in the districts of Saida, Zahrani, Tyr, Nabatiye, Marjayoun and Bent Jbeil which count about 325000 inhabitants.

This fact shows that the number of inhabitants, who will benefit from the Litani irrigation project, represents 20% of the total number of the Lebanese inhabitants. Thus, the implementation of the LRA projects present a positive social and economical impact and are essential for the development of the country.

b- Irrigation of the western mountains

The irrigation project of Canal 800 which constitutes the first phase of the irrigation master plan takes its source from the Qaraoun dam (100 Mm³) and extends till Baraachit in South Lebanon crossing the regions of Marjeoun and Nabatieh. The dinking water distribution system which will be supplied from the Qaraoun dam with 30 million m³/year, will cover the entire district of Djebel Amel.

The second phase of the master plan, which takes into account the existence of three dams: Qaraoun, Khardali on the Litani watercourse and Bisri on the Awali River. The storage capacity of Bisri dam amounting to 120 million m³ if the technical geological complication would be resolved will provide Beirut city with drinking water. Under these conditions the total of the irrigated surface situated on the west mountain side watershed may reach 33000 hectares. The utilization of ground waters by the private sector shall increase the irrigated surface of the Qasmieh – Ras el Ain project from 4000 to 6100 hectares. The master plan was programmed to be executed in three phases according to the details given in tables 29 – 30 – 31 and 32.

Designation	**Characteristics**	**Objective**				
		Irrigation			**Water distribution**	
		Surface (ha)	**Geographic situation**	**Water allocation (Mm³/year)**	**Status**	**Water allocation (Mm³/year)**
Project of the Canal 800	Starting from the Qaraoun dam to Baraachit village	15000 first priority in south of Qasmieh	Edge of 800 to 500 m Regions of: Marjayoun, Nabatie south of Qasmieh	100 dams of Qaraoun	Villages of Jebel Amel	30 from of Qaraoun
Project of Khardali dam (1)	Storage capacity: 128 million m³ Middle altitude: 305 m over sea level	6600	Edge between 500 to 200 m and south of Siniq River	38	Villages between the edges 500 and 200 m	7
		6100	Qasmieh edge 100 m till the sea level	40		
Irrigation	In operation since	4000	From the	--	--	--

schemes Qasmieh – Ras el Ain	1950		edge of 200 till sea level			
Irrigated schemes by ground waters through private initiatives	--	--	Between the edge 200 and 100 m	---	---	---
			Regions out of the perimeter of Qasmieh – Ras el Ain to the edge 100 m			

Table 29: irrigated lands of the mountain western watershed

The irrigated lands in the frame of this project are distributed between the internal and low region of South Lebanon. The total area of irrigation is 51477 hectares among which 4000 hectares are currently under at the coastal plain (project of Qasmieh Ras el Ain). The details are specified in table 30.

Sector	**Low region (ha)**	**Internal region (ha)**	**Total (ha)**
Damour – Awali	-	2277	2277
Awali – Siniq	-	1396	1396
Zahrani – Litani	202	3284	3486
Litani – Border	1544	13601	15145
Coastal plain	4000	-	4000
Total	9018	42459	51477

Table 30: geographic distribution irrigation schemes

The environmental study developed on these areas has shown that 64% of the total irrigable lands presents an economic positive impact appropriated for the irrigated cultivations which means a total of 3300 hectares. Table 31 presents the new repartition of the irrigated areas and tables 32 and 33 show the repartition of irrigated surfaces related to the Awali River. It is necessary to mention that the surface of irrigated lands within the scope of the Qamieh –Ras el Ain rural development reaches 6100 hectares among which 4000 hectares are situated in the coastal plain and 2100 hectares are situated on the inferior edge at 100 m of altitude and are irrigated by the private wells.

Sector	**Low region (ha)**	**Internal region (ha)**	**Total (ha)**
Damour – Awali	-	1300	1300
Awali – Siniq	-	800	800
Siniq – Zahrani	200	2000	2200
Zahrani – Litani	1000	8000	9000
Litani – Border	2000	13700	15700
Coastal plain	4000	-	4000
Total	7200	25800	33000

Table 31: appropriated regions for the irrigated cultivations

Sector	Surface (ha)	Rate (%)
North of the Awali River	1300	4
South of the Awali River	31700	96

Table 32: Appropriated regions for the irrigated cultivations related to the river

Sector	Surface (ha)	Region
Awali – Siniq	800	Pilot irrigation zone
Between the sea and the edge 100 m	6100	Qasmieh – Ras el Ain
Between 100 and the edge of 400 m	11900	Middle
Between 400 and the edge 800 m	15000	Canal 800

Table 33: appropriated regions for the irrigated cultivations in the south of Awali River

c- Irrigation of South Bekaa

This project situated between the city of Rayack and Qaraoun dam consists in applying efficient irrigation networks based on drip or sprinkler techniques. It covers a total zone of 21500 hectares starting from the 900 m edge.

The water resources derivate from (table 34):

- Qaraoun dam with the pumping of 30 million m³ of water per year.
- The sources of Anjar and Chamsine, with a water volume of 33 million m³ per year.
- Underground waters with a volume of 75 million m³ per year.

The total volume required to meet the demands for this project is estimated to 138 million m³ per year.

The project comprehends as well a drainage project of 5000 hectares of lands situated in the Bekaa plain.

№	Designation	Outputs (Mm³/year)
1	Qaraoun Lake	30
2	Sources of Anjar & Chamsine	33
3	underground waters	75
Total		**138**

Table 34: irrigation of south Bekaa: water allocations

d- Sectors of use

The master plan of drinking water, irrigation and industrial utilization comprehends (Table 35 – 36):

- 30 million m³ of water per year for the villages situated in the irrigation area between 800 m and 500 m of altitude.

- 7 million of m³ per year, starting from the Anan Dam, for the villages situated in the pilot irrigation area in operation since 1970.
- 106 million m³ of water per year, starting from Bisri dam, mainly reserved to the drinking waters and industrial sectors, for the regions situated in the North of Awali till greater Beirut; all these projects that integrate the concept of the master plan will be managed from Qaraoun, Khardali and Bisri dams.

Region	**Between the Awali river and Damour**		**Water allocations for the Greater Beirut Mm³**
	Irrigation	**Water allocation**	
From Bisri dam: slope 100	10	10	80

Table 35: water allocation of Bisri dam situated in the North of Awali River

Categories	**Designation**	**Water resources (Mm³)**				
		Qaraoun Dam	Khardali Dam	Ain Zarqa source and Tunnel of Jezzine	Litani River discharge area	Sources of Ras el Ain, Rachidieh
Irrigation	Irrigation pilot zone			8		
	Canal 800: 15000 ha	100				
	Between the level 400 & 800m :11900 ha		80			
	Qasmieh – Ras el Ain zone : 6100 ha		20		10	15
Water Canalization	Between the Awali & Qasmieh rivers (excluding Saida)			32		
	Irrigated zone of Canal 800	30				
	Middle region 400 – 800 m					25
Total		**130**	**100**	**40**	**10**	**40**

Table 36: Water allocation for the region situated in the South of Awali river (Mm³)

XII – Five-year Strategic master plan

In 1993, the LRA has established a work program spread over five years and designated to execute the Litani master plan. This program comprehends three phases:

1. Emergency Recovery Program
2. Short and medium term plans
3. Long term strategy for irrigation and drinking water supply

XII – 1 Emergency Recovery Program

During the war, the Litani installations suffered from huge damages especially after the Israeli invasions. An emergency recovery plan was established to update the uncompleted infrastructure projects and rehabilitation of damaged incurred to the equipments and water supplies.
This program of emergency situation concerns the rehabilitation and the updating of the following entities:

- Administrative offices and technical establishments
- The installations of Qaraoun dam and the energy production plant of Markaba, Awali and Joun.
- Irrigation project of Qasmieh – Ras el Ain.
- Irrigation project of South Bekaa, including:

    - Updating the feasibility study of the right bank and the north regions (12888 ha)
    - Rehabilitating the upstream zones, achieving the network infrastructures and installing 2000 ha over the left bank.
    - Rehabilitating and rectifying the Litani River watercourse between the lake of Qaraoun and Aamiq bridge (14.5 km)
- Agriculture research zone situated on the upstream of Qaraoun dam.
- Irrigation Pilot project of Saida – Jezzine.
- Hydrometric equipments, meteorological stations and their softwares.
- Feasibility study and directory plan for the water distribution of the regions in Iklim el Kharroub and South Lebanon, starting from level 600 m.
- Detailed studies of the second phase of Bisri dam.
- Update and achievement of the studies related to the project of Canal 800.

XII – 2 Short and medium term plans

These plans are designated for the rehabilitation and updating of the following projects:

a- Irrigation zone of Qasmieh – Ras el Ain as well as the auxiliary infrastructures which are:
   - Water intake reservoir of Zrariyeh, with an access road of 5 km.
   - A dam and a storage reservoir upstream of Litani, to irrigate the zones of lands situated down the slope of 100 m and also to improve the irrigation networks of 2000 hectares situated between the level of 100 m and the existing supply canalization.
   - Water drainage infrastructures and the secondary irrigation canals.

b- Execution of these projects is recently accomplished by a loan from the World Bank.
   - Works comprehend the watercourse beds situated over a distance of 12.5 km.

- Feasibility studies and the master plan (May 1996) for the regions of Iklim el Kharroub and South Lebanon. Similar studies for Anan reservoir, Joun tunnel and Canal 800.
- Accomplishment in May 1996 of the irrigation networks for the pilot project of Saida – Jezzine (700 ha).

c- Increase of Anan reservoir storage capacity which will increase the power production during the pick hours, in Awali and Joun plants. Two alternatives were considered:
- Increase of the overflow level of 0.65 m in order to widen the reservoir storage capacity of 25000 m³.
- Execution of a 70000 m³ storage reservoir on the west slope. Total of the supplementary storage volume reaches 95000 m³.
- Equipment of 15000 hectares starting from the Canal 800
- Equipment of 6000 hectares starting from the Khardali dam.

e- Supplementary drinking water canalization for South Lebanon villages.

f- Updating of the studies and geological investigations for the execution of Khardali dam as well as preparation of the tender documents.

g- Supply of the zones situated upstream the Qaraoun dam

h- Preservation of the Qaraoun Lake from the urban, agricultural and industrial pollution.

i- Equipment of the sectors situated on the left bank in the frame of the irrigation project of South Bekaa (6700 ha)

j- Detailed studies for the execution of Bisri dam which is designated to the supply of Beirut city with drinking water.

XII – 3 Long term strategy for the irrigation and water supply
This strategy comprehends all the works mentioned in the master plans and which requires over five years of execution phases. These projects are the following:

- Execution of Khardali dam
- Achievement of the irrigation project of the Bekaa (12888 ha)
- Achievement of 5000 hectares drainage area in the Bekaa.
- Execution of the irrigation project in South Lebanon which include an area of about 30000 hectares.

XIII- CONCLUSION

The study of the water resources in Lebanon shows clearly that this country is blessed with an annual precipitation volume of about 8 billion m^3/ year but several disadvantages render the utilization of this water quantity a very complicated task to be accomplished. These parameters are the following:

- 90 % of the rainfall quantity occurs with a period of three months

- Evapotranspiration rate is evaluated to be 50% and this volume will tend to increase with the climate change phenomenon.

- Geological Karstic nature of the Lebanese soil induces a high infiltration ratio.

- Relying on groundwater utilization as a major source of water supply for the Lebanese population constitutes a bad design for the water planning and management in Lebanon. This concept leads to an over pumping of the aquifers generating environmental problem as:

    - Seawater intrusion in the costal zone aquifer
    - High level drops of the water table in the Bekaa valley
    - High financial consequences related to the electricity bill to be paid by the water establishment due to the water pumping.

- Absence of waste water treatment plant makes difficult the utilization of non conventional resources for agriculture and municipal sectors. Also this resource could be used for the artificial recharge of aquifers in addition to the high pressure induced on the ecosystems of the watercourses.

- Absence of surface water storage since the 1960 led to a continuous discharge of fresh water in the Mediterranean sea amounting to about 1.2 billion m^3/year. This irresponsible behavior from the water administration and the political decision makers constitute a waste of financial input to the national budget evaluated to be around 100 billion US dollars. Until 2002 only the Qaraoun dam has been built on the Litani River.

- Construction of Chabrouh dam which was completed in October 2007 was the only project executed of the 10 year strategic master plan established by the GDHER-MEW.

- 27 dams were planned to be executed in 10 years but unfortunately this objective was not met and the dams were not implemented mostly due to political disturbances.

- Difficulties in the achievement of the agricultural schemes forecast for 2010-2040 estimated to be 280 000 hectares without the implementation of the 10 year strategic master plan. This situation will generate a negative effect on the food security of the country and will force the Lebanese government to continue importing its demands in agricultural crops. The notion of “virtual water” which is highly harmful for Lebanon water resources future utilization will be applied and enforced by the international community.

- The drinking and irrigation water networks efficiencies should be improved in order to meet IWRM requirements with respect to the water losses and for a better service coverage.

- Other non conventional resources for the future utilization such as: sea fresh water spring, desalination and reuse of wastewater require a new complementary formulation within the 10 year master plan bearing in mind that the resources utilizations by gravity should be used at first priority.

- Climate change effect on Lebanon tends to let the Lebanese territory to be progressively drier. The first obvious measure to be taken by the Lebanese Government is to reduce the amounts of water discharging into the sea.Unfortunately due to the political complication. Theapplicability of this solution seems to be difficult

CHAPTER X

INTEGRATED WATER RESOURCE MANAGEMENT IMPLEMENTATION IN LEBANON

I- Introduction

In the southeastern region of the Mediterranean Sea, the concept of Integrated Water Resources Management is currently adopted by many countries and particularly by Morocco, Egypt and Lebanon. The implementation of IWRM in these countries depends on the politicians will and their disposals to apply the appropriate reforms in the water management field. The achievement of these reforms requires a series of priority actions, for instance:

- Creation of river basin organizations.
- Elaboration of reasonable economic development policies.
- Implementation of regulations and clear institutional frameworks
- Elaboration of a fair tariff system
- Installment of a communication system that takes into consideration the participation of all the stakeholders in the decision making process.
- Development of an adequate administrative system for the resources management. The Public Private Partnership (PPP) might be considered according to the needs of each country.

The implementation of the above-mentioned actions constitutes the first step for starting the process applying this concept. The role of the governments at this stage is a determining issue for launching the process. The implementation mechanism should be elaborated through new water codes by suggesting solutions to the problems that constitute an obstacle for all institutional reform. However, the governments must provide their support in order to apply the process quickly and to launch the efficient dialogue with the users. The public authorities interventions could be introduced by applying the following actions:

1- Elaboration of a strategic plan and a road map to accomplish the above-mentioned goals. This program should define in details the roles and responsibilities of each entity in order to facilitate the cooperation between all governmental departments.
2- Implementation of a structured process for the participation of the main water stakeholders on the local, national and if possible regional levels.
3- Launching of a communication system between the government and the public. The goal of this procedure aims to a better understanding of IWRM advantages.

The public sector should be associated with this procedure in coordination with the following sectors: education (schools, universities) and medias (radios, press, televisions). The planning and implementation of pilot projects in all the water resource utilization sectors should be also considered. This mechanism aims at presenting IWRM as a concept of a strategic policy for a given nation within a common vision of the different institutional entities. A calendar should be set to follow-up the short, medium and long term undertaken actions along with a well defined financial budget. At this stage, the dialogue with the private sector is recommended in order to facilitate the partnership between the public and the private authorities.
Furthermore, the financial policy undertaken by the government should take into consideration the costs invested in this reform. This procedure requires considering within the global tariff policy, the billing of the wastewater treatment. The purpose of this approach is to influence the users behavior by stimulating a high efficiency in the water utilization, including the reduction of

polluted waste discharges. In addition, these financial supplementary charges could be used to improve the quality of the water supply infrastructures, for instance:

- Rehabilitation of the distribution networks and the increasing of their efficiency.
- Renovation of the wastewater treatment plants to achieve an outstanding process (secondary and tertiary treatment). This action aims at increasing the total water volume of a given country through the water reuse process.

According to the market conditions, this improvement in the water supply could reduce the price for the consumers. In Morocco, the study case on “the drinking water supply in the coastal region of Rabat and Casablanca” showed that the undertaken actions in the IWRM framework led quickly to reduce the water price and recover the expenses investments.
The following section presents in details the application of the IWRM process in Lebanon launched by the General Directorate of Hydraulic and Electrical Resources (GDHER) with the support of the French government and the European Union Water Initiative (EUWI) in the framework of the Mediterranean component managed by Greece.

II- Integrated water resource management in Lebanon

The decennial water strategic plan for the Lebanese government (2000-2010) promulgated as a law program by the GDHER of the Ministry of Energy and Water (MEW) implemented the technical approach of the IWRM concept in the country. This decennial strategic plan ratified by the parliament concerns the following hydraulic infrastructure projects:

- Rehabilitation of the drinking water supply system and networks
- Irrigation projects and their efficiency improvement.
- Wastewater treatment and their reuse.
- Flood mitigation and river beds alignment.

The launching of this concept in Lebanon encouraged major water stakeholders on the local and international level to complete this approach with other institutional texts that are needed to implement the integrated process. Therefore, laws number 221 and 241 published respectively in May and August 2000 and then law number 337 issued in Mars 2002, established a new institutional policy for the water management in Lebanon. In their final version, these laws were structured according to the following principles:

- New competences of the Ministry of Energy and Water in view of: the General Directorate of Hydraulic and Electrical Resources and the General Directorate of Exploitation (GDEXPL).
- Water Establishments (WE) replacing the 21 drinking Water Authorities (WA) and the 321 irrigation commissions.
- Private Public Partnership (PPP) and the different management modes of the Water Establishment (WE) (France role in the institutional adjustment).
- Water code (French government initiative).
- Tariff policy implementation.
- National dialogue launched by the European Union Water Initiative (EUWI).

III- New competences of the Ministry of Energy and Water (MEW)

Since Lebanon independence (1943) until 1966, the water sector was managed under the supervision of the Ministry of Public Works and Transport. The Ministry of Hydraulic and Electric Resources was established by the promulgation of law 20/66 amended twice in 1972 and 1973 to be reorganized on the basis of two entities:

The first on is the General Directorate of Hydraulic and Electric Resources (GDHER) with two departments, concerning technical infrastructures and water studies. The GDHER missions consisted of:

- Design, execution and control the hydraulic and electric projects.
- Apply the laws and regulations relative to the protection and utilization of the public water sector.

The second one concerns the General Directorate of Exploitation (GDEXPL) with two departments which concern tutelage and control of concessions. The GDEXPL fulfill the following missions:

- Administrative supervision on the Water Authorities (WA) and irrigation committees according to the decree 4517/72 relative to the public establishments status.
- The control of water and electricity concessions.

The GDEXPL exercised the tutelage on the 22 Water Authorities (WA) responsible of the water distribution, operation and maintenance of the hydraulic equipments. Furthermore, this tutelage was exercised on the Electricity of Lebanon (EOL).
The merging of the Petroleum Ministry to the Ministry of Hydraulic and Electric Resources led to the creation of the Ministry of Energy and Water (MEW) with extended competences to cover the energy sector in the country.

As to the water sector, this reform aimed at improving:

- Water resources management through the implementation of IWRM concept.
- Improving the services provided to the water users, by establishing the Public Private Partnership (PPP).

This reform opened the gate for Lebanon to integrate the European Neighborhood Policy (ENP) and consequently applying the requirements of the EU Water Framework Directive (WFD).
In order to accomplish these objectives, this water sectorial reform was based on the reorientation of the Ministry missions based on the following tracks:

- Global management of water resources (IWRM) that integrate the whole water cycle and mainly drinking, irrigation, wastewater treatment and reuse.
- Improvement of the design efficiency and planning mission on the national level.
- Backing up of the Governance and water policy.
- Implementation of a new control system on the Water Establishments through a performance evaluation commission headed by the Minister and General Director of Resources and Exploitations.
- Communication mission aiming to inform and raise awareness of the populations on water usages.
- Supporting role of the design execution and control of large national projects.

- Transfer of the water operation and maintenance infrastructure to the regional Water Establishments (WE).
- Widening the autonomy and awareness of the Institutional entities through the merging of 22 water authorities and 320 irrigation commissions in four public Water Establishments with a geographic attribution.
- The recently established Ministry of Energy and Water is run by two General Directorates, one concerns the Hydraulics and Electrical Resources and the other is related to the exploration sector.

a- For the General Directorate of Hydraulic and Electric Resources (GDHER): these entities cover the following competences areas:
- Technical studies for the hydraulic and electrical infrastructures.
- Economic and environment feasibility studies.
- Elaboration of a general master plan on water.
- Technical control and management of the water and electrical projects.
- Regulation and proper usage of the hydraulic resources.
- Planning of the groundwater and related infrastructures.

b- For the General Directorate of Exploitation (GDEXPL):
- Contribution to improve the performances of the four Water Establishments.
- Control and application of the standards and procedures determined by the technical services of the GDHER.
- Supervision of the public Water Establishments.
- Control of the concessions.

III.1 Competences of the new public Water Establishments:

The four newly created Water Establishments (Beirut – Mount Lebanon, North, South and Bekaa) with the Litani River Authority (LRA) that maintains its initial status are responsible of the following actions:
- Hydraulic projects in their respective area
- Financial investments requirements
- Projects design along with the master plan framework set up by the Ministry.
- Execution of the water networks.
- Operation and maintenance of all water infrastructures including wastewater collection and treatment plants.
- Tariff collection for all water sectors.
- Quality control of drinking and irrigation water and sludge treatment of wastewater.

These entities operate according to their own regulations elaborated and approved by the Council of Ministers in 2005. These new regulations gave the WE the necessary flexibility to work on commercial bases, such as the supervision and the management of their services by private operators.

The recruitment policy depends on their real needs and the nomination of employees comes under the authority of the Public Recruitment Council. The evaluation performances commission draw the guidelines of their yearly business plan with the appropriate tariff systems and the monitoring and auditory of their work. The Chairman of the Board will be at the same time the Chief Executive Officer (CEO) of the water Establishment. This issue will facilitate the work and prevent any conflict between the board and the executive entity in the WE.

III. 2 Pricing policy in Lebanon:

Although the investments in the water sector constitute a heavy financial load, the unit tariff of this product usually evaluated either in m^3 or liter remains in general very affordable with respect to other natural resources. The reason is that water is not yet regulated by the market policies related to supply and demand but by other aspects such as sanitary, environmental, economic and social consideration.
Even with a private public partnership approach, this social criteria is the most important item for the drinking and irrigation tariff design policy of the water distribution systems.
Starting from the design phase, the difficulty for the public authorities is in the integration of the economic criteria that should consider for the user of the water service several constraints such as:

- Financing the connections
- Tariffs structure and limitation
- Services charges stabilization
- Forecasting the eventual taxes

Consequently, the financing of the water sector in Lebanon should conform to the following principles:

- Water service has a cost because this resource must be transported, treated and protected.
- Utilization of each service must be financially balanced
- Implementation of the “polluter payer” principle that consists in forcing the polluter to pay and the non polluter to be supported financially.

The expenses generated from the water services should be covered by the corresponding revenues and can not be financed unless exceptionally from the local and national taxes. Thus, the water bill must include the following elements:

- Infrastructures implementation, quality control management procedures, operations and maintenance. These actions represent approximately 40% of the total bill.
- Urban wastewater treatment cost.
- Taxes and service charges (20.5%) for the account of the Ministry of Energy and Water, owner of the hydraulic infrastructures, when the water supply is taken from dams, watercourses or wells and 1 % for the National Fund of the Water Supply that provides a national budget for the benefit of the rural zones (entity that must be established under the GDHER).
- Indirect assessment tax of the State on the basis of the value added tax (VAT).

The legislator suggests then to charge the consumer of the whole direct and indirect costs linked to the water utilization, which prompts to use the resource in a responsible and reasonable way.

The 221, 241 and 337 law texts set out the considerations to be taken into account in the tariffs structure as stated in section b, in paragraph 1 of article 4.
“The Water Establishments will be in charge, each in its operation area and within its competences to suggest the service tariffs of the drinking water supply, irrigation and wastewater collection and treatment. These Establishments should take into consideration the social and economic conditions in general of their operation area and more specifically of the consumers within the Basin. Furthermore, theses regulations texts specify that the “implementation methods will be settled by the decrees adopted by the Council of Ministers based on the joint suggestion of the MEW and the Ministry of Finance.

It is important to draw the attention to the fact that the old regulation mentioned the obligation “to reach through the tariffs policy the financial stability of the water authorities taking into consideration the social conditions of the consumers”.
However and due to the fact that the new regulation texts give a commercial framework to the Water Establishments, it is understood that they must not operate at loss but with benefits in order to ensure their financial sustainability.

These public organizations must take into account in its tariff structure the following factors:

- Operation and maintenance costs of infrastructures of all water sectors.
- Financial investments and their interests
- Development of the infrastructure projects
- Renewal of the water supply plants

In addition to other elements that are completely linked to the employees salaries and the retirement gratuity that are parts of the social security contributions.

Finally, the socio-economic conditions should not be ignored because it is considered as a very heavy weight on the majority of the Lebanese people and it is not possible suddenly to increase the tariffs without justification. The implementation of the real value that reflects the effective water service cost must be progressively accompanied by an orientation campaign to familiarize people with the principle of “polluter payer”.

IV- Role of France in the institutional reform: cooperation on the “Water Code”

A cooperation program in the water sector between the Lebanese and the French government was implemented in order to help the MEW in its technical approach for IWRM implementation and the institutional support in the “Water Code” Governance framework. The French experts carried out many consulting missions in all the water sectors and they proceeded to the transfer of technologies and professional development actions oriented towards the MEW staff within a time components frameworks.

IV- 1 Component 1

The implementation mechanism of this component was programmed for 26 months starting from 30 October 2003. The proposed steps for the to definition of the legislative and regulation code known as the “Water Code” are the followings (Table 1):

- Legal framework status and recommendation
- Ratification of the editing framework with the stakeholders
- Training on draft code editing
- Publication of the water code first draft
- Presentation of the orientations and stakeholders inquiries on the water code
- Integration of the water stakeholders comments by the reading committee
- Final workshops
- Follow-up of the implementation mechanisms and launching the parliamentary debates.

Objectives	Activities	Results
1- Reinforcement of the legal and technical skills.	**1-a** Training the MEW and WE staff and other concerned ministries.	**1-b** Training of several managerial employee in Lebanon. “Water Code” editors trained in France.
2- Updating the current legislation taking into consideration the international good practices.	**2-a** Supporting the “Water Code” editing.	**2-b** “Water Code” project specifying the new government missions. Distribution to all stakeholders.

Table 1: chart of the component 1

IV-2 Component 2

This component handles the restructuring and the institutional reorganization of the water sector. It was programmed for 26 months and includes the following steps (Table 2):

- Actual status and stakeholders satisfaction inquiry.
- Workshop for the legal framework validation and consultation with the water stakeholders actors.
- Strategy and functional framework of the MEW and the WE acquired and required competences.
- Workshop for the proposals presentation and validation. Skilled engineering and human resources management of the recruitment and training plan.
- Implementation of the new organization: Ministry, pilot projects, supporting of new procedures and work systems, training in France and Lebanon, implementing the MEW master plan for water management.
- Satisfaction inquiry.
- Final workshop of component 2.

Objectives	Activities	Results
1- Definition of the organizational functions of the MEW and the WE.	**1-a** Actual status and stakeholders satisfaction inquiry. Supporting the MEW framework and training plan.	**1-b** Appropriate framework with respect to the new missions of the MEW and WE.
2- Creating a regulatory and control authority.	**2-a** Installing the control body (missions definition and required skills, training, installing framework).	**2-b** Control body to regulate the contracts signed by the WE with the private operators.
3- Master plan for Beirut – Mount Lebanon water management.	**3-a** Leading consultation mechanism involving all concerned water resource stakeholders.	**3-b** Organization and elaboration of a master plan for development and water management of Beirut and Mount Lebanon WE

Table 2: chart of the component 2

V- Role of France in the institutional reform water sector

The current laws implemented in Lebanon, anticipates the regulatory framework of the WE for the private operators intervention in the management of the water sector. It sets the relations between the public institutions and the private operator.
In France, this new form of partnership, known as "delegated management" represents nowadays 80% of the drinking water distribution sector and more than 40 % of the wastewater services. Only a minority of municipalities, essentially rural, kept the initial system of direct public management.

Within the institutional reinforcement program of MEW initiated by the French government, a new partnership form with the private sector was established in cooperation with the WE of the North (Water Authority of Tripoli). This action associated capitals and competences of the French private companies in order to meet the objectives defined by the Lebanese authorities. The delegated management mode entrusted to the Lyonnaise des Eaux in 2003 gave very satisfactory outcomes after two years of direct interventions.

The success of this operation resulted from several parameters:

- Technical skill of the management team.
- Commercial dynamism and financial unity of the French groups.
- Financial back up of the French Development Agency (FAD).
- Lebanese managers willing to integrate positively in this process.

The Tripoli PPP experience allowed developing pragmatic solutions to be applied to other water Establishment in Lebanon. Before the launching of this partnership, many forms of PPP contracts were progressively defined in consultation with the MEW and which might appear appropriate to be applied to the management of the water sector in Lebanon. A summary of these forms are presented in the following paragraph.

a- Concession

In the concession, the operator could either finances the whole or a part of the infrastructures, in addition to the investment capital required to the operation and maintenance process. At the end of this long term contract, installations are returned to the WE. The water price estimated by the operator must permit to compensate and refund the invested capitals, cover the operation and maintenance expenses, the salaries of the employees and a profit to ensure the infrastructures development.

b- Factoring

This form is different from the concession whereas as the public collectivity manage itself its own investments .The private operator invest only the investment capital required to the operation of the sector.

c- Outsourcing

In this type of partnership, the collectivity ensures the construction and the equipments turnover, manage the water supply operation and maintenance, determine and perceive the tariffs. In this case, the private operator is remunerated not by the consumers but by the public collectivity. The operator could also be remunerated with a fixed premium and another one related to the productivity and eventually a supplementary benefit on the services.

d- Public corporation

In the public corporation, the operator remuneration is proportional to several physical parameters such as the consumer's numbers and the water volume (m^3) pumped or distributed.

e- Technical assistance contract

The technical assistance or the service management contract is the mode adopted by the WE of the north which delegated technical and administrative assistance for a two years period to the Lyonnaise des Eaux as a private operator. It is important to clarify that whatever the contract form is, the "delegated management" is based on the balance between three complementary partners which are: the WE, the operator and the consumer.

The relation between the WE being the "client" and the operator is set during the negotiation and the contract signature. The WE can rely on an expertise of its choice (Tripoli case) to evaluate the propositions and to make its decision.

The WE and the consumer relations are of different nature. Consumers association can interfere in the matter of contractual services such as water quality service and price improvements in the case of Tripoli.
The consumer and operator relation can be established over a commercial exchange; it is the responsibility of the authorities to legalize the public service billing system and to control the technical water quality, service improvements and the financial modalities (structure and tariffs rates).
The forms that confer a big responsibility to the private operator are “the concession and the factoring”. In this case, the operator works in his risks and perils especially in the presence of the investment program financed carefully with the competition of the commercial banks and the public bonds.

f- Proposition of the “Water Code”

The “Water Code constitutes a legislative directive based on consultations and strategic orientations that aims to apply “a sustainable water management concept in order to accomplish an economic and rational utilization of the resource”.

The code acknowledges the fundamental right for each person to have water according to his needs and his elementary requirements for life and for his dignity. It subordinates the expected payment of charges. In addition, it considers that wastewater treatment is an element of the right for water.
The water status is defined in this project as a national wealth. It includes the surface and groundwater comprises also the resurgences of fresh water along the sea coast and the atmospheric water as an element of the earth and aquatic ecosystem.

It foresees the creation of the Water National Council under the authority of the Prime Minister and participated to the definition of the general objectives and orientations of the water national policy. The council can also define the priorities to be retained in order to reach theses objectives and implement the general water master plan, the tariff policy, the taxes and other projects of all nature linked to the water management. The council calls for organizing the environmental protection police and also launching research, teaching, training and awareness at all educational levels.
In general, the council studies each proposition that aims at improving or facilitating the resource management.
The instruments of sustainable water management are established in the framework of hydrographic basins, completely integrated in the general water master plan and applicable on the whole national territory including the coastal water. This master plan defines the basin catchments area, detailing its characteristics and justifying its elaboration, starting from the resource to the ecosystems evaluation. This part of the “Water Code” suggests to conclude contracts with public and private entities, in order to ensure the sustainable management of the resource (surface, groundwater).

Title III of the code defines the implementation mechanism of the sustainable management and provides also the administrative application measures of the present code by means of the “water police”.

The economic and financial regulation of the water management gives to the WE an industrial and commercial status, financed primary by the water services delivered to the consumers in conformity with the service continuity principle. The tariffs are determined on the basis of a financial and a clear social and economical approach and by the implementation of the “polluter payer” principle. It should permit to accomplish the financial balance of each service, taking into consideration the social and economic status of the consumers. These tariffs might be progressive according to the consumed volumes.

The consumer’s information regarding the tariffs and also other important issues are organized by the Medias, in addition to the justifications on modifications carried out and their date of implementation. An inquiry in the opinion of the consumers should be achieved each three years. The results of the inquiry are submitted to the MEW and MoF and circulated in the Medias.

Title V of the code determines the scope of work of the WE regarding the expected services for drinking water, irrigation and wastewater treatment. These services might be subjected to the delegated management process and take all possible concession forms adopted by the public authorities. It can be subject of a Build Operation and Transfer (B.O.T.) Contract for a long term period usually of 30 years.

The preventive measures regarding the protection of water and aquatic ecosystems were defined in title VI. The prevention and protection against natural risks and water stress situations are listed in title VII.

Title VIII presents the penal provisions applicable in case of damaging the installations, the hydraulic and telemetric networks and the environment conservation.

The promulgation of this code by the Lebanese Parliament is keenly wished because its contents draw the orientations and regulation framework of a balanced water management. Furthermore, it harmonizes the partnership principles that associate the main water actors such as: the Lebanese Government, the collectivities and the consumers. The implementation of this code confirms the concept of planning and integrated water management in addition to the Lebanese government decision to integrate the European Union Neighborhood Policy (ENP) and mainly the implementation of the EU Water Framework Directives.

g- European Union Water Initiative in Lebanon (EUWI)

The Mediterranean component of the EUWI managed by the Greek Government launched for the first time in the Mediterranean region the “Beirut Water Week” (14 to 17 November 2005) in coordination with the MEW. This international conference was achieved with the cooperation of several international organizations such as:

- ESCWA
- EU
- GWP-Med, (Mediterranean component of the water world program
- MIO-ECSDE
- COMPSUD (Circle of Mediterranean Parliamentarians for Sustainable Development)
- Water Energy and Environment Research Center (WEERC) in Notre Dame University.
- Regional Center for Water and Environment in Saint Joseph University (CREEN/USJ-ESIB)

- MEDIES (Mediterranean Education Initiative for Environment and Sustainability)
- Lebanese NGO for the Environment AMWAJ
- BGR, German Federal Institute for Geosciences and Natural Resources
- GTZ, German Federal Institute of Technical Cooperation
- UNESCO regional office.
- Lebanese National Commission for UNESCO.
- Secretary General of the Catholics Schools in Lebanon.

The General Director of Hydraulic and Electric Resources of MEW deployed important efforts for the scientific organization of this event and the coordination between the different participants. The main objectives of the "Beirut Water Week" conference are as following:

a. Inform about the importance of sustainable development policies, water resources preservation, and access to drinking water and irrigation for every human being.
b. Dialogue as key issues concerning the water public services management with transparency, understanding and tolerance spirit.
c. Compare the various solution adapted by the represented countries to assess their advantages and limitations.
d. Educate the young generation about the "Water Culture" through the school's programs and the media as well as preparing and raising the awareness of teachers.
e. Recommend actions plans to be implemented and conducted in order to accomplish the objectives of Rio de Janeiro and Johannesburg World Summits on Sustainable Development (WSSD). The Agenda 21 and the spirit of the water decade announced by the United Nations Secretary General, Mr. Kofi Annan.

Thirty countries of the Western Asia region, the Mediterranean region and Europe participated in the activities of the Beirut "Water Week". This conference gathered approximately 200 experts, among which 110 international organizations members or representatives of the participated countries.

VI - Opening of the conference at ESCWA (4 November 2005)

The work schedule and the objectives of the Water Week were presented in addition to the regional perspective of the water governance. The discussions focused on the challenges, priorities, key issues to be resolved, mechanisms to be implemented, concepts and action plans to be conducted on the national level.

The first two days in the conference were dedicated to the regional ESCWA seminar related to "Water Governance" and to the role of the partners and civil society institutions in the countries of West Asia.

The objective of the seminar was to provide a platform for discussions and exchanges for all the stakeholders involved in the water management sector in the ESCWA region, such as:

- Water users associations (WUA)
- Operation and maintenance services
- NGO's
- Universities and research centers
- Ministry of Water Resources, Agriculture and Environment
- Public Private Partnership

The ESCWA seminar focused also the following issues:

- Setting the environmental policy for integrated water resources management.
- Technical role of the water utility services in the ESCWA region.
- Stakeholder participation
- Water governance.
- Gender main streaming in the water governance.
- Identification and mobilization of the required financial resources to cover the water demands.
- Legislation and regulation of the water sector
- Installment of an adequate environment for the mobilization of the political authorities.

This meeting revealed to be very efficient on the level of building blocks and exchanges between the represented member countries. The objectives aimed at identifying and comparing the acquired experiences mainly in the areas of water drought management.

The debates led to the identification of the concerned parties and their potential role. The water policy component was highlighted on the national and regional level in the perspective of the institutional and legal reforms needs. Furthermore, participants emphasized also the need for coordination among the different categories of consumers capable of ensuring an equitable and rational distribution of water. This step aims to prevent conflicts between the consumers over the limited resources and to maximize the related social and economical returns.

VI- 1 - Inauguration of the water, energy and environment research center (WEERC)

The “Water Week” was launched on Monday 14 November 2005, with the inauguration of the Water, Energy and Environment Research Center (WEERC) at Notre Dame University (NDU). The interventions focused on the importance of research and training on IWRM application in Lebanon and in the Middle East. In this occasion, the annual award of the WEERC was dedicated to the professor Michael Scoullos, a well known international personality in the water and environment field.

This inauguration created the opportunity to exchange the ideas between H.E the President of the Republic General Emile Lahoud and the European Parliamentarians of the COMPSUD. The issues approached the sustainable development of the water projects in Lebanon. The discussions exchanged in depth the perspectives of the equitable and reasonable utilization of water in the Middle East in the perspective of the consolidation of the peace process in the region.

VI- 2 – Official launching of the Mediterranean education initiative for environment and sustainability (MEDIES)

The MEDIES is a component of the Water European Initiative. It aims to implement awareness campaign for the populations and mainly the young generation by establishing an education program oriented towards the water culture in the Mediterranean. Five training workshops were organized, involving a group of 42 teachers from all Lebanese schools.

During this initiative, many interventions made by the Lebanese water experts, training organizations, international bodies and the MEDIES group representatives. About a hundred participants took part in this event, including the parliamentarians of the Mediterranean countries, journalists and educators of the public and private sectors.

VI- 3 – Group of the Mediterranean parliamentarians for sustainable development (COMPSUD)

The fourth meeting of the group of the Mediterranean parliamentarians for sustainable development (COMPSUD) was held in November 14th 2005 at ESCWA headquarters in Beirut.

This meeting was attended by 23 parliamentarians and politicians from 10 different countries of the Mediterranean region (EU and non EU members).

The issue of COMPSUD involvement in the next Water World Forum (Mexico 16-22 March 2006) was raised and it is considered as a major international event organized every three years by the World Water Council and seeking to the improvement of life standard and the promotion of the social behavior. This meeting focused also on water policies related to the good governance and institutional reforms.

COMPSUD approached also the “Regional Water Dialogue” in the Mediterranean basin and proposed actions plans aiming at improving sustainable development in the framework of a global strategy for the region.

Representatives of NGO's and journalists from 9 different countries were associated to the parliamentarians discussions.

The “Beirut Water Week” was an important communication platform for the European parliamentarians, to establish profitable exchanges with the Lebanese political and governmental authorities through the visits organized by the Ministry of Energy and Water.

VI – 4- National dialogue

The National Water dialogue was launched at Notre Dame University in the 16th of November 2005 by the Mediterranean Component of the EUWI lead by Greece since 2003.

This meeting considered as a first initiative in the Mediterranean countries aimed at consolidating the European Neighborhood policy (ENP) between the EU and Lebanon and to identify the gaps and deficiencies relevant to the national policies and the implementation programs, related to all water sectors in Lebanon.

The Lebanese “National Water Dialogue” aims also at applying IWRM process and identifying the obstacles action plans introduced by the donors for this matter. Moreover, its objective is to establish a permanent platform for coordination and consultations between the principal partners associated in this action, including the donors’ agencies.

The work plan adopted in the “national dialogue” process involves four principal stages:

- Initial workshop for identifying the gaps in IWRM implementation.
- Field visits in order to proceed to the required bilateral and multilateral consultations.
- Workshop to present and to adopt a national action plan.
- Follow up visits and events to overview progress monitoring.

The final objective of this action is to establish a national platform for exchanges, evaluation and recommendations, with the purpose of identifying the main needs and priorities of the country targeted to implement the IWRM concept.

Accordingly, the “national water dialogue” process must take into consideration the EU Neighborhood Policy which represents new cooperation instrument and will provide starting 2007 new perspective of support to finance the development programs in the region.
It includes successively:
- Legal and institutional organization,
- Operation of the Water Establishments,
- Investments programs and projects under achievement,
- Private public partnership.

It is important to mention that the “national dialogues” process initiated in Lebanon represent a first practical experience that will be transferred to other countries of the region.

VI – 5- Regional water and environment center at Saint Joseph University (CREEN)

The seminar organized by the CREEN treated: “The Groundwater in Lebanon towards an information system for sustainable management of resources”.
The presentations and debates focused on the following subjects:
- Existing research capacities in Lebanon,
- Weakness of the measurement mechanisms and quality of existing data,
- Weakness of consultation between the public services involved in the meteorological and hydrological measurements,
- Particular status of the Karst aquifer in Lebanon,
- Evolution of the investigation methods and telemetering system by remote sensing.
- Stochastic complementary models for the precipitations and the volumetric simulation models evaluation of ground reservoir.

Consequently, it was recognized by all participants that the “Water Week” constitutes an ideal platform of communication in order to confirm the necessity of capacity building and research in all the water sectors.
The establishment of a hydrogeology referential revealed to be a high priority for Lebanon.

VI– 6- Closure and resolutions

The closure speech of the “Water Week” was pronounced at the Water, Energy and Environment Research Center (WEERC) by:
- Professor Michael Scoullos – President of the Mediterranean component of the EUWI and the Global Water Partnership (GWP).
- Dr. Fadi Comair, General Director of Hydraulic and Electric Resources of the MEW. In this occasion, training certificates on water education were handed to 42 teachers that took benefit of these sessions, during the “Water Week”, by European specialists.

The main resolutions of the “Water Week” focused on the following points:

a. The Conference recognized the importance of the “national water dialogue”, as viewed in the framework of the EUWI and in support to the European Neighborhood Policy. Its role is to evaluate the actions plans and the projects in the technical, socio-economic, institutional, legal and financial fields.

b. The Conference insists on the necessity of choosing actions and programs for the water sectorial and intersectorial developments. This approach presents the major steps to conduct for the organization operation of the water sector and its institutions. Consultation to coordinate action plans and projects is required for the comprehensive understanding of policies, strategies, technical, operational, financial, institutional, legal, social and educational options.

c. It is recognized that Lebanon is effectively engaged in the reconstruction of its water institutions and the protection, management and access for the population to the hydraulic resources. It is also important to carry and consolidates the benefits of the sectorial organization, implementation of the Decennial Strategic Plan of the MEW and the application of the law 221. The efforts must be carried in order to:
   - Reinforce the integrated water management,
   - Ensure the effective decentralization of means and responsibilities including financial resources and adequate staffing as well as capacity building.
   - Facilitate the emergence of a real regulatory authority for the water sector PPP activities.
   - Participation of the private sector for an efficient management of the water services,
   - Motivate universities and research centers to develop innovation, prepare and train the young generations on the water professions.

d. The Conference stresses on the necessity to create a data base and an information system on the water resources in order to reinforce the knowledge and the status of Lebanon. This action should take into consideration as first priority the preservation of the national hydraulic wealth by adopting a real sustainable development policy. The status of the water resources is confronted to climatic changes, pollution and urbanization. The effect of these factors must be observed and measured permanently. The strategies and the investment programs must be evaluated and implemented on the basis of the actual status of the natural environment, its evolutions and the major risks that can affect the ecosystems equilibrium.

e. The Conference supports the MEDIES initiative and recognizes the importance of the awareness and the population education to the water and environment culture.

f. The conference congratulates the engagement of the European Union to pursue its support to Lebanon in reinforcing the water sector in conformity with its neighboring policy and with its program of MEDA WATER.

g. The Conference stresses on the need to financially support the application of the Lebanese national action plan, in the framework of the European Neighborhood policy (ENP).

h. The concerned parties in the water governance dialogue request a better identification of the civil society implicated in the water sector. The role of stakeholders requires a clear identification in order to implement the major activities related to water governance of IWRM.

i. The conference recommends:
   - To encourage the political involvement of the governments in order to initiate the (ENP) policy, reinforce the partners and encourage their implication in the water sector.
   - To establish bonds between all water sectors stakeholders in order to ensure a better coordination, solve the concurrent demands, and optimize the socio-economic revenues of the water consumers.
   - To improve visibility in each water event and encourage the media coverage in order to mobilize the public opinion and influence consequently their decisions on questions related to the water resources and the environment.
   - To reinforce brain storming and skills for establishing regularly reports in water status and generate pertinent operational interventions.

j. Finally the Conference highlighted the importance of applying the United Nations Convention of 1997 concerning International Watercourse management in order to underlines consensus related to "equitable sharing and reasonable use" of transboundary basins.

Therefore, the participants of this conference support the proposition of the General Director of the Hydraulic and Electric Resources of Lebanon that consists of elaborating university training programs which treat the subjects of IWRM and hydrodiplomacy of the transboundary watercourses in order to encourage the "Water Culture" as an option for the peace in the Middle East.
This proposition aims to harmonize strategies and policies applicable in the bilateral and multilateral negotiations on international rivers. The "Water Culture" in the Middle East is an essential and indispensable subject for the peace process evolution in this region.
The implementation of IWRM concept in the diplomatic context allows to approach in practical terms regional negotiations in a spirit of cooperation in order to eliminate the specter of "Water Wars" in the Middle East. Therefore the transboundary watercourses will be consider as a "catalyst" for peace and consequently leading to sustainable economic productivity in the region.

VII- Paris III donors meeting for the water sector

On January 22, 2007 the Water Sector Reform Workshop took place in Beirut at the Grand Serail in the presence of H.E the Prime Minister Fouad Seniora aiming to organize the Paris III Donors preparatory meeting.
During this workshop, Dr. Fadi Comair presented the strategic water paper that has been sent to the donators countries. A summary of its content is presented in this section .

VII-I Water strategic paper

All the stakeholders agreed that water is a vital resource for Lebanon whether it is surface or underground and must be planned and managed in:

- a global integrated approach
- with a quantitative, qualitative, coherent and balanced concept

Attention should be made to long term planning and management for urban and rural development. It is required to secure sustainable development.
The specific management of each application of water should be efficient, harmonious and evolutively balanced involving a vast number of both public and private bodies partnership.

Management of the water resources involving legal and institutional tools should be suitable for all water sectors (drinking, irrigation, sanitary, flood mitigation and reuse).
The application should be made with the involvement of scientific, technical, economical and financial instruments which are properly adapted for the social and cultural Lebanese environment.

Integrated Water Resources Planning and Management (IWRP and IWRM) required greater collective awareness, solidarity and cooperation on all sides (Ministries, Water Establishment, Municipalities, Private Sectors, Regulatory Bodies, Donors Agencies).

The principal challenges facing the sector can be summarized as:

- Increasing the availability of both potable and irrigation water in the Summer and Autumn by stocking the Lebanese water in dams, hill lakes and recharge the aquifers; collecting and treating the large proportion of wastewater that currently pollutes streams, aquifers and coastal waters throughout the country;
- Reducing the estimated 50% loss of water in distribution systems;
- Transferring the full cost of providing water supply and sewage disposal services from the State to consumers, through an equitable tariff and collection system;
- Streamlining and increasing the effectiveness and efficiency of the institutions responsible for water supply, sewage disposal and irrigation.
- Establishing a new concept of Private Public Partnership for managing the water sector.

The key reforms that should be implemented in the coming 2-3 years can be summarized as follows:

- Updating of the 10 year strategic plan endorsed by the Lebanese Government and the Lebanese Parliament along with preparing an integrated Water Sector strategy with a clear vision under the concept of the Law 221, its amendment and the By laws published in October 2005..
- Preparing and approving a National Water Master Plan and a “Water Code”.
- Improving the water sector governance by ensuring that all the necessary tools are put in place.
- Strengthening the capacities of the MOEW and RWAs to enable them to carry out in an efficient and optimal way the tasks entrusted to them.

- Ensuring that Operations & Maintenance (O&M) of the water supply and sanitation services are contracted out to private operators and that the O&M of the irrigation small and medium schemes are gradually transferred to Water Users' Associations.
- Adopting an adequate tariff structure that would be based on costs and volumetric consumption taking into consideration an equitable tariff for the needed population.
- Preparing a short and medium term investment plan for the water sector taking into account the priorities and available funds.

The supply of drinking water in Lebanon should be guaranteed for everyone of the population.
At every level, water should be subjected to constant surveillance from the time it is harnessed up to the point it is returned to nature. The water quality should be guaranteed by the measurement of 63 parameters defined by the Lebanese Ministry of Health in compliance with WHO standards.

Consumption of drinking water should be stable and the campaign against leaks (unaccounted for water) in network and the introduction of none effective household apparatus have to compensate for increasing demand resulting from demographic growth and improvement to people standard of living.

- Metering should be systematic in Lebanon: individual meters should be installed (or collective ones in the case or touristical or industrial building) to allow us to measure water consumption by subscribers who, a result feels more responsibility for their levels of consumption.
- Dispatching centers should control all the distribution networks in order to ensure operation and transparency.

More than 70% of the water consumed in Lebanon is used for irrigation cultivated lands. This proportion will increase as a result of demographic growth which is bound to bring an extension of cultivated land and intensification of crop farming.
In order to manage major irrigated zones in Lebanon, the Ministry and the water establishments has to ensure the construction, exploitation and maintenance of water – related infrastructures (reservoirs, canals, galleries and networks). The water establishments has to manage the big irrigation projects leaving for the water users associations (which should be integrated within the By laws the management of medium and small scheme projects). The Ministry of Agriculture and other organizations (NGO's) should offer consulting services to farmers with a view to more National use of water (incentives for water savings, good fertilization practices).

Water policy in industry and energy generation should targets better quantitative and qualitative management. The policy seeks to control the risks of chronic or accidental pollution. Water establishment should have substantial experience in the area of industrial pollution central. Consequently, waste from major industry aught to be well controlled.
The communication process with the Lebanese industry should lead the industrial companies to develop innovative process for the multi-site treatment of industrial effluent (problem of Litany and Jeita Catchment pollutions).

Throughout the whole world, increasing populations and the desire/demand for increasing quantities of water to satisfy expectations for higher standards of living have inevitably led to the recognition of the need to optimally use all waters and to maximize the reuse of treated waste waters.

Promoting the safe and efficient use of treated wastewater for environmental protection and public health safety, and encouraging the safe use of this renewable source of water shall constitute a new source for irrigation of non-edible crops (containing important nutrients for intensive agricultural practices), artificial recharge of the aquifers, as well as industrial water uses (for example, for cooling and process water needs).
On the other hand, the core issue for sustainable water resource usage is enhancing the water use efficiency and that water saving should be given higher priority than exploitation of new sources.
On the operational level, it would be advisable to draw a first outline of this water development plan even if the required data is not completely available or dependable. This would serve as a tool for taking some forthcoming decisions and determine the steps needed to improve this plan. Progressively, these water policy documents will be refined and at the same time allow to deal with the actual requirements in order to preserve the necessary water allocation to the Lebanese population.

Table 3 presents the matrix concerning the Sector Reform study of water and waste water.

Sector Reform Objectives	Completed Actions	Actions to be completed by June 30, 2007	Actions to be completed by December 31, 2007	Actions to be completed by December 31, 2008	Reform Outcome – by December 2008	Principal Responsibility
Integrated Water Sector Strategy & Policy.	- 10 Year Strategic Plan, Ministry of Energy and Water (MOEW) - CDR Development Programme 2006 – 2009. - EU Neighbourhood Policy. - Privatisation study « Société Générale », Rafik ElKhoury. - Report on Water Sector Policy and Action Plan, IPP Water. - Agriculture Sector Strategy (FAO/World Bank). - World Bank Water Sector Note. - World Bank Irrigation Sector Note.	- Cabinet approval of "Water Code".	- Preparation of the national water sector strategy and a Water Master Plan that would take into account: availability of water resources (irrigation, domestic & industrial) and Institutional, regulatory, financial & environmental aspects. - Public Expenditure Review of the water sector. - Benchmarking study & performance indicators (Unaccounted for Water, Cost recovery, collection rate, etc.). - Complete a study of modernization of Irrigation with MOA. - Complete a survey of users` satisfaction.	Government's approval of Integrated Water Sector Strategy & Policy.	- National Water Master Plan. - "Water Code".	MOEW in association with CDR/RWA/ MOA/ MOEnv. / Donors.
Improve Sector Governance.	- Law 221 and its amendments. - Decrees (By-Laws) October 2005. - Appointment of Boards and DGs for all the Water establishments.	- Finalize model organization under Law 221 for MOEW. - Reactivate the National Water Council.	- Cabinet decision to allow: * RWAs to recruit qualified staff. * Procure Works, Goods & Services with appropriate thresholds. * Management contracts with private operators. - Establish mechanisms for tariff adjustments and service standards. - Establish a review process to define the roles of each stakeholder. - Initiate the process of handing over the O&M of small/medium irrigation schemes to Water Users' Associations.	- Adopt mechanisms for tariff adjustments and service standards. - Complete the process of handing over the O&M of small/medium irrigation schemes to Water Users' Associations. - Finalize MOEW organization under Law 221. - Update RWAs Business Plans. - Study & draft water sector regulatory framework.	- Finalized regulatory Framework. - New organization of the MOEW set up. - Clear definition of roles & responsibilities of the various actors. - Establishment of Water Users Associations for irrigation. - Clear policy on cost recovery and subsidies for sector.	MOEW in association with CDR/ RWAs/Donors.

Table 3: water and wastewater sector, reform strategy workshop – matrix

Sector Reform Objectives	Completed Actions	Actions to be completed by June 30, 2007	Actions to be completed by December 31, 2007	Actions to be completed by December 31, 2008	Reform Outcome – by December 2008	Principal Responsibility

Sector Reform Objectives	Completed Actions	Actions to be completed by June 30, 2007	Actions to be completed by December 31, 2007	Actions to be completed by December 31, 2008	Reform Outcome – by December 2008	Principal Responsibility
Capacity Building.	Law 221 and its amendments.	- Finalize training program for the RWAs staff with KfW, EU & WBI. - Prepare a detailed plan aimed at reinforcing MOEW, RWAs and LRA staffing & logistics.	- MOEW and RWAs to set measures to optimise O&M of water and wastewater facilities. - Bylaws of Law 221 fully implemented by RWAs. - Complete MIS in all RWAs. - Install an integrated financial & accounting system in RWAs.	- Recruitment of qualified staff in MOEW, RWAs and LRA.	- Completion of water establishments staffing plans, management and equipment tools.	Government, MOEW & RWAs /LRA.
PPP & Private Sector Participation.	- Tripoli Water Authority Management contract. - Baalbeck-Nabi Chit Service Contract (O&M). - O&M contracts for wastewater treatment plants under construction. - LWPP. - Consultant appointed to study PPP options for North Lebanon.	- Assess Tripoli management contract by independent party. - Study PSP possibilities in Irrigation with Litani River Authority (LRA).	- Prepare a regulatory framework which includes dispute resolution. - Appoint a consultant to MOEW, CDR and RWAs to develop model Tender and Contract Documents for service, Management Contracts (with WB assistance) and Model Contracts for Regulation (GTZ).	- Set up of a regulatory body for the water sector. - Establish a regulatory framework which includes dispute resolution.	- Model Tenders for RWAs. - Service Contract launched for RWAs. - Regulatory body in place.	CDR in association with MOF, MOEW, RWAs
Sustainable Use of Water Resources.	MOEW 10 Year Programme: - Shabrouh Dam - Brissa Dam - Extension of Dbayeh Water Treatment Plant.	Finalizing the evaluation of tenders for Canal 800.	- Appointment of consultant to update the studies relating to Awali-Beirut Conveyor, Bisri Dam. - Appointment of a committee of experts to recommend guidelines for re-use of treated wastewater.	Secure finance for: - Boqaata, Assi, Nahr Ibrahim, Nahr El Bared & Bisri Dams. - Awali-Beirut Conveyor. - WSS O&M (South & Bekaa regions) for RWAs.	Start construction of the Dams and the conveyor.	MOEW & CDR in association of MOF & MOA.
Strategy for Sanitation, and Targeting the Poor.		- Apply for GPOBA funding for targeted subsidies to low income communities. - Apply for BNWPP.	- Complete GPOBA study.	- Implement GPOBA. - Secure Donor funding for implementing recommendations of the feasibility studies for sanitation.	- GPOBA report and launching implementation.	MOEW in association with MOF/ CDR& RWAs.

– The above matrix is based on the original one presented during the workshop held on January 15, 2007. However, the number of rows has been reduced from 8 to 6 to avoid duplication.
– The aim of all above implementation reforms and actions is to optimize the use of available water resources in an integrated way and to reduce the sector dependency on national budget.
– All current investments and institutional strengthening programs are to be completed according to their original schedule as set by the managing authorities.
– Emerging program aimed at repairing war damaged facilities should be completed before end 2007.

BNWPP: Bank/Nederland Public Private Partnership *PSP: Private Sector Participation* *LWPP: Lebanon Water Policy Program.*
GPOBA: Global Partnership for Output Based Aid. *IPP: Investment and Planning Programming*

Table 4: water and wastewater sector, reform strategy workshop – matrix

VIII- Action Plan for Iwrm Enforcement in Lebanon

VIII-1 Main topics for a national action plan

This study could initiate the main topics of an action plan aiming at defining an overall water policy. These topics can be summarized as follows:

- Monitoring and data collection
- Strengthen, optimize or put in place the measurement networks necessary for a better knowledge of water resources (hydrometry, piezometry, water quality …).
- Better evaluate the water resources both underground and surface; particularly determine the limits of exploitation of aquifers during the drought period.
- Carry out an assessment of water withdrawal for different purposes and particularly, irrigation and potable use; engage in putting in place metering device systems.
- Develop an **efficient system for data collection and management** concerning resources, demands, and all parameters affecting the balance directly or indirectly.

Technico-economic studies:

- Continue with **the studies of dam sites** and hill lakes;
- Assess the possibility of captage of **submarine springs** even though this solution is highly expensive due to energy cost needed for pumping;
- Establish a list of **equipments** needed to supply the various geographical regions: wells, river intakes, basin to basin conveyance; and verify their feasibility.

A more accurate water balance (demands v/s resources):

- Determine the water balance (demands v/s resources) for each geographic unit as far as new data is available, particularly, refine information related to the resource and include elements of sector policies that induce water demands.
- Alert persons in charge of these sector policies on the actual situation in the water sector in general and for irrigation in particular.

Efficient water management and protection:

- Find ways to **rationalize** and optimize water use in order to save this resource. Public awareness campaigns shall be set for that matter.
- Appreciate the **vulnerability** of the various water resources and put in place a strategy for protecting aquifers and rivers: wastewater collection and treatment, captage protection
- Study a reform of the water institutions and laws, aiming at reaching a better efficiency.

A water policy to be adjusted periodically:

- establish an overall strategy, under the framework of a **water development and management plan**, incorporating all aspects mentioned above (in addition to others, such as flood prevention) in order to insure the consistency of the various actions and allow a maximum efficiency; put this plan in the frame of development master plan reflecting the national territorial development policy.
- Periodically adjust these various components (for example each 3-5 years), to take into account the effective growth of socio-economic characteristics of Lebanon and new

objectives to reach. The following flow charts present the IWRM Enforcement plan to be carried out by MOEW and related GOL Institution

The master plan of water management in Lebanon should consider the following chart of actions to be implemented for IWRM enforcement. These are structured under major themes:

1- Information system for the water sector
2- Adaptation of the institutions
3- Economic analysis
4- Health and environment
5- International basins
6- Projects

ACTIONS

OBJECTIVES

Theme No.1: INFORMATION SYSTEM FOR THE WATER SECTOR

A- Reactivate measurement networks:
- Flow measurement of water courses during the drought
- Validation of existing data
- Concept and execution of networks:
  - flows (springs and rivers)
  - levels (aquifers)
  - water quality
  - organization of the hydrology department

1. Verify Balance in the actual situation
2. Upgrade the value of existing hydrologic data
3. Collect additional data concerning surface water resources, as well as the evolution of aquifers

B- Data base:
- Management of hydrologic data
- Geographic Information System for the water

1. Facilitate the access and the updating of water related information
2. Edit plans to assist in decision making

C- Simulation models by watershed
- Prediction of resources during the drought period
- Simulation of the impact of water extraction

1. Anticipate drought situations
2. Assist in the evaluation of future water balance

D- Show information on aquifers (3 aquifers are concerned)

Evaluate the possibility of a more intensive use of aquifer water

General Study

Particular Study

ACTIONS | **OBJECTIVES**

Theme No.2: ADAPTATION OF THE INSTITUTIONS

A- Institutional study:
- Diagnosis of the actual situation
- Propositions for the distribution of roles

1. Determine the role of the Government, the communities, the private sector, according to the projects importance (regulation, financing, execution and private public partnership.)

Theme No.3: ECONOMIC ANALYSIS

A- Economic value of water:
- Updating of the price for existing schemes
- Impact of the structures on the water cost
- Principle of water tariffing in general

1. Set the permissible limits of projects costs
2. Propose a tariffing system that includes preventive measures for pollution and spill.

B- Economic data for hydro agricultural projects
- National objectives for agricultural production
- Cost effectiveness of irrigation for the farmer
- Parameters for group productivity and impact on industry

Acquire basic elements for the economic evaluation of the projects case by case

C- Economic evaluation of urgent projects (Ex: North and South Lebanon and North

Check the projects economic feasibility for the community, the farmers and the management

General Study

Particular Study

ACTIONS | **OBJECTIVES**

Theme No.4: HEALTH AND ENVIRONMENT

A- Setting of sanitary and environmental objectives:
- Diagnosis of the actual situation
- Water quality objectives and criteria to be applied

→

1. Establish priorities for the elimination of pollution
2. Set objectives to reconquest rivers, aquifers and swimming places

B- Study of the protection of the main potable water intakes
- Actual chronic or accidental pollution
- Recommended measures

→

1. Identify proclaimed contaminations and risks
2. Protect water intake.

Theme No.5: INTERNATIONAL BASINS

H- Development of international rivers
- Evaluation of resources from Lebanon
- Identification of projects of international use that could be executed in Lebanon

→

Already implemented with Syria for the Orontes and the Nahr el Kebir but still pending for the Jordan River.

General Study | Particular Study

ACTIONS

OBJECTIVES

Theme No.6: PROJECTS

I- Definition and programming of hydraulic development projects within the 10 year plan

- Updating of existing studies
- Master plan for water resources
- Hydro agricultural master plan:
- Water supply master plan for the coastal region
- National wastewater master plan

4. Allocate water resources according to location and usage.
5. Determine works and structure in a coherent approach
6. Establish a time frame for financing and execution
7. Undertake necessary studies when needed

N- Feasibility studies for dams within the 10 year plan

- Additional topographic, geologic and hydrologic studies
- Additional concept studies
- Cost estimation

1. Amend existing studies to reach a homogeneous level of precision, thus allowing a rational decision making
2. Eliminate non feasible projects or structures.

General Study

Particular Study

VIII-2 Operational Level

On the operational level, it would be advisable to draw a first outline of this water development plan even if the required data is not completely available or dependable. This would serve as a tool for taking some forthcoming decisions and determine the steps needed to improve this plan. Progressively, these water policy documents will be refined and at the same time allow to deal with the actual requirements.

As a long term strategy, an integrated water resource management system is to be established. The broad objectives of this water management shall cover the utilization and development of water resources in an efficient, environmentally sound, equitable and reasonable manner in order to satisfy society's demand for water, water -related goods and services, as well as to safeguard the ecological functions of water resources. It aims at providing all users with sufficient amount of water, to guarantee efficiency in water usage by maintaining balance between supply and demand and by sustainable development of water and other related resources.

Throughout the whole world, increasing populations and the desire/demand for increasing quantities of water to satisfy expectations for higher standards of living have inevitably led to the recognition of the need to optimally use all waters and to maximize the reuse of treated waste waters.

Promoting the safe and efficient use of treated wastewater for environmental protection and public health safety, and encouraging the safe use of this renewable source of water shall constitute a new source for irrigation of non-edible crops (containing important nutrients for intensive agricultural practices), artificial recharge of the aquifers, as well as industrial water uses (for example, for cooling and process water needs).
On the other hand, the core issue for sustainable water resource usage is enhancing the water use efficiency and that water saving should be given higher priority than exploitation of new sources.

CHAPTER XI

Hydrodiplomacy in the Jordan River Basin
Conflict between Lebanon and Israel
on the Hasbani-Wazzani River

Hydrodiplomatic Stakes of Chebaa Farms

I – Introduction

Since 1948, Israel started the design of a huge water supplies project entitled the "National Water Carrier" using the water of the Jordan River basin in order to irrigate the arid regions of Neguev, situated in the Southern part of the country.
This large scale project launched in 1951 and programmed to be executed on the basis of three main phases was the origin of many military operations between Tsahal and its neighboring Arab countries. The construction phases of the National Water Carrier were the following:

First construction phase: Consisted of draining the marshy zone of Houle with the aim of increasing the water input of Tiberiad Lake. These works that reached the Syrian territory have resulted in an armed conflict between Tsahal and the Syrian Army. The Israeli air forces targeted the village of Al Hammah situated in the demilitarized zone on the borders of Lake Tiberiad causing then the massive exodus of the Arab populations.

Second construction phase: Despite the decision taken by the Security Council ordering to stop the construction works, Israel started over in 1953, digging of a second canal in Jisr Bannat Yacoub in the south of Houle and this under the protection of Tsahal. Having considered these works undertaken by Israel within the demilitarized zone as illegal, Syria deployed its armed forces all along the border and opened fire against the construction sites. This situation lead to an armed conflict between the two countries followed by the intervention of the United Nations and American mediations (known as Johnston mission) which put a temporary end to the conflict but without reaching a settlement for the problem concerning the division of Jordan River.

Third construction phase: The Israeli project was launched in 1956. The plan intended to divert the waters of the Jordan River at the locality of Ested – Kinerot, on the shores of the Tiberiad Lake, avoiding the problem engendered by the constructions undertaken in the demilitarized zone. As a response to this step, the Arab countries convened in January 1964 in the headquarter of the Arab League in Cairo, decided to implement the project on the derivation of the Hasbani River in Lebanon and Banias in Syria to the Litani and Yarmouk basins. Tsahal replied directly with an air strike to the works sites in Lebanon and Syria, in March, May and August 1965, then in July 1966. The Israeli occupation of the Golan Heights in June 1967, has given a final term to the Arab plan.

Unfortunately, all these uncontrolled unilateral actions, which started in the 1950's by the Israeli Government, had direct consequences on Lebanon through the pressures initiated by the Hebrew state to prevent Lebanon from using the waters of the Hasbani River. The Lebanese government was not able to meet the needs of the southern population in drinking water and irrigation. This situation that lasts till now shows that Israel continues to impose its hegemony all over the water sources of the Jordan River by controlling in a systematic manner the global management of the basin.
This Israeli approach of the water issue in the region and especially in Lebanon was completely rejected by the "point 4" mission (United States Bureau of Reclamation) based in 1950 in Lebanon. They established a master plan for the Lebanese waters and underlined in their final report that the improvement of the socio-economic conditions of south Lebanon is mainly related to the integrated water development of the Litani and Hasbani Basins. This was confirmed after 40 years (July 1999) by the UNDP study undertaken in this region, and also by the High Committee of Relief of the Lebanese Government.

Since 1978 and during the 22 years of the Israeli occupation of south Lebanon, the majority of inhabitants of this district took their way to the exodus. The citizens of the South were forced to leave their houses to the destination of the capital and live in its Southern Suburb “Dahiya Janoubia”. They constituted the poverty belt of Beirut; while those who stayed there were not permitted to use the available water resources in order to fulfill their needs. Moreover, the Lebanese Government was unable during this period to develop the drinking water and irrigation supplies networks in the occupied zone. As a result to this situation, the Israelis beneficiated from this opportunity to irrigate wide zones in their territory by using the Lebanese share of the Hasbani river without verifications or compensation, breaching through this conduct, the provisions of the United Nations Convention on non navigational use of international watercourses (1997). It was obvious for the observers on the southern border that the Israeli rural development contrasted with the regions that experienced the war in the Lebanese territory and of which Israel was the main cause.

II – Liberation of South Lebanon and beginning of the conflict on the Hasbani - Wazzani watercourse.

In May 2000, most of the Lebanese territory was liberated with the exception of the Chebaa Farms and three localities within the “Blue Line” drawn by the United Nations Organization, as a withdrawal line. The Lebanese government issued reserves on the permanent occupation of its territory and launched a diplomatic campaign towards the United Nations to restitute this territory. In parallel to this diplomatic approach, the Lebanese resistance, mainly constituted of the Shiite party of Hizbollah, proceeded to military action for the liberation of the Chebaa Farms. The liberation of the South has encouraged the entire communities to get back to their destroyed villages and cultivate their lands despite the presence of the mines. Consequently, the water needs substantially increased in south Lebanon which leads the Lebanese government to fulfill this demand by relying on the Wazzani source. Israel used this water source since longtime ago and installed two pumps with a capacity of 2000 m^3 per day in the intake basin of the Wazzani.

On 31 August 2002, the Lebanese Government through the Council of the South started the construction of a pumping project in the Wazzani catchment basin with the purpose of providing drinking water supply (12000 m^3 per day or 4.4 million m^3 per year) to the villages of the region. The water assessments studies have shown a “Water Stress” situation on the overall basin because the quantity allocated for every inhabitant is 50 liters per day while the consumption of every inhabitant in Israel is about 350 liters per day. The lack of water resources in the Hasbani basin leads to mobilize only a total volume of 3190 m^3 per day for a population counting 65000 inhabitants.

Since the starting of this project, Israel continued to accuse Lebanon for diverting the Hasbani watercourse to the Litani basin region. The Israeli government accused Lebanon that the Wazzani project constitutes a violation to the international law. As a result of this complicated situation, it appeared that the Israeli accusations were completely void without relying on any basis and contradicted the real action taking place on the project site.

II – 1 Reactions of the Lebanese political leaders

Facing the Israeli allegations, the permanent contact was directly established between the Lebanese leaders. The Speaker of the parliament and the Prime Minister studied the whole measures to be taken on the national, regional and international levels. A crisis cell was formed by the Prime Minister Rafic Hariri, with the objective to prepare a convincing file, full of facts and based on technical, socio-economic and judicial data in order to present it as soon as possible to the international community.

The threats of the Israeli Prime Minister, Ariel Sharon, were taken very seriously by the Lebanese officials who doubled the declaration to condemn them. In New York, the Minister of foreign affairs, Mahmud Hammoud who was assigned to the works handled by the General Assembly of the United Nations, was received on 14 September by the Secretary General Kofi Annan. During the meeting, Mr. Hammoud has supported the Lebanese project with respect to the utilization of the Wazzani waters and requested the United Nations support. Minister Hammoud has rapidly asked the United States Ambassador in Beirut, Vincent Battle, to protest against the threats of Prime Minister Sharon. Moreover, he asked the Secretary General of the Ministry, Mohammad Issa to convoke the ambassadors of the permanent member States of the Security Council and to communicate the Lebanese position to the leaders of their countries. The Minister of foreign affairs also protested violently from New York against the Israeli threats. He requested as well from his team to prepare a memorandum on the Lebanese rights concerning the Wazzani waters, which has been distributed to the ambassadors of the member States of the Security Council.

The head of state, President Emile Lahoud, while receiving a delegation of French-Lebanese friendship group of the French Senate, headed by senator Adrien Gouteyron, declared on Saturday 4th of September 2002 that “the Lebanese decision to start using the Wazzani water in order to irrigate the lands and supply the villages suffering from drought in south Lebanon is a final and irreversible decision. The Israeli threats shall not be able to prevent us from applying international agreements and conventions that give the right for nations in using the water taking rise from their territory. Lebanon follows up its contacts with the United Nations to display its position, based on its legitimate right in irrigating arid lands in South Lebanon. All means of pressures would be exercised on Israel in order to stop causing a new problem for our country”.
President Lahoud has recalled that Israel, all along the years of its occupation in South Lebanon, pumped the Wazzani water to irrigate its lands and supply touristic projects and pools. However, he underlined that “This fact does not grant to Israel the right to continue its aggression and that Lebanon considers the conduct of the Hebrew State as a transgression of the national sovereignty, mainly after the liberation of the major part of its territory.”

In addition, the Speaker of the Parliament Nabih Berry, during his weekly meeting with the President of the Republic has evoked the question of Wazzani confirming that “Lebanon has the complete right to increase its share of the water sources”. Mr. Berry convened as well with the Ambassador of the United States and declared that “Facing the General of War, thirsty for blood (Ariel Sharon), it is important to put in force the international law as soon as possible in this region.”

Always regarding the same question, the Minister of energy and water, Mohamed Beydoun has condemn the Israeli threats indicating that by virtue of the international conventions, Lebanon is entitled to have at least 70 million m^3 of the waters of Hasbani – Wazzani watercourse, while Israel is using the whole of the output.

Hezbollah, the Shiite militia in Lebanon, hurled back by threatening to shell the Hebrew State if Israel attacks the pumping plant.

II – 2 Reactions of the international community

American reactions

The United States decided to directly intervene in the litigation arising between Lebanon and Israel on the utilization of the Wazzani waters. In Jerusalem, an american official who requested the anonymity indicated that “Washington has decided to send a mediator to seek a settlement for the conflict between Lebanon and Israel with respect to the utilization of the Wazzani waters. This American mediator will visit the region within few days and will start then the discussions with the Israeli and Lebanese officials in order to find a solution of a peace compromise”.

As to Richard Armitage, the vice Minister of foreign affairs of the United States called for “taking this matter with great seriousness” and sent to Lebanon the hydrologist in chief of the State Department, Charles Lawson to handle consultations with the officials of the Ministry of energy and water.

b- Reaction of France

The President of France Jacques Chirac during his short visit to Beirut in August 2002 within the scope of the Francophone Summit, has called both parties to avoid all kinds of instigations. France has sent two experts on the field, in a mission of expertise for the settlement of this conflict.

c- Reaction of the Arab League

The Arab League has expressed in a "communique" its support to Lebanon and its “great concern” towards the Israeli threats against this country.

The league has announced that the Lebanese point of view with respect to the utilization of the Wazzani and Hasbani waters “relies on a legal basis and on the international law provisions”. The league has also underlined that “the Israeli Government has threatened with war in order to prevent Lebanon from beneficiating from its waters”.

d- Reaction of Russia

The Russian Minister of foreign affairs has called Lebanon and Israel to settle their disputes in a peaceful manner through negotiations “taking into consideration that the lack of water resources in the Middle East represents a traditional reason for tensions.” He indicated in his statement published on 13th of September 2002 “that it is primordial to take immediately the necessary measures to settle the current conflict between Israel and Lebanon because this will cause the aggravation of the situation which is already very critical between both countries”.

III – International mediations

Mr. Terje Road-Larsen, the personal representative of the Secretary General of the United Nations, Kofi Annan, has recognized in 2002 the rights invested to Lebanon concerning the waters of the Wazzani. Stephan de Mistura, the UN representative in Lebanon has recognized also that the United Nations will bless a peaceful settlement for this conflict, particularly that the Lebanese Parliament ratified in 1999 the UN Convention on the Non Navigational Uses of International Watercourses.

From the American point of view, the water expert of the State Department Charles Lawson, arrived to Lebanon on the 18th of September 2002 and headed directly to the Wazzani source to examine the situation in the presence of a Lebanese delegation presided by Mr. Fadi Fawaz the technical consultant of the Prime Minister Rafic Hariri and the Director General of Water and Electric Resources, Dr. Fadi Comair. The European Union has also sent a delegation of experts presided by Mr. Franco Mazzettii, President of EMWIS the Euro Mediterranean water Information System. Mazzetti has invited the officials in charge of the Ministry of Energy and Water to collaborate with the European Union in order to launch a socio economic development program for South Lebanon.

The Lebanese Government underlined that the American expertise won't have a binding value but it shall be lately taken into account within the framework of the mediation of the United Nations Organization, being the only international authority competent to settle this conflict.

It is important to note that after the media row that surrounded the launching of the project for internal political reasons related to the parliamentary elections in South Lebanon, the Lebanese authorities rapidly led this issue to its real dimension. The position of the Lebanese diplomacy leaned on the fact that the country owns legal and convincing assets since, unlike Israel; Lebanon has ratified the UN Convention on the Non-navigational uses of International Watercourses. Lebanon has perfectly the right to call the UN and defend its point of view according to the actual pumping volumes that are considered to be of reasonable quantities. The design of the Wazzani project fixed a total of 7 million m^3 / year while the Johnston plan of 1950s allocated to Lebanon 35 million m^3. Hence, this approach was made to meet the real need of the South Lebanon population. The Lebanese experts Commission appointed by the Prime Minister to prepare the Wazzani file declared that the position of Lebanon would be strong and will constitute a real challenge to Israel since it leans on the general provisions of the UN Convention pertaining to the equitable division and the reasonable water use. The elements that were used to apply this approach for an equitable sharing were based on the following factors:

Interaction between surface and groundwater of the Jordan River. If the division of surface waters is relatively easy, the mechanism for groundwaters is quite complicated.
Technical of the Jordan basin and economical characteristics as well as the social situation of the inhabitants.
Priority in the water division that firstly concerns the domestic and then the irrigation sector.
Direct negotiations with Israel are impossible and it is necessary to seek indirect negotiations through the United Nations.

Despite the Lebanese optimism, international observers were predicting escalations to the extent that the threats of an American war against Iraq were definite. These observers were afraid that Israel takes advantage from the new regional context to attack the Hezbollah, the ally of Syria and Iran. From their points of view, the Wazzani conflict may be the pretext of a regional escalation. This is the reason why the EU and UN diplomats invest all efforts to calm down the political position of all stakeholders and reduce tensions in order to enforce the diplomatic solutions.

III – 1 Mediations of the USA

On the 19th of September 2002, two meetings took place in the Ministry of Energy and Water with the American mediator Charles Lawson that occupies the position of Chief hydrologist in the State Department. Lawson informed the Lebanese officials that the Israeli has until now expansion projects on the waters of the Jordan River. These projects remains to be executed, even after a half century of the elaboration of "the Johnston" plan. Lawson has clearly indicated to the Director General of the Hydraulic and Electric Resources Dr. Fadi Comair that Lebanon shall compose with its Israeli neighbor and call for international mediation to avoid the arise of a new escalation of the situation which may be translated in a bombardment against Lebanon. It has also indicated that the United States may be the main mediator nation in this conflict. It is worth to mention that the visit of Mr. Lawson was preceded by a visit of the experts of the USAID headed by Mr. Raouf Youssef, the Director of the agency in Lebanon accompanied with American experts of the Water Authority of Jordan (WAJ).

The core of the discussions concerning the Wazzani project between the Lebanese and American parties are stated in the following paragraph.

Negotiations between Lebanon and USA

Lebanese Party	**Representative of the American State Department: Charles Lawson**
Lebanon has expressed it "Good Will" towards the International Community by ratifying on 13 March 1999 the UN Convention (1997) on the Non navigational Use of International Watercourses. In the execution of the Wazzani project, Lebanon has implemented article 5 of this convention which defines the provision of an "equitable and reasonable sharing" as well as the factors related to the implementation of such provision. The Lebanese officials have insisted on the implementation of this Convention to meet the vital socio-economic needs of South Lebanon by referring to article 6 of paragraph (b) of the UN text.	The United States and Israel did not ratify the UN Convention (1997) on the Non Navigational Use of International Watercourses. The provisions of this Convention shall be used under the condition to refer to the "Johnston" plan proposed to the Arab League in 1953.
The Decennial strategy of the Lebanese Government based on the application of the Integrated Water Resource Management was elaborated by referring to the water master plan prepared in 1952 by the American "Point Four" mission of the Bureau of Reclamation. This report specifically stated that the economic development of south Lebanon could only be realized through irrigation projects in order to stabilize the social situation and the development of Lebanese rural zones.	2 – The Israelis specifically stated that the pipe of 16 inch diameter installed by Lebanon gives an annual output exceeding 2 Mm^3 and may reach 8 Mm^3. In the event that the Lebanese Government established hydraulic infrastructure projects with regard to the studies of the American Point 4 mission, it shall positively reconsider the Johnston project on the division of Jordan River water. This project constituted the fundament of negotiations between Jordan and Israel as well as the Oslo Agreement between the Palestinians and the Israelis.

It is obvious that the population of the south decreased during the Israeli occupation and nowadays after their withdrawal the southern citizens get back to their villages. The population in the Hasbani basin counts for 102000 inhabitants in 2002 and their number may reach 300 000 inhabitants in 2040.	3- The Israeli authorities prefer that the supply of the southern Lebanese villages will be done from the Litani river and not from the Wazzani source since the Litani is actually unused and discharge into the Mediterranean sea.
The strategy of the Lebanese Government consists of encouraging the return of the population of the south to their villages that were under the occupation of Tsahal all along the past 20 years. The drinking water supply to these villages is a major factor to reach such objective. In addition, the Lebanese Government developed in 1993 a five-year master plan for the utilization of the Litani River but unfortunately Lebanon was prevented from executing this important plan due to the Israeli occupation.	4- Israel insists on the principle of establishing a joint agreement with all the riparian States sharing the Jordan River rather then negotiating separately with each of the watercourse countries. The U.S.A approved as well the multilateral negotiations on the Jordan River by leaning on the Johnston plan principle.
The Wazzani project which is under execution, aims only to reach a humanitarian and social goal with reference to article 6 of the UN Convention (1997). Consequently, it shall not be interpreted as a project with political goals and regional dimension.	5 – The United States thinks that it is necessary to calm down the conflictual situation between the two countries. The Israelis prefer that the water experts of both states play a priority role in this conflict. However, they suggest not install the pumping system.
It is obvious to notice that by looking on both sides of the border (Blue Line), a huge need for drinking and irrigation water will reveal in favor of Lebanon in comparison to Israel.	6- The American administration recognizes to Lebanon the right to use a part of the Jordan River water but in conformity with the Johnston plan. The Secretary of State, Colin Powel will request the Israelis to calm down the situation.
The Lebanese noted that a European mediation is currently in process and will perhaps lead to a settlement plan of this conflict, but Beirut prefers that the mediation role would be under the patronage of the United Nations.	7- It is recommended not to involve many parties in the Wazzani negotiations. The U.S.A could play the role of a third party in this conflict. Non official negotiations shall take place between the Lebanese and Israeli experts through the United States. Moreover, the "Hydraulic Blue Line" suggested by the Lebanese Speaker, Mr. Nabih Berry is considered by the Americans as a message to launch the negotiations with Israel on the water sharing of the Jordan River.
The message of the Lebanese Speaker was incorrectly understood by the American authorities. Mr. Berry had never noted to launch possible negotiations with Israel. The speaker wanted to	8- The Lebanese share cannot exceed 30 Mm^3. The Israeli officials would be very vulnerable and even nervous if the developments remain without negotiations.

consolidate the Lebanese right in using the water of the Wazzani source. Anyway, we consider that the Johnston plan is obsolete and requires to be reviewed. On the basis of detailed studies, Lebanese experts announce that the water needs in Lebanon from the Hasbani-Wazzani upstream tributary of the Jordan River may exceed 100 Mm^3.	
9- Lebanon currently prepares a report to be submitted to the United Nations based on the water needs of the Hasbani basin region for the year 2040. The Johnston plan does not take into consideration the groundwaters that infiltrate to the occupied territory and which are valuated to be around 200 million m^3 /year.	9- The U.S.A. recommends Lebanon to draft the facts finding report before starting the pumping of the Wazzani water.

Before ending the dialogue session, Lawson insisted to know if the project was conceived and executed only by the Council of the South or in coordination with the Ministry of Energy and Water. Dr. Comair replied that the Lebanese Government constitutes one integral entity and there is no difference between the concerned institutions in this conflict.

IV – United Nations mediation

On the 21st of July 2002, the United Nations officials started their first visit to the Wazzani pumping project site. The UN commission has inspected the upstream watercourse of the Jordan River (Hasbani – Wazzani) till the Blue Line that constitutes the border with Israel. The purposes of this mission were the followings:

Inspect the location of the pumping plant as well as the water equipments laid on the site. Effectuate measurements of the water outflow on the site. This mission was assigned to the hydrological service of the General Directorate of Hydraulic and Electric Resources.

The second mission was programmed on 25th of July 2002, in the presence of the representative of the UN Secretary General in Lebanon, Mr. Stephan de Mistura, accompanied with two Italian engineers appointed by the United Nations as international experts in the field of water supply.

The commission headed by Stephan de Mistura has inspected the place of the pumping plant as well as the two Israeli pumps laid on the catchment zone of the source. These two pumps supply the village of Gadjar in the occupied territory with drinking water.

The delegation has also imposed a second campaign on hydraulic measurements on the blue line of the borders between the two states.

The third visit that took place on 29th of July 2002 aimed at controlling the work progress over the Basin of Hasbani – Wazzani and comparing the new hydrologic measurements to those previously effectuated.

The observations noted during the process of this mission as well as the dialogue between the UN Commission and the Lebanese experts are stated in the following paragraph.

Observations of the delegations: UN commission – Lebanese experts

The Wazzani source emerges from several places in a rocky land and forms a catchment zone situated on the blue Line at the Lebanese Israeli borders.

Ecosystem of the Hasbani – Wazzani watercourse is well preserved but the presence of wild plants on the shores of the catchment source turned the process of the hydrologic measurements very difficult.

From the Israeli side of the Blue Line, two pumps were installed and linked to two 4 inch-diameter pipes. The Israeli installation is designated for supplying with drinking water the village of Gadjar at a flow rate of 15 l/s.

One pump is installed at the Lebanese side serving to supply the village of Wazzani with drinking water. A 4 inch diameter pipe is connected to the installation with a flow rate of 15 l/s.

Two pumps were installed by two farmers in the Wazzani source upstream the Blue Line. Official authorizations were granted for these installations by the GDHER. These two facilities present the following technical characteristics:

“Abdallah” pump output: 55 liters per second.

“Numeiri” pump output: 66 liters per second.

The irrigated surface covered by these two pumps is 40 hectares. The utilization of this zone of a high priority to ensure the food security of the “Abdallah” and “Numeiri” families.

Outflows measurements of the Wazzani source were done according to three measurement campaigns The flowmeter propeller equipment used for these campaigns gave the following results:

Mission dated 21 July 2002 : 651 liters per second (with pumping)

Mission dated 25 July 2002 : 648 liters per second (with pumping)

Control mission dated 29 July: 701 liters per second (without pumping)

Two supplementary measurements: 698 liters per second (without pumping)

Results of the total flow of the Wazzani source was evaluated around 750 l/s by adding the pumped flow to the measured values. The numeric simulation effectuated to valuate the theoretical flow of Hasbani-Wazzani watercourse has perfectly met the measured flows.

Negotiations between the United Nation Commission and Lebanese water experts

The dialogue occurring between the UN commission and the Lebanese officials treated important issues related to the satisfaction of the citizens needs in the different water sectors. The major points of these negotiations are stated in the following paragraph:

United Nations Organization	**Lebanon**
The UN delegation has required information on the actual and future needs in drinking water and irrigation concerning the population of the Hasbani-Wazzani basin.	The needs in drinking water for the localities situated on the Hasbani – Wazzani basin are evaluated to be 18.2 Mm³/ year for 2001. The drinking water supply is currently limited to 4 Mm³ /year. A deficit of about 13 Mm³ / year is registered by the GDHER. The needs in drinking water for the year 2040 was evaluated to be 58.3 Mm³ / year for a demographic growth rate fixed at 2.74%.
The UN team has required information about:	The totality of the irrigated surface by the

* Irrigated surface of the region. * Prospects of the Lebanese Government for the rural development of the basin. * Evaluation of the surface and groundwater pumping rate.	system of Hasbani – Wazzani covers 517 hectares. This value is negligible compared to the surface declared by the FAO and the GDHER. This irrigation zone is a priority in order to meet the food security of the basin population. The optimal irrigation surface is evaluated to be 4470 hectares. The Lebanese experts have indicated that the irrigation schemes are currently supplied from three sources: Watercourse: 477 hectares with water consumption of 3.34 Mm^3 / year. Water sources of the region: 48 hectares with a consumption of 0.34 Mm^3 / year. Wells: 75 hectares with consumption of 0.52 Mm^3 / year. These data shows that the Hasbani river is the main source for domestic water and irrigation supply for the agricultural sector.
The UN team has required some information about the population of the basin and the growth estimations for the future.	The registered population living inside the Hasbani Basin was valuated of 102000 inhabitants in the year 2000 and could reach 302000 inhabitants in 2040. The demographic growth rate being 2.75%. The registered population of Djebel Amel region was valuated in 2000 of 246000 inhabitants. It is planned that it reaches 485000 inhabitants in 2040.
The UN experts have demanded instructions on the future vision of the Lebanese Government for the economic and social development of this region.	The Lebanese Government encourages the development of the agricultural food industry in the basin region and this with the intent to stimulate the regional economy and create job opportunities.
The commission has required information on the hydraulic development projects planned in the region of the Hasbani basin.	In order to ensure the economical development of the region and to meet the needs of the different water sectors of uses, the Lebanese Government planned the construction of Ibl-El-Saki dam with a stock capacity varying between 30 and 80 Mm^3 / year.
The construction of Ibl-El-Saki dam will complicate the situation with the Israeli Government since the Hasbani is a part of the Jordan River system. This project requires a prior coordination with Israel.	This dam will regulate the flow of the Hasbani as well as the whole Jordan River. It shall be used to develop an integrated water management in the region.

The UN Convention of 1997 ratified by the Lebanese Parliament specifically stated that the States situated upstream the watercourse shall protect and preserve the Basin ecosystems. Israel exerts huge political pressures on the Lebanese Government. Prime Minister Ariel Sharon has qualified your works as an "act of war". The General Director of Mekerot (Water Office in Israel) accuses you to have diverted the Wazzani water and it calls for its government to abide Lebanon to stop immediately the pumping operation.	The General Directorate of Hydraulic and Electric Resources will start the construction of waste water treatment plant in order to ensure the protection of the water quality as well as the watercourse ecosystem. According to our knowledge, the Israeli Strategy tends to divide the Basin of Hasbani, principal tributary of the Jordan River into two parts: The Hasbani watercourse with an outflow limited only to the winter period. The Wazzani source which remains abundant even during the dry period. The purpose of these political pressures is to dissociate the sub basin of Wazzani from the Hasbani watercourse, which will permit to Israel to beneficiate from a water source of exceptional quality and of a stable output during the wet period. As a result, Israel will be the beneficiary country on the sharing of the upstream system of the Jordan River when the conflict will be settled.
Israel accuses Lebanon to breach the international laws. Lebanon should have notified Israel through the UN before the starting of the works, especially that the Lebanese government recognizes the application of the 1997 Convention. The United Nations could serve as mediator in the conflict that put you in confrontation with Israel.	Israel uses since sixty years more than 95% of the annual output of Hasbani (surface and groundwater). This nation has always prevented Lebanon from using the upstream system of the Jordan River hindering by this behavior the right of our country to use its resources. We insist on the application of international law and the UN Convention of 1997. This project does not affect in any way Israel which does not proceed till today to ratify the UN Convention.
Lebanon has always accused Israel of diverting the Litani River, and uses the upstream of the Jordan River sources. Now Lebanon will start pumping the Wazzani without notifying in advance Israel.	Concerning the Litani, such hypothesis seems to be very unlikely. The chairman of the LRA, Dr. F. Comair at that time (1993) declared that Israel is not diverting the Litani river because such huge construction work cannot be discretely done. It requires heavy technical logistics means.
Prime Minister Ariel Sharon insisted via the UN representatives that the Lebanese Government shall immediately stop the construction. It constitutes a "disastrous development", since according to Sharon, the Hasbani River intervenes in about 25% of the	It is necessary that the Israeli Government recognizes that the Hasbani River represents the smallest tributary of the Jordan River with an annual outflow of about 125 Mm^3 considering the Wazzani. Israel beneficiates from the totality of the water volume of this

water supply of the Jordan River and constitutes in decreasing the salt rate of Lake Tiberiad. A similar situation was already produced in 1964 between Israel, Lebanon and Syria. Lebanon has as well foreseen to divert the Hasbani water to the villages of the south. The UN wants to avoid a "water war" status that may arise between Lebanon and Israel.	river including the groundwater. It is important to note also that the "Chebaa Farms" situated on Mount Hermon adjacent to the Syrian Golan Heights are still under the Israeli occupation. This Lebanese land, rich in water, contributes in the supply of the Dan watercourse which constitutes an affluent of the Jordan River. Israel should stop its landscape irrigation for the parks and gardens of the occupied zone and waste uselessly this important resource. The Lebanese population has access only to 40 liters/ day per inhabitant and the total volume of water that will be pumped does not exceed more than 2 to 3 % of the total output of the Hasbani – Wazzani system.
Israel always claims an access in the water resources of south Lebanon. The Israeli officials justify their pretensions by explaining that a big volume of the Litani is discharged in the Mediterranean Sea while it could serve in the supply of the Arab populations in Palestine. The good usage of the Litani may meet the needs of the Lebanese and Palestinian in Israel. The economic value of the Lebanese waters which will be sold to the Palestinians in Israel will constitute a financial income to be added to the budget of Lebanon.	In fact, Israel should take strict measures in its archaic water management. This nation should implement the concept of IWRM rather than to persist in applying its agricultural policy that enhances the waste of the water resources of the region. The water consumption in Israel for irrigating a hectare is 15000 m^3 especially in the Southern region of the country whereas in Lebanon, it does not exceed 10000 m^3 / hectare. The Wazzani project constitutes a measure of emergency situation for the supply of the southern villages. In addition, the Israeli occupation of the South does not allow the Lebanese Government to use the potential of the Litani River and implement the five-year master plan suggested by the LRA. Lebanon nowadays is in need for all the Litani resources in order to supply Beirut with drinking water and develop the irrigation schemes in the Bekaa and the South. As to the Palestinians, the implementation of the bilateral agreement of Oslo concluded to guarantee the water supply from Israel to the Palestinian Authority.

c- Lebanese road map:

As a follow up to these missions, it was convened that the Lebanese Government, though its Wazzani work team, prepare an explanative document stating the facts and details of the water supply project as well as the future view for the rural development of the southern region. This document will be submitted to the Secretary General of the United Nations, Mr. Kofi Anan in order to clarify the "typically humanitarian" Lebanese position to the Israeli Government. The United Nations will take in charge the mediation between the two belligerents countries.

A great number of international experts as well as Mr. Stephan de Mistura of the United Nations and Charles Lawson of the United States, remarked that Lebanon was not diverting the Hasbani watercourse, unlike the Israeli allegations.
The purpose of the Lebanese Government is to ensure the needs in water for the villages situated in this basin by referring to its sovereign right and to the UN Convention and international water laws. In addition to this approach, the concept of food security gives Lebanon the right to use its resources that emanate from and flow in its territory within the framework of an "equitable sharing and reasonable use".
The Lebanese official report concerning the current status of the Hasbani – Wazzani basin was largely based on the principle of the UN Convention of 1997. This report submitted to the head of state President Emile Lahoud and Prime Minister Rafic Hariri relied on the following points:
Equitable sharing and reasonable use of water resources
Factors relevant to an equitable sharing and reasonable use of international watercourses.
Obligation not to cause significant harm.
Protection and preservation of the watercourse ecosystem
Prevention, reduction and control of pollution
Settlement of disputes and joint arbitration committee.

The official position of the Israel transmitted to Lebanon by the international mediators specifically stated that this country was refusing to implement the 1997 UN Convention articles. Table 1 designates the main articles of this text and the position of each country with respect to their implementations.

Article	**Description**	**Implemented by Lebanon**	**Implemented by Israel**
Article 5	Equitable division and reasonable utilization of water resources	Yes	No
Article 6	Factors relevant to an equitable sharing and reasonable use of international watercourses	Yes	No
Article 7	Obligation not to cause significant harm	Yes	No
Article 8	General obligation to cooperate	No	No
Article 9	Regular exchange of data and Information	No	No
Article 10	Relationship between different types of uses	No	No
Article 20	Protection and preservation of the watercourse ecosystem	Yes: waste waster treatment plant	No
Article 21	Prevention, reduction and control of pollution	Yes: waste waster treatment plant	No
Article 24, 25 and 26	Management, regulation and Installations	No	No
Article 33	Settlement of disputes and joint arbitration commission	UN, EU and USA	UN, EU and USA

Table 1: Principal articles of the UN Convention and the position of every country with respect to their implementation

V – Economic value of water captured by Israel

The economic value of the Hasbani – Wazzani water, used by Israel from a unilateral side is considered to be around one billion US$. This calculations made by the GDHER were based on the following hypotheses:

- Annual runoff volume equivalent to 28 Mm^3. This volume is calculated on the basis of the 35 Mm^3/ year allocated to Lebanon by the Johnston plan in 1953 and the actual volume of 7 Mm^3 / year used starting 2002.
- Price of m^3 of water : 0.3$
- Interest rate of 4% (excluding inflation)

The GDHER imagined also other scenarios by considering an annual runoff water volume of 40 Mm^3 or 50 Mm^3. These values will double the financial amount to be compensated by Israel to the Lebanese Government.

VI – Characteristics of the Hasbani-Wazzani watercourse

VI – 1 – Basins localization

The Hasbani watershed including the Wazzani source are situated in the southeastern part of Lebanon and geographically extends over three departments: Rashaya, Hasbaya and Marjayoun. The surface of this water basin being 600 km^2 taking into account the Aiha Lake constitutes the border limits of three countries: Lebanon, Syria and Israel.
This watercourse flows in a distance of 21 kilometers inside the Lebanese territory starting from the source of Hasbaya at a slope of 1.34 % and opened gradually to form large plains situated in the river bed. Most of the watershed falls on the eastern and the northeastern region of the river which include the Lebanese part of Mount Hermon. Four tributaries and sources supply the Hasbani River:

- Wadi el Fater which drains the northern part of the basin with the Hasbani source.
- Abou Jaji, Delb, Fardis, Wadi Chebaa and Sreid.
- Wazzani source.

The above tributaries become dry during the summer season except for the Wazzani course.
The Hasbani watercourse is characterized by the asymmetry of its beds which extends on the left and north side to Mount Hermon elevated to an altitude of 2814 m and declines softly and gradually to reach the plain of Marjeyoun. The most elevated side of the right bed is Mount Dwaweer situated at an altitude of 1300 m.

Table 2, indicates that the precipitations average of four measurements stations situated on the Hasbani watershed vary between 860 and 1000 mm per year.

Plant	**Rachaya**	**Kfeir-ez-Zait**	**Hasbaya**	**Marjayoun**
Altitude m	**1235**	**940**	**750**	**760**
Month	**Precipitations**			
January	192	241	252	210
February	169	195	190	169
March	137	156	152	135
April	58	71	60	54
May	29	33	29	22
June	1	1	1	1
July	0	0.5	0.5	0.5
August	0	0.5	0.5	0.5
September	2	3	3	3
October	28	31	30	32
November	83	93	88	96
December	161	175	194	176
Annual Total	860	1000	1000	899
Average Annual precipitations in the Hasbani watershed				

Table 2: Precipitations in the Hasbani regions

VI – 2 Hydrometric network of the Hasbani River

In the 1960s, the LRA has set up, on the Hasbani River, a hydrometric network located in the following regions:

a- **Kfar Kouq:**
This station is situated in the valley of Kfar Kouq at an altitude of 1165 m. This point covers a watershed surface equivalent to 17.5 Km².

b- **Beit Lahia:**
This station is situated in the valley of Wadi El Delb at an altitude of 850 m. This point covers a watershed surface equivalent to 116 Km².

c- **Abou Jaji River:**
This station plant is situated near the bridge that links Rashaya to Hasbaya, at an altitude of 927 m. This point covers a watershed surface equivalent to 81 Km².

d- **Hasbani at the upstream of Hasbaya source:**
This station is situated at an altitude of 548 m. This point covers a watershed surface equivalent to 340 Km².

e- **Fardis River:**
This station is situated on the level of Fardis Bridge, before joining the Hasbani River at an altitude of 494 m. This point covers a watershed surface equivalent to 448 Km².

f- **Hasbani River:**
This station is situated near the Fardis Bridge (downstream) after the intersection of the Fardis River and the Hasbani River.

g- **Sreid River:**
This station is situated on the Sreid River before joining the Wazzani source.

h- **Hasbani:**
This station is situated just upstream of the Wazzani source. The watershed surface is very small at this location.

i- **Hasbani at the downstream of the Wazzani source:**

This plant is situated just downstream the Wazzani source. In this point, the total volume of the Wazzani runoff and the Hasbani River is measured.

Table 3 shows the measured runoff volumes of the Hasbani River for these different hydrometric stations which have been used to modelize the flow for over then 50 years and are compared to other plants situated in Lebanon.

Hydrometric Plants	Average (Mm³/year)	Humid years (Mm³/year)	Dry years (10 years) (Mm³/ year)	Dry years (20 years) (Mm³/year)
Kfar Qouq	0.046	-	-	-
Beit Lahia	-	-	-	-
Abou Jaji River	2.36	3.06	1.71	1.5
Hasbani (Upstream Hasbaya Source)	20.6	26.8	15	13
Fardis River (before joining the Hasbani River)	6.87	8.9	4.9	4.4
Hasbani (Fardis Bridge)	55.14	71	40	35
Sreid River	20	26	14.6	13.4
Hasbani (upstream the Wazzani Source)	61.7	80	45	40
Hasbani downstream Wazzani Source)	130	170	95	85

Table 3: Hydrometric measurements on the Hasbani River

VII- Hydrology

The total volume of water within the Hasbani watercourse results from the combination of rainfall and melting snow. The percentage of the volume flowing between December and April is approximately between 70 to 80% of the total annual volume. In the period from mid November to mid May, the percentage of volume flowing is approximately 75% to 90%.

a. Average run-off water

The average run-off water downstream of Wazzani Springs in the Hasbani watercourse has a calculated average of approximately:

- 143 Mm3/y, based on a 30-year average, which includes dry and wet periods;
- 164 Mm3/y, based on a markedly wet 10-year period.

b. Underground water

The total annual underground water flowing through the Lebanese territory to the Houle depression and the occupied territories is estimated at 200 Mm3/y, to 210 Mm3/y.

VII – 1 Hydrogeology and the aquifer units

The limestones of Jurassic, middle cretaceous and middle eocene make the major aquifers. The sandy-clay complex of the lower cretaceous and the Haouran basalt form semi-permeable to low permeable geological units.

The marls and marly-limestones of the higher cretaceous and the lower eocene make an aquiclude and impermeable unit. These marls play a very important hydro-geologic role, they make a waterproof substratum for the overlaying limestones (middle Eocene) and a waterproof roof for the underlaying limestones (middle cretaceous).

The lower cretaceous formations (marly-limestones complex) play a similar but less important role by being present between the Jurassic limestones and the middle cretaceous limestones.

The major aquifers neighboring the Lebanese southern border have been classified in five zones.

ZONE A: Hermon Jurassic aquifer

The Hermon limestones are fissured and karstified with high permeability where runoff water disappears sometimes at the bottom of the closed basins. This formation feed the springs of Chebaa located along the Chebaa-Rachaya fault, the springs of Banias bordering the lake Houlé plain and the springs of Aarné east of the massif.

The watershed surface of those limestones is around 400 km^2, of which one third (130 km^2) outside the Lebanese territories. This massif receives on average 1000mm of rainfall. It is crossed longitudinally by Chebaa-Rachaya fault. At the west side of this fault, close to the mountain, the layers fall towards the north-west and south of Chebaa, in the Majdel Chams Joubbat Zaïte region, the layers fall south-east.

The infiltration coefficient is around 40%. The maximum groundwater storage capacity of this aquifer is estimated at 160Mm^3/year (400km^2x1,000x40/100 = 160Mm^3/year) of which 2/3 of this quantity (106Mm^3) falls into the Lebanese territory.

The springs flows are estimated at:

Chebaa springs	10Mm^3/year (Ain Jaouz & Nabaa El Mghara)
Sreid spring	20Mm^3/year

The water pumped by the existing boreholes is estimated at around 1Mm^3/year. The total amount of water leaving the aquifer is evaluated to be 31Mm^3 and the available reserve is 75Mm^3/year. Part of this volume transits across the semi-permeable formations of the lower cretaceous and thus feeds the middle cretaceous aquifer (Zone B). This volume is evaluated at 50% of the capacity of the aquifer. The volume transferred to the occupied territories is estimated at 10% of the infiltrated volume.

Zone B: Aquifer of the middle cretaceous (Cenomanien - Turonien) of the Hasbani

This aquifer extends in a narrow band between Khiam in the south up to Kfarmechki in the north. At the west side, it is confined by the Hasbaya fault and by the thick marly layer of the senonien lower eocene. It stands on the sandy-clay complex of the lower cretaceous which keep it apart of the Hermon jurassic aquifer. The aquifer is crossed from the north to the south by the Hasbani valley; the layers form a monoclinal with a high dip towards the west.

This aquifer feeds the springs of Hasbani near Hasbaya, Ibl El Saki and the spring of wazzani in the Ghajar zone.

The watershed surface of this aquifer is around 100 km^2. The annual average precipitation of this region is 900mm and the infiltration coefficient is around 40%.

The maximum groundwater storage capacity of this aquifer is estimated at:

$100km^2$ x 900mm x 40/100 = $36Mm^3$/year

This aquifer is indirectly fed from the Hermon Jurassic aquifer. The volume transferred to the occupied territories is estimated at 10% of the infiltrated volume.

ZONE C: Aquifer of the middle cretaceous at the west of the Yammouneh fault

This aquifer is disconnected from the Hasbani aquifer by the Yammouneh and Hasbaya faults. Its layers fall mildly towards the west. It is completely separated from the middle eocene by the thick marly layer of the senonien lower eocene. This aquifer forms part of the middle cretaceous limestones, which outcrop in the Lebanese territories and the Galilé. The watershed area in the Lebanese territories is around $320km^2$. Its primary outfalls in the Lebanese territory are the springs of Ras El Ain and Rachidiyé and others in the sea.
The annual average precipitation of the region of Jabal Amel is 750mm. The infiltration coefficient in the fissured limestones is around 35%.

The groundwater storage capacity of this aquifer is estimated at:

$320km^2$ x 750mm x 35/100 = $84Mm^3$/year

The volume transferred to the occupied territories is estimated at between 5 and 10% of the infiltrated volume. In this report the figure of 8% is assumed.

ZONE D: Middle Eocene aquifer - Eocene of Marjayoun-JoubJanine (West Bekaa)

This aquifer extends from Majdel Anjar in the north to Marjayoun in the south. The area of the recharge zone where the watershed at the middle Eocene limestones is around $271Km^2$. This reservoir corresponds to a stretched out synclinal structure of axe ENE-WSW. These formations stand on the higher cretaceous – lower Eocene marls with a function of a waterproof substratum**.**

This reservoir is limited:

a- from the bottom by the senonien-lower Eocene marly complex;
b- in the south–west by the fault of Yammouneh which play the role of a waterproof screen for the groundwater flows;
c- in the west and north-west by a fault system which puts in contact cenomanien and Eocene limestones;
d- in the east by the marly senonien complex.

These very karstified eocene limestones are crossed by the Litani valley where are located the major outfalls of the aquifer, Ain Zarqa and Bourghos. They are divided in the following three separate hydraulic sectors. They are in relation with structural axis which represent transversal ondulation vis a vis the principal syncline axis.

ZONE D1: north sector (region of Joub-Jannine)
It extends in the north from Lala village to Majdel Anjar. The watershed area of the limestones is around $55Km^2$. This zone receives 550mm of annual precipitation. Infiltration amounts to 40% of the precipitation. The quantity of infiltrated water is therefore:

$$55km^2 \times 550mm \times 40\% = 12Mm^3/year.$$

This quantity is almost entirely pumped from the existing boreholes.

ZONE D2: median sector (Bourghos - Zarqa)
This sector covers an area of almost $200km^2$. It is crossed by the Litani where the springs of Ain Zarqa, Bourghos and other secondary springs are located. These springs and other boreholes are the draining routes of this zone. This zone receives 875mm of annual precipitation. Infiltration amounts to 50% of the precipitation. The quantity of infiltrated water is therefore:

$$200km^2 \times 875mm \times 50\% = 87Mm^3/year.$$

ZONE D3: south sector (Marjayoun - Marj El khokh)
This sector covers the southern edge of the eocene aquifer in the region of Marjayoun. Its northern extent corresponds to the limit of the anticlinal of Blat. Whereas at the west, its extent corresponds to the line of the fault of Yammouneh. At the east, it is limited by the marly complex of the higher cretaceous and lower eocene. At the south, it is limited by the contact of the marls of the higher cretaceous and lower eocene under the quaternary deposits and the closing of the synclinal.
The watershed area of these eocene limestones in this sector is around $16km^2$. This zone receives 900mm of annual precipitation. Infiltration amounts to 50% of the precipitation. The quantity of infiltrated water is therefore:

$$16km^2 \times 900mm \times 50\% = 7.2Mm^3/year.$$

Draining of this zone is achieved through the springs of Dardara and Hammam located within the axis of the synclinal as well as through existing boreholes. A volume of 1 million cubic metres diffuses through the superficial quaternary deposits.

ZONE E: Eocene of Nabatiyeh - Bint Jbeil

It is a synclinal structure of north-south axis, falling towards the north. This zone is crossed by the Litani River along a straight line. It is limited everywhere by the marls of the higher cretaceous-lower eocene.
The watershed area of this zone is around $250km^2$. This zone receives 700mm of annual precipitation. Infiltration amounts to 40% of the precipitation. The quantity of infiltrated water is therefore:

$$250km^2 \times 700mm \times 40\% = 70Mm^3/year.$$

The drainage of this zone is achieved through the springs of Hjair and others along the Litani path.

VIII- Socio-economic conditions within the Hasbani watercourse area

VIII-1 Population

The inhabitants of the Hasbani watercourse area, along with all the inhabitants of the region formerly under Israeli occupation, live a precarious economic existence.

The present population is estimated at 170,000 inhabitants with a growth rate of between 2.2 to 2.5 %.

The UNDP-Ministry of Social Affairs report of October 2000 considered south Lebanon a priority in the field of regional development actions. The study reported that deprivation in the previously occupied areas reached 60%.

One quarter of monthly household incomes within the region are less than US$ 300 for a family of 4.8 persons, which is the average size of households in the region. One third of household incomes come from government grants aimed at alleviating the deleterious effects of the occupation. Other sources of income include small-scale non-irrigated agriculture. Furthermore, the socio-economic circumstances of the inhabitants are exacerbated by the number of people who were displaced, orphaned, disabled or imprisoned during the occupation.

The region displays the scars of the long Israeli occupation. Vast areas are planted with land mines by the Israelis; while most areas of Jabal Amel display severe deforestation. In addition, the evidence of badly damaged agricultural land can be found in all regions formerly under the occupation.

It must be noted that the region was much less developed than the rest of Lebanon before the occupation in 1978, particularly in terms of public infrastructure such as drinking water networks, sewerage collection and disposal networks and irrigation systems.

The challenges facing the region of the Hasbani watercourse service area are numerous, and include particularly the construction of infrastructure facilities to improve the living conditions.

VIII-2 Socio-economic indicators

This region has for 22 years lived apart from the rest of the country due to the Israeli occupation. Every aspect of life has been affected by the occupation and associated conflicts. The local economy, health services, educational facilities, basic infrastructure, such as drinking water and sanitation services, have all been devastated.

The survey undertaken by the Ministry of Social Affairs and UNDP in 1998 indicates that the villages previously under Israeli occupation are characterized by high illiteracy, high rate of unemployment and gender inequality in illiteracy rates. The socio-economic indicators of the three administrative cazas in which the watercourse area falls are lower than the national average. The percentage of illiteracy in the Caza of Marjayoun for instance is 23.6%, nearly double the average national value.

Approximately, 19.3% of former detainees are illiterate while only 36.8% have completed elementary education. Approximately, 20% of the detainees are unskilled, while 80% are semi-skilled. The unemployment rate is 39.3% amongst the former detainees.

a. Widows and orphans

The Israeli occupation caused thousands of deaths in all groups of population. Those killed often leave behind families and orphans. Thousands of families have lost one parent while hundreds have lost both. Most orphans live with extended families, and charitable organizations take extreme cases.

Without a doubt, families that lose their source of income after the principal income earner dies, face real difficulties in terms of nutrition, education, clothing, health and other social problems.

b. Handicapped

The number of people wounded during and after the occupation from shelling and mines explosions continues to grow.

The handicapped situation places affected families under tremendous stress. The loss of income is severe if either the handicapped is the main income earner or if another active family member is forced to leave his job to care for the handicapped. Unfortunately, access to professional care for handicapped is limited, which means they are unable to achieve any sort of economical independence or contribute to the economic well being of their families.

IX. Estimation of water demands in the Hasbani watercourse Area

IX-1 Population

The Hasbani (Wazzani) watercourse has around 70 villages and towns within its watershed area. The corresponding registered population in 2002 is approximately 172,000 people, with an estimated population growth rate of 1.5 to 2.5 percent in this watershed (table 4).

	2002	2010	2015	2025	2050
Population in Hasbani (Wazzani) watershed	172,000	210,000	232,000	269,000	390,000

Table 4: **Projected population**

IX-2 Present and future demand for domestic water

a- Domestic water use

For the water domestic supply needs as shown with respect to the data as the demand for potable water within the Hasbani (Wazzani) catchment basin is as follows:

Population					Water needs per year (m^3/ day)			
Cities & Villages	2000	2015	2025	2040	2000	2015	2025	2040
Chebaa	15000	22500	29500	44300	3700	5600	7400	11000
El Hebbarieh	3900	5900	7700	11600	1000	1500	1900	2900
Kfarchouba	7000	10500	13800	20700	1700	2600	3400	5200
Kfar Hammam	1000	1500	2000	3000	200	400	500	700
Rachaya El Fukhar	4000	6000	7900	11900	1000	1500	2000	3000
El Marieh	1000	1500	2000	3000	200	400	500	700
El Majidieh	50	100	100	200	10	20	20	50
El Fardis	750	1100	1400	2100	200	300	300	500
Abou Qamha	250	400	500	800	100	100	100	200
Ain Jarfa	1300	2000	2600	3900	300	500	600	1000
Kawkaba	3500	5300	7000	10500	900	1300	1700	2600
Chouaya	1500	2300	3000	4500	400	600	700	1100
Ain Kinia	1700	2600	3400	5100	400	600	800	1300
Hasbaya	18000	27000	35400	53200	4500	6700	8800	13300
Khiam	28000	42100	55200	82900	7000	10500	13800	20700
Ibl Saki	2500	3800	5000	7500	600	900	1200	1900
Wazzani Ain	400	600	800	1200	100	100	200	300

Arab								
Sarda	50	100	100	200	10	20	20	50
Beit Lahia	840	1300	1700	2600	200	300	400	600
Aiha	1400	2100	2800	4200	300	500	700	1000
Ain Ata	1150	1700	2200	3300	300	400	500	800
Bakkifa	730	1100	1400	2100	200	300	300	500
Tanourra	330	500	700	1100	100	100	200	300
Rachaya El Wadi	3570	5400	7100	10700	900	1300	1800	2700
Kfair	2350	3500	4600	6900	600	900	1100	1700
Mimes	1380	2100	2800	4200	300	500	700	1000
Total General	**101650**	**153000**	**200700**	**301700**	**25220**	**37940**	**49640**	**75100**
Current Water Resources (m³/day)					**Water Deficit per year (m³/day)**			
					2000	**2015**	**2025**	**2040**
Shares of Chebaa + Hasbani *				18000	(7220)	(19940)	(31640)	(57100)
Total needs in Drinking Water per year					**Water demand per year (m³/year)**			
					2000	**2015**	**2025**	**2040**
					9205300	**13848100**	**18118600**	**27411500**

Table 5: Needs in Water inside the Hasbani watershed

** Part of these sources is used for irrigation*

It is worth mentioning that for the systems E1 – E7 of Jabal Amel, the water distribution will be effectuated during the winter by the future canal (slope 800 m) of Litani. During the summer the waters of Litani will ensure the irrigation of 21500 hectares in the valley of Bekaa and 33000 hectare in south Lebanon, as well as a part of the needs in drinking water of Beirut city.

		Population per year				**Needs in water (m³ /day)**			
Systems	**Cities & Villages**	**2000**	**2015**	**2025**	**2040**	**2000**	**2015**	**2025**	**2040**
E1-E2-E3	El Taibe Deir Siriane Almane El Qouassair Adchit Qantara Qabrikha Talloussa Majdal Selm Touline Es Saounaé Khirbet Selm Kfar Dounine hehabiye Jouaya Deir Mimas Tel en Nahass Kfar Kila Beni Hayan Tamrié	69000	103700	136000	204300	17200	25900	33900	50900
E4	Markaba Houla Meiss El Jabal Mhaibib Blida Roub El Tlatine Adaisse	32500	48800	64000	96100	8100	12200	16000	24000

E5	Chaqra Barrachit Jmayjmé Safad El Batikh Tibnine Aitaa Ez Zot Bir El Sanassel Soultaniye	27500	41300	54200	81400	6900	10300	13500	20300
E6	Beit Yahoun Haddatha Kounine El Tiri Beint Jbeil Ainata Maroun Al Rass Aitaroun Yaroun Ain Ebel Remaysh Aita Chaab	71000	106700	140000	210300	17700	26600	34900	52400
E7	Blat Marjayoun Dibbine El Qlaiaa El Kherbe Deir Mimas	46000	69100	90600	136100	11500	17200	22600	33900
Total General		**246000**	**369600**	**484800**	**728200**	**61400**	**92200**	**120900**	**181500**
Current Water Resources (m³ /day)						**Deficit in water (m³ /day)**			
						2000	**2015**	**2025**	**2040**
Pumping plant of Taibé (Litani)						8000			
Well of Marj El Khokh						4000			
Different drill holes						2000			
TOTAL GENERAL					**14000**	**47400**	**78200**	**106900**	**167500**
						Needs in water per year (m³ /an)			
						2000	**2015**	**2025**	**2040**
Needs in fresh water per year						**22 411000**	**33 653000**	**44 128500**	**66247500**

Table 6: water needs for Jabal Amel systems E1 to E7

Hasbani calibrated watershed (during 12 months per year)	**2000**	**2015**	**2025**	**2040**
Total of annual needs in drinking water m³ / day	**9 205300**	**13 848100**	**18 118600**	**27 411500**
Systems of Jabal Amel E1-E7 (during 6 months per year) Annual needs in drinking water	22 411000	33 653000	44 128500	66 247500
Available groundwater (600 m³ /day)	2 190000	2 190000	2 190000	2 190000
Available potential of Litani canal 800 (half of the needs during winter or during 6 months)	11 205500	16 826500	22 064250	33 123750
Adjusted total of the drinking water annual needs	**9 015500**	**14 636500**	**19 874250**	**30 933750**
Totals of needs	**18 220000**	**28 480000**	**37 990000**	**58 350000**

Table 7: Needs in drinking water for the Basins of Hasbani & Jabal Amel

The calculation of needs is based on water demand of 150 l/day per inhabitant, with industrial water demand of 10% and losses in the network of 25%. The Lebanese Government has also encouraged the development of the agricultural food industry in the region of the basin in order to stimulated the regional economy and create job opportunities. Consequently, the water needs will increase of 10 Mm³ /year due to the expansion of the agricultural industry.

Table 7 shows that the needs of the region for the forty next years are considered of:

- 18.2 Mm³ for the year 2000
- 28.4 Mm³ for the year 2015
- 38 Mm³ for the year 2025
- 58.3 Mm³ for the year 2040

	2002	**2010**	**2015**	**2025**	**2050**
Population	172,000	210,000	232,000	269,000	390,000
Demand per capita per day	150	150	150	175	200
% Non-domestic demand	10	15	20	20	20
% Unaccounted for water	30	25	25	20	20
Rate of water supply Litres/capita/day	216	216	225	252	288
Domestic water supply cm/year	13,500,000	16,500,000	19,000,000	25,000,000	41,000,000

Table 8: Projected demands for potable water

b- Irrigation

According to FAO Land Cover Map which was developed for Lebanon and published in (1991), 15,636 hectares were classified as green-covered within the Hasbani (Wazzani) catchment area, among which 11,916 hectares were classified as agriculturally cultivable lands, and 11,785 hectares are actually under agricultural use.

The FAO Map indicates the presence of 7,700 hectares of agricultural lands under partial irrigation, among which the 5,980 hectares are of a good soil nature, and are at present irrigated intermittently.

From the FAO land cover map analysis of irrigable land within the Hasbani (Wazzani) catchment basin, the potential irrigable area offering favourable as well as feasible agricultural schemes if water and adequate networks are available, varies between 4,500 and 6,000 hectares.

In the Hasbani basin, the agricultural lands come from alluvial sands, colluvial strong limestone, basalts and soft chalky limestone.

By virtue of the study of FAO, the presence of 15636 hectares of green lands, among which 11916 hectares can be considered as cultivable lands.

These agricultural lands can be classified in five important classes are “harvest of fields” of vegetative code (3), “olive” (4a), “vinery” (4 b), “Fruit Trees of deciduous leaves” (4 c), “Lemon” (4 d) and other varieties that can constitute a combination of these five classes (table 9).

Vegetative Code	3*	4 a	4c	3/4a	3/4b	3/4c	3/4a/4b	J/4b/4c
Surface (ha)	8323	1214	291	1035	670	65	99	213

Table 9: Distribution of land coverage with regard to agricultural lands in Hasbani basin

N.B. * the land coverage of vegetable code “3” is considered as agricultural land irrigated in first priority.

This study indicated as well the presence of 600 hectares of irrigated lands which are distributed in the following regions:

- The plains of Hasbani and Meri (300 ha), directly irrigated as of the river and rarely as of the neighboring sources.
- The plains of Ibl El Saki (65 ha), irrigated through direct pumping of the river.
- The plains of Chebaa (160 ha), irrigated by the local sources.

Few properties situated in Khiam, Blat and Ibl el Saki are irrigated through water pumping and are intermittently supplied. The current distribution of irrigated lands is represented in table 10:

Sources	Watercourse	Sources	Wells
% Irrigation	79,5	8	12,8
Irrigated Surfaces (ha)	477	48	75
Water Consumption (Mm^3)	**3,34**	**0,34**	**0,52**

Table 10: Distribution of irrigated lands based on the water sources

Currently, the irrigated surfaces hardly reach 7.2 % of the agricultural lands from the first category (“Harvest Fields” 3) and 5% of the totality of irrigable lands in the Hasbani Basin. The total consumption of water for irrigation in this basin is 4.2 Mm^3/ year.

According to the FAO map, the irrigated areas representing an economic profitability are limited only to 5980 hectares. The deduction of the FAO lays on two important elements, knowing:

- The maximum height of pumping as of the Hasbani source (altitude of 600 m) cannot exceed the slope 700 m (the maximum pumping height for a good income is 100 m).
- The classifications of grounds 3, 3/4a, 3/4b is considered as a superior category to ensure a good production.

In conclusion, we deduce from this study that the needs of the Hasbani Basin for irrigation use can reach 60 Mm^3/year. These needs may decrease to reach 48 Mm^3/year in the event of drop by drop or sprinkling is used (table 11).

In terms of the demand for irrigation of irrigable lands within the Hasbani (Wazzani) catchment basin, it is approximately between 45 and 60 Mm^3/y, if classical irrigation methods are used. In the case of modern irrigation methods being used, the demand for water will decrease to between 30 and 48 Mm^3/y.

	2002	2010	2015	2025	2050
Cultivable and Irrigable lands in Ha	-	2,500	3,500	4,500	6,000
Rate of water for irrigation/Ha/year in m^3	15,000	12,000	10,000	8,000	8,000
Total demand for Irrigation /year in m^3	-	30,000,000	35,000,000	36,000,000	48,000,000

Table 11: Projected demands for irrigation

c- Industrial needs

The Government will be encouraging the establishment of agro-industry within the catchment basin area to stimulate the regional economy and create employment opportunities. As a result, demand for water due to agro-industry uses is estimated to grow to 10 Mm^3/y.

IX-3 Water balance in the Hasbani–Wazzani watercourse

Agriculture being the main activity in the basin, the total water demand is highly influenced by the water demand for irrigation. The water balance is therefore a major issue for the 5 months of June, July, August, September, and October With the actual prevailing conditions along the Hasbani-Wazzani watercourse, the positive water balance in April and May cannot be mobilized to overcome the negative water balance of the dry season.

	2002	2010	2015	2025	2050
Domestic water supply m^3	9,000,000	11,000,000	12,000,000	18,000,000	28,000,000
Total demand for irrigation m^3	-	30,000,000	35,000,000	36,000,000	48,000,000
Total Water demand for Agro - alimentary /year in m^3	500,000	3,000,000	3,000,000	4,000,000	5,000,000
Total demand for Water per year in m^3		44,000,000	50,000,000	58,000,000	81,000,000

Table 12: Total water demand

IX-4 Current water use

The volume of water that Lebanon presently withdraws from the Hasbani watercourse is less than 7 million cubic meters per year, as shown in (Table 12).

Use	Amount withdrawn (Mm^3/y)
Domestic use	2.70
Irrigation	4.18
Total	**6.88**

Table 13: Water withdrawn from watercourse

The present supply of drinking water does not meet the demand. The supply and distribution networks and facilities require rehabilitation and additional resources should be developed to meet the growing demand.

IX-5 Israel installations on the Wazzani springs

During the occupation of south Lebanon, the Israeli forces installed two pumps, operating 24/24 hours, on the Wazzani Springs, within Lebanon's territory, to supply villages in the occupied territories. These pumps installed on Lebanese territories are still operating. They are supplied with power from Israel.

The two submersible type pumps are immersed in the Wazzani springs to supply a reservoir in the occupied territories through two 4 inch polyethylene pipes across Lebanon's eastern border. Two other vertical axial pumps are installed near the reservoir to pump the Wazzani spring water deep into the occupied villages.

The estimated volume of water extracted from the Wazzani springs through these Two Israeli pumps is estimated to be approximately 2,600 m^3/day or 1 Mm^3/y. The remaining surface and underground flow of the Hasbani-Wazzani watercourse is naturally diverted to the south and is being used by Israel. This situation is preventing Lebanon from developing its rural and urban sectors.

X- Water schemes within she Hasbani watercourse area

The Government of Lebanon has made a firm commitment to develop the Hasbani Watercourse area which has witnessed hostile military activities since 1948. Lebanon's primary aim is to rebuild the area and insure the reintegration of its population by creating employment opportunities in agriculture and associated food industries. The Government has sought the assistance of the international donor community in its effort to develop the region.

XI- Wazzani water supply project - 2002

This project is part of the Government's plans to meet the immediate needs defined previously. The need for drinking water in the region served by this project is urgent.

At present the existing water supply system does not provide the inhabitants with adequate amount of water to sustain their daily activities. Once the project is completed people of the region will have access to water that is affordable and sustainable. The project should have been completed some years ago, particularly in light of the great need for drinking water in the area served by the project. However, the Israeli occupation of 22 years prevented the execution of the project. Israel continues threatening the ongoing works.

The Wazzani water supply project consists of pumping around 12,000 m^3/day of water from the Wazzani springs. As can be seen from (Table 14), the project will only meet part of the current demand which is approximately 13,490 m^3/day (4.9 Mm^3/y). The expected daily shortage is 1,490 m^3/d in 2002. Adequate management of the demand and supply would be required to cover the expected shortage.

Name of Village	**Population 2002**	**Drinking water needs 2002 (m^3/day)**	**Drinking water supplied in 2002 (m^3/day)**
Adeisseh	5,347	1,150	160
Kfar Kila	7,683	1,652	120
Deir Mimas	3,562	766	75
Khyam	20,311	4,367	875
Ain Arab	817	176	20
Majidieh	50	11	0
Ibl Saqi	3,348	720	175
Blat	2,985	642	175
Debbine	2,670	574	120
Marjayoun	9,187	1,975	750
Bwayda	391	84	0
Qlaia	4,882	1,050	600
Bourj Mlouk	1,502	323	120
TOTAL	**62,735**	**13,490**	**3,190**

Table 14: Population and needs for Wazzani water supply project

All the above villages are within a radius of 12 Km from the Wazzani spring. They are within the Hasbani watercourse area and are in urgent need of drinking water for humanitarian reasons.

XI-1 Hasbaya-Habbarjeh water project

The Hasbaya-Habbarieh water project will involve both drinking and irrigation water and is part of the Government's plans to meet medium and longer-term needs.

The project serves 13 villages with a population of approximately 70,000 people.

XI-2 Ibl Al Saqi dam project

The Government plans to increase the irrigated area within the Hasbani Watercourse Basin from the current 500 hectares to meet the FAO future forecast.

To improve the productivity of the agricultural sector, irrigation networks and techniques would have to be modernized. To reach this end, the Government is working closely with concerned international agencies for the selection of suitable crops and irrigation methods. The Government efforts will allow a reduction of actual losses and an increase of cultivated lands.

To provide the necessary water, in light of the existing yearly deficit in water supply within the Hasbani watercourse area, particularly during the 5 dry months from May to October, the Government plans to construct a water storage dam on the Hasbani watercourse, at Ibl al Saqi. This dam will create renewable sources, by maximizing the storage capacity of run-off and surface waters and will therefore offset part of the water deficit in the region.

The Ibl al Saqi project is at the project identification stage. The different options of the dam axis locations and capacities are as follows:

Option 1 30 Mm^3/y
Option 2 50 Mm^3/y
Option 3 80 Mm^3/y

The final option will be chosen after the geological and hydrological investigations which are actually performed by the GDHER of the MEW.
This dam could either regulate the upstream flow of the Hasbani River – Jordan River system, through option 3 with its maximum capacity if the investigation meets the technical requirements or it could be used only by Lebanon to develop an integrated water management system for the Hasbani watercourse.
The geological formations of the dam basin are constituted of basalts and Cenamonian limestone. It will be built up by the covered rockfill with a height of approximately 55 m and a length of crest of about 550 m.
At the downstream of the dam a treatment plant will be established with characteristics meeting the qualities of WHO standards. The treatment capacity shall be 125000 m^3/ day, planned to be used in 2010. The treatment procedure will foresee:

- Flowmeter
- Flow control of distributors
- Chemistry Doses
- Flocculation
- Clarification
- Fast filtration by gravity
- Disinfection
- pH adjustment
- Exit reservoir of waters (2000 m^3)

It is foreseen also to equip the installation for a future ozonization with the use of granulated activated carbon, at the place of the filtrating area.
This project will comprehend as well a building for the administration and control, laboratories, a restaurant and a workshop which will serve as a place for reparations and maintenance. A permanent residence for the personnel shall be as well operational at the beginning of 2010.
A pumping station is required for draining water at 475 m (down the dam) till the slope 500 m where there exists a treatment station. This station will be conceived in a manner that the potential energy of water level on the dam can be recuperated in order to decrease the costs of pumping.
The treated water will be distributed by gravity and by pumping in a way to serve all the regions of Hasbani as well as the zones of system from E1 to E7 of Jabel Amel.
The dam can ensure water for irrigation for a surface area of 1321 ha situated under the slope of 700m.
In addition, this work can be used to develop the IWRM within the Hasbani – Wazzani system.

XI-3 Hasbaya wastewater project

For the protection of local water sources quality and the preservation of the environment, the Government is planning to implement the Hasbaya wastewater project.
The project involves the construction of sewage collection networks and a wastewater treatment plant located in Hasbaya by secondary treatment. The project will serve the towns of Hasbaya and Ain Qenya with a population of approximately 20,000 people.
This project will comprehend as well a building for the administration and control, laboratories, a restaurant and a workshop which will serve as a place for reparations and maintenance. A permanent residence for the personnel shall be as well operational at the beginning of 2010.

A pumping station is required for draining water at 475 m (down the dam) till the slope 500 m where there exists a treatment station. This station will be conceived in a manner that the potential energy of water level on the dam can be recuperated in order to decrease the costs of pumping.
The treated water will be distributed by gravity and by pumping in a way to serve all the regions of Hasbani as well as the zones of system from E1 to E7 of Jabel Amel.
The dam can ensure water for irrigation for a surface area of 1321 ha situated under the slope of 700m.
In addition, this work can be used to develop the IWRM within the Hasbani – Wazzani system.

XIII – Conclusion

The information presented in this chapter constitutes the core of the report submitted to the Secretary General of the UN, Mr. Kofi Anan. This document which was based on the technical and socioeconomic data related to the region of south Lebanon has taken away the phantom of “Water War” that the Hebrew State and its Prime Minister Arial Sharon was threatening to launch against the country of cedars.

CHAPTER XII

LITANI HYDRODIPLOMACY AND THE ISRAELI – LEBANESE CONFLICT

I- Historical facts

Israel ambitions in the water of south Lebanon in general and in the Litani River in particular go back to the project of the International Zionist Movement for establishing a Jewish State in Palestine. After the end of the World War I, the Zionist movement had never agreed on the Middle – East division as it was made by Great Britain and France according to the Sykes – Picot agreement.

The Belfour declaration of 1917 which promised the creation of "a homeland for the Jewish people" in Palestine was not satisfactory enough for the Zionist leaders who wanted to enlarge the country borders through the reclamation of the Jordan River sources and the control over its two sides as well as the Litani watercourse.

On 29 December 1919, the president of the World Zionist Organization, Haim Weizmann, sent a letter to the British Prime Minister at that time, Lloyd George, in which he claimed: "It is essential that the northern border of the future Jewish State includes the Litani valley for a nearly 25 miles distance which means around 40 km upstream Khardali, as well as the West and East flanks of the Mount Hermon".

The Maronite Patriarch, Mgr Youssef Howayek who was present at the Versailles Conference objected on the Zionists claims and led the French Prime Minister, Georges Clemenceau to use his veto against Weismann allegations. Clemenceau wanted to satisfy the Patriarch demand which consists to create the state of "Great Lebanon", but he also wanted to block the British influence in the region. He pointed out to the nations representatives in the region that this territory is a part of the Sykes – Picot agreement. In addition to that, he integrated the Djebel Amel (a territory of a Shiite majority) in "Great Lebanon" created under a French mandate.

In 1940, the director of the National Jewish Funds, Youssef Weitz, wrote to the Israeli Prime Minister, Levi Eshkol (who created the Mekrot, Water Agency in charge of controlling the water resources in Israel): "We must explain to Roosevelt and to all the leaders who are friends of the Jewish nations that the land of Israel is not too small if all the Arabs leave it, and if the borders are pushed back a little to the north, all along the Litani River, and to the east, on the Golan Heights."

A great number of Israelis politicians, consider that the Israeli – Arab war of 1948 will not have an end in the north before taking over the Litani River.

In David Ben Gourion mind (Newspaper of 21 May 1948), the Northern borders of Great Israel, shall include the Litani River with the waterside located in Israeli territory.

The commander of Tsahal at that time, General Moshe Dayan proposed to the Israeli Prime Minister Moshe Sharett, on the 16th of May 1954, the annexation of the Lebanese territory starting from the Litani River to south Lebanon.

II- Litani operation

Israel didn't give up its dream to take over the Litani River in south Lebanon and succeeded in 1978 through a military invasion called "Litany Operation" to occupy the southern Lebanese territory. The Israeli Government declared officially that this mission was launched in order to push back the Palestinian organizations implanted in south Lebanon. Israel wanted as well (the real reason of this operation) to force the Lebanese government to negotiate the water issue on the Litani within a bilateral agreement for sharing of the entire water resources in the south, including the upstream system of the Jordan River which contains the Hasbani-Wazzani watercourse.

This new "water war" that the State of Israel created in South Lebanon, was its unique occasion to bring back to light the famous "Johnston" plan for the water division in the Middle East. This plan established in 1953 by the American ambassador, Eric Johnston, aimed at reducing the tensions between the Arab States and Israel after the drainage of the Houle Lake. The "Johnston" plan which was rejected by the Arabs countries proposed in its first version, the integration of the Litani River in the Jordan Water system division giving to Israel privileged interests in the Lebanese national water resources.

Once again, Israel was unable to realize its dream in using the Litani River. With the promulgation of resolution number 425 on 19 March 1978, the United Nations imposed to Israel the immediate and unconditional withdrawal of its troops from south Lebanon.

Unfortunately, the withdrawal was only executed on a part of south Lebanon and the Israeli government created a small "security zone" inside the Lebanese territories with the help of Lieutenant – Colonel Saad Haddad, an officer in the Lebanese army who was the commander of the Marjeoun sector. Officer Haddad also organized an anti – Palestinian militia that permitted to Israel to operate freely in the 850 km^2 occupied territory.

The rural development projects realized by the Litani river authority (LRA) at the upstream of the Qaraoun dam were completely destroyed. The irrigation scheme of Qaraoun – Joub Jannine (2000 ha) equipped by a drip irrigation system, as well as the pumping station situated downstream the dam were under the direct targets of Tsahal during this invasion. In addition to that, the irrigation canal of Qasmieh - Ras el Ain which supplies 4500 Hectares in the South region littoral was completely demolished.

III- "Galilee Peace" operation

The "Galilee peace" operation was launched in June 1982 by the Israeli Prime Minister at that time, Manahem Begin. According to the Israeli official version, this action was a completely defensive move that consisted to push back the OPL Katiouchas to a distance of about 40 km to the borders. In fact, this Israeli invasion was meant to occupy Lebanon and invade its capital "Beirut" gaining this way a total power over the country and then forcing the Lebanese government to sign a peace treaty with the Hebrew state. Supported by the United States, the Israeli government executed pressure on Lebanon to sign the peace agreement of 17 May 1983 that included "undeclared" clauses directly related to the water resources sharing of Lebanon. The former President of the Republic, Amine Gemayel, rejected this agreement and considered it as very compelling and inequitable for Lebanon. Once again, all the Litani infrastructures related to the Qaraoun dam were the first to be attacked before Tsahal redeployment in 1985. A new "security zone" of eight to fifteen kilometers inside south Lebanon was established all along the Israeli – Lebanese frontier. The administration of this region was entrusted to General Antoine Lahad, officer in the Lebanese army. Due to the successive operations of the Lebanese resistance movement, Lahad faced many difficulties in maintaining the stability in the new "security zone" in south Lebanon.

IV- Liberation of south Lebanon in May 2000

The Lebanese resistance affiliated to the Shiite Hezbollah movement forced the Israelis to withdraw on May 2000, leaving behind them an environment loaded with terrible humanitarian conditions. Nearly 20000 Lebanese persons were killed while 30000 were wounded, as well as many devastated regions by the “Israeli burned land” policy.

Facing such a situation, the Lebanese Government was always set to justify the importance of developing agricultural projects on the Litani basin in order to reinforce the region economic stability and food security. During this period, Mr. Raymond Edde, an important Lebanese political figure (deputy, minister and president of the National Block), was the first politician to alert the Lebanese Government and the International community against Israel plans aiming to divert the water resources of South Lebanon.

V- Litani hydrodiplomacy

The Israelis leaders were continuously and officially denying the declaration of intentions by the Lebanese leaders concerning the water diversion. The Israeli Prime Minister at this time, Ishac Rabin, asserted that Israel had “absolutely no ambitions in Lebanon land or water”. He also stated on the 12th of February 1986 that “Israel have no wishes to take over a single square centimeter of the Lebanese land, not even a drop of Lebanon water. It goes the same for President Shimon Peres who reasserted in December 1995 Israel “good intentions” towards its Lebanese neighbor.

However, the assassination of Prime Minister Ishac Rabin by a member of a Jewish extremist political party put an end to all the “good intentions” attempts that were initiated in the region in order to reach a stable and sustainable peace between the Arab states and Israel.

Facing such a situation, the Israelis declarations were no longer important enough to reassure the Lebanese Government especially that the Arab press was publishing and confirming at that time the Israelis intentions to divert the Litani water.

The situation was very critical to the point that on the beginning of October 1982, the vice speaker t of the Lebanese parliament questioned the government about the reality of the information indicating that Israel has actually started some infrastructure works in order to divert the Litani water into its own land. Since then, the denunciation of the Zionist ambitions in the Lebanese waters became a subject of declaration for many politicians. So, and among the country first ranked politicians, the speaker of the Parliament president Nabih Berri never missed an opportunity to point out the “Zionist” ambitions in south Lebanon water resources.

The declarations of the Lebanese politicians, that were qualified by some experts as being often naive, demagogic and sometimes not even built on scientific ground, did not help Lebanon to build up a fundamental issue on the water resources future of the country. On the contrary, these quite daily denunciation of Israel ambitions in the Litani water created an international implication of what have become from nearly half a decade an unexploited national water resource issue.

The president of the Shiite High Council, Sheikh Mohammed Chamseddine, regularly alerted the Lebanese government of the “Zionists dangers that threaten not only the Lebanese land and water but also the spirits and culture?” Water has become an extremely sensible subject for Lebanon to the point that in October 1993, a minor political storm was provoked because of the participation of two Lebanese lecturers, among whom the Vice President of CDR, Dr. Boutros Labaki (CDR), in a regional conference on water in Turkey.

However, the controversy on the Litani water "theft" by the Hebrew State was mainly focalized in 1993 – 1995 on the downstream part at the Beaufort castle location, where the river forms a rough turning to the West and then passes by the downstream part of the River to reach "Qasmieh" where it discharges in the Mediterranean Sea.

Many hypotheses, accusing Israel, were presented to explain the causes of water "theft". The press as well as some politicians often made outbidding positions of this denunciation. The Lebanese daily newspaper El – Safir; for instance, pretended to lean on information provided by the CIA, in confirming on the 11th of January 1992, that Israel, in order to have access to the Litani water has dig a tunnel to divert the water of the river at the Khardaleh location in front of the Beaufort castle. This tunnel will allow the diversion of the Litani through Deir Mimas to the Houle plain. Some politicians even ensured that the Israeli project has already been executed or will soon be. This is the case of the former parliamentarian of the South Lebanon district, Mr. Hussein El Abdallah, who estimated at the end of the same year, that "the deployment of the UNIFIL forces in 1978 on a line from which the Khardaleh region is excluded, shows that Israel has diverted the Litani River at this same point". However, no proofs have been submitted by the observers in this concern.

In the contrary, for the LRA president, Dr. Fadi Comair, any water supply project which consists of diverging water through a river into a determined location, cannot be made unless by an underground tunnel or a specialized canalization. This project requires the execution of heavy works in a real construction site in order to proceed to the works of deviation, collecting and distributing the water resources. In addition to the other auxiliary works such as sand cleaning of chambers, pumping stations, tunnels drilling and concrete arch galleries, it constitutes huge works that should be obvious to be seen by everybody and cannot be a hidden site".

The LRA President affirmation, based on scientific proofs and hydrological measures helped in reassuring the Lebanese people. In addition to that, Comair indicated that the World Bank loan given to rehabilitate the LRA projects is still the best guarantee given by an International Institutions concerning the national river identity. He emphasized that since Israel occupied the Golan Heights, it longed more for an agreement with Lebanon on the Hasbani – Wazzani waters.

UN peacekeeping forces confirmed the statements of the LRA president about this issue. They mentioned the existence of wells connected to a pumping station which supply water to the Southern villages and will be connected to the Israeli network through a distribution system towards the villages of Rmeich, Bent Jbeil, Ain Ebl and Debel.

In May 1994, ESCWA issued a public report during its annual ministerial meeting confirming the existence of the diversion tunnel executed by Israel on the Litani River. The debated that followed the publishing of this report was a real illustration of the situation overruled at that time. This report that also condemned Israel for taking possession of the West Bank and Golan water which estimated to 215 million m³ the annual water quantity that the Israelis are diverting from the Wazzani and the Litani. According to the report, "Israel started diverting the Litani water since 1978 through a pumping system with a total capacity of 150 million m³ per year that were installed near the Khardaleh Bridge". The report added that "the Hebrew

State is also taking the Wazzani water in an amount of 65 million m³ per year. After the invasion of 1982, Israel had built a tunnel of 18 km that joins its territory to the Litani River.

Mr. Uri Lubrani, "coordinator for Lebanon" in the Israeli Ministry of Defense, immediately denied the fact that Israel may divert Lebanon waters, and considered the report allegations as "absurd". However, the Lebanese Government decided to present and official request to an immediate intervention of a United Nations commission of inquiry which will take in charge to reveal the Israeli behavior. At that time, the UNIFIL repeatedly clarified the situation by declaring that the given gathered facts about this issue were not enough documented to give a real judgment based on the ESCWA information.

Unfortunately, the ESCWA report caused a big turmoil among all the Lebanese leaders and revealed some serious political division. Each one of them has presented its own prospect and interpretation about this problem. The Prime Minister Mr. Selim HOSS declared that "Lebanon should submit a complaint against Israel to the Security Council in which it requests to put an end to the aggressions committed against our territory and the diversion of our waters". While Mr. Walid Joumblatt ironically "noted" that "the leaders have finally discovered, after long hours of meditation, that the Litani waters have been subject to a diversion, as if the public was unaware of this fact". Once again, Mr. Hussein EL Abdallah, affirmed that Israel was actually diverting the Litani water through a ground tunnel that directly joined the bridge of Khardaleh, located at an altitude of 240 m, to the Israeli colony of Kyriat Shmona in the Galilee, located at 140 m downstream the river. Whereas the Lebanese Speaker, Mr. Nabih Berri, said that "the participation of Lebanon in the bilateral negotiations with Israel could be questioned if it reveals that the Hebrew State is actually diverting water quantities from the Litani and the Wazzani watercourses".

The Minister of Foreign Affairs at that time, Mr. Fares Boueiz, and after consulting Dr. Fadi Comair, LRA president, adopted a moderate, prudent, and even skeptical accent, towards the content of the report published by ESCWA. Also, the members of the Lebanese Parliament asked him to seize the United Nations Security Council for supplementary clarifications. Mr. Boueiz answer was that the "word water theft" may have different meanings, is it about the rivers waters or the groundwater? Does it concern the water whereas the sources are located in Lebanon and discharge in the Lebanese territory or the water whose sources are in Lebanon but discharge in non Lebanese territories? We still unable to say that we have proofs of a direct theft of the waters of South Lebanon by Israel. This nation may benefit from the Lebanese waters in two ways: - Use of all the Hasbani and Wazzani water that run on their territory
- Pump the waters from the aquifers between the two countries.

On the other hand, the UN has refused to comply with the Lebanese authorities request to inquire on the possibility to divert the Litani water. The UN General Secretary at that time, Mr. Boutros Boutros-Ghali, in a letter addressed to be Lebanese Minister of Foreign Affairs, expressed his regrets that the relevant report was not based upon any concrete proof. As Minister Fares Boueiz and LRA president Dr. Comair thought about the inaccuracy of the ESCWA document, this report was in fact an "analytic study" that was made by a Palestinian researcher in collaboration with the UN agency and without taking any recent facts into consideration. Mr. Boutros-Ghali considered that "due to the lack of new elements on that issue, nothing may justify the appointment of an inquiry commission".

During this wide hydrodiplomatic campaign, a Lebanese delegation negotiating with the World Bank in Washington a financial loan for the development of agricultural projects on the Litani Basin. The World Bank recognized the Lebanese identity of the river and agreed after many negotiation sessions, to grant the LRA a loan amounting to 13 million US$ for rehabilitating the irrigation schemes that were destroyed by Israel. This loan concerns the Qasmieh – Ras El Ain project that extends between the village of Saida and Tyr and covers a surface area of 4500 Hectares as well as the South Bekaa irrigation scheme between the Qaraoun dam and Joub – Jannine (2500 Hectares) along with the pumping station that supply a surface area of 8500 Hectares. The LRA president Dr. Fadi Comair, was mandated by the Minister of Agriculture, at that time Dr. Adel Cortas to negotiate this project with the World Bank leaders.

Granting this loan to the Lebanese government reflects the support of the United Nations to the development of irrigation projects in the Litani basin. The Word Bank support to the LRA is of a great importance because the recognition of the Litani water projects give an intersection guarantee of the Lebanese sovereignty over this basin.

Once again, Lebanon wins the war over the Litani basin. The Cedars Country was able to convince the International Community that this basin was an important resource for the country economical development and a particularly sensible subject of the national political life.

Towards this extremely difficult hydropolitical situation, the Israeli government seems today less obsessed by the accessibility to the Litani river. The current strategy of Israel consists of reaching an arrangement with Lebanon on the Hasbani – Wazzani watercourse and to maintain its occupation of the Chebaa farms.

CHAPTER XIII

HYDRODIPLOMACY BETWEEN LEBANON AND SYRIA ON THE ORONTES (ASSI) AND NAHR EL KEBIR WATERCOURSES

I- Characteristics of Orontes (Assi) watercourse

The Orontes known in Arabic as “Nahr al-Assi”, which means the rebellious river, rises at Ain Zarka between the mount-Lebanon and the Anti-Lebanon chain of mountains in Hermel, located in the region of north Bekaa. This watercourse covers several irrigation schemes located on a distance of around 570 km in the Lebanese and Syrian territories.The Orontes discharge afterwards in Turkey in the Mediterranean Sea at the Gulf of Iskenderun.
Unlike other rivers in the Middle – East, the Orontes runs from the west to the north and forms a strong and regular flow in Ain Zarka all year long, varying from 12 to 15 m^3/ s. Before the revising of the water treaty between Lebanon and Syria, the utilization of this transboundary river in Lebanon was limited to fish culture and to the irrigation of small schemes from few wells located in the Kaa region. This watercourse supplies also the cities of Hama in Syria with drinking water and integrates numerous cultivated lands in the Syrian plains. The Orontes also receives water from two effluents the Afrin and Karasa in Antioch city and passes through the Turkish province of Hatay in Iskenderun where it reaches 32m^3/s at its discharge point.

The Orontes constitutes the most important river in ancient Syria and its priority of utilization concerns the drinking and irrigation sectors in this country. This river supplies many infrastructures in Syria among which the Zeinoun dam constructed in 1998 and collapsed in 2003 due to piping effect.

The technical characteristics of this river are the followings:

- Length — 571 km
- Source — Ain Zarka
- Flow — 12 to 15 m^3/s
- Medium flow — 13 m^3/s
- Surface of the trans-boundary basin — 37900 km^2
- Watercourse riparian States — Lebanon, Syria and Turkey
- Sectors of use — Drinking water, irrigation
  Aqua culture and canoe

The Orontes represents a diversity of relieves between Lebanon and Turkey. In Lebanon, this river forms a real canyon in Hermel of 50 to 90 m depth situated in a mountainous dry area that joins the Lebanese Bekaa plain to Syria. Ain Zarka source which is located in the Hermel district forms a real oasis. The ancient monastery of St Maroon (the place where St Maroon monks started their apostolate in Lebanon) that overhangs Ain Zarka is connected to this source through many water wells.

II- Negotiations on the Orontes (Assi): Agreement of 1994

The negotiations between Lebanon and the Syrian Arab Republic on the Orontes started since 1940. After more than sixty years, the two countries concluded an agreement in the 30th of September 1994 concerning the division of the water river; the essential points of this agreement are presented in the following sections:

- **Lebanon water allocation**

The share of water allocated to Lebanon is fixed at:

- 80 Mm^3/year if the river flow is exceeding 400 Mm^3
- 20% of the annual flow if the discharge volume is less than 400 Mm^3

It was considered that the essential quantities of water deriving from all the sources listed in article 2 of the agreement will be counted among Lebanon water share. According to this agreement, the quantities of water allocated to Lebanon will be distributed according to the periods defined in table 1.

Periods		**Quantities allocated to Lebanon Mm^3**
1	September	10
	October	
2	November	10
	December	
	January	
	February	
3	March	10
	April	
4	May	50
	June	
	July	
	August	
	Total	80

Table 1: Quantities of water allocated to Lebanon

- **Ground waters from wells:**

The operational wells that were drilled before the signature of this agreement will remain in use. However, it is forbidden to drill any further wells starting from this date.

III- Historical facts

His Eminence Cardinal Nasrallah Boutros Sfeir (the Maronite Patriarch) was the only one to awake the Lebanese leaders conscience to the terms and concept of the Lebanese-Syrian agreement concerning the Orontus. This agreement was signed and approved in 1994 by the Lebanese Minister of Hydraulic and Electrical Resources at that time Mr. Elias Hobeika and his Syrian counterpart, the Minister of Irrigation Mr. Mohammed Madani and confirmed by both the Lebanese and Syrian presidents Elias Hraoui and Hafez Assad.

After this agreement, Cardinal Sfeir declared in the weekly sunday homily in Bkerke: “The terms of this agreement as well as its technical details were not favorable to Lebanon vital interest and formed an obstacle to its national sovereignty”. Cardinal Sfeir considered this treaty as "anti-constitutional and containing some humiliating items for the Cedars country".

After the agreement signature by Ministers Hobeika and Madani, Cardinal Sfeir, solicited the Litani River Authority president Dr. Fadi Comair (previous member of the Executive Committee of the Maronite League) through Emir Hares Chehab (previous president of the Maronite League), to evaluate and assess this treaty.

As a follow up to the matter, a long conversation took place between Dr. Comair, Hares Chehab and Cardinal Sfeir during which the following remarks were communicated to his eminence:

- More than 1/3 of the water quantities allocated to Lebanon are during the winter season, outside the irrigation period. This volume of water will be a total waste in the absence of dams infrastructures.
- The treaty does not refer in its provisions to the stocking infrastructures such as diversions and accumulation dams in order to use the Lebanese share in spring and summer, the period during which the irrigation is necessary for the agriculture.
- The articles of the treaty do not specify the hydrogeologic limits of the aquifers. The Syrian may consider that the basin watershed in question may include the Nahr Ibrahim River.
- The terms of this agreement do not mention the sectors of use that the Lebanese government may develop in the region of Kaa and Hermel.
- On the judicial level, this treaty does not lean on an international framework such as: the international right of water; the Helsinki principles…etc
- The text clauses do not show an implementation mechanism on how to use the Lebanese share, and not even a regional committee to manage the basin.
- This treaty may constitute jurisprudence for the Israelis that will deprive Lebanon from its right in the Hasbani – Wazzani water, main tributary of the Jordan River.

III- 1 Addendum of 1997

On the 11th of January 1997, an addendum was added to the initial agreement signed on the 30th of September 1994. This addendum considered the basins of Yammoune, Marjhine, Joubab el Homor and Ouyoun Orghosh as closed basins and their waters are not deemed as common sources. Furthermore, the waters of the Laboueh source may be used during the irrigation period starting from the end of April till 15 October as well as the quantities of drinking water needed for some of the villages of the region.

This agreement specify that a year is considered to be "dry" happens when the river flow at the bridge of Hermel is below 400 Mm^3, including wells discharge and pumping stations as provided in article 2. In this case, the Lebanese share will decrease as long as the proportion of the Orontes water decreases. This share shall be equal to 20% of the river total water volume while taking into consideration as well:

- Water volume pumped from the wells localized around the sources and the rivers that influence the flow. These wells are localized in a radius of 1500 m where the radius meets the center of the source.
- Pumping plants localized along the river as well as the sources situated on the border of 500 m width of the two river beds.

In 1997, the minutes of the meetings were approved by the competent authorities and comprehended the following points:

- Yammoune, Marjhine, Joubab el Homor and Orghosh basins:
  They are considered as closed basins. The utilization of these waters shall be equal to the quantity of renewable water in these basins.

- Laboueh sources:
  The social conditions of the region of Baalbek – Hermel have been taken into consideration. The Lebanese party may benefit from all the waters deriving from the Laboueh sources during the irrigation season starting by the end of April till the 15 of October, as well as from the drinking waters in use by the neighboring villages.

  - During the rest of the year, all the rain and the water sources shall be convoyed to the Orontes. The Lebanese party shall certify that no actions of retention are taken on these water sources.

IV- Resumptions of negotiations

In 1999, the Lebanese – Syrian High Council of Coordination considered resuming the negotiations. This mission that lasted for more than 3 years was entrusted to the General Director of the Hydraulic and Electric Resources Dr. Fadi Comair who formed a commission of experts from the MEW as well as experienced consultants. This commission has set a road map determining all the technical, economic and judicial measures required as well as clear priority objectives among which the most important were the followings:

- Refer to the UN Convention on non navigational international watercourses sharing of 1997 ratified by both the Syrian and Lebanese parliaments.

- Rectify the current Lebanese situation versus the Syrian position after the 1994 water agreement. This approach was qualified as a “looser – winner” situation in 1994 and should be transformed towards a “win – win” situation.

- Enhance the concept of cooperation between the watercourse States in consideration of the direct and indirect economic benefits that will affect the entire basin.

- Restitute the hydrodiplomatic position of Lebanon with respect to Syria in presumption of eventual future negotiation with Israel on the Jordan River.

- Ensure the social stability through the creation of many job opportunities for the Lebanese population in Kaa and Hermel districts. These opportunities could concern the agricultural, construction and touristic sectors.

- Convince the Syrian officials that a “win – win” hydrodiplomatic situation between the two states will strengthen their position regarding the Israeli negotiators.

- Foresee a mechanism of application of the 1994 treaty between Lebanon and Syria.

- Define the infrastructures needed in order to stock the surface eater flow consigned in the treaty.

- Increase the allocated volume with regard to the irrigation experiences in the Hermel and Kaa regions.

- Develop the production of hydro energy in order to reduce the electrical pumping prices for the agricultural sector.

- Preserve the quality of the water river especially the one used in Syria for domestic needs.

- Establish a data base for hydraulic measurements with a permanent “monitoring” system of the resource quality.

- Install a waste water treatment plant in the region of Hermel in order to preserve the quality of the water basin and the river ecosystem.

- Define the irrigation schemes that bring economic benefits for the region of Kaa and Hermel.

The negotiation has been delayed for six months due to many complications mainly related to the agenda definition.

On the 3rd March 2001, the Lebanese – Syrian High Committee decided to adopt the previously mentioned annotations. This decision was ratified by all the country competent authorities.

Upon these agreements, the share of Lebanon was fixed at 80 Mm^3 in addition to the quantities of water that were extracted through the wells achieved before the conclusion of the agreement and whose total declared quantities was 16 Mm^3. These waters are designated for the irrigation of a surface area of 7000 Hectares among which 1000 hectares are currently cultivated through the use of groundwaters. The technical and economic assessments showed that the utilization of the Orontes water must be planned to cover both banks of the river in the following areas:

First: Directly after Ain Zarka and Daffash sources through the construction of a diversion dam and a pumping station for the banks of the watercourse.

Second: Stocking dam upstream of Hermel Bridge.

The selection of this place as an appropriate site for the dam was made upon the following standards:

- **Socio – economic**

The construction of a dam upstream the Hermel Bridge will help to preserve:

- The touristic sites of the region including: hotels, restaurants, sport clubs…
- The inhabitants located in the shallow basin and from both sides of the Orontes beds.

- **Technical:**

The stocked water will be used for the drinking and irrigation sectors and also for the power production (30 Mega Watt, 6 hours per day) in the years of dryness. This project will furnish financial funds for any future development in the regions near the dam site.

- **Environment**

The location of the dam axis line upstream the Hermel Bridge as well as the expected derivation aiming to maintain the permanent water volume flow allocated to Syria help preserving the ecosystem of the river.

- **Financial**

The cost of this project is included in the Decennial Strategic Plan of the Ministry Energy and Water (2001-2011) and will be financed by the National Budget funds.

This project shall be executed according to two stages:

1st Stage: June 2005. This stage shall be subdivided into two tender parts:

- The first tender is related to the construction of the derivation dam, the pumping stations and the reservoirs.
- The second includes the irrigation networks and their infrastructures.

2nd Stage: June 2007. This stage shall be subdivided into two tenders:

- Storage, dam, pumping stations, water supply lines and reservoirs.
- The second includes the irrigation networks and their infrastructure, the control equipments needed for the irrigation of 7000 Hectares.

Tables 2, 3 and 4 present all the details of the irrigation schemes covered by the water of the Orontes dam.

Region	Total area (hectare)	Approximate area presently irrigated (hectare)	Actual water source	Total area for rehabilitation (hectare)	Areas that will be irrigated by the project (hectare)
			Left river bank		
River bank	274	247	River bed	-	-
Hermel, Mansoura, Bouwayda, Kawakh, Qaser	3,924	549	Wells and pumping from Orontes	3,109	2,875
Hermel village and surroundings	683	376	Ras el Mal, river springs and wells	-	-
Total of left bank	**4,881**	**1,172**		**3,109**	**2,875**
			Right river bank		
Tal assouad	555	389	Pumping from Orontes	422	390
Mar Maroun	686	-	-	652	603
Qaa – Wadi Khanzir	307	92	Pumping from Orontes	292	270
Qaa - Banjakiya	982	49	Laboueh springs and wells	933	863
Qaa - Baayoun	1,075	-	-	1,021	945
Ras Baalbek – el Sahel	817	-	-	776	718
Total of right bank	**4,422**	**530**		**4,096**	**3,789**
Total amount	**9,303**	**1,702**		**7,205**	**6,664**

Table 2: Orontes irrigation project, irrigated areas

Region	Total area (hectare)	Approximate area presently irrigated (hectare)	Actual water source	Total area for rehabilitation (hectare)	Areas that will be irrigated by the project (hectare)
		Left river bank			
Hermel, Bouwayda, Qaser	3,924	549	Wells and pumping from Orontes	2,100	1,943
Total of left bank	**3,924**	**549**		**2,100**	**1,943**
		Right river bank			
Mar Maroun	686	-	-	652	603
Qaa – Wadi Khanzir	307	92	Pumping from Orontes	292	270
Total of right bank	**993**	**92**		**944**	**873**
Total amount	**4,917**	**641**		**3,044**	**2,816**

Table 3: Orontes irrigation project, phase one

Region	Total area (hectare)	Approximate area presently irrigated (hectare)	Actual water source	Total area for rehabilitation (hectare)	Areas that will be irrigated by the project (hectare)
			Left river bank		
Mansoura and Kawakh,	3,924	549	Wells and pumping from Orontes	1,009	933
Total of left bank	**3,924**	**549**		1,009	**1,943**
			Right river bank		
Tal assouad	555	389	Pumping from Orontes	422	390
Qaa - Banjakiya	982	49	Laboueh springs and wells	933	863
Qaa - Baayoun	1,075	-	-	1,021	945
Ras Baalbek – el Sahel	817	-	-	776	718
Total of right bank	**3,429**	**438**		**3,152**	**2,916**
Total amount	**7,353**	**987**		**4,161**	**3,849**

Table 4: Orontes irrigation project, phase two

V- Return to the “starting point”

The rehabilitation of the agreement scheduled on December 2001 and restricted to the two heads of the countries delegations, a sudden change in the situation took place from the Syrian side which included also all the concerned ministries in charge with international negotiations and proposed that this agreement be returned to the “Starting point”. This change was partially justified by the fact that Lebanon is located upstream the Orontes, what makes it capable, if a political conflict occurs with Syria, of managing the water flow as a mean of pressure against it. We should note that Syria had established on this river large water infrastructures widely spread along the country.

This larval fear may also be explained by the fact that this agreement brings back the bad memories of their conflict with Turkey on the Euphrates with all the following repercussions on Syria.

The Lebanese delegation had then only two alternatives left:

- Return to the basis of the conflict, the 1994 agreement itself.
- Succeed in making them changing their minds.

As a result, the best procedure adopted by the chief of the Lebanese delegation was the simulation of an accelerated departure with a realistic explanation of the unfortunate consequences that Syria may causes if it renounces to the signature of the agreement. These consequences would have negative effects on a major part of the Shiite population in this region that lives under the threshold of poverty and may revolt against Syria; in addition to all the Lebanese communities which stood in favor of this new revised agreement.

On the other side and on the basin of the Syrian current position towards Lebanon concerning the Orontes, the Israeli could avail such opportunity to impose the same terms of treaty on the Jordan River with the following consequences:

- Non-restitution of the Golan Height
- Non-recovery of the water shares belonging to Syria.

The presence of the Syrian president cousin Mr. Kaiss Assad among the Syrian delegation who is in charge of the water file helped accelerating the ratification process by giving his direct guarantee to sign this agreement after the position taken by the head of the Lebanese delegation.

VI- Negotiations concerning Nahr el Kebir River

VI- 1 Hydrogeographical description:

The Nahr el Kabir River takes its rise partly from the Lebanese territory and constitutes the "tracé" of the Lebanese northern border with the Syrian Arab Republic. It is fed by a number of springs located in southern parts of the Syrian coastal fills and northern Lebanon. Its mean yearly incoming flow is evaluated to be around 150 Mm^3.
These springs are Khalifa, AI- Farash, Assafa, and Nabeh Al Nassiria where their flows in the Syrian areas are given in table 5.

Table 5

	Name of the spring	Average flow for the last four years (m^3/s)
1	Khalifa	0.438
2	Al Farash	1.514
3	Assafa	1.575
4	Al Nassiria	1.368

The River runs around 62 km between Lebanon and Syria in the Akkar area. The basin total area is about 1300 km^2 with a pond cover of high demand for water in terms of its human settlements, agriculture and forestry. The basin area of EI-Kabir river receiver between 500 mm-1200 mm of rain per year but with 40% - 50% lost by evapo-transpiration, and there is another few hundred mm. equivalent coming from snow on the mountains.

Drilling water wells is loosely controlled with estimated yields ranging between 500-5000m3 per day (m3/d) per well. On the other hand, in Lebanon it is fed by forge spring. The Cornet Arabah summit constitutes the highest point in the catchments basin whose elevation reaches 2215 m. The greatest portion of the catchments Basin of Assafa River is located in the Lebanese areas, at present, there are 3 dams located in the catchments basin of Nahr el Kabir in Syria. These dams are the following:

1. Tel Houch dam of storage capacity of 52.08 Mm^3 that feeds an area of 6,280 hectares through irrigation network.
2. Khalifa Dam of storage capacity of 3 Mm^3 that feeds an area of 700 hectare.
3. El Maziene dams with a storage capacity of 19.2 Mm^3 that feeds an area of 2,032 hectares.

On June 11, 2002, the decree No. 8005 was promulgated, forwarding a law project to the Parliament aiming to allow the Government to set an agreement between the Lebanese Republic and the Syrian Arab Republic regarding the distribution of Nahr el Kabir basin waters, and, the construction of a joint dam on the main river course (hereinafter referred to as "the Agreement").

VI- 2 Agreement on Nahr El Kabir:

The Agreement was set according to International Laws, particularly the 1997 UN's **"Law Agreement on Using International Water Courses for Non Navigational Purposes"**. This law which was ratified by Lebanon and Syria constitutes the sound basis for a rightful and rational water distribution of international riparian rivers. Based on the above, the joint committee for shared waters established the rightful and rational distribution of the Nahr el Kabir waters and the construction of a dam in the location of Idlin – Noura el Tahta.

The Agreement included:

<u>In Article 1</u>: The mean yearly incoming flow: 150 MCM

<u>In Article 3</u>: The two countries agreed on sharing the Nahr el Kabir waters giving a share of 60% to Syria of its total annual water resources and 40% to Lebanon of its total annual water resources. These shares were decided following a study of the watershed areas in both countries.

<u>In Article 4</u>: The shares as decided in Article 3 of this Agreement are applicable on the distribution of the Nahr el Kabir waters in all conditions, whether in a wet or normal or dry year.

<u>In Article 6</u>: Regarding the river's annual water resources and the requirements for both countries in all sectors (potable, irrigation and industrial), the two countries have decided the construction of a joint dam in the location of Idlin – Noura el Tahta, with a storage capacity of 70 MCM, according to technical and economic feasibility studies.

The clauses of this Agreement and especially Article 1-3-4-6 have strengthened the understanding of the **<u>Law on Using International Water Courses for Non Navigational Purposes</u>** that backed the principle of cooperation between Lebanon and Syria in this field. This is clearly shown in Article 5: Equitable and reasonable sharing and benefiting, and, Article 6: Factors related to rightful and rational benefiting.

The principle of accurate cooperation in water storage and sharing for each country was applied to guarantee the right of each country. This principle was stipulated in Article 12 of the Agreement including:

"If either Syria or Lebanon wish to use certain amounts of water from the upstream portion of the river within the limits of their part (60% and 40% respectively), all with respect to the ecological considerations mentioned in Article 5, this amount shall be deducted from their share of stored water. Any country that does not use its entire share of stored water by the end of a hydrological year, according to the schedule of water intake shown in Annex 2 to this Agreement, is not allowed to use this share during the coming years.

The Agreement also included annexes:

Annex 1: The methodology in the study and execution of the common dam on Nahr el Kabir in the location of Idlin – Noura el Tahta (Based on Article 24-25-26 of the UN Convention 1997).

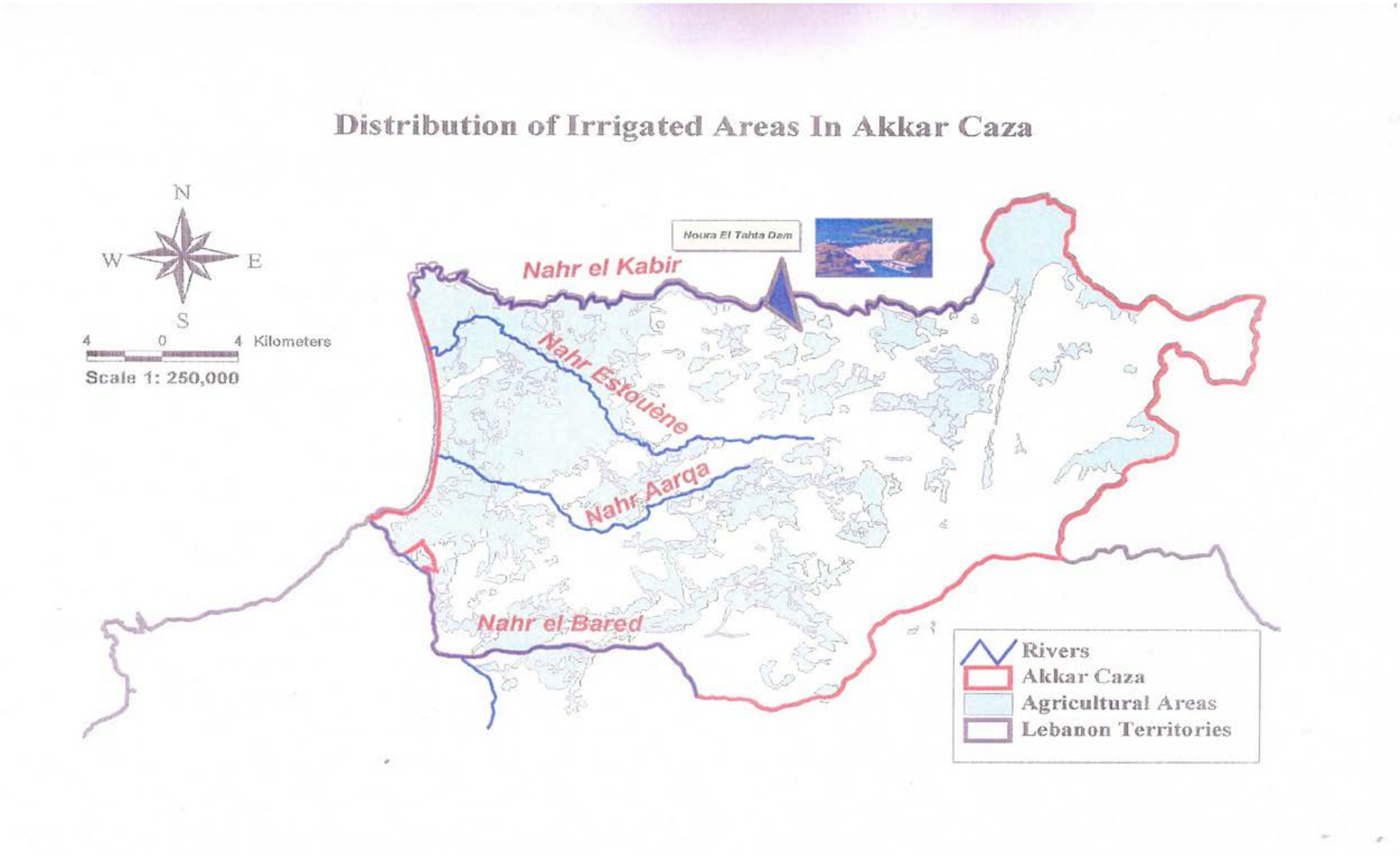
Annex 2: The methodology of watercourse management and sharing of the Nahr el Kabir River (UN convention 1997).

This Agreement is the result of an institutional work carried out by the Joint Lebanese Syrian Committee and it represents a specimen for applying the article of UN convention on a transboundary river.
The Ministry of Energy and Water has established 10 years work plan aiming at insuring additional water resources by increasing the amount of stored water coming from precipitation and surface runoff by the means of constructing 27 dams and Hill lakes. Among these reservoirs, four dams will regulate the management water flow of the Transboundary Rivers in Lebanon. These additional resources shall be used for potable water and irrigation purposes.

In the context of developing and managing water resources for Lebanon and Syria, the two countries decided to join efforts for the construction and management of a dam on Nahr El Kabir.

VI-3 Idlin-Noura el Tahta dam:

The construction of Idlin-Noura el Tahta dam provides a yearly storage of 70 MCM approximately and insures agricultural development for both countries. In addition to the agricultural applications, the stored water may be used when necessary for potable needs following proper treatment. The Idlin-Noura el Tahta dam is located near the northern order of Lebanon with Syria, north-east of Tripoli on the Nahr el Kabir at an altitude of 82m, 800m north of the village of Noura el Tahta. The construction of this dam will be of a great benefit to the agricultural lands located in the Akkar plain and some of the lands in the vicinity of Noura el Tahta village (see Map 1 & Map 2).


Distribution of Irrigated Areas In Akkar Caza
N
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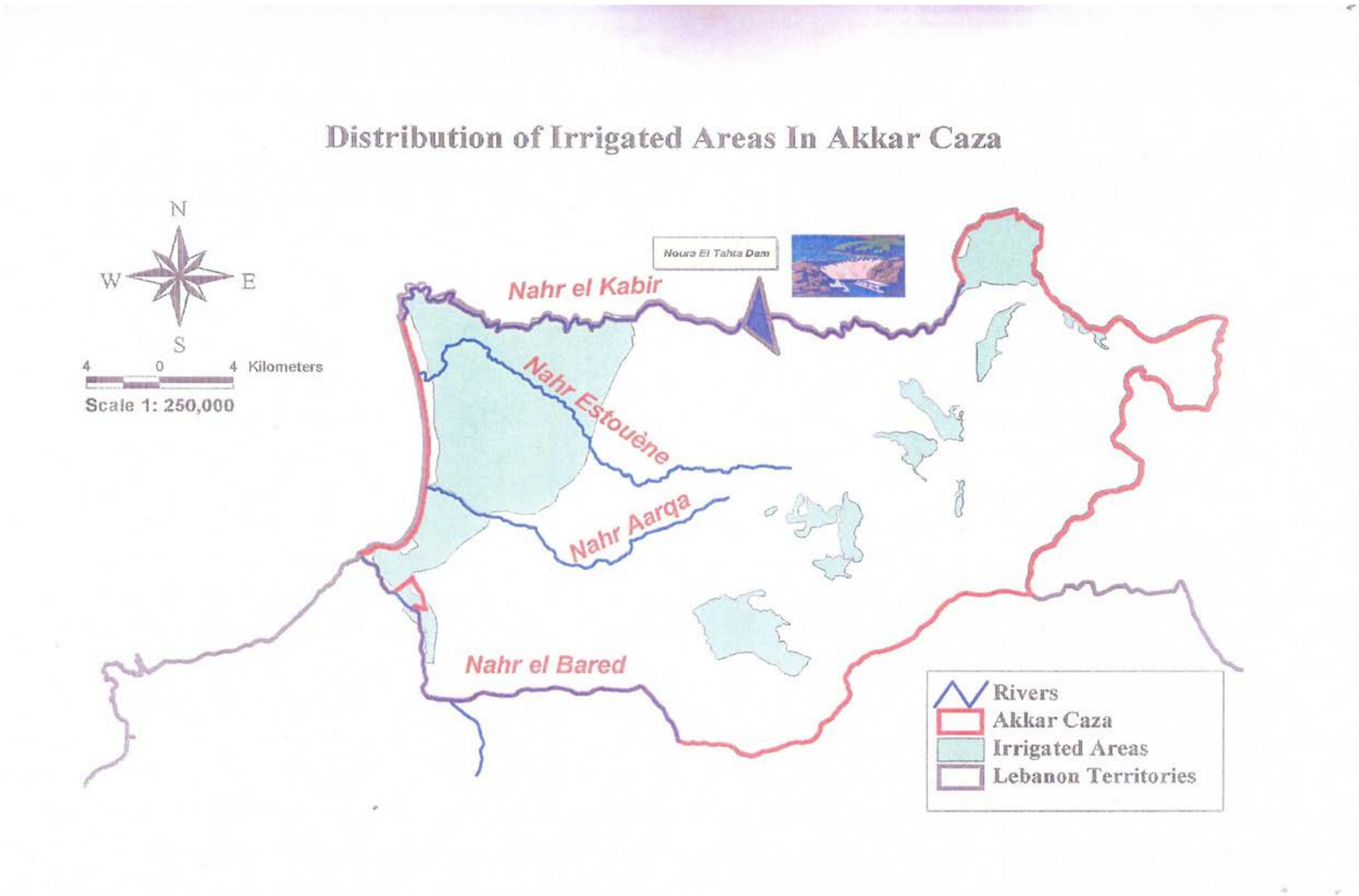
4 Kilometers
Scale 1: 250,000
Houra El Tahta Dam
Nahr el Kabir
Nahr Estouène
Nahr Aarqa
Nahr el Bared
Rivers
Akkar Caza
Agricultural Areas
Lebanon Territories

Map I


Distribution of Irrigated Areas In Akkar Caza
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Noura El Tahta Dam
Nahr el Kabir
Nahr Estouène
Nahr Aarqa
Nahr el Bared
Rivers
Akkar Caza
Irrigated Areas
Lebanon Territories

Map 2

The preliminary cost estimate for building this dam is US$49 million approximately.

The Idlin-Noura el Tahta dam project shall contribute in strengthening the economy of the region and shall provide Lebanon a storage volume of more than 35MCM approximately. This water shall be used for irrigating around 4,959 hectares and consequently reduce the area of dry land. It will also be used for potable and industrial purposes.

In addition to agricultural applications, wherever a necessity occurs, water could also be used for potable water supply provided an adequate treatment is implemented.

The preliminary cost estimate has indicated that the project's cost of one cubic meter of water produced for irrigation is $0.19 for a real interest rate of 6% and 25years study period. The social net present value of the project is 67.8 million dollars if each irrigate and newly reclaimed hectare is assured to generate 4000$ of net resources.

Moreover, the project is willing to contribute to the reduction of rural exodus towards the capital with all the benefits it may incur. The net value generated by the project would constitute, through the macro economic investment multiplier, an important mean towards the economic wealth of the region.

The basic output of the Al-Kabir River relates to the character of the natural setting and Socio-economic aspects in the watersheds on the Lebanese side. These aspects have eventually influenced the quantity allocation and quality of water, explain major causes of environmental issues and accordingly point out environmental management concerns and mechanisms that the two countries should corporate to implement. The Water resources on the Lebanese watercourse, with due effects on environmental characteristics of the shared water are given in **table 6**.The General social characteristics of water use and availability on Lebanese watercourse, with due effects on environmental character of the shared water are presented in **table 7**. The General distribution of land cover and land use on Lebanese side, with due effects on environmental character of the shared water are presented in **table 8**. The comparative details of the UN convention 1997 versus Nahr el Kabir agreement are presented in **table 9**.

			Al-Kabir River surroundings watershed area 300 km^2 (about 40% in Lebanon)
Climatic Evapotranspiration	Precipitation	Snow (mm eq.) Rain (mm)	500 - 1200 (coastal) (mountains) . . . . 200 - 500 (contributes to above) . . . . 38 - 45
Natural Flow (Mm3)	Surface	Subsurface	- River itself 150Mm^3 - Major springs 30 - Runoff % 20-30 . . . . - Infiltration % 10-20 - Karstic % 5-8 - Aquifers: moderate
Artificial	Dams	Wells	-"Noura Al- Tahta" 70mcm (both countries) .... - loosely controlled yield -m^3/d 500-5000

Table 6: all data on climatic parameters are best estimates, not absolute measurements.

TABLE 7

			AI-Kabir River area
Human related	Population (approximate)		170000
	Settlements (size)		200 - 35000
	Social character		Mixed urban and rural
	Climate		Sub - humid
	Major economic activity		agricultural
Water	use	Domestic l/d	70 - 90
		Irrigation m3h/yr	5000 - 6000
		Stock l/d	8-10
		Industry l/d	16 - 18
		Municipal l/d	35 - 40
		per capitai /id	130 - 180
aspects	Potentials	Availability	Easily
		Risk (source stability)	Slightly endangered
		quality	Moderate - poor
		conflicts	High potential
		monitoring	poor

Table 7: social characteristics informations

		AI- Kabir River Surroundings			
Land c0ver	Major types	Forest	Agric-culture	Urban	Bare lands
	Water demand	high	Very high	high	low
	Surface holding capacity	Very high	high	Very low	low
	Degradation capacity	Extremely low	Very low	Extremely high	high
Land use	Major types	Urban	Irrigated	Rain-fed	Excavated
	Impact on water quantity	Very high	Extremely high	Very low	Very low
	Impact on water pollution	Extremely high	high	Very low	Extremely high
	Development priority level	extreme	extreme	high	Very high
	Impact on land	Extremely high	low	Very low	Extremely high

Table 8: land cover and use of the Al Kebir River

During the meeting held in Damascus the 26th of October 2002, it was agreed to prepare the invitations for the detailed design of the dam to be carried by international consulting firms. This was accomplished on 2nd December 2003.
The Joint Syrian-Lebanese committee held a meeting chaired for the Syrian side by Dr. Sleiman Rammah, assistant to the irrigation Minister and for the Lebanese side by Dr. Fadi Comair, and attended by Mr. Malek Yazigi delegate of the Secretary General of the Higher Syrian Lebanese Council. The two parties discussed the work methodology for implementing the dam project proposed on Nahr El Kabir. The two parties were pleased by the outcome of the procedures of ratifying the agreement and the exchange of documents. By the end of the meeting, the two parties agreed on forming a Joint sub-committee responsible for setting the internal regulations for the Principle committee and the elaboration of the tender documents for advertising an international bidding for the study and design of the dam. It was also agreed that funding for this design shall be

provided by both countries equally. Tender documents shall be set in accordance to Arab and International Funding agencies.

During the launching the Lebanese head of delegation, Dr. Fadi Comair, made the following statement: “We consider projects of development in Lebanon as being of common interest between Lebanon and Syria especially in the development of water sectors, as water is a great wealth. We began executing this concept by working at great speed with the Joint Lebanese-Syrian committee at the highest level of technical and administrative cooperation based on the UN convention on non-navigational uses of international watercourses.”

VII- Comparative study: UN Convention and agreement on the Orontes and Nahr el Kebir Rivers

The integrated water resources management concept included in the framework of the two Lebanese – Syrian treaties shows that the Transboundary basins may form the catalytic of cooperation rather than a source of conflict. This concept will be decisive in order to fight against water scarcity in the region (table 2).

The experience shared between Lebanon and based on the United Nations provisions has strengthened the spirit of compromises between the two states. Moreover, the two parties have worked together to help in developing the direct and indirect economic benefits over the two basins. The sustainable development of these two basins cannot be implemented without an adequate governance approach, which requires that the management of these two systems shall be exercised in a spirit of:

- Participation
- Responsibility
- Efficacy
- Coherence

It is convenient to present the ideas deduced from the Lebanese experience in their negotiations with the Syrians and that may constitute a base of brainstorming for any other matter that may occur in the region.

UN convention	Orontes agreement	Nahr el Kebir agreement
Articles 5 and 6: Factors relevant to the equitable and reasonable use of watercourse.	If the mean runoff flow is >403Mm^3 →Lebanon allocated part 80 Mm^3 If the mean runoff flow is <403 Mm^3 → Lebanon allocated part 20% of the total flow **Projects:** Derivation dam: capacity of 37 Mm^3. Stockage dam: capacity of 37 Mm^3. Surface area of irrigation 7000 Hectares.	Lebanon allocated part of the total flow 40% Syria allocated part of the total flow 60% **Projects:** Joint stocking dam: 70 Mm^3. Surface area of irrigation: 10000 Hectares.
Article 7: Obligation not to cause any significant harm.	The Orontus is considered as a joint utility and its utilization must not cause any significant harm.	**Article 1:** The utilization of the river waters must not cause any significant harm.
Articles 8 and 9: The obligation to cooperate and to regularly exchange data and information.	**Article 5:** Monitor of the runoff as well as the wells and pumping of sources all along the watercourse.	**Annex 2 – Articles 1, 4, d, e, g:** Installation, maintenance of instruments, measurement of meteorological data, volume and flow of ingoing and outgoing water.
Articles 20, 21 and 23: Protection and preservation of ecosystems as well as prevention, reduction and control of pollution.	**Article 6:** Regular verification of pollution and preservation of the ecosystem.	**Article 5:** The watercourses States must protect and preserve the ecosystem.
Article 24, 25 and 26: Management, Regulations and Installations.	**Article 5 and 6:** Monitoring the distributions of the water volumes and control of the basin management.	**Annex 1**: Methodology of design, construction of the joint dam and of the additional works. **Annex 2**: Methodology on the watercourses management, the instructions for the operation and maintenance of the dam and auxiliary work.
Settlement of disputes	**Article 7:** Joint arbitration committee.	**Articles 7 and 8**: The joint committee of water and/ or the ministries of both states.

Table 9: United Nations convention in respect to the Orontes and Nahr el Kebir agreement.

In the following paragraph, some of the main ideas are presented to be adopted in order to ensure the sustainable development in transboundary basins with the following facts:

- Million of persons in the Middle – East have no access to sufficient quantities of water. The water rareness is the greatest threaten for both human and food security in the MENA region. The international basins may, for this reason, form the centers of tensions between neighboring states: an upstream cooperation between watercourse States may prevent the potential conflicts. The application of the United Nations convention (1997) could enhance the "win – win" situation between nations and lead to the elaboration of a sustainable long lasting treaty.

- The International institutions such as the UN or the EU work on bringing together the watercourse hostile riparian States and suggest a management system that could be integrated to the political conditions in the region. This concept promotes the development of the direct and indirect economic benefits between the nations.

- The progressive deterioration of the quality and the irrational management of the water quantity, influence the credibility and the stability of a nation and sometimes the stability of the entire neighboring region. The integration concept at the basin requires new monitoring techniques of the quality and quantity of the resource. This control shall be executed through a telemetric measurement system all along the watercourse.

- The agreements that the countries may negotiate must include clear and flexible standards concerning the resource allocation as well as on the preservation of its quality. These clauses shall reduce the eventual tensions between states and favor a positive political climate in the region. The international institutions such as the United Nations and the European Union suggest research programs and education modules at the regional basin level aiming at ensuring the sustainable development over the watercourse. These institutions help identifying the clear mechanisms for the integrated management of the resource taking into consideration the social needs of the basin as well. The tariffs policy must take into consideration the existence of poor social classes.

- Some of the watercourse States may consider certain usages as priorities. In this case, the other nations of the basin could adopt and enforce the management through financial compensation in order to limit the conflicts.

- The equitable distribution between the riparian watercourse States is the adequate way to ensure a good management of the system. The idea is that the water division is made for beneficial purpose allowing the working out of equitable agreements for the different parties.

- A detailed mechanism must be adopted in order to resolve the eventual conflicts between the watercourse States. It is essential to initiate experts in every concerned country in order to reach equitable solutions in case of legal dispute. The international institutions suggest training programs for the riparian watercourse States experts. These programs are very useful for the practice of hydrodiplomatic negotiations.

These ideas may constitute a common basis for the consolidation of dynamic division process of water resources in the Middle – East. The integration of the water principal stakeholders in dynamics cooperation on the regional basins level will positively contribute to the economic and social development of the watercourse States. The future perspectives that will be suggested in the following section will help to raise the challenges up again and to create the opportunities towards improving the peace in the Middle – East.

CHAPTER XIV

Water Management and Hydro diplomacy of the Nile River

I- localization of the Nile Basin

I – Hydrology of the Nile Basin

The Nile constitutes one of the main and largest transboundary river of the world with a surface basin estimated to be about 2870000 km². It is formed with the confluence of the White Nile which has its source in the falls of Moujoumbiro in the region of the great lakes of Oriental Africa in Burundi and Rwanda and of the Tana lake which forms the Blue Nile in Ethiopia and which provides about 86 % of the basin water resources. Figure 1 presents the basin of the White and Blue Nile.

This river, whose annual average discharge volume is estimated to be around 84 billions m³ with an importance inter-annual irregularity, covers a distance of 6671 kilometers and passes through nine countries which are: Rwanda, Tanzania, Uganda, Congo, Burundi, Kenya, Ethiopia, Sudan to join the Mediterranean Sea through Egypt.

The uneven discharge recorded of the river which varies between 1 and 4.4 is mainly due to the distance covered by the river which crosses three different climatic zones: equatorial, tropical and desert zones.

In Egypt, the Nile registered flood in Assouan appears in summer by the end of July to the end of November. During this period, the output varies in proportion of 1 to 16 corresponding to a discharge water outflow of 520 m³/ second in May and rises to 8500 m³/ second in September.

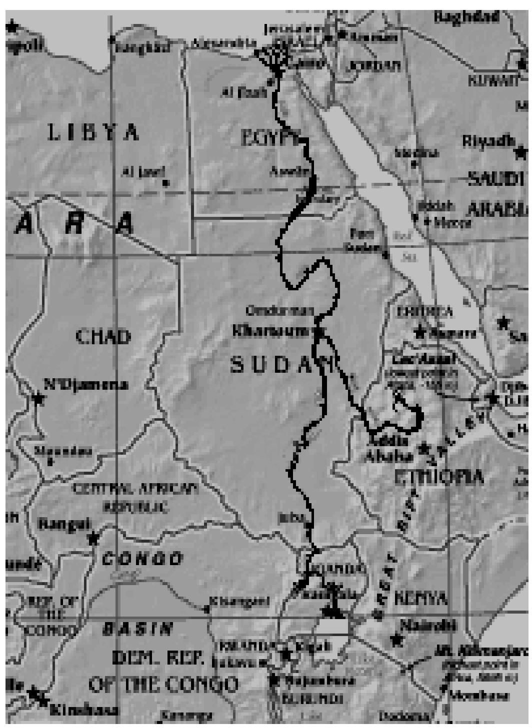

Figure 1: Basin of the White and Blue Nile

II- Socio-economic pressures on the Blue Nile

Egypt launched a large-scale development program based on the construction of large infrastructure dams on the Nile with the aim of satisfying the technical and economic requirements for its development in the following sectors:

- Regularization of the water flows entering in the country.
- Supply of water resource and the demand management in all the sectors of use and mainly agriculture.
- Provision of the increasing population needs for drinking water.
- Provision of the socio-economic increase for the tourist and industrial development.

The Egyptian government has started in the 1960s the construction of the Assouan dam which was inaugurated in 1971 and operated at its full capacity in 1975 with the following characteristics:

- Total water volume:163 km^3
- Useful water volume is 90 km^3
- Available effective water volume after evaporation and silting up: 74 km^3
- Reservoir length: 3.6 km
- Crest height: 111 m
- Lake surface: 6500 km^2 (11 times the Leman Lake in Geneva)
- Lake length : 500 km
- Lake width: 12 km

Two essential problems are facing Egypt which is relatively considered to be more developed than the other riparian States sharing the Blue Nile Basin:

- Risk of drought
- Increase of population.

This major evidence makes Egypt to depend entirely on the Nile River for its socio-economic development which is directly associated to the safeguard of its water and food security of its population.

Since the 1960s, this country launched a large program of hydraulic infrastructure based on the construction of great water reservoirs.

Egypt is the only country of the Nile Basin which practically lacks of precipitations and relies completely on the Nile water in order to produce food for less than the half of its population. The government should necessarily head towards the importation of large quantities of cereals and wheat in order to meet the food security of its population. The importation of food represents for the water experts a quantity of “virtual water” that the country will require for producing its agricultural needs. This exigency which is directly related to the demographic growth in Egypt, Sudan and Ethiopia in the Blue Nile Basin, constitutes the essential elements for the negotiations on the division of the River water.

The total population of these states which can be currently estimated at about 180 million inhabitants is expected to increase to variable rates between one country and the other. For instance, the current population in Egypt which exceeds by 10 % that of Ethiopia will change in favor of Ethiopia in 2025 comprising 25 % of inhabitants more than Egypt.

The population growth rate constitutes an important factor for the equitable sharing and reasonable use of the Nile water, as well as for other essential settings for the division of the water quantities among the riparian watercourse States such as: total surface of irrigated lands, hydrology, past and future use of irrigated water, economic and social needs. These factors could be evaluated or measured in an objective way and should be coupled to a specific weight varying between one country and the other. The application of this concept has constituted the basis of the sharing of international watercourses within the framework of the United Nations Convention adopted in 1997 as well as the regulation of Helsinki concepts representing a common basis for the planning and water resources attribution between the watercourse States. Furthermore, these basic settings should be taken into consideration within the concept of the Integrated Water Resources Management in the Blue Nile Basin between Egypt, Sudan and Ethiopia.

Despite the changes occurring in the demographic growth of these states, Egypt continues to adopt a position of status quo towards the water quantities that enter into its territory.

In 1959, Sudan and Egypt did not invite Ethiopia to participate in the negotiations division of the Nile basin and the construction program of large infrastructure on the Nile. The treaty which concerns the total use of the Nile waters, concluded between Cairo and Khartoum in 1959 divided up the river between the two countries. Sudan was granted 18.5 billion m^3/year and Egypt 55.5 billion m^3/ year. The other watercourse States, mainly Ethiopia with more than 60 million inhabitants that will reach in 2025 more than 120 millions, where 85 % of the Nile water flows from its tables and using till this date less than 1 % of the river resources.

The bilateral agreement signed between Egypt and Sudan in 1959 allocated a quantity of 55.5 Km^3 to Egypt per year and could be reconsidered within the scope of the basin global management.

III –Geopolitical Stakes of the Blue Nile

The demographic increase which happens very fast in the Nile basin countries constitutes a very alarming basic setting for the planning and attribution of riparian states water demands.

Despite this important factor, Egypt continues to hold a status quo position towards its fixed water quantity of the Blue Nile. This country keeps on claiming historic rights over the water of the basin, while Ethiopia is noting that it has plans for the construction of dams over the tributaries of the Nile and in its territories. Ethiopia intends to administrate construction works on its territory which constitutes the upper Nile basin through financing proposed programs by international organizations.

The upper watercourses of the Nile, known as “Abbay” in Ethiopia, unfurls in a wide buckle at the outlet of Tana Lake. In 1952, the United Kingdom and Italy have divided the water of the Gash, a seasonal tributary of the Nile. The United Kingdom launched at the upstream of the Nile basin at Khartoum between the intersection point at both the blue and white both Nile, the irrigated area of Gazirah that stayed for a long period, the widest project of agricultural development in the world.

In the year 2000, during the inauguration of the industrial sugar refinery in Fintchoa, the Ethiopian President declared in front of the foreign diplomats that “Ethiopia which provides 85 % of Nile water flows does not consummate more than 0.3 % of the water potential of Abbay (Ethiopian Nile) and of its tributaries”. In fact, the water of the river does not irrigate more than 0.02 % of the agricultural surface in the country. The President added that “Ethiopia rejects the treaty concluded between Egypt and Sudan considering it null and void”. In order to enhance their economic development, the government of Addis Ababa with the assistance of Israel has considered the possibility to ensure additional hydraulic resources through the construction of about 40 dams in the Ethiopian Nile Basin. Following these declarations and events, Egypt has rapidly developed a military intervention plan against Ethiopia in case this latter tries to block or reduce the Nile allocations designated for the downstream riparian to countries. The recent conflict arising between Ethiopia and Eritrea led the Ethiopian Government to postpone its inter infrastructure plan.

It is worth to remember that in 1979, Sudan and Egypt started the construction of the Jonglei canal with the aim of draining and diverting the Nile from the marshland in the South region of Sudan where the evaporation of the water basin is quite high. In 1983 a military aggression of unknown air planes strike and bombarded the canal destroying all the main infrastructures. Military experts confirmed that this intervention was done either by the Ethiopian or the Israeli army in order to stop the works. The civil war and the sabotage acts that started in 1983 in Sudan have freezed all the hydraulic infrastructure development and the priorities of the government in Sudan. In 2007, this country started again its hydraulic program with the help of the World Bank and the western countries.

Despite the progress considered by the Ethiopian government within the frame of the policy to promote the country economic development, the socio-economic situation remains till now very difficult. About 30 % of the 3 million inhabitants of the capital agglomeration are not supplied with water system with the presence of only one treatment waste water plant. In the rural regions that gather 85 % of the population, the inhabitants pump directly the water from the river and use it to fulfill their needs without any treatment.

Ethiopia suffers also from big energy dependence since the complete shut down of the oil refinery of Asab in Eritrea. Addis Ababa which counts approximately 3 million inhabitants suffers from the interruption of the electrical current during a good period of the year, mainly when the dams equipped with hydropower turbines become empty. In spite of the interconnection works, each part among the seven sectors of the capital is supplied by energy one day a week.

The Ethiopian leaders have always proclaimed that by building new infrastructures of large dams in the Abbay gorge and its main tributaries such as those of Omo and wadi Shabeele, the country could meet the needs of its fast-growing population and sell power and waters to the neighboring States. The international experts in the energy field indicate that the utilization of waterfalls on the Nile tributaries may generate the hydropower energy. The studies undertaken by the Ethiopian government foresee the following infrastructures:

a- Equip many hydropower electric plants over Takkaze River.
b- Double the energy production capacity of the Tes Esat on Abbay and Fintchoa.
c- Install hydropower plants on the watercourse of Oma, Awash and wadi Shabeele.

The Ethiopian government used the financial compensation from its later war during the Italian mandate to equip the Awash Valley located near the capital with hydropower plant. In addition, the geological and seismic investigations have showed the presence of gas field in Ogaden but its utilization was suspended waiting for international finance. The design and the equipment of the irrigation schemes in Gibe and Tana-Balas were also foreseen at the upstream of the Awash Valley on the Blue Nile.

The Awash Valley Authorities (AVA) has planned to equip with irrigated schemes with different cultivations such as: cane sugar, sugar beet, cotton, banana and fruit trees with the financial revenues deriving from the hydropower plants in Qoqa. Ethiopia loyal alliance with the Soviet Union prevented the Government of Addis Ababa from receiving the international loans needed to accomplish all these programs and make true the execution of the Ethiopian new GAP project like the Turkish one. This project that will develop the rural agricultural area through irrigation and the production of clean energy will impose Ethiopia as an economic power in the region. Ethiopians leaders consider till this moment that their status as the water castle of Africa, confers them a legal right to use the upstream Nile watercourse for the benefits of its country population in coordination with the riparian nations located downstream their territory.

From another side, the government of Sudan launched in 1994 a wide program to build up dams over the Nile, an action that harassed the Egyptian government to the extent that its leaders intended to launch military operations against Sudan in order to stop the project. Egypt has always closely followed the political military situation in south Sudan and was always afraid that the civil war in this country enhances the formation of a new state along the Nile by the southern rebels in favor to the politics in Ethiopia and Eritrea. It is worth to mention that Ethiopia which maintained excellent relations for ten years with the United States became in 1970 under the control of the Marxist regime represented by Mengistu Haile – Mariam. This latter has recalled for the soviet expertise to study the possibility to divert the Nile tributaries and stock the watercourse resources in dams. The Egyptian government, during the President Sadate mandate who changed his political alliance and entered a new one with the United States, directly threatened Ethiopia to launch military responses aiming to destroy every dam built up by this country. The political tensions in the Nile continued even during the years 1990s and caused diplomatic incidents to the extent that Egypt accused the regime in Sudan to seek the destabilization of President Hosni Moubarak. Moreover, Sudan and Ethiopia worked hard to isolate Egypt on the hydrodiplomatic level by the formation of the "Nile Blue Valley Organization". The goal of this basin agency was to design and implement hydraulic infrastructures such as 36 dams and this without the consultation of Egypt.

IV –Nile Basin initiative

In order to face this situation, the Egyptian government has adopted a new strategy towards the Sudan and Ethiopia riparian watercourse states known as the "iron hand with velvet glove". Egypt launched warnings of military intervention targeting Sudan and Ethiopia and at the same time it undertook hydrodiplomatic steps through the World Bank and other international organizations for a possible cooperation over the Nile. During five years of preliminary negotiations, the watercourse States of the Nile Basin among which Egypt, Sudan and Ethiopia declared in July 2001 that they had obtained the finance from the World Bank (WB) and the United Nations Development Program (UNDP) for a series of studies designated to apply the concept of "equitable sharing" of river water resources within the frame of a new project known as "the Nile Basin initiative". Upon a first stage of meeting among the watercourse States, NBI succeeded to mobilize the donator countries and obtained loans amounting to three billion dollars in order to promote:

- Socio - economic sustainable development
- Equitable use of the basin water resources
- Equitable division of benefits among the riparian basin states.

The political support of the NBI was formulated by the declaration of the Egyptian Minister of Water, Mahmoud Abou Zeid who occupies this position since more than twenty years declaring that: "The Nile disposes of a huge potential still unused. Over the entire basin, the population can make much more benefits if they know how to share it. Each state can have an equitable part of the river without harming its neighbors". Having sustained NBI, the World Bank wishes to apply a strategy based on the following goals:

- Establish the spirit of cooperation among the watercourse States despite the persistence of conflicts.
- Obtain the consensus of all the watercourse States on less debated questions while deferring the water quotas-related issues to later stages.
- Apply the concept of sustainable water supply to countries located downstream the basin with the chance for countries development located upstream such as Ethiopia.

This initiative constitutes an approach to consolidate the trust building among the nations of the basin. Ethiopia was then able to undertake the construction of ten small dams for a better utilization of the Blue Nile resources. At the same time, these infrastructures protected Sudan in the periods of floods and the dam of Assouan from the accumulation of sediments. According to the Ethiopian Government, these dams have also contributed in the development of the hydropower production on the basin level and the watercourse nations can profit from the benefits of such development. The Egyptian expert in Hydraulic resources, Mr. Rushdie Saied opposes to these arguments and confirms that the sediments retention are a dangerous issues because the water flow discharge of the river will grow in a way that will harms the ecosystem and the downstream zone of the Nile. He added in opposing the argument through which the Ethiopian dams will allow to the downstream neighbors to profit from this energy development by saying: "neither of these nations is industrialized or big energy consumer and it is badly perceived who the intended neighbors are".

V- White Nile geopolitical stakes

Concerning the transboundary waters issue of the White Nile, it is related to the upstream six sovereign countries which are Uganda, Dr. of Congo, Kenya, Tanzania, Rwanda and Burundi. These countries present serious political and socio - economic crises. Civil and tribal wars invaded their territories, the instability of their political system conducted to many Coups d'Etat and assassinations among their political leaders. In addition, the political leaders were unable to ensure food security of their inhabitants. Poverty in these nations and the lack of financial capacity prevent them from providing an economic development of their basin.

All these countries required that the development of water resources in the basin should be the main option of their socio - economic development and safeguard of their food security.

These nations have claimed financial aids helping them to use their land in the agricultural sector for the medium and long term. This may induce to a water transfer all the way of the upstream and downstream basin, reducing water resources of the river and consequently depriving the downstream countries from the use of the Nile discharge. This situation will provoke political tensions between the countries sharing both, the Blue and white Niles basins. New conflicts will also arise among riparian nations which shares the same Nile basins. All these developments related to the water conflicts on the Nile seem to be inescapable in the new future.

Moreover, Lake Victoria, which constitutes a sub basin of the Nile, represents a typical example of a multi-facetted conflict situation. As to the countries located upstream, the lake is a water reservoir used in priority for irrigation. For the watercourse riparian States, the lake represents a source for food security, an infrastructure of transportation and a sink for sewage discharge. The infrastructure development in the region and the cooperation spirit between the basin states may constitute a regional goal for the application of a sustainable management of the lake.

For this purpose, the management of Victoria Lake needs a coordination mechanism targeted towards specific goals involving countries of common interests and others countries whose interests are completely different. The technological and institutional approaches, based on the Planning and the Integrated Water Resources Management according to the concept of economic cooperation between the nations through a widely mandated basins organizations, can be an example to be adopted in order to ensure the sustainable resource of the river.

VI- FAO Conflict resolution models

In 1995, The FAO proposed three models of the Victoria Lake management among which:

a. Global operation based on a multiple management concept with a permanent secretariat assembling all watercourse States.
b. Global operation based on a multiple management concept within the frame of the "Cooperation Agreements of Eastern Africa".

c. Global operation within the frame of the current management structure classified in sub sector and heading towards “Fishing Organization of Victoria Lake”.

Starting from the experience of other transboundary basins in the world, the FAO proposal was subject to multiple reactions, mainly by the concerned countries which have chosen to maintain till now the initial status of the basin management model. The reactions can be resumed by the following:

a. The first alternative was not supported by the watercourse States and appeared to be so expensive.
b. The second alternative could have been accepted in case of the establishment of a regional basin agency. This institution should be independent from all political pressures as well as the sectorial deviations.
c. The third option will depend on the strategic political positions and on the financial resources available with the watercourse States and donator agencies.

Since more than fifty years, the tensions provoked due to the Nile water division created a climate of political instability between the watercourse riparian States. However, all the parties admit that the cooperation spirit between the countries of the basin is the unique possible alternative to settle the conflict. Active hydrodiplomacy would be the reliable mean to ensure an equitable sharing of the Nile and reach a reasonable use of these resources. It is useful to find a ground of understanding among the countries through the NBI which allows putting on the negotiation table of all the different ideas among the states and eliminate the climate of a water war in Africa.

CHAPTER XV

Cooperation on transboundary watercourse
Orange – Incomati – Kunene- Danube- Colorado

I –Experience of the South African Countries and the Cooperation in the Region with SADC

The watercourses system in "South African Development Community" was positively affected by the recent changes in the region. The independence of Namibia in 1990, the establishment of a democratic regime in South Africa in 1994 and the peace process in Angola and Mozambique, gave rise to a collaboration environment of a water division system, as well as the establishment of the rivers basins organizations was ratified in 1995 by eleven countries in the region.

The majority of the water resources in SADC is then "equitably" divided and "reasonably" used. This situation shows the importance of the regional ramifications of water division with the aim of settling the potential conflicts between the watercourse States. The national and regional goals are affected within the sharing of water frame associating the basin management with the regional transfers of important water quantity in order to ensure the demands of each country.

The cooperation established between Lesotho and South Africa in the scope of "Lesotho Highlands Water Project" will supply the majority of the industrialized regions in South Africa with supplementary water input of 30 m^3 /s and will provide Lesotho with all the electrical power that it needs.

The tariff of water transferred into South Africa was fixed at an economical price aiming to enhance the benefits related to the infrastructures development at the basins level of these two countries.

I – 1 Orange River

The division of water resources downstream the Orange River, between Namibian and South Africa, presents a succeeded case study that leans on the effective coordination, between these two countries which are parts of the South African Union. The mutual trust between the two governments, even after the independence of Namibia in 1990, allowed the implementation of the following common actions:

- Preparation of harmonious national water policies.
- Allocation of effective and equitable shares for both countries
- Planed socio-economic development
- Water supply in both countries

The total surface of the Orange Basin is valuated at 945000 km². It is divided among four watercourse riparian States (table 3):

Countries	Total Surface of the Basin Km²	Percentage of Calibrated Watershed
South Africa	563900	59.65
Namibia	240200	25.40
Botswana	121400	12.85
Lesotho	19900	2.1

Table 3: Orange Calibrated Watershed

The suggested agreements have permitted to provide South Africa with water resources necessary to meet the demand for the mining sector and this for some decades till the exhaustion of the mine resources. Namibia will use then water designated for the mines in South Africa for increasing its domestic use. This new input will be added to the limited underground water resources.

I –2 High Basin of Incomati

Inside the SADC region, the Incomati River is divided between the following countries: Mozambique, South Africa and Swaziland. This basin is governed by a tripartite agreement which regulate the utilization of its water resources.

The Incomati sub basin is currently divided between South Africa and Swaziland, upon a recent agreement. This watercourse is jointly managed and developed by the "Water Authority of Incomati Basin".

Mozambique, being a country situated downstream the river, and the half of its water needs depend on upstream countries, is member of the tripartite agreement, established during the colonial period. This country did not get involved in the dialogue and cooperation over Incomati, because of the civil war that erupted before ten years over its territories.

The total surface of the Incomati Basin is 467000 km². It is divided among three watercourse riparian States (Table 4).

Countries	Total Surface of the Basin Km²	Percentage of Calibrated Watershed
South Africa	29200	62.47
Mozambique	14600	31.2
Swaziland	3000	6.33

Table 4: Incomati Calibrated Watershed

Recently, South Africa and Swaziland reached an agreement consisting of drafting a joint bilateral development plan of the Incomati sub basin. The plan entered into effect since the Apartheid government in South Africa and foresaw the development of water resources and its equitable division among both countries. This agreement admits both the regulations of Helsinki and the laws in Mozambique.

I –3 Kunene Basin

Kunene basin covers a distance of 110000 Km² part of which 95300 Km² crosses in Angola and 14.000 Km² in Namibia. The different developments concerning the water resources infrastructure in Northern Namibia were executed within the scope of the international agreement that were instituted during the following meetings:

- Berlin Conference in 1885
- Agreements conducted between the Portuguese and South African colonial power in 1926.
- Agreement of use of the water basin in 1969
- Agreements of 1990, directly after the independence of Namibia.

The total surface of the Kunene Basin is divided into two watercourse riparian States (table 5).

Countries	Total Surface of the Basin Km²	Percentage of Calibrated Watershed
Angola	95300 km²	86.68
Namibia	14700 km²	13.32

Table 5: Kunene Calibrated Watershed

The benefits of the cooperation between the watercourse States have allowed the economic development of Kunene Basin mainly in the energetic and agricultural domain. The projects that were executed are the following:

- Matala dam
- Dam dam
- Caleque dam

The SADC region represents a variety of hydroplomatic case. Most of the countries of this region stand under an unstable political situation due to the frequent changes of the political regimes, starting from the civil war erupted in Mozambique till the declaration of independent new countries. It is beneficial to follow the development of the dialogue among these new governments which were subject for so long to civil wars but which reacted positively vis-à-vis the water division related problems in the region.

There are other countries of the SADC, particularly Botswana and Zimbabwe that are considered as countries poor in water resources and will directly depend for their economic development on the water resources of the bordering countries in the regions. These nations count on the equitable sharing of water resources with a possible water volume transfer between the basins. They have to cooperate together in order to enhance the direct and indirect profits that they can take out of the basin and consolidate more and more the big projects of water transfer. They will be also able to agree as much as possible upon a common agricultural policy adapted to the lack of water that extends in many countries in the region.

The protocol of the water division system of 1995, inside the SADC region, constitutes a promising regional initiative for the management, development and use of basins. The water resource management based on harmonizing national policies within the scope of regional cooperation is used also in other regions such as Central America and can be taken as model for a widest cooperation in the North African Basin (Nile) as well as the South African Basin.

I I- Danube Basin: Regional European Cooperation

The Danube being the biggest river in Europe of a basin surface of 817000 Km² assembles a population exceeding 90 million inhabitants who directly depend on the water resources sharing between the European States.

The competitive and multidisciplinary utilization of waters in the Danube for drinking water, transportation, irrigation, industry, energy, fishing and rubbish sectors, make the water resources of this river rare. The Danube basin which is divided between 17 states witnessed during the past two centuries of critical and complicated periods on geopolitical level:

- First: the two world wars with their Eastern and Western conflict.
- Second: the current transitional period of Eastern and Central Europe to the democratic and economic regime of the European Union common market and their integration with the EU.

It is important to indicate that 10 States constitute the main watercourse riparian countries where can exist upstream industrialized and rich countries and downstream states of transitional economy. Figure 3 presents the Danube basin crossing many European countries.

The cooperation and management of the Danube basin was established in 1856 with the treaty of Paris and cover as well the periods that follow the World War II.

The first goal of this treaty was the free Navigational uses, but this utilization was diminished during the periods of planned and centralized economies of the countries of Eastern and Central Europe. After the collapse of Communist Bloc and with the modification towards the democratic regimes with opened economies on the European Market, better climate of cooperation was created between the watercourse countries. Unfortunately, this situation becomes complicated for the countries situated downstream the basin and this has caused the arising of ethnic conflicts, economic difficulties and divergent interests of ex-socialist states.

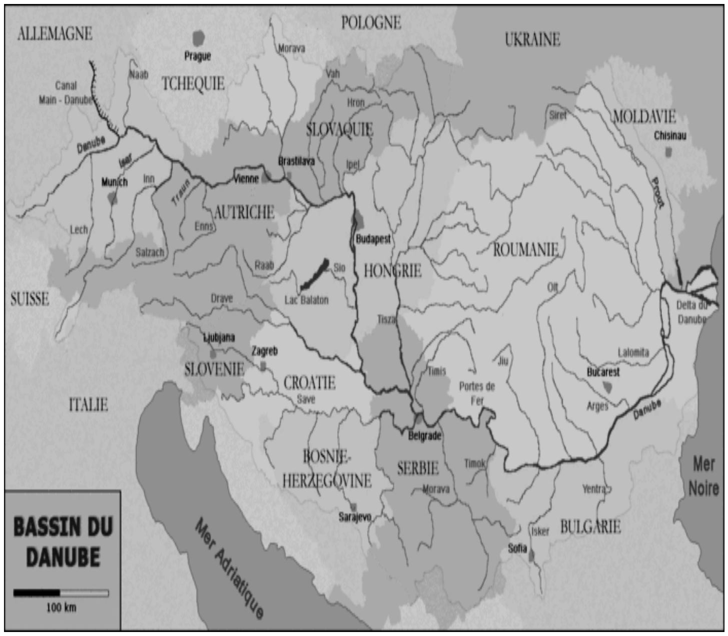

Figure 3: Danube Basin

Due to the political transition that the region recently witnessed and the lack of coordination between the Eastern and Western countries in the past, many treaties concerning the management of Danube watercourse were subjects to tensions political. The major conflicts such as Gabaikovo / Nagymaros project that was debated, not only between Hungary and Slovakia, but also between stakeholders such as: politicians, water and environmental engineers of this region.

However, with the amelioration of the political and economic environment in Central and Eastern Europe, the national positions of the riverside states of the Danube basin became more appropriated for the future utilization of the watercourse and for the European cooperation. This recent cooperation which aims to the Navigational uses is subjected to major developments in order to improve the water management and the environmental protection of the basin.

The integration of the Danube within the regional agenda of Europe has permitted the reinforcement of the institutional and economical capacities of the countries situated downstream. Promising progresses were perceived next to this cooperation and can be attributed to the approaches that convert towards the harmonization of a policy of national planning in Europe within the scope of the EU Water Framework Directives (EUWFD).

It is worth to mention that the Convention of 1994 on the protection of the river comprehends a mechanism for the settlement of litigations and conflicts. It reflects as well the participations on the level of the national policy in the watercourse states.
This convention and the EUWFD constitute then valid references since they reflect a consensus over the cooperation between different riverside states. These different options of cooperation designated for the Governments of the European countries are in need to be consolidated as of the success and the impact of the particularities of the reference texts.

III- Colorado Basin

Treaties concluded between the United States and Mexico on the water-related conflict of Colorado Basin and which deal with the following items:

- The consequences of the intrusion of salt water downstream in the watercourse.
- The shares allocated by the United States of America to Mexico. This situation constitutes an example of a direct solution for the settlement of this dispute between these two watercourse States. This cooperation takes into consideration the following points:
- Equilibrium between the different country and utilization interests.
- Consideration of the economic national interests within the scope of the institutional development capacities of both countries.
- Existence of administrative gap in the water agencies in Mexico.

The USA with its well know strong economy was interested in promoting cooperation on the regional level in order to maintain a good international image for a positive conflict settlement with Mexico. Therefore, it has established a list of goals to reach and disputes to be solved on the water resources of the Colorado River. Figure 4 shows the Basin of Colorado between the USA and Mexico.

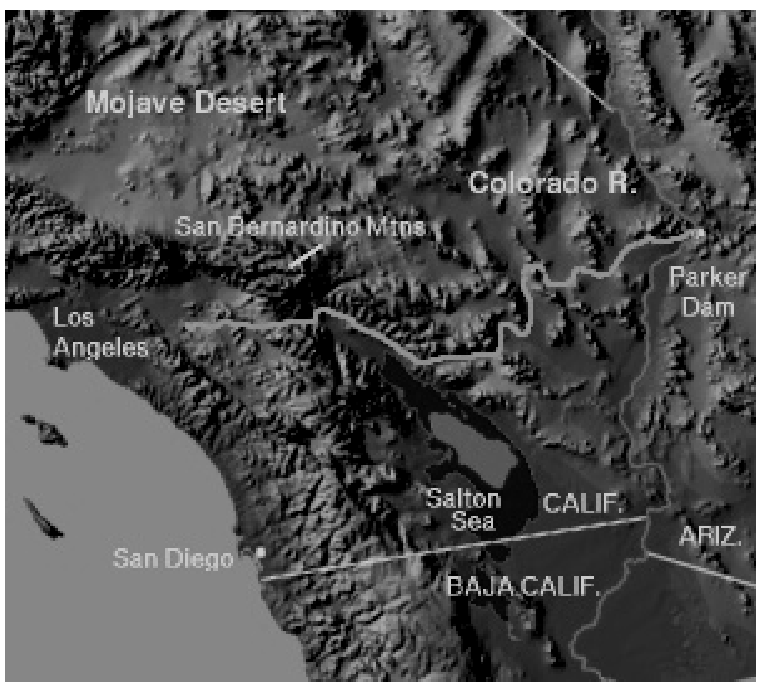

Figure 4: Hydrological Basin of Colorado between USA and Mexico

The USA institutions have encountered a coordination problem between its internal water agencies on management issues and mainly in relation to the water quality preservation such as the salinity problems. Solutions adopted by the USA country have affected the high costs of desalination of Colorado Basin water, before entering to the Mexican territories. However, the USA has fixed a diplomatic price for the cost of good water quality that Mexico will receive in order to meet its domestic and agricultural needs. On the other hand, USA has undertaken many actions concerning training programs intended to support water agencies in Mexico.

IV – Conclusions

The Integrated Water Resources Management approaches which could be implemented inside the nations national jurisdictions legislative systems leads to the objectives related to the direct and indirect economic benefits which are not always well known on regional and international level.

The great challenge is then to insert the concept of the Integrated Water Resources Management in favor of the development and regional stability in the political agenda of the countries that share a transboundary watercourse.

With regard to the water resources which become more and more rare along with the lack of political cooperation among the watercourse States, the regional and national safeguard of food security and water resource for social stability, have reached critical thresholds which may give rise to several conflicts on the trans-boundary basins. These political developments call upon us to take up the challenges and go ahead with the application of the Integrated Water Resource Planning and Management in an effective way in order to avoid the litigations and serious conflicts.

National position applied by riparian country requires coordination on regional level within the scope of a mutual and well established trust and confidence between the Governments.

The positions of these countries which will develop towards the establishment of regional or international agencies for basin management will be based on a political consensus and diplomatic stability between the watercourse riparian states.

Therefore, a legislative training and institutional capacity building concerns the creation of treaties and the application of Integrated Water Resource Management over international watercourses represent a great priority and should be rapidly materialized.

Some suggestions for the practical and applicable options for a successful management of international watercourses taken on the basis of case studies in different regions such as Nile, Victoria Lake, Tigris – Euphrates system, Jordan River, South Africa, Danube and Northern America. These recommendations should be also applied also on the Middle East region:

- Recognition and application of the EU or UN political and technical instructions with the capacity to adapt to the changes of the political environment.
- Reinforcement of the integrated management institutions within the frame of existing regional cooperation works.
- Recognition of the national line of conduct with the harmonized goals in the frame of the policy of joint water between the states.
- Establishments of management tools and regulation texts in order to lead the different parties to the same equality level for the bilateral negotiations.

- Identification and execution of the priority objectives that motivate the application of coordination levels between the watercourse States while maintaining as priority objective the national and regional safeguard of food and water security.

CHAPTER XVI

WATER MANAGEMENT IN LIBYA

PROJECT OF ARTIFICIAL GREAT RIVER

I – Generalities

Libya is located on the Southern shore of the Mediterranean Sea near the Gulf of Syrte and counts currently about 5 millions inhabitants, 60% of them live in urban areas. This country receives along its coast an average of precipitation varying between 400 and 500 mm per year, whereas the internal part, scattered with oases, is an arid region.

The agricultural lands do not occupy more than 2% of the surface area of the country. The revenues of oil and natural gas (90% of the exportations of the country) constitute the major wealth of Libya. These resources allow the realization of some landscaping projects and the application of a wide program of rural development oriented towards irrigated cultivations.

Thirty years ago, President Mouammar Kadhafi, Head of the great revolution of September has proclaimed that "It is time to build up a new civilization". And he added by saying that "all Libyans deserve to live on a land of freedom, justice and abundance." The dream of Khadafi was about to come a reality through the design and implementation of the Artificial Great River by relying on the water resources of the fossil aquifer present in the desert.

According to the statement of President Kadhafi, the abundance resides in the fossil water aquifer deep down the Libyan Desert and constituting a real ocean of pure water but unfortunately non renewable. President Kadhafi declared as well in 1983 that "the Arab people of Libya have chosen, with revolutionary freedom, to build up the greatest success ever of civil engineering which had never been experienced by mankind with the Artificial Great River (AGR)".

II – Project Planning

The Artificial Great River Project constitutes a water plan of large scale. The technical components of this project are the following:

- A wide spread networks of ground pipeline.
- A huge field of wells in the Libyan Desert.
- Reservoirs of huge dimension built for water stocking.

More than 1300 wells were dig representing in their majority more than 500 meters in depth. The water flows till the Mediterranean coast through pipelines of 4 m in diameter each, 7.5 meters length and 86 tons in weight. Therefore, two ultra modern factories were constructed for the fabrication of pipes with the objective to produce the principal canalization network of 3500 kilometers in length and consisted of about 500 thousand pipes.

A long term construction program sustained by a huge infrastructure which comprehends the following elements: power production, communication networks, rolling ways as well as the factories using the most updated technologies. The details on the construction of the project are presented herein after. Figures 1 and 2 show the pumping through the fossil water aquifer to feed the cities of Sarir, Kufra, Hamadah and Muezuq.

a – Water wells

- **Drill holes:** More than one thousand wells were dig for this project some of which reaches 650 meters in depth. They cover a total surface area of about 13000 Km².
- **Pumps installation**: Pumps connected to a main canalization are installed in the wells collections zone in order to pump the water to the surface. Water is subjected to quality analyses in order to verify that it matches the required specifications.
- **Heads of the wells:** Once the wells are achieved, the heads of the wells are planned and connected to the surface canalizations transporting the water till the collection system.
- **Collection:** Water pumped from each well is drained through a network of prestressed concrete and steel pipes of high ductility that lead to the main supply. This canal with a diameter of four meters transports water across thousands of kilometers till the coast.

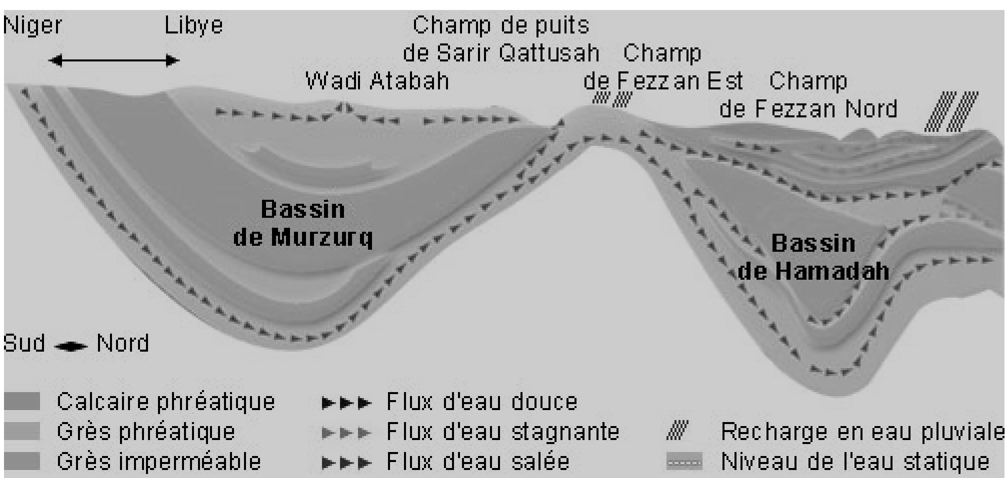

Figure 1: Hamadah and Murzurq Basins

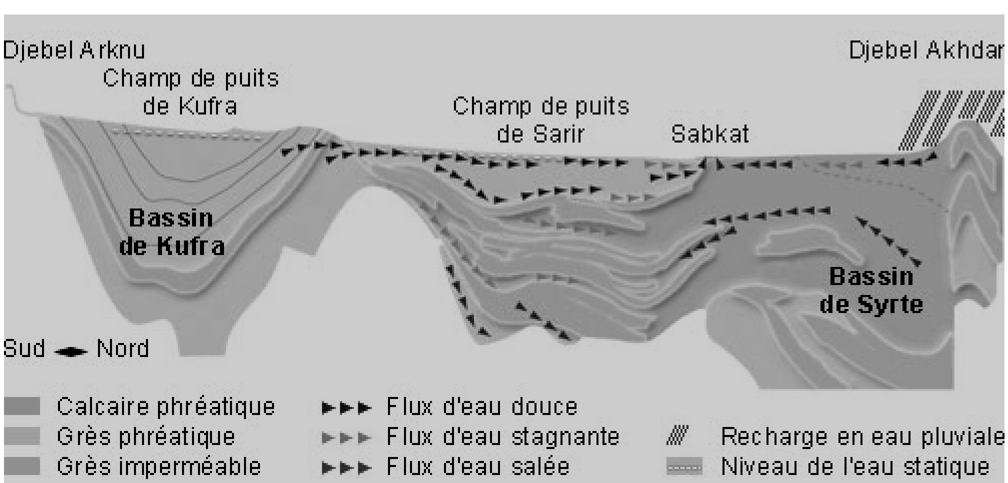

Figure 2: Sarir and Kufra Basins

b – Power Stations:

- **Power Station of Sarir:** It is composed of six groups of generators with gas turbines. The capacity of production of each generator reaches 15 Megawatts. The power station was specifically equipped to feed the fields of extraction of Sarir and Tazerbo as well as the relevant centers of exploitation, support and maintenance (CESM).
- **Secondary Power Stations:** Two large secondary stations with a capacity of 220/66 KV were built to feed with energy the extraction fields of Jabal Hasouna. The produced power is distributed among eleven subsidiary stations of 66/33 KV. All these power stations use high-tech installations built especially to provide optimal performances in the desert region.
- **Air Electric Cables:** Air electric cables transmit the produced electricity till the Artificial Great River. These cables have a capacity of 220 KV, 66 KV or 33 KV.

c – Fabrication of canalizations:

- **Canals:** They extend to a total length of 5000 kilometers including the connections canalizations. Their construction requires more than 500000 pipes. The Sarir and Brega factories have a production capacity of 220 elements per day.

- **Welding:** The column is composed of steel sheets welded with each others to form a cylindrical pipe which edges are connected by jointing rings and cords of connection. The integrity of this steel cylinder is controlled by the testing on the hydrostatic level. This steel cylinder forms the base structure around which are constructed the pipes.

- **Pouring and Drying:** A cast in situe concrete layer is poured on the internal and external surfaces of the steel column. The pipes are then placed in the intake rooms, mainly constructed in order to fix the concrete on the column.

- **Protection and reinforcement:** After pouring the concrete on the pipes, a prestressed post tension cable is applied on the surface with the purpose to reinforce the tubular structure. The external surface of the element is recovered with a mortar layer designed for protecting the steel net. The underground canalizations which shall be in an aggressive place are painted with a protective layer of coal tar epoxy.

- **Inspecting:** After the fabrication, the pipes are subject to an advanced control aiming to meet their conformity with the quality standards.

- **Stocking:** The pipes are stocked, ready to be loaded in transporters.

- **Transporting:** The canalizations are moved through transporters specifically built to bear their weights, which can vary between 75 and 86 tons.

d- Implementation of canalizations:

- **Excavation of trenches**: The trenches, of about six meters in width and seven meters in depth are dug by using all technical means and even by explosives. Mechanical shovel with a capacity of 7.6 m^3 are also used for the purpose.

Some special materials are also used to form the base designed to receive the canalizations.

e- Installation of canalizations: The pipes are put in underground trenches built mainly to ensure the integrity of the canalizations to be ready for their exploitations. Cranes of 450 tons are used in order to implement them. The last phase of installation consists to place the units in position through bulldozer before proceeding to the final alignment.

f- Finishing and backfilling: The alignment of canalizations is verified by laser beam. They are linked all together in a way to make the network electrically continuous. The connections of pipes are tested to make sure of their watertightness. They are joined by injection of cement on their internal and external surfaces. A cathode protection is used in the trenches dig in aggressive soil. These trenches are then backfilled by sand and aggregates especially treated to terminate the installation.

g- Visiting views: Visiting views are placed at intervals of 600 m along the canalizations. They allow to reach the network and to realize the necessary electrical connections to protect the canalization from corrosion. More than 3000 vans of aeration were installed along the column and canalization in order to ensure the security of the work.

h – Rolling Ways

i- Construction of the rolling ways: The roads were especially supplied to bear the weighs of canalizations transporters and prevent their access to the classic public road network. This new road network called “rolling ways”, constitute a great network of transportation through which are canalized the pipes starting from two factories of fabrication till the work site (3000 km).

j- Reservoirs

Sarir Syrte-Taberzbo/ Benghazi system comprehends five reservoirs with a combined capacity of 55 million m^3 which measures each nearly one kilometer of diameter. The unitary stocking capacity of these reservoirs is the following:

- Ajdabiya: 4 million m^3. This is a buffer reservoir that allows the adjustment of the flow in the period of high demand.
- Al Garbabiya: 6.8 million m^3
- Omar Mukhtar: 4.7 million m^3
- Syrte: 15.4 million m^3
- Al Khadra: 24 million m^3

The reservoirs were constructed through excavation in a way to form Earthfill Lake in the land. They are covered with a geotextile membrane designed to hinder the leakage.

k – Centers of exploitation, support and maintenance (ESM)

The centers of exploitation, support and maintenance (ESM) constitute the headquarters where all the aspects of the Artificial Great River project including the pumping stations, power plants and reservoirs are controlled. They contain as well the installations for rest and entertainment designed for the personnel.

III – Exploitation of the Artificial Great River

The water quantity produced by the exploitation of more than 1500 wells equivalent to a volume exceeds 7 million liters per minute. This quantity that takes 9 days to cross this long distance to reach the coast flows by gravity. Several control centers allow the management of the flows and the route of water in the networks. The canalizations emerge from the desert to feed the huge coastal reservoirs which capacity varies between 4 and 24 million m³. Starting from these reservoirs, the water is transmitted by mean of the derivation canalizations and as well through a secondary network. The centers of ESE control and command the exploitation of water starting from the wells fields till the canalization system that feeds the reservoirs. An ultramodern network of communication and data capture by beneficiating from the microwave technology and optic fiber is used for this purpose. The figure 3 shows the system of GFA.

Caption:
Achieved systems
Under realization
Future
Fields of drill holes
Reservoirs
Reservoir of regulation
Pumping stations
Centers of exploitation and maintenance
Factories for the fabrication of pipes

Figure 3: Artificial Great River System

The project of President Kadhafi which brings back temporarily the life to the land of Libya is currently operated to meet the demands of the sectors of drinking water, industry and mainly irrigation that consumes approximately 70% of the daily flow of the river. The irrigation covers 135000 ha of fertile lands of cereals, 760000 tons of production through the use of wide surface areas of fruit trees and vegetables. Before launching the project, 1/10 of these lands were supplied with water taken from the coastal aquifers which excessive pumping leads today to the pollution of the wells by sea water of the coast. In addition to that, the use of water of the Great River will progressively allow the

regeneration of these costal water tables but unfortunately on the account of the non renewable water of the fossil aquifers.
The cultivators may then use methods of cultivation of less intensity in order to preserve the fertility of the lands. We distinguish in Libya two types of agricultural exploitation, the large scale exploitations and the family small scale exploitation.

The 6.5 million m³ of drained water every day increased the share of available water to each citizen of the Jamahiriya to reach 1000 liters per inhabitant.

A preventive and routine maintenance was integrated to the project. The network is maintained under a permanent control and the quality of water is permanently verified. The center of exploitation and maintenance coordinates its activities with a very sophisticated control system. The regional centers are connected to a central control system that ensures the transfer of data through a complex system of communication based on the microwave technology. The control rooms of the different centers ESE constitute the point of intersection of all the information related to the project of the Artificial Great River.

Thus, we may have access to the information concerning the lesser detail of the system, for instance the values of water outflow as well as the specific position of the well.
Since the starting of this operation, the operators may identify the elements that require technical intervention to reduce the maintenance costs especially that the team have to cross long distances through the desert without disposing of specific information.

The AGR project is currently under expansion with the developments of networks related to new wells in order to reach the most isolated agricultural communities. The technological fascinating facts that underlined this huge installation are the following:

- 5 million tons of concrete used in the fabrication of pipes may allow the construction of a road linking the city of Syrte, in Libya to Bombay in India.
- 1300 wells pump every day 6.5 million m³ of water in order to provide daily more than 1000 liters of water for every citizen.
- Main canal extends for a distance of 3500 km and crosses a surface area compared to that of the occidental Europe.
- Transporters of the pipes have crossed a total distance equivalent to 2 times the distance of the earth to the sun.
- Total depth of all the wells in the desert is 70 times the height of mount Everest.
- Length of the prestressed cable used in the fabrication of canalizations is 280 times the circumference of the earth.
- The quantity of aggregates used in the construction of the project may be sufficient to build 20 pyramids similar to the size of the greatest pyramid of Khoufo.

IV – Future of the integrated water resources management in Libya

The water supply of the AGR from the non renewable fossil water aquifers and the huge infrastructure for water supply, constitute a conclusive example of the non sustainable water resources management in Libya. Although the fact that this project reaches its objective by ensuring the demands of the population in drinking water as well as the food security, the country should confront very serious medium and long term environmental problems. The Lybium strategy which is based on the social stability of the country is a highly expensive investment in terms of agricultural production in Libya compared to the international crops markets. Many international experts have indicated that Libya is situated in the margin of the program launched by the United Nations for the application of the Integrated Water Resources Management (IWRM) of the Mediterranean region.

Thus, it is recommended that the exploitation of the water resources in Libya will be based on the safeguard of the environment and the sustainable utilization of the resource, as it is the case of most countries of the region. To accomplish this objective, Libya should exert its efforts to improve the planning of its water resources which may be accompanied with more efficient measures with the purpose to study the demand and drought management. This situation may be ameliorated by integrating the concept of IWRM in identifying the economical, social and environmental advantages attributable directly and indirectly to the Artificial Great River with regard to other sustainable solutions and that could be:

- Desalination of the sea water.
- Water basin transfer from Lake Tchad or other resources.

The implementation of these new alternatives requires a systematic mechanism and an integrated approach recognizing the interdependence of three main domains: the environment, the social stability and the economical development. The choice of one of the proposed alternatives will lead with no doubt to a certain number of changes in the strategic operational management of the resource in order to satisfy the demands of the Jamahiriya.

One of the lessons taken along the years is that the technical solutions cannot only be the right way to preserve the demands for social and food security of the increasing population of this region. Libya should integrate the technical, institutional, social, environmental and economical aspects in its management strategy of the water resources. This solution will allow to this country the harmonization of its demand with regard to a new Water Mass (NWM) concept that could be:

a- Renewable water resources in Libya.
b- Non conventional water resources (desalination and reuse of waste water).
c- Water import from transboundary basin transfer and that could be from Lake Tchad or other resources.

CHAPTER XVII

PUBLIC PRIVATE PARTNERSHIP (PPP)

I- Introduction

Reforms of the water sector in the developing countries started at the beginning of the 1980, and still under way driven by political expediency and philosophy.

This study meant to highlight the gains and the limitation of recent experiences with the private sector participation in the water sector in developing countries. It aims to draw out valuable lessons from six case studies selected and illustrating a variety of different models of private sector participation, from service and managerial contracts to leases and concessions. These lessons will be useful for the ESCWA countries to consider when planning and implementing current and future project linked to the private sector participation.

Infrastructures in the market economy of several countries in the world have entered a new system of partnership between the private and public sectors. This new form of cooperation has emerged to be a promising way for the water supply and wastewater utilities in order to attain several objectives as:

- To improve the performance of this utility.
- To expand service coverage and raise the quality of service.
- To increase operating efficiency.
- To provide alternative mechanisms of financing investment.
- To reduce the burden on public budgets.

A very complicated path should be adopted in order to attain the aforementioned goals. Experience shows that if it happens to be a success for a given country, it could be a drastic failure for another country. This complicated pattern has several parameters to be applied simultaneously, which are:

- Relation between privatization and Regulation.
- Institutional reforms versus privatization.
- The role of politics in the reform versus regulation.
- Financial set up, managing and allocating risks.
- Assessing competition and regulation.
- Private contracts versus regulation.
- Tariffs design by price capital or rate of returns.
- Poverty and politics of prices.

II. General trends for public private partnership

The design and implementation of efficient, equitable, and sustainable tariff systems remain a high priority and a great challenge for public and privately operated water utilities in developing countries. The cases reviewed in this study indicate that, although progress has been made, rigidities continue to impede the imposition of adequate tariff systems.

Tariff structures under private sector arrangements have followed no uniform trend. Different levels and structure, investment needs and financing sources needs and financing sources, the type of contractual arrangement, the regulatory framework, and socioeconomic and political factors.

II-1. - Regulations

The key factors of regulation process in particular institutional environment are the type of quality and incentives provided. The costs and benefits of regulation must be estimated not on bases of what the ideal institution would produce but on a realistic assessment of actual institutions and governmental effectiveness.

Effective regulation is the cornerstone of sustainable private sector participation and successful regulatory reform will require effective institutional reform as well as stronger public administration.

To enforce regulatory regimes and provide guarantees to investors and consumers that improve the institutional and financial viability of projects in which the private sector is involved. But the creation of regulatory framework does not by itself guarantee effective regulation.

In Theory:

> **a-** Regulation can improve economic efficiency by inducing natural monopolist to produce at a socially optimal level.
>
> **b**- When the regulatory framework is clear and stable regulatory authorities strive to maintain a balance between conflicting interests of governments, the regulated utilities, and the consumers.

In practice:

> **a-** The balanced situation between public & private sectors is difficult to achieve. One of the dangers of responding to multiple and often opposing interest in that regulatory authorities may amend their decisions too often creating an environment of uncertainty and distrust among investors and consumers.
>
> **b**- The quality of interventions is a major concern for the regulatory body. Regulators may tend to intervene excessively in the market place and this by interfering with investment decisions and managerial control.
>
> Frequently, regulatory agencies place too much emphasis on punitive threats which are often ineffective and too little on appropriate positive incentives and on enhancing the legitimacy of regulatory process through equitable, just, and transparent policy decisions.
>
> **c-** The economic cost of regulation in case of a regulatory failure can faster efficiency losses greater than the dead weight monopoly losses it is intended to avoid.

Design of Government regulatory bodies:
Governments must find effective ways to design responsive regulatory policies and to identify the right mix of instruments and incentives to implement them.

Whatever the model of private sector participation adopted regulated companies and regulatory authorities face a steep learning curve in their attempts to define their relationship with each other and ensure an equitable and efficient provision of services.

Regulatory models and institutional arrangements cannot be easily transferred from one country to another. Regulatory systems need to be tailored to suit the specific economic and social distortions and the economics in which they will operate there characteristics institutional endowments, and the effects of regulatory legislation on consumer habits.
Whatever the model of privatizations in service provision that the developing countries will be adapting, major critical regulatory issues need to be addressed and evaluated.

Definition of the roles and objectives of regulatory entities:

- Design of the regulatory entities and of the financial mechanisms that will allows them to fulfill their obligations.
- Design of adequate incentives and regulatory instruments.
- Development of technical expertise.
- Choice of strategies to deal with informational. Systems.
- Enforcement of regulatory policies by institutions with limited means and capabilities.
- Choice of strategies to maintain the independence of the regulatory agencies, to prevent their "capture" by experienced private companies or by political interests.
- Choice of strategies to maintain the legitimacy and openness of the regulatory decision process.

II-2- Tariff System

Tariff increase following the entry of private sector participants is likely to be substantial, especially during the transition from public to private sector provision. There are several reasons why this is so.
First water and waste water systems in developing countries are characterized by low rates of coverage and large and increasing investment needs for expansion and rehabilitation. Second, before the private sector participant is brought in, poor financial practices usually cause water rates to fail to cover operating costs.
Third under the new arrangements with private sector participation, necessary tariff increases can partly be offset by gains in productivity gains alone will be enough to generate the large increase in funding that are needed. In the case of large and inefficient utilities, private sector participation can lead to significant cost reductions, which in turn increase the likelihood that water rates can be reduced to reasonable levels for consumers.

a- Barriers to Implementing Efficient Tariff systems

An efficient tariff system requires that prices reflect the value of the resources and services produced. An efficient system must also be functional, in the sense that it is understandable and perceived as fair, politically feasible, and capable of influencing the behavior of consumers in a predictable way. In only a few cases have local governments or private companies adopted the policies necessary to achieve efficiency in tariff regimes in their water and wastewater sectors.

b- Failure to Link Tariff Regimes to Productivity

In many of the cases reviewed here, tariff regimes are not linked to productivity gains or investment requirements. An interesting issue is how to create appropriate tariff regimes that incorporate profitability and efficiency incentives for private operators and encourage the optimal use of resources by consumers. Once a system has been designed with the right incentives, the issue is how to determine the degree to which the operator has achieved an optimal and feasible cost structure, as well as how these costs are incorporated in the level of tariffs. Finally, if productivity gains are achieved, decisions will have to be made about how to distribute the benefits.

c - Low Metering Levels

Low metering coverage is another important limitation. A basic principle of economic efficiency is that consumers should pay on the basis of their actual consumption, which implies metering. Promote efficient water use by residential consumers at least in the initial stages of the concession, when pressures for capacity expansion are low. A massive increase in metering coverage could have a negative effect on net revenues, given the difficulty of reducing operating and investment costs in the same proportion as the expected reduction in consumption. The key issue is how to design a revenue-neutral tariff, at least for the transition period. The concessionaire and the regulator are looking into the problem. Meanwhile they have agreed to install a minimum of 80,000 meters (7 percent of Aguas Argentinas water customers) per year.

d - Distorted Tariff Structures

Tariff structure could be based on cross-subsidies between the hotel, industrial, and residential sectors. Such a regime introduces strong distortions. As a consequence, some hotels are studying the possibility of disconnecting from the system and installing desalinization plants.

This regime reflects a clear conflict of objectives: on the one hand, there is a contractual commitment to provide services to the poor on the other, a distorted tariff structure introduces disincentives for private investment in low-income areas and generates resistance to paying bills in the hotel sector. Tariff adjustments above inflation must be submitted for approval by the regulatory agency.

e - Lack of Clear Mechanisms for Setting Tariffs

The lack of systematic mechanisms for setting tariffs also limits the implementation of more efficient tariff systems.

The municipal council and the private operator renegotiate a new rate every year through a complex and time-consuming process.

f- The Need for Consistency

Investment programs need to be designed using sensible pricing criteria.

In some cases of private sector participation a tendency has been observed to overestimate the expected revenues from tariff increase that theoretically will serve to finance ambitious investment programs, with out a realistic assessment of the demand response. The introduction of tariff increase combined with expanded metering may dramatically alter consumption patterns. These variations in consumption can have different outcomes: on the other hand, they might reduce the utility's revenues; on the other hand more efficient use of resources diminishes the pressure for investment to expand the network. However when most consumers are unmetered as is usually the case before private sector participation,

estimates of the elasticity of consumption demand are unreliable. In countries facing high inflationary pressures, in which output and real incomes are falling or in which a large proportion of consumers are poor, substantial tariff increase may dramatically affect the financial viability of investment programs.

An important lesson that emerges from these experiences is the need to reconcile in a more realistic way the potential revenues from tariffs with investment plans. Various studies indicate that the income elasticity of water consumption can range between 0.1 and 0.5. These elasticities are higher when the water bill represents a large share of total monthly household income.

Price elasticities are on the order of -0.3 to -0.6 for residential consumers.

Firms can raise from tariff increases. These limits vary according to the circumstances of each country or city, but they need to be reflected in the design of realistic investment plans.

g- The Importance of Subsidies and Additional Sources of Funds

When additional funds for investment are required beyond the limits imposed on revenues by structural constraints, the needed financial resources must come from sources other than tariffs (for example, government credits, subsidies, and cofinancing schemes). In such cases a coherent, direct subsidy structure is a fundamental tool to ensure the political and financial viability of tariff regimes that accurately reflect the economic value of the resources and services produced. This is especially so when investment programs or expansion of coverage need to be accelerated, when projects include social objectives, and in the case of wastewater treatment projects. The design of innovative financial programs and incentives to promote the required investments remains a major challenge for local and national government, multilateral lending organizations, and the financial sector in general.

h-Lessons

Several lessons can be drawn from these experiences with water pricing:

-Regardless of the model of private sector participation used-and given the existence of highly underpriced services, plus the large capital investment required for expansion and rehabilitation of water and wastewater systems in developing countries-there have been strong upward pressures on tariffs.

-Despite a consensus on the need to promote more efficient tariff structures that give the right signals to investors and consumers alike, strong rigidities slow their application.

Many private companies have inherited or adopted inefficient tariff structures.

-In many cases there has been a tendency to set unrealistic goals, especially during the initial stages of private sector involvement. Investment plans should be more realistic and consistent with the potential for revenue generation from tariffs. Greater attention should be given to assessing the impact of metering and pricing on consumption patterns.

-Highly distorted, cross-subsidized structures continue t provide disincentives to expand services to the poor. Incentives have to be created for private companies to serve the poor, and these customers must be helped to pay for services through targeted subsidies explicitly included in government budgets.

-Tariff setting following private sector participation continues to be heavily influenced by political factors. Although most private sector arrangements anticipate some mechanisms for tariff adjustment, theses are not always transparent. The lack of clear policies and procedures for tariff adjustment invites external interference. An important lesson is that tariff changes should be transparent, well defined, and, if possible, self-adjusting on the basis of easily explained principles. Guidelines should specify how often tariffs will be adjusted, the process for adjusting them, and the methodology or principles to be used.

Level and quality of services

This paragraph describes the effects of private sector participation on the level and quality of water and wastewater services in the six principal cases. The cases show that private sector participation did lead to improvement in the quantity and quality of service delivery.

The direction of the observed changes is not surprising, for two reasons.

First, as experience elsewhere has shown, in the short term, capital injections and sound technical advice lead to increases in coverage and improvement in water quality even in inefficient public water utilities.

Second, the decision to contract with a private service provider is usually made in response to chronic degradation of existing systems and manifest incapacity of the public operator to overcome severe deficiencies, in Buenos Aires and Cartageana, for example, the public systems were under imminent risk of collapse. This low starting point could magnify the initial effects of any change. What is a welcome surprise is the speed with which private companies have been able to implement these changes. Even more important, however, is understanding how these changes can be consolidated and sustained.

Some conclusions and general trends can be drawn from these six cases:

-Private operators have been able, to a greater or lesser degree, to both expand the quantity and improve the quality of water and wastewater services. The greatest improvements are observed in Buenos Aires and Santago, whereas the Cancun concession shows little progress. Public sector participation in Guinea showed impressive results initially, as a result of significant capital injection from an international Development Association credit, but further gains have been elusive. These differences seem to endorse the view that the magnitude of these gains may depend not on the particular model of private sector participation but on the quality of the incentives perceived by the water companies themselves.

-Many of the initial improvements were achieved by introducing relatively simple management and operating procedures that do not require large investments or sophisticated technologies.

Private firms have shown a remarkable capacity to optimize the operation of existing infrastructure shortly after taking control.

-Private sector participants have given first priority to increasing the flexibility and improving the reliability of water and wastewater systems and to equipment rehabilitation, inspection and mapping of distribution systems, regulation of network pressures, identification of required rehabilitation and other activities to reduce water losses, and implementation of systematic control procedures.

-On the commercial side of the business, immediate improvements include new billing, and collection systems, updating of cadasters, rapid incorporation of users into the commercial system, systematization and decentralization of information, and better consumer service.

II.3 - Financial Aspects

Financing investment in the water and wastewater sector remains a challenge: to meet demand developing countries will need to invest around $60 billion per year, or $1.2 billion every week, during the next ten years. This will mean increasing water supply and sanitation investments from less than 0.4 percent to about 1.0 percent of their combined GDP in the next decade. Most private operators have made on the cases reviewed in this study indicate that, given the current balance of risks,incentives,and rewards, the private sectors is unlikely to invest its own resources in the water and wastewater sector in developing countries. Most private operators have made only minor investments in operational improvements, choosing those with obvious high returns.

In cases involving concessions, where private operators have overall responsibility services, including capital investments, the major source of investment has been cash flow generation and borrowings supported by that cash flow. Private sector participation clearly has produced gains in productive efficiency and generated financial surpluses. These gains are positive and real. But they will not be sufficient to fund all the sectors Investment needs.

The water and wastewater sector offers fewer competitive options than do other infrastructure sectors. Assets required per dollar of annual revenue are greater in this sector than in telecommunications, transport, or electric power, and these assets amortize over long periods and have limited or no resale value.
Moreover, the financial performance of water and sewage utilities in developing countries is often worse than that of other infrastructure sectors. A recent World Bank study found that cost recovery in the sector is only around 35 percent. Part of the problem is the ambivalent nature of water as both an economic and a social good, which sends a conflicting message. In addition, both the weakness of domestic capital markets and increasing evidence that public policy concerning water utilities remain high on the political agenda even after the private sector enters the picture have led private investors to become more selective in their participation in projects in this sector.

Domestic and foreign credit operations pose special challenges in developing countries.
In practice, lending operations and restricted under current models of private sector participation. First, because neither concessionaires nor operating companies own the assets they are charged with managing, they cannot use those assets as security. This is not an insurmountable obstacle, although it requires finding ways to use the revenues

generated from those assets as collateral instead. This mechanism works well if the tariff-setting and adjustment process is predictable and if revenue-pledging arrangements are legally in place.

Second, the private sector participants' equity is usually small relative to investment needs, and in many cases its use is explicitly curtailed.
Access to long term loans requires sophisticated capital markets, financially responsible companies and well structured projects.
The private sector can play a valuable role when these are present. But where capital markets are incipient, as they are in most developing countries, the transition from public financing to long term private financing will take time and ingenuity.

The use of loans guarantees to support private project lenders has met with difficulties in its practical application. World Bank guarantees, for instance, require that countries provide counter guarantees to the Bank. However, many developing countries have decentralized their public sectors, transferring responsibility for the water and wastewater sector to the local level. This has made central governments reluctant to guarantee municipal lending operations unless a reliable revenue-pledging arrangement can be put in place, which is more the exception than the rule.
The magnitude of the financial challenge and the specific constraints of the water and wastewater sector require the design of coherent, longtermfinancial strategies. The private sector can and should play a decisive role in these strategies. But its role is a limited one and should be managed in a more pragmatic and balanced way, according o the specific challenges, risks, and opportunities.

III - Summary

Four major conclusions can be drawn from this analysis.

First, unless significant changes are introduced in the system of incentives, risks, and rewards facing the private sector, the bulk of financial resources for the water and wastewater sector in developing countries will come from the cash generated by the utilities themselves and from lending operations leveraged with the resulting cash flow. Cash generation is increasingly being paid for by consumers through tariffs. Thus, the ultimate guarantee to investors and lenders will depend on the effectiveness of politically and socioeconomically sustainable tariff regimes.

Second, investments have in general not proceeded according to expectations. There is a tendency in private sector arrangements to concentrate a large proportion of the investment program during the first phase of the contract. This puts strong pressures on tariff levels at the beginning of the arrangement. Greater coherence should be pursued among investment targets, tariffs, and quality standards.

Third, a coherent strategy for private sector participation in the water and wastewater sector should distinguish between two different approaches. The first of these is appropriate for water and sewerage systems that are already relatively well consolidated, with high coverage levels, particularly in growing and stable economies with developed capital markets and reliable institutions. In these circumstances, private investors should

be encouraged to take financial risks and compete for credits in financial markets to guarantee efficient management and operations, expansion, rehabilitation, and system maintenance.
The second approach is recommended for low-income economies with underdeveloped capital markets, low coverage levels, rapid population growth, increasing demand for expansion, and weak institutions. Here the rationale for private investment follows a different story. Private investors will tend to reduce their own risk, funding investment as much as possible out of cash generation. In a well-operated utility in a typical developing country, these resources usually cover operation and maintenance costs and part of capital expenditure but do not cover all investment needs for expansion and wastewater treatment.

Under the latter approach, the public sector may have to maintain a financing role in the water and wastewater sector for some years to come. The principal challenge is to find the right mix between public and private finance. The role of private companies needs to be focused first on developing managerial and operating skills, improving the quality of services, increasing productive efficiency, formulating comprehensive investment plans, introducing accountability, and transforming unviable enterprises into financially viable companies capable of receiving and administering credits and government (or multilateral) funds. In this context, options other than concessions may be more suited to improving service delivery. The private sector can contribute to reducing- but will not eliminate- the need for government financing and the obligation on governments to develop financial mechanisms, strengthen capital markets, and provide guarantees and subsidies when necessary.

IV- Case Studies:

This paper describes and synthesizes the results of six representative experiences with private sector participation in providing these services in developing countries as well as economics in transition. Its principal objective is to draw recommendation that can be applied to Design and Implement such a project both now and in the future in Lebanon and the MENA region.

The countries:

The countries and cities studied: Argentina (Buenos Aires), Mexico (Cancun), Columbia (Cartagena), Guinea (Conakry), Chili (Santiago), Poland (Gdansk). These countries have vastly different social, political, economic and institutional conditions (Table 1).

Case	**First year of private sector participation**	**Type of contract**	**Agency responsible for regulation**
Argentina -Buenos Aires	1993	Concession	Autonomous Regulatory Agency
Mexico - Cancun	1994	Concession	Regional Agency
Columbia - Cartagena	1995	Operation & Management	Municipal and National Governments
Guinea - Conakry	1989	Lease	National Agency
Chili - Santiago	1990	Service contract	National Agency
Poland - Gdansk	1992	Lease	Municipality

Table 1: principal features of private sector, Arrangements in the six cases

The six cases shown in table 1, illustrate a variety of different models of private sector participation, from service and managerial contracts starting to leases and concessions.

The reasons for each government to solicit private sector involvement are:

- **Argentina -Buenos Aires**: The federal government entered into a concession agreement as part of an extensive national privatization program undertaken to stabilize the economy.
- **Mexico – Cancun**: The provincial and municipal governments were unable to meet the increasing need for water and sewerage services because of explosive growth in the tourist industry and population surge. A concession contract has been given to a private company.

- **Columbia – Cartagena**: The municipal water and wastewater company had become identified in the public's mind with chronic inefficiency, political interference and poor service. The national government has made several efforts to restructure the company, but all these efforts failed. The mayor of the city decided to liquidate the company and in 1995 a new company was constituted under joint public-private ownership.
- **Guinea – Conakry**: Water supply was reaching less than 40% of the urban population in 1989. After failing to reform the public water company, the National government entered into a lease arrangement to provide water services for the City of Conakry and 16 other towns.
- **Chili – Santiago**: Public corporations were formed to operate water and sanitation services as autonomous commercial enterprises with the Government as majority shareholder. Service contracts have been relied on extensively, since 1979 and a comprehensive tariff system was developed to replace cross-subsidies with targeted subsidies funded by central government.
- **Poland – Gdansk**: A mix enterprise was formed in 1992, in the context of democratic reforms and decentralization, to meet the need for system expansion as well as the need for better wastewater treatment facilities.

IV-1- Cases Analysis:

Analysis of these six cases suggests that private sector participation in the water and wastewater sector is likely to result in sharply improved managerial practices and higher operating efficiency. However, it is unrealistic to expect the private sector in the short term to overcome all the inherited institutional and operational efficiencies and to compensate for underinvestment by the public sector. Moreover, the public sector's failure to establish clear regulatory frameworks and to implement adequate tariff regimes and subsidy mechanisms, constituted a clear financial risk management for the sustainability of the private sector arrangements.
Complementary reforms are required especially in the areas of regulations, service pricing and financing.

Overall, private sector participation has led:

- To improve service quality and expand coverage
- Management has been strengthened
- Productive efficiency has improved quickly
- New commercial practices have increased revenues
- Employees have rapidly become more comprehensive towards the public and their complaints
- Water losses have diminished
- Attention to customers has improved significantly.

Many of these successes have resulted from relatively <u>simple management improvements that did not require large investments and sophisticated technologies.</u>

Private firms have shown <u>a remarkable capacity to optimize the operation of existing infrastructure within a short time.</u>

However, several problems have been encountered through the process, as:

- Unfavorable macroeconomic conditions
- Weak regulatory environments
- Political involvements in institutional reforms
- Inadequate incentives can limit any gain in productivity

Moreover, initial gains and benefits, although important and positive, cannot by themselves compensate for the structural problems as:

- Ineffective financial public institutions
- Low productivity
- Low domestic saving rates
- Regressive tax systems
- Extreme poverty and incomes disparities between social classes in a given country.

The cases show also that the achievements cannot be fulfilled if effective institutional transformation and strengthened public administration are not implemented.

The success of reforms depends on:

- Strong political commitment
- Support of supplementary reforms in the three basic areas:
    1. more effective regulatory frameworks
    2. realistic and efficient tariff regimes accompanied by direct subsidy mechanisms that increase the prospects for political and financial viability of tariff levels and make it possible to provide quality service to the poor;
    3. Development of new financial strategies taking into consideration the specificity of the market economy of each country.

V- Recommendations to be adopted

The experience from the six case studies testifies that the development of private sector arrangements is not free of risks and difficulties. The principal recommendations that can be drawn from these cases can be summarized as follows:

1. *Quantity and Quality of Service Provision*

Private sector participation has led to substantial benefits to consumers in terms of expanded coverage and quality of services as well as improvements in productive efficiency.
However, consolidation of these gains in the future will depend heavily on:

- Strong leadership
- Continuous political commitment
- The ability of governments and financial institutions to implement complementary reforms in the fields of water pricing, financing and regulation.

2. *Efficient Tariffs Regimes*

Most privatized water utilities have inherited or adopted inefficient tariff structures mainly due to:

- Bad initial design in the water resources
- Strong political influences
- Methodology for calculating tariffs should be transparent and objective
- Subsidies for service expansion to the poor.

3- Improving Regulations.

Effective regulation is the cornerstone of sustainable private public sector participation. Experience shows that there are no universally applicable regulatory models or institutional arrangements that can be simply transferred from one country to another.

Successful regulatory reforms will require:

- Effective institutional reform
- Stronger public administration
- Enforce regulatory regimes
- Provide guarantees to investors and consumers that improve the institutional and financial viability of projects in which the private sector is involved.
- The definition of regulatory functions
- The interpretation of contract
- The threat of capture of the regulatory agencies by the regulated companies and political interests.

4- <u>Innovative Financial Strategies.</u>

Experience shows that the private sector is unlikely to invest its own resources in the water sector in the developing countries.

Innovative financial instruments and more effective incentives need to be introduced to induce further private sector involvements.

For medium term in such countries, the bulk of the sector's financial resources will come from cash generation and from lending operations with this cash flow.

The success of future financing of private investment in developing countries will rest on the design of comprehensive long-term financial strategies. The principal challenge is to find the right cooperation of public and private finance and manage the risks through reliable institutions.

VI - Conclusion

The experiences with public-private participation reviewed in this study are few and recent. Their political, socio-economic and other characteristics will not necessarily match those in other countries.

Although analysis of these experiences can offer valuable lessons for other countries and suggest basic principles and guidelines, it may not be possible to apply similar strategies in the same way elsewhere.

CHAPTER XVIII

FUTURE PROSPECTS OF THE HYDRODIPLOMACY IN THE MIDDLE-EAST

I- Water resource and the society: a strategic world stake

Since the early 20th century, water resources and supply was a major source of conflict between riparian states sharing transboundary watercourses in the Mediterranean basin. This situation was aggravated at the southeastern border shore of the basin due to major parameters leading to growing scarcity of this resource and the fast increasing water demands in all the utilization sectors. These major parameters are:

- Climate change and its negative impact on the resource.
- Irrigation that consumes over 65% of the resource total volume.
- Demographic growth and urbanization expansion in big cities.
- Industry and touristic sectors classified as great water consumers.

The hydrodiplomatic situation deteriorated quickly and generated to some recent conflicts resulting from the water management method applied by many countries of the region. These nations have shown that they were able to deprive a neighboring country from its water resources share generating thirst to its inhabitants and high risks on their food security preservation.

The practice of such a management approach by some southeastern nations of the Mediterranean basin changed the nature of the political conflict in such a way that the poorest countries in water resources, usually located downstream the transboundary basins, became the strongest on the military level. This is the case of:

- Egypt which completely depends on the Blue Nile waters that take its rise from Ethiopia and Sudan.
- Israel which is located downstream of the Jordan River and completely depends on waters generated from the Arab countries located at the upstream of the watercourse.
- The political environment of these two countries is surrounded with a continuous panic climate of "water obsession" with the permanent thought that their water supply can be threatened one day.

A reverse situation has been encountered with the GAP project in Turkey being the upstream Euphrates country.
The GAP project affected the transboundary water flow of the Euphrates and a new situation of water scarcity had recently emerged in Syria and Iraq. Table 1 presents the most important transboundary watercourses basin affected by many conflicts in the Middle East region.

Watercourse	Riparian States
• Euphrates through the GAP project and the repercussions that followed due to the filling up of Ataturk dam.	Turkey, Syria and Iraq
• Jordan River and the Israeli policy of expansion towards the Golan occupied territory in Syria and the Chebaa Farms in Lebanon.	Israel, Lebanon, Syria, Palestine and Jordan
• Nile and its tributaries	Egypt, Sudan, and Ethiopia at first followed by many other African countries

Table 1: Major riparian states affected by transboundary watercourse conflicts in the Middle East

The United Nations and the European Union exert efforts in order to find solutions for these conflicts hoping to reverse the situation in favor of a regional cooperation and consolidate a permanent peace between the watercourse riparian States. The legislative texts such as the UN convention of 1997 and the EU Water Framework Directive (WFD) were important and trustworthy but they were rarely used in setting up agreements and treaties between the nations. The watercourse riparian States generally require guarantees for equitable divisions of the resources between the users and prefer the application of the secure management mode for the international watercourses (refer to chapter II).

The hydropolitical analysis that was presented in this documents incites us to propose in the following sections some new future prospects of water sharing and management in order to find solutions for the conflicts that have emerged in the Middle – East, with the intent to guarantee a sustainable peace between the watercourse riparian States.

II- The Arab – Israeli conflict

It is Israel diplomatic responsibility to find solutions for the management and the equitable division of the water resources in the region. A new vision for the future peace settlement integrating a positive hydrodiplomacy initiated by Israel may raise the blockade of the situation. This country was the first to occupy water sources in the Arab territories and should be able to anticipate the future by normalizing the political situation for the sake of its survival among the Arab populations. Also on the strategic plan timing, the situation is not running in favor of the Israelis who are fully aware of that. The pressure that the Palestinian population is suffering from, in addition to the big demographic growth and their abominable life conditions, lead both the Arab and Israeli extremists to adapt the “culture of violence” towards each other. This behavior will constitute the first internal danger factor that can destabilize politically and economically the State of Israel.

The arrival of new Jewish immigrants who are supposed to live in descent conditions constitutes another factor that forces to think differently and to adapt regional dialogue initiatives with the Arab countries and thus avoid the risks conflicts in the region. According to recent estimations, the Israelis population that counted 5.3 millions in 2005 will reach 7 millions by 2015. On the other hand, the Palestinian demographic pressure that is highly increasing at a rate of 3% per year must incite the Israeli Government to start discussing with their Arab neighbors concerning a sustainable peace implementation mechanism for the future.

Unfortunately, the ambiguous conduct of the Israeli government is affecting the peace process that seems indefinitely waiting but could be initiated again through the Turkish mediation which is actually in progress between Syria and Israel. The position of Syria, concerning the principle of “Land against Peace” does not constitute for Israel on the strategic plan a positive step for the reinitiating of the peace process. According to Israelis experts, the Hebrew State survival depends on the water resources management and supply. This resource constitutes for the Israelis an incontestable fact: return back the occupied territories to the Arab countries means to Israel the lack of water resources for its social and food security.

In the year 2000, during the Israeli – Syrian negotiations that took place in the Geneva summit that gathered the American president Bill Clinton and the Syrian president Hafez Assad, the demand formulated by Syria for the return to the 4th of June 1967 frontiers was the culminating point for the negotiation failure between these two countries. Beyond that Syrian proposal to recuperate the Golan is also hidden two major requests:

- Recuperation of the Golan water and aquifer that was mainly a Syrian property.
- Sovereignty of Syria over the shore of the Tiberiad Lake. Syria will be able to claim back new rights on this reservoir, according to the international rules that have determined and drawn the borderline that existed before 1967 war, at five meters away from the Tiberiad Lake shore that totally belonged to Palestine. Syria had signed an agreement with Palestine in 1923 to give the Syrian fishermen the freedom to use the lake.

After the Clinton – Assad summit, peace between Israel and Syria seems completely closed, mainly with the emergence of the Chebaa Farms problem and the Lebanese claim to restitute these territories.

The “Gaza – Jericho” agreement that was first initiated by the American diplomacy launched the peace process again in the region few years ago. The US successive demands in order to return progressively to a non belligerence situation constitutes very important phases for showing the good will of the two Palestinian and Israeli parties in order to reach normal relations. Unfortunately, recent development in the Gaza strip seemed to have complicated the internal political Palestinian environment. This situation constitutes a doubted task for the Palestinian Authority that shall face the Islamic movements such as Hamas as well as other armed groups. These Islamic movements can not politically exist unless by combating the Hebrew State through armed resistance as it was the case in Lebanon with the Hezbollah resistance against Israel.

On the other hand, Israel will have to moderate its extreme right movements and ensure its population from the benefit of adopting cooperative dialogue with the Arab countries. Unfortunately the destroying war against Lebanon in 2006 complicated much more the situation and showed that extremist solutions are still now practiced by the Israeli Government towards its Arab neighbors.

All these successive events make the water problem be a key issue for the peace in the region. Political analysts declared that the real hydrodiplomatic negotiations are actually between the hands of Israel and its recent positive position concerning its retreat from the Golan Heights could lead towards real hopes in the peace process implementation.

III- New water mass for the peace in the Jordan River

All the riparian watercourse States of the Jordan River shall positively collaborate with the intent to ensure a real policy for the water management in this basin, based on an equitable sharing and a reasonable use of the resource. This also implies that all the watercourse States shall have enough water to insure the social well-being and the economic prosperity for the future generations. In order to start a conflict resolution process and to present solution to this problem in order to reach a sustainable peace in the region, these nations have to enhance the integrated water management of the whole Jordan River basin according to the provisions of the following legislative texts:

- Water International law and UN 1997 Convention on the non navigational use of International Watercourse.
- EU Water Framework.

This new concept of integrated management should lead to a calibrated watershed and shall mobilize a total water mass in the region which will include:

- Jordan river basin 1.8 billion m^3/year
- Water from the Red Sea and Dead Sea canal 1 billion m^3/year
- Non conventional water:
    - treated waste waters 0.5 billion m^3/year
    - sea water desalination 0.3 billion m^3/year
    - marine water sources 0.2 billion m^3/year

The mobilized input volume will be around 3.8 billion m^3/year and shall be equitably divided between the basins countries with respect to their needs. This approach will allow the restitution of the Arab countries occupied territories of 1967 such as the Golan Heights in Syria and the Chebaa Farms in Lebanon.

This new water volume of 3.8 billion m^3 /year which should be divided among the riparian watercourse States according to the concept of equitable sharing and reasonable use. This procedure should be based on a united and well determined criteria for the following sectors of use:

- **Drinking water sector:**
    - 200 l/day/person including the unaccounted of water (networks leaking) that should not exceed a rate of 25%. A joint effort should be invested in order to increase the surface coverage of the drinking water networks supply. A global rehabilitation strategy for the distribution networks must be launched for this purpose, in addition to the water stocking infrastructures dams of Ibl Saki in Lebanon and Al Wehda at the border

between Syria and Jordan. These infrastructures are strictly necessary for the regulation of the upstream management of the Jordan River system.

- Equitable tariff policy for the users related to the conventional or non conventional nature of the resource. The regions in which the efficiency of the distribution networks supply exceeding 75% shall have decreasing rates.
- Installation of flow meter counters on all the distribution networks is a must to insure an equitable and regular distribution of the water resource.

- **Irrigation sector:**
    - Optimal water volume needed to irrigate one Hectare of agricultural land shall not exceed 7000 m^3/ha.
    - Implementation of new irrigation methods like sprinklers or drip techniques must be applied for a better efficiency of the water networks.
    - Improvement of the fertilization methods and the adoption of a new quality control system for the irrigation water.
    - Installment of water users associations (WUA) for Irrigation in order to insure the efficient management of the small and medium size schemes.
    - Reuse of treated waste waters for irrigation.
    - Reduction of the landscaping green spaces which consumes a high water volume.

- **Preservation of the environment**
    - Application of the “Polluter Payer” principle to the watercourse States that pollute the international basin.
    - Preservation of the watercourse ecosystems and the implementation of a technical control system that will permanently monitor the non degradation of the rivers.
    - Establishment of waste waters treatment plants in order to protect the quality and ecosystem of the rivers water.

The regional cooperation on the "New Water Mass" (NWM) suggested as a peace project for the equitable sharing of the Jordan River basin requires the formation of a “Regional Basin Management Organization”. The basic role of this institution is to transcend the watercourse States administrative divisions and constitutes a mechanism that will allow ensuring an adequate environment for the establishment of IWRM. An adequate staffing of this regional basin organization will has the task of executing the following functions:

- Equitable water division between the riparian watercourse States.
- Entire planning of the infrastructure projects.
- Formation of regional collectivities.
- Definition of the natural resources management strategies and the rehabilitation programs for the degraded ground and watercourses.
- Adoption of a training program for the settlement and the management of the conflicts.

- Establishment of a regional data bank, trustworthy and accessible for gathering water resources data on both aspects: quality and quantity levels. The Euro-Mediterranean Water Information System (EMWIS) could help in mobilizing a regional antenna in order to ensure the follow up of this institution.

The management of this regional organism that could be established under the United Nations umbrella shall be constituted by the representatives of the five watercourse States as per a rotating presidency between these countries.

This initiative will create a permanent solution to face the water scarcity and grant the future Israelis and Arabs generations a sustainable peace in the region. Water will be then the force of understanding and the application of the “peace culture” in the Middle – East.

Finally, the Arabs and Israelis shall have to make a very clear and painful choice between: a present based on the culture of hate or a future consolidated by a sustainable peace.

IV- Hydropolitical orientations of Turkey

The development of the GAP project by Turkey in order to irrigate 1.7 million ha created additional tensions in the Middle – East region.

This project adjourned all the Tigris and Euphrates arrangements that were conceived by the riparian watercourse States among which Iraq and Syria. The filling of the Ataturk dam in 1992 caused a major water scarcity crisis in Iraq during the Gulf war and led to a total interruption of the Euphrates watercourse for a month.

As for Syria, this country also deprive Iraq from the Euphrates waters stocked in the Tabqa dam whereas the replenishment started in 1975 and caused some serious tensions between the two countries and nearly led to an armed conflict between the two Bassists regimes.

The impacts of this project on the region countries must instigate Turkey to launch a sustainable development strategy based on a spirit of cooperation towards the neighboring nations in the purpose of unlatching and guidance an all levels changing process in the political, social, economical and cultural fields. This strategy should help the countries of this basin to turn for IWRM for a more use of the water resources. As per Turkey, the prospect for its future role in the region is gradually implemented as a major key player in the Middle East such as the Islamic Iranian Republic.

As it was proposed in the previous section for the Jordan River management plan as a "New Water Mass proposal”, the Integrated planning through the Tigris and Euphrates Calibrated Watershed should be used as a basic unit for a future sustainable utilization. This strategy must give priority to the satisfaction of the human essential needs and mainly take hold to guarantee water access for the irrigation. This way of management could encourage Turkey to adopt an energetic participatory action with Syria and Iraq within a mechanism of mutual coordination between the national planning and the decision making on regional level. This approach could create synergies for the basin development and enhance all kinds of benefits between and beyond the watercourse States.

V- Hydropolitical future of the Nile basin countries

Despite the rural and economic development and benefits (tourism, energy production, infrastructures…) that Egypt witnessed from the construction of the Assouan dam that made possible the expansion of the cultivated area from 3.9 million Hectares registered in 1952 to 5.46 millions in 2001, this country still confront a medium and long term great dilemmas which are:

- Increasing the water demand in all sectors of use specially the life standards development. This situation led to the decreasing of the amount of renewable water availability for each person from 922 m^3 in 1990 to 337 m^3 by 2025.

- Increasing of the Egyptian population brought the cultivated area for each person back from 0.22 feddan to 0.11 feddan (1 feddan = 0.42 hectares). This situation led to the increasing of the demand on food and Egypt is forced to the importations of expensive food products. The population will count 120 million inhabitants in 2040.

- Acceleration of the fertile soils erosion which causes a reduction of the useful agricultural area in addition to the increasing salinity of the Nile Valley. This dramatic situation is ruining the efforts of improvements that have been made since thirty years in this region that furnishes the main national production of rice. It is to note that the fertile soils erosion phenomenon is enhanced by the sediment blocking in the Assouan dam.

- Search for new lands in Sinai desert and in High – Egypt region through the "Ghor Toshka" program that consists of diverting the Nasser Lake waters to the West. This new water transfer approach would lead to a reduction of the flows downstream the Delta.

- Insurance of the food security makes from this country the world third grain importer and the first wheat importer. Statistics reveal that during the year 2002, Egypt has imported 11.6 million tons of grains among which 4.5 million tons of corn and 7.1 million tons of wheat.

- Destabilization of commercial balance in Egypt due to the increasing of the world wheat prices from US$ 60 to 250$ for the ton in 1972. The wheat importations went from: US$ 147 millions in 1972 to US$ 400 millions in 1973 and then to US$ 3.9 billion in 2002. This post represents nowadays around 30% of the country total importations.

Ethiopia that is located upstream of the Nile basin and that furnishes more than 85% of this river flow does not use more than 0.3 of the river volume. This country asserts that its population is increasing faster than the Egyptian population and that the high dryness periods that have occurred since thirty years causing catastrophes and famines could have consecutively been avoided through the implementation of irrigation infrastructures projects. But, it is also important to mention that a great responsibility rely on the governments of this country because of the following reasons:

- The civil war that Ethiopia have witnessed for over twenty years after the revolution against the emperor Hela Silasse.
- The corruption and rigidity of the Mengistu communist regime.
- The communal lands division system that was imposed by Mengistu and that does not enhance until today the investment in irrigation projects.

The change that occurred with the collapsing of Mengistu regime in 1993 and the end of the war with Eritrea in 2000 led the new government to launch again the ambitious rural development projects in this country. The World Bank gave its agreement to finance an irrigation project that will develop 1.5 million hectares through a derivation of the Tana Lake waters.

During the following years, Ethiopia will have to face as Egypt many problems such as the food security preservation for its population and that will affect the economic development of country:

- The first challenge is the quick increase of the population. Statistics actually show that this country counts now around 68 million inhabitants and according to the demographic increasing projections, the Ethiopians will reach 94 millions in 2010 and 120 millions in 2025.

- The second challenge is the consequences of the cumulated dryness periods and their impacts on the country food and sanitary security. Furthermore, the dryness seasons has drastically reduced the number of forests that was estimated at 40% of the total surface of the national territory at the beginning of the 20th century and that reached now only 4%.

- The third challenge is the water conflict that will take place with Sudan and/or Egypt following the accomplishment of the planned hydraulic infrastructure projects for the development of more than 1.5 million ha of irrigation surface area. According to the FAO sources, these irrigation projects have a high priority in order to ensure the food security of the country. The Ethiopian government considered that the rural development projects will need an ambitious hydraulic stocking infrastructure such as big dams that will mobilize 10 billion m^3 of water volume from the Blue Nile and Lake Tana. This master plan was programmed upon three stages:

    - Short term: equipment of 90000 ha within the stock of water coming from the Tana Lake.
    - Medium term: equipment of an agricultural scheme of 430000 ha.

- Long term: extension of the irrigated potential area in order to reach a total surface of 1.5 million ha.

It is certain that the mobilization of the 10 billion m^3 of water volume upstream the Nile basin will lead to a quick deterioration of the political situation with the riparian countries located downstream the Nile. The new Ethiopian master plan will decrease the water flow volume of the river downstream and will generate social, economical and environmental repercussions over Sudan and Egypt.

The Ethiopian government that is currently helped by Israel in the planning of such a huge project has officially asked the governments of Sudan and Egypt on March 1998 to renegotiate the water treaty of 1959 which exclude Ethiopia from the water sharing of the Nile.

Sudan actually confronts just like Ethiopia the same social and economical problems that require the implementation of an emergency action plan that could propose solutions to the following stakes:

- Accomplishment of big water infrastructure projects in order to ensure the food security of the country.
- Loss of wide usable agricultural surfaces due to ground erosion problems in addition to the industrial and commercial projects designed for foreign investors.
- Crisis of the “Darfur” issued from the civil war between the north and the south of the country. This conflict is now one of the European Union and international governments priorities.
- Political instability that rules Sudan many years ago will complicate more the accomplishment of the agricultural development projects decided by the Government of this country.

From its side, the Egyptian governments is taking advantage from the instability that rules in Sudan and maintain its position related to the integral application of the treaty of 1959 concerning the allocated water quantities for the two countries.

As to the great lakes region, it seems that countries like Tanzania, Uganda, Kenya and Burundi have nearly doubled their irrigated surfaces. The purpose is to ensure food for their populations and fight the recurrent dryness effects. As same as Ethiopia, the Government of Uganda has called for Israel to help in the planning of the rural development of its territories. On the other hand, the political declarations of the riparian African countries Governments show a rallying in their positions towards Ethiopia and the renegotiation of the treaty of 1959.

The solution of this extremely complicated situation of the Nile basin is definitely in the hands of the Egyptian and Sudanese governments. Despite the creation of the Nile basin Initiative (NBI) and the climate of cooperation that rules now all the leaders of the countries, Egypt should take an action in favor of the renegotiation of the treaty of 1959 that includes all the riparian watercourse States. This approach needs a lot of courage, a firm commitment to apply equitable sharing and an important political leadership from the Governments of Egypt and Sudan. These two countries should renounce at first to the integral attribution of the Nile river flow for the establishment of a total and integrated management of the basin.

This new vision needs an implementation mechanism and a road map for the IWRM approach. Furthermore the adoption of many technical and economical steps towards the basin riparian state will lead to a "Win – Win" situation among all basin nations. The creation of a "Fluvial Basin Agency" (FBA) is crucial for the formulation and application of the IWRM programs and policies.

The adoption of this project as a new prospect for the Nile basin management will consolidate the Egyptian government position for medium and long term plan towards the remaining eight watercourse States that miss no chance to solicit foreign political supports and that are generally hostile towards Egypt. The aim of these actions is to weaken Egypt in order to hinder its economic development and its food security. The strategic change for Egypt is essential with the hope that this country will manage to moderate and to reabsorb the positions of the eight watercourse States through the adoption of this project. This approach will consolidate the ancestral identification of "Egypt as the Nile Gift" and shall keep its continuity in the region.

VI- Nile, Euphrates and Tigris :Basin comparison

The Euphrates, compared to the Nile, shows an inverse situation, with great economic development upstream the river and inside the territories where the majority of water are gathered. The upstream deviations, pollution and salinity of the river are negatively perceived by the affected states located downstream the basin.

In all the trans-boundary basins of the world, countries located upstream have obvious benefits compared to countries located downstream as it is the case for the Euphrates while as to the Nile; countries located downstream are the biggest water consumers.

The adoption of the spirit of cooperation in the management of the two basins is necessary for the protection and the conservation of the two rivers ecosystems. In relation to the Euphrates, there is till today no treaty implemented between the three watercourse riparian States while the divisions of the Nile water are submitted to bilateral treaties between Sudan and Egypt.

As to the Euphrates, bilateral and tripartite meetings were organized since the years 1960 between the Turkish, the Syrian and the Iraqis Governments. These meetings resulted in a great number of agreements concerning the guarantee of the international discharge volumes but the dialogue among the officials of the three countries was not achieved yet.

Similarly to the case of NBI, the Euphrates and Tigris water resources could be increased and available for all the watercourse countries, provided that a situation of trust and collaboration will be established between the states in the region.

In order to fill the gap of water shortage in the region and meet the demands of the watercourse countries, two solutions on technical and economical level can be adopted, such as:

- Division of cumulated volumes of the two basins in an equitable way between the watercourse States
- Development of direct and indirect benefits between the riparian states

VII- University role and the "water culture" in the Mediterranean basin

The problems related to the climate change that influences the water resources such as the floods, dryness and supply prevent actually our countries from facing their economic and social development objectives. Are the recent approaches on the rural poverty, the food security, the infantile mortality and the environment degradation failed? The adoption of a research and development strategy as well as an awareness action plan about the necessity of implementing an IWRM concept through the academic support may help to consolidate a sustainable approach of the utilization of the water sector in the technical, economic and social development of our society.

The University role may be an important, useful and indispensable mean to rise up specific challenges concerning sustainable development and optimize the concept of equitable use of this resource at the geopolitical levels for the International watercourses.

The University role within its education and applied research curriculum could establish targeted actions in the hydraulic domain in order to provoke a positive change in the preservation of our water resources. This process will include a higher political commitment to the support and the active participation in this sector. For this reason, the sustainable development education in our universities is the best way to invest in the amelioration of the existing water resources management and in the research for new utilization means such as (dams, recharge of aquifers, supply infrastructures, sewage systems, irrigation systems, treatment plants and water reuse, hydroelectric plants, desalination…). For most of the Middle – East countries, this approach is related to the overcoming of a great "financing pit". The solution will probably be the combination of these two options, in addition to an optimal technical and economical approach that will be very useful for the development of this sector. It actually allows getting more benefits (social and economic) from future and existent investments and also could motivate the countries to attract the financing they need in order to rehabilitate the water infrastructures and the resource management efficiency. The academic education is an appropriate place to form and train the future water leaders of the Mediterranean basin. This is the challenge that the Mediterranean basin universities must overcome in order to meet the educational components of the Millennium Development Goals (MDG's) of Johannesburg Summit.

The University may also try to elaborate a permanent and coordinated decisional mechanism through the water educational sectors, the research and the management approach. This is the essential way in order to resolve the problems that are related to water and that cannot be resolved through mono sectorial conventional approach. This approach offers the possibility to resolve these problems with more efficiency through the identification of the deep reasons and the solutions outside any mono sectorial frame. In addition to these subjects, universities could propose tailor made programs to train the new generation of the water future leaders on transboundary watercourse management and the conflict resolution framework in order to slow down the intensification of the water struggle problem.

The university institutions will involve all the stakeholders in the main stages of this concept and will guarantee a realistic plan for its application. Furthermore, the role and responsibilities of all economic and social sectors and their related responsibilities will be clearly defined in order to reach a strategy for reinforcing of the administration institutional capacities as well as the role of good governance.

The University can help in the formulation of these strategies that should include the change of specialization programs aiming to satisfy the industrial as well as our social needs.

It is worth to mention that the United Nations former Secretary General, Kofi Annan, said that the "water is not only the first vital need but also the heart of sustainable development and it is essential to eradicate poverty". The water is directly related to health, agriculture, energy and biodiversity. Without the progress in the water field, it will be difficult, if not impossible, to reach the other Millennium Goals for Development.

VIII- Hydrodiplomacy and sustainable development

Sustainable development must be a global objective that aims to meet the current needs of the society and to prepare the ground to satisfy the futures generations needs without exhausting the region natural resources.

The MDG's that was adopted by 189 countries in September 2000 in Kyoto and the implementation of the Johannesburg plan that was adopted in 2002 by the World Summit on the sustainable development underlined the urgent need for a increasing commitments in order to reduce the inequalities and contribute to the development of the poor countries.

Therefore, the European Union and some of the Mediterranean northern shore States will have an important role to perform in order to overcome these challenges. They will be led to adopt strong aid policies in order to enhance the north and south co-development. The EU and its Mediterranean partners will also have to work together to encourage the democracy process, reinforce the institutional capacities, ameliorate the governance and enhance the peace process in the southeastern region of the basin that witnessed permanent water and resources conflicts. The application of dialogue, institutional reinforcement and capacity building strategies through the ENP program (European Neighborhoods policy), if oriented towards implementing the sustainable development process, will help the Mediterranean southeastern countries to reach their aspirations faster than the way planned before in the Euro – Med partnership mechanism.

At an early time, this proceeding could facilitate the application of the national and regional dialogue the IWRM that was released by the EU Water Framework Directive (WFD) with the intent to implement of this new management concept over all hydrogeographical basin or "Water Mass" in the basin region.

This initiative led by the EU encourages the principal water players in the Mediterranean basin to develop cooperation bilateral or multilateral exchange policies aiming to ameliorate the “Water Mass” utilization on the regional level. For this reason, a considerable part of the IWRM implementation mainly lays on the conflicts settlement and hydrodiplomacy. This will help the governments to establish formal water conflict settlements on permanent basis.

Given that the water in the Mediterranean southeastern region is a rare, fragile, and unequally distributed resource in time and space, and that the climate change accentuates the participations irregularities and decreases their volume, all the countries of this basin shore are simultaneously confronted to many water related challenges.

We consider that this book will help in overcoming and finding solutions to the questions that the Mediterranean citizens keep asking about.

How to limit the climate change effects on the countries of the Mediterranean sea?
How to permanently manage the poor hydraulic resources in the region?
How to ensure the access to good quality of water and sufficient quantities for the populations?

How to educate the water users to adopt economic conducts while using this important and rare resource?

How to chase away the phantom of water war in the southeastern Mediterranean shore through inciting governments to adopt policy of cooperation and participation in the transboundary watercourse management field?

Some of the basin countries have begin to ensure a more efficient water management like that called for in the Summits of Kyoto, Johannesburg and Mexico. The EU has launched an initiative on water (EUWI) with a Mediterranean component of which represents a cooperation framework to contribute in reaching of the Millennium Development Goals for the region.

For the leaders of all the Mediterranean countries, the challenge consists of using the strategy of dialogue and regional cooperation as an opportunity to realize together the coordinated progresses in the human and economic development fields, the protection of water resources and the cultural advance. The consolidation of water culture for the peace is essential for the Mediterranean countries. We leave the judgment for the reader, keeping in mind that “time is the best teacher, it fixes things well…”.
