WATER IN LEBANON
STRATEGIC MANAGEMENT
DATA NATIONAL ASSESSMENT MATRIX

MINISTRY OF ENERGY AND WATER

Preliminary National Water Strategy (2011)

MINISTRY OF ENVIRONMENT

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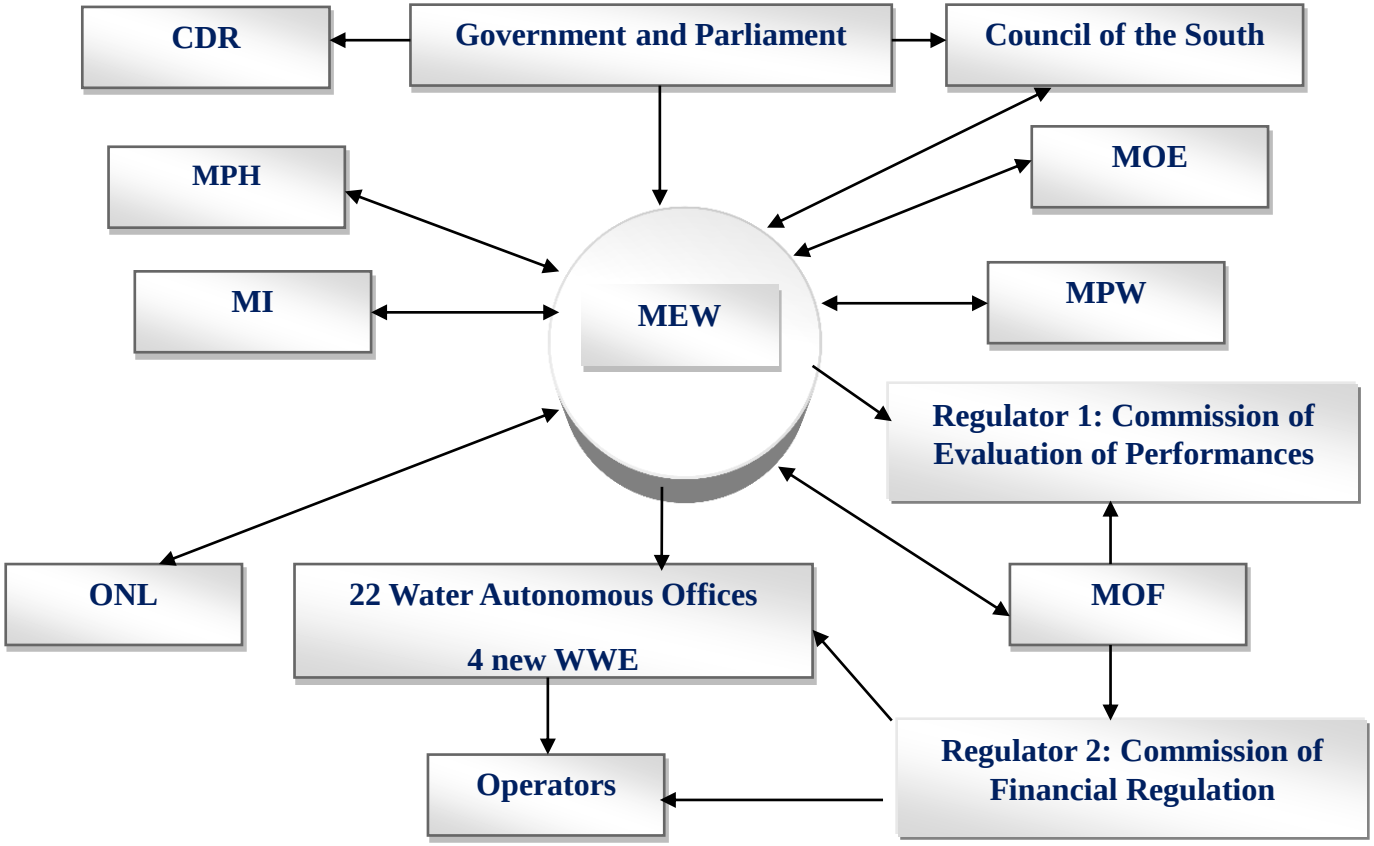
OUTLINE

I. Water data sources in Lebanon
II. Improving water and sanitation services
III. Managing water supply and demand
IV. Mitigating water resources degradation / improving quality of water resources
V. Adopting to extreme hydro-meteorological events

I. Water data sources in Lebanon

A. Water sector institutional actors in Lebanon ex post reform (law 221/2000)



I. Water data sources in Lebanon

A. Water sector institutional actors in Lebanon ex post reform (law 221/2000)

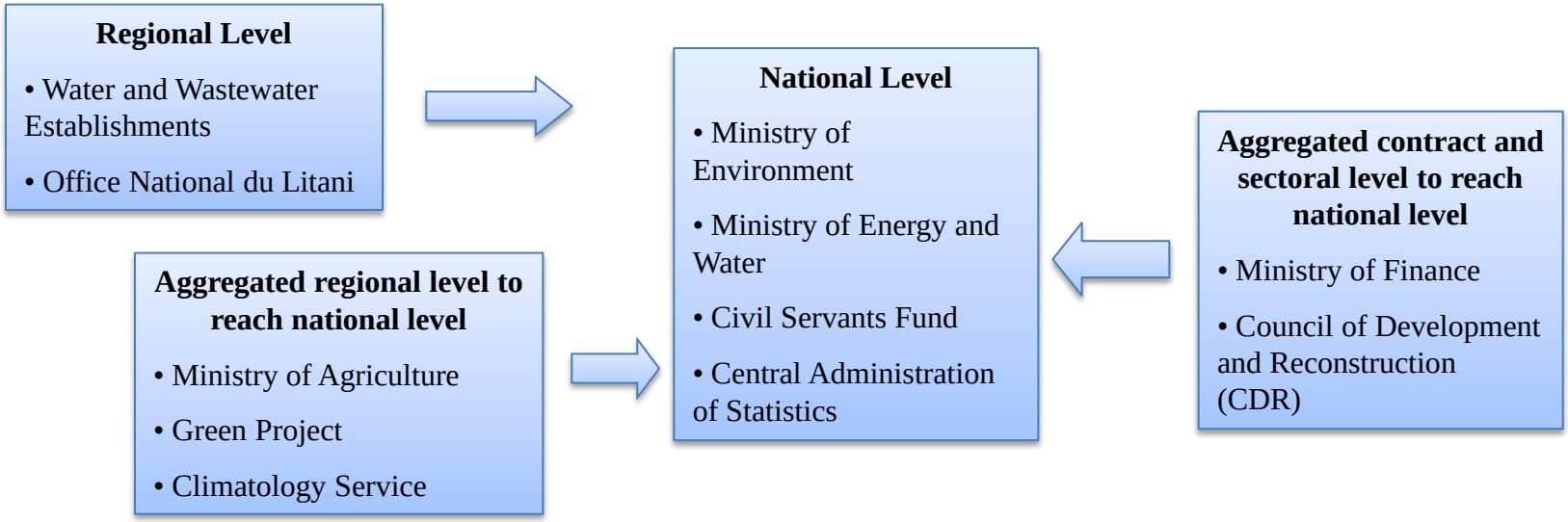
National reform assessment

Strengths	Weaknesses	Suggested solution
Reduced the water sector fragmentation	The 4 new WWE inherited the 22 autonomous financial and HR problems	Empower these WWE with necessary HR and financial resources
	Administrative autonomy of the 4 WWE which do not accept to provide data even to the MEW or the mandatory authority	Find an incentive to push these WWE to provide their data even if it is partial
Creation of 2 regulators: managerial and financial	The two regulators are not working yet	The national water strategy should work on this fact
	Private operators are an oligopoly and are very powerful	Try to enhance competition and water utilities delegation laws (BOT projects)

I. Water data sources in Lebanon

B. Filling some SEEAW tables with the available water data in Lebanon

WHAT ARE THESE DATA AND THEIR COVERAGE LEVEL???



HOW TO USE THESE AVAILABLE WATER DATA???

Source: CAS based on Statistical yearbook data providers

I. Water data sources in Lebanon

B. Filling some SEEAW tables with the available water data in Lebanon

Strengths	Weaknesses	Suggested solution
	Fragmented non accessible water data in Lebanon with no metadata	
CAS is able to standardize and organize the water data collected	The data received by CAS is partial and not sent on time if it is sent	CAS can work on the IRWS to estimate some data and to be able to fill partially some data and can discuss them with other water stakeholders in Lebanon to improve them

II. Improving water and sanitation services

- Water reform and strategy aims in Lebanon at improving water and sanitation services
- In fact, the multiple water reforms in Lebanon wanted to increase water available resources and to implement non-conventional water resources
- The 2011-2035 strategy wishes to:
    - Increase the water production from 1,589 MCM in 2010 to 2,200 MCM in 2035:
    - Access to water:
        - Total number of primary residences in 2007: 888,813
            - Percentage of primary residences connected to public network in 2007: 45.9%
            - Percentage of primary residences connected to private network in 2007: 2.3%
            - Percentage of primary residences connected to artesian well in 2007: 5.1%
        - Total number of primary residences in 2007: 888,813
            - Percentage of primary residences connected to public sewers network in 2007: 65.7%

Sources: CAS Households' living conditions 2004 and 2007 surveys and MEW water national strategy 2011

II. Improving water and sanitation services

- Tariffs:
  - Water supply:
    - Volumetric tariffs to be introduced in pilot areas of fully metered connections (25% of customers in 2012) and gradually rolled out (75% customers by 2015)
    - Rate per CM to be maintained at the current average of USD 0.39 until 2014 and then increase to reach O&M recovery by 2015 and full cost recovery by 2021
    - Collection to be improved from current national average of 47% to 60% by 2012 and 80% by 2015
  - Irrigation:
    - Volumetric metering is the preferred solution whenever applicable (target by 2015: 60% volumetric; 20% per hour; 20% per area)
    - Rate per CM to be maintained at the current average of USD 0.12 until 2014
    - Collection to be improved from current national average of < 10% to 30% by 2012 and 60% by 2015
  - Wastewater:
    - Collection and treatment to at least preliminary level of 80% by 2015, and of 95% by 2020
    - The new wastewater tariff (25% of the Water supply tariff at an initial stage) to be introduced in 2011 to pilot areas, to be then increased to gradually reach full recovery of all O&M costs by 2020
  - Average tap water CM tariff: USD 145/year

Source: MEW water national strategy 2011

II. Improving water and sanitation services

- Investments in infrastructure and value of infrastructure:
  - Total revenues in 2011: 110 million USD
  - Projected total revenues in 2020: 520 million USD and full cost recovery is expected by 2020
- Volume of water abstracted, distributed and lost:
  - Water production: 1,589 MCM in 2010 through:
    - Surface water: 649 MCM
    - Groundwater: 705 MCM
    - Dams: 235 MCM
  - Estimated water production: 2,200 MCM in 2035 through:
    - Optimization of surface water resources: additional 64 MCM by 2020
    - Artificial recharge of groundwater aquifers: up to 200 MCM at an initial stage by 2020
    - Surface storage – dams and hill lakes: additional 670 MCM static / 880 MCM dynamic in identified sites by 2035
    - Water supply transmission (2,800 Km) and storage tanks (191,000 CM) by 2020
    - Water supply distribution (9,600 Km) and customer metering (1 million water meters) by 2020
    - Irrigation rehabilitation and expansion: additional 30,000 ha during 2011-2020 to reach 60,000 ha by 2035
    - Wastewater collection: 80% by 2015 and 95% by 2020
    - Wastewater treatment: 30% by end 2012, 80% by 2015, and 95% in 2020

Source: MEW water national strategy 2011

II. Improving water and sanitation services

- Capital expenditures requirements for Lebanon water sector 2011-2020 in million USD:
  - Short term: 2011-2012: 1,973 million USD
  - Medium term: 2013-2015: 3,272 million USD
  - Long term: 2016-2020: 2,661 million USD
- Unaccounted for water:
  - Network leakages in CM/day: 43,970 CM
  - Leakages because of illegal connections in CM/day: 18,505,116 CM/day
  - Total leakages in CM/day: 26,027,0111 CM/day

Sources: MEW water national strategy 2011 and regional water authorities in Lebanon 2008

II. Improving water and sanitation services

Strengths	Weaknesses	Suggested solution
Plenty of water reforms in Lebanon aiming at improving water public utility and water resources	Discontinuity of water reforms Each water reform neglects the previous water reform	There should be a link to insure a reform continuity in Lebanon
CAS households' living conditions survey are available but partial	CAS surveys do not provide complete water data in Lebanon. They only deal with the dwelling characteristics regarding water	CAS should enlarge its questionnaires to get more SEEAW indicators
Water tariffs by type are very well taken into account in MEW water strategy (2011-2035)	How to implement these tariffs later on? Is there a practical way to do it? What are the criteria made in order to calculate these tariffs?	MEW should establish metadata about water tariffs in its strategy
Estimated data exists	No real data exists and not metadata for water data estimates	
Plenty of Wastewater plants exist in Lebanon	These wastewater plants are not working in Lebanon	WHY?????
	Space and time water data discontinuity and some laws obliges some official water stakeholders to sell data	

III. Water supply and demand

Water Resources Availability - Lebanon's water resources, under stress.

See estimates of available water resources in table based on several sources (measurements date back to 1960s and 1970s)

Source	*Mm³(1)*	*Mm³(2)*	*Mm³(3)*	*Mm³(4)*
Precipitation*	8,600	8,600	8,200	9,300
Evapo-transpiration	(4,500)	(4,300)	(4,100)	(4,500)
Losses -Rivers to neighbours -Groundwater	**(1,400)** (700) (700)	**(1,700)** (670) (1030)	**(1,333)** (648) (685)	**(2,400)**
Total Renewable Resources -Surface Water -Ground Water	**2,700** 2,200 500	**2,600**	**2,767** 2,200 567	**2,400** 2,000 400
Net Exploitable Resources	**2,700**	**2,000**	**2,767**	**2,400**

Sources: 1) MOEW, 2010b, 2) MOE/ECODIT, 2002, 3) MOEW, 2010c and 4) Fawaz, 1992

III. Water supply and demand

Water Demand

Current demand estimates vary depending on source and assumptions

Three different demand estimates ranging from 1,473 to 1,530 million m^3 / yr

Sector	*2010[1]*	*2010[2]*	*2010[3]*
Domestic	501	467	505
Industrial	150	163	158
Agriculture	900	900	810
Total Demand	1,515	1,530	1,473
Sources and assumptions:	(1) Comair, 2010	(2) WB, 2009a	(3) MOEW, 2010a
Population Per capita consumption Network efficiency Irrigated area Irrigation consumption Industry demand	4.5 million 200 L/d 70% 145,000 Ha 8,000 m^3/ha 30% domestic	4.2 million 140 L/d 65% 103,000 Ha 9,000 m^3/ha 35% domestic	4.5 million 180 L/d 52% 90,000 Ha 9,000 m^3/ha 31% domestic

III. Water supply and demand

Water Demand (Cont.)

Water demand projections 2010-2035 by the WB and MoEW:

Sector	*2010*		*2020*		*2030*	
Domestic	467	31%	767	37%	1258	44%
Industrial	163	11%	268	13%	440	16%
Irrigation	900	58%	1020	50%	1120	40%
Total	**1,530**	**100%**	**2,055**	**100%**	**2,818**	**100%**

WB, 2009

Sector	*2010*	*2015*	*2020*	*2025*	*2030*	*2035*
Domestic	505	460	427	467	512	562
Industrial	152	138	128	140	154	169
Tourism	6	8	10	13	16	21
Irrigation	810	877	935	983	1,021	1,050
Total	**1,473**	**1,483**	**1,500**	**1,603**	**1,703**	**1,802**

SOER 2010

III. Water supply and demand

Wastewater Generation

- 52% of buildings connected to sewage networks in 2004 (see Table)
- 48% rely on sceptic tanks many of which are permeable or deliberately drained to prevent overflow
- Nationwide, the highest rate of sewage connection recorded in Beirut (96%), followed by Tripoli Baabda (each 91%) and Zahle (83%)
- Lowest connection rates in Batroun (1%), followed by Bent Jbeyl (4%) and Jbail (10%).

Mohafaza	*Population*	*Domestic WW Mm3/year*	*BOD Load (tonnes/year)*
Beirut	361,366	25.1	10,040
Mount Lebanon	1,484,474	93.8	37,525
North Lebanon	763,712	50.2	20,092
Bekaa	489,865	33.6	13,428
South Lebanon	416,842	29.4	11,751
Nabatiyah	242,876	17.1	6,854
Total	**3,759,135**	**249.2**	**99,690**

Notes: Based on 2007 population *Source: WB, 2010*

III. Water supply and demand

- Renewable inland water resources in 2008:
    - Total number of rivers and springs: 135
    - Total number of wells: 668
- Rain:
    - Mm of rain in Beirut International Airport: 811.6 mm in 2009; 485.6mm in 2010
    - Mm of rain in Zahleh (Bekaa): 836.4 mm in 2009; 554.2 mm in 2010
    - Mm of rain in Tripoli (North-Lebanon): 968.1 mm in 2009; 574.4 mm in 2010
- Water abstracted/consumed/returned by economic activities in 2008:
    - Rivers and springs:
        - Exploited cubic meters by authorities per day: 848,424 CM/day
        - Available CM of tap water per day: 576,460 CM/day
        - Available CM of irrigation water per day: 176,313 CM/day
    - Wells:
        - Total average value of tap water produced of cubic meters/day: 860,847 CM/day
    - Tap water treatment plants:
        - Treated CM per day: 534,000 CM/day
    - Wastewater treatment plants:
        - CM of collected wastewater by water authorities: 38,000 CM

Source: Regional water authorities in Lebanon 2008

III. Water supply and demand

- Water tanks:
    - Pumped water to tanks per year: 17,472,552 CM/year
- Water subscriptions in 2008:
    - Subscriptions in 2008: 779,480
    - New subscriptions in 2008: 10,845
    - Installed counters: 54,749
    - Number of installed gauges: 559,192
    - Volume of charged water: 893,592 CM/day
- Irrigation water subscriptions in 2008: 6,925 subscriptions
- Water consumption:
    - Daily water demand in CM: 1,114,388 CM/day
    - Water leakages in CM/day: 174,923 CM/day
    - Consumed cubic meter/day: 79,099,044 CM/day
    - Connected inhabitants to network: 1,474,968 inhabitants
    - Water litres/inhabitant/day: 674 l/inhabitant/day

Source: Regional water authorities in Lebanon 2008

III. Water supply and demand

Table: Annual yield of private licensed wells

Mohafazat	Number	Water Uptake (Mm^3/year)			Total Yield (Mm^3/year)
		Domestic	Irrigation	Industry	
Beirut	1,680	5.14	1.23	0.77	7.14
Mt. Lebanon	10,718	19.56	34.23	20.54	74.33
Nth. Lebanon	2,966	6.50	34.23	20.54	61.27
Sth. Lebanon	2,282	1.67	14.58	2.50	17.08
Bekaa	2,678	1.47	19.55	1.47	22.49
Total	**20,324**	32.67	103.82	45.82	182.31

Source: SOER 2010

III. Water supply and demand

Strengths	Weaknesses	Suggested solution
Some WWE possess exhaustive data	Some WWE do possess partial data and some of them do not possess data. The WWE that possess data refuse to provide water data . The pretext is data adjustment but in fact, they sell the data	
	Water balance is very old and not updated in Lebanon	
	No updated data about groundwater in Lebanon	
	No statistics about illegal water connections and wells	

IV. Mitigating water resources/degradation/improving quality of water resources

State of Water Resources

Rivers, springs and groundwater adversely impacted by raw sewage and other wastes, both domestic and industrial, discharged without pre-treatment.

Rivers and springs

- High BOD load and faecal contamination in several river systems (see table)

River	***BOD_5 (mg/L)***	***NO_3 (mg/L)***	***TDS (mg/L)***	***SO_3 (mg/L)***	***Total Coliform (c/100mL)***	***E. Coli (c/100mL)***
Kabir	14.4	3	270	20	900	20
Bared	28.2	2.8	225	28	610	17
Abou Ali	39.3	3.4	280	22	26,500	3,000
Ibrahim	62.8	1	150	8	3,500	200
Antelias	53.2	3	300	30	28,000	6,000
Damour	21.3	3	200	38	490	15
Awali	33.4	7	210	22	710	1
Qasmieh	22.5	5.5	250	21	80	0
Limit Value	**Nil***	**50***	**600***	**250***	**500****	**100****

Notes: Reported values are averages for period Jul-Aug-Sep 2004
** WHO (2006) standards for drinking water quality*
***MOE Decision 52/1-1996: requirement for bathing water quality including sea, rivers and lakes*

IV. Mitigating water resources/degradation/improving quality of water resources

State of Water Resources (Cont.)

Comparison of water test results of 2010 LRBMS VS 2005 BAMAS :

Surface Water	Lake water
1. Tenfold increase in BOD values in surface waters (Sources of BOD: discharge of untreated sewage from homes and industries, leachate from nearby municipal solid waste dump sites. 2. TDS values and pH also increased (more alkaline). 3. Microbiological load in the form of fecal coliform lower than in 2005 (the 2010 sampling occurred during summer characterized by prolonged exposure to sunlight UV radiation)	1. BOD load did not change markedly 2. TDS and pH increased 3. Fecal contamination increased tenfold 4. Pollution from agricultural runoff in both surface and lake water showed a significant drop in phosphate and nitrate levels. 5. Detection of trace metals (arsenic, nickel, mercury and chromium) in river and lake sediment samples, reflecting and confirming continued exposure to industrial pollution. 6. MOE and UNDP commissioned the preparation of a Business Plan for Combating Pollution of the Qaraoun Lake

Source: SOER 2010

IV. Mitigating water resources/degradation/improving quality of water resources

Protection of Water Resources: Wastewater Systems

Status of Lebanese WWTPs

Number of WWTP	***Population Served***	***Capacity m^3/d***	***Status***
Main Coastal STPs			
11	4,913,600	741,750	Saida and Ghadir Operational
Main Inland STPs			
4	179,000	19,000	None
Litani Basin (Bekaa)			
11	790,830	127,330	Aitanit and Fourzol Operational

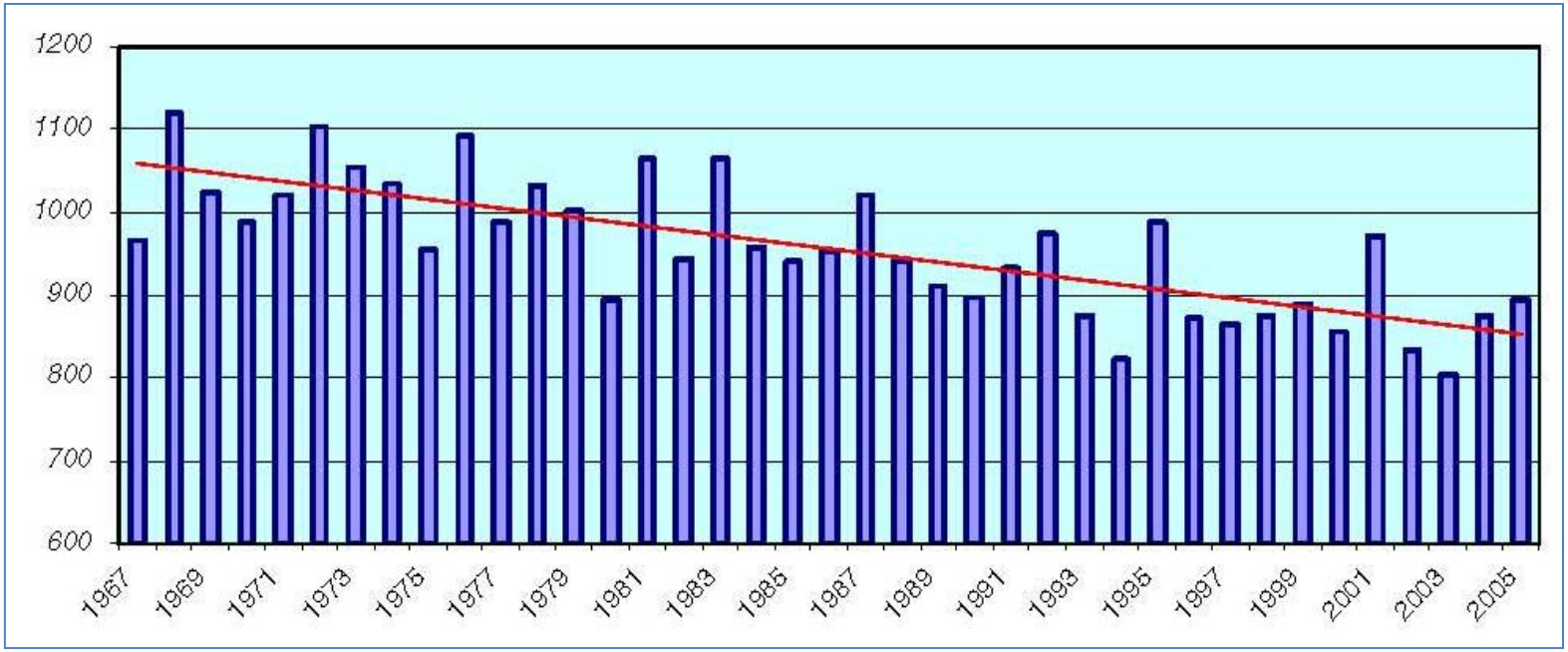
Source: SOER 2010

IV. Mitigating water resources/degradation/improving quality of water resources

Strengths	Weaknesses	Suggested solution
MOE possesses some data about water quality and is very cooperative while trying to respect international standards	MOE water quality data are not exhaustive and it needs the help of MEW and the WWE in this task	
Private thinks tanks work on water quality	No cooperation is available and this work is not known by Lebanese and by public administrations	

V. Adapting to extreme hydro-meteorological events

- Disturbance prevention: Climate change:
  - Global warming will affect precipitation, in turn affecting freshwater availability and quality, surface water runoff and groundwater recharge
  - Most studies addressing climate change conclude that it is too early to discern a change in precipitation ! However...
  - Lebanon is witnessing signs of decreasing precipitation and increasing drought and desertification (see graph)



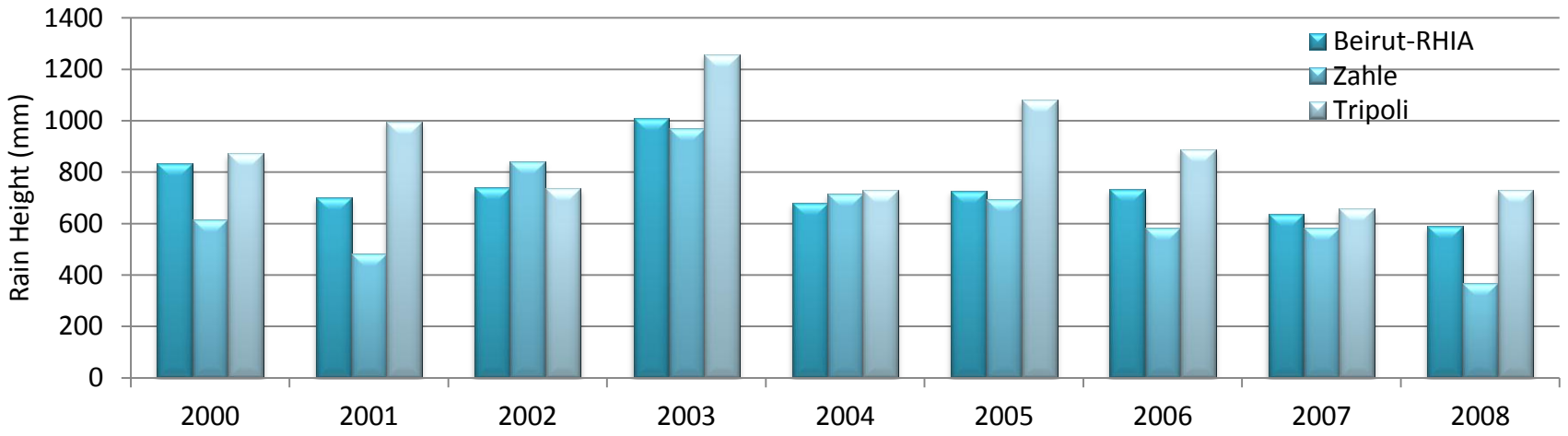
***Note**: Between 1966-1978, data collected from 70 gauging stations; data for period 1978-1997 from 11 stations: >1997 data collected from 24 stations*

Source: Shaaban , A. (2009) in SOER 2010

V. Adapting to extreme hydro-meteorological events

- Disturbance prevention: Climate change:

No conclusions can be drawn due to short time series (see graph for Beirut, Zahle and Tripoli):



Source: Meteorology service, Ministry of Public Works and Transport

V. Adapting to extreme hydro-meteorological events

- Disturbance prevention: Climate change:
  - Global warming will decrease precipitation and increase losses due to evapotranspiration
  - If temperature rises by 1 degree C, current total water resources will decrease by 250 MCM/year
  - If temperature rises by 2 degrees C, resources will decrease by 450 MCM/year and snow cover will decrease dramatically
  - River peak flow would shift from the end of April to the end of February, river flows would increase between December and February, and as snow melt decreases from April to June, river flows will dramatically decrease during periods of high demand for irrigation water
  - Need to increase water resources to meet water sector demands
  - Ecosystems maintenance and adaptability requirements are urgent in the future

Source: SOER 2010

V. Adapting to extreme hydro-meteorological events

Strengths	Weaknesses	Suggested solution
CAS is trying to establish economic and environmental time series data in order to study better the climate change study		