



Conjunctive Management of surface and groundwater in the context Of National Water Sector Strategy and the New Water Code : Objectives and Priorities

UNESCO-IHP Coordination Meeting, 28 February 2023,
Beirut

Presented by : Eng. Mona Fakhri, Director of Water, Ministry
of Energy and Water, Lebanon



Mediterranean
Action Plan
Barcelona
Convention

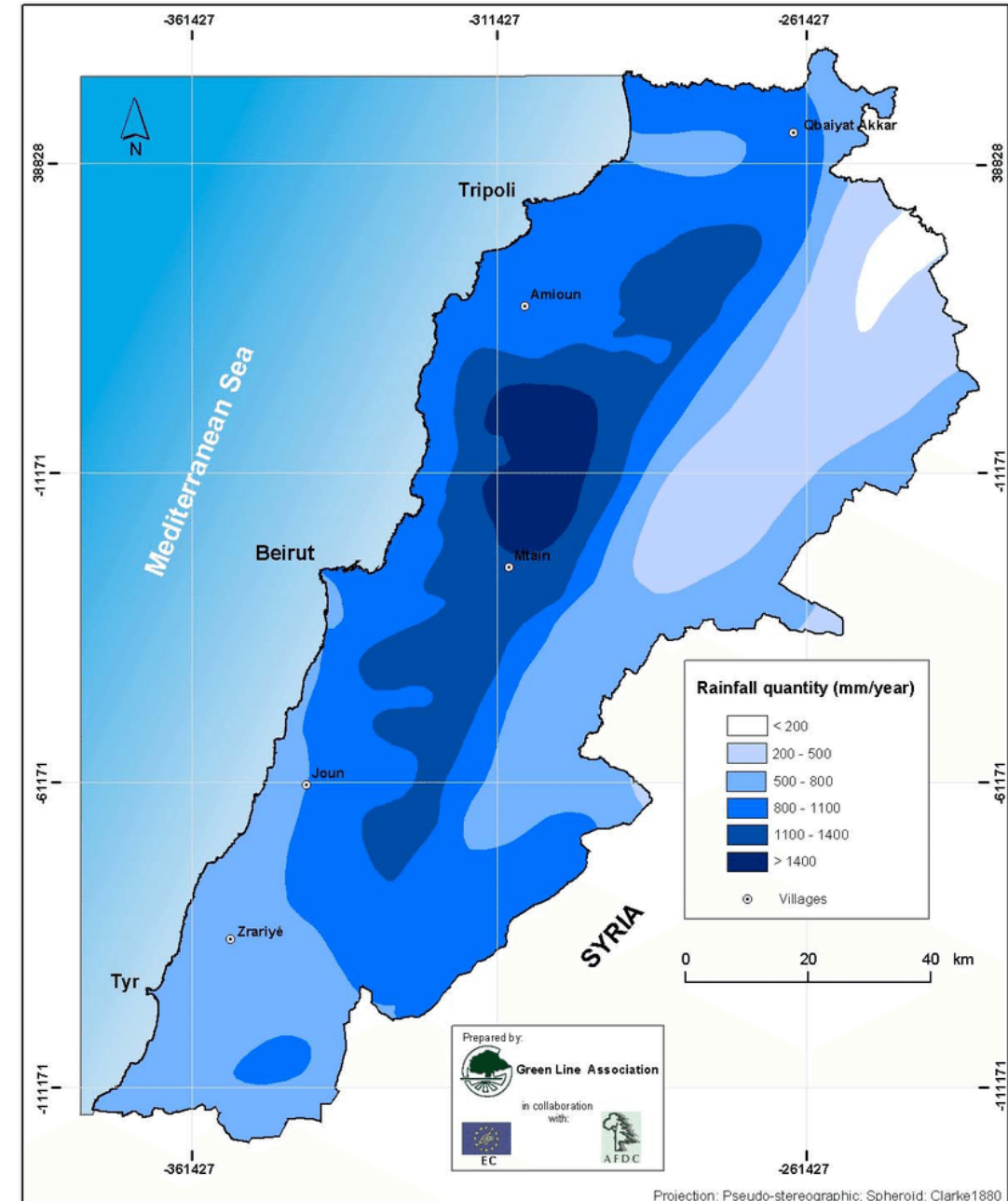


PROPOSED OUTLINE

- Introducción to the water context in the country: main issues and challenges
- Key Laws and policies in Lebanon
- Conjunctive Management of surface and groundwater in the context
Of National Water Sector Strategy and the New Water Code
- Way Forward

Water Resource Availability Estimations

- Lebanon receives 8,559 Mm³ (million cubic meter) of precipitations yearly, of which 3,000 Mm³ are estimated to fall in the form of snow.
- Lebanon has 8 major aquifers that store around 1,360 Mm³ of water, of which 400 to 1,000 Mm³ are exploitable



Water Resource Availability

- The groundwater supply :
 - over 50% of the irrigation demand a
 - 80% of potable water
- The excessive reliance on groundwater and the large number of illegal wells are threatening this resource and causing saltwater intrusion in coastal aquifers



Water Balance

Designation	Flows (Mm ³)		
	Inputs	Outputs	Total
Total annual precipitation	8200		
Natural evaporation and transpiration		4100	
Losses in groundwater flowing towards neighboring countries		300	
Losses in surface waters flowing towards neighboring countries		648	
Sea spring sources		385	
Total renewable waters			2700
Ground water			567
Surface waters			2200

Global water balance in Lebanon : Non Conventional Water

Designation	Flows (Mm ³)		
	Inputs	Outputs	Total
Non Conventional Water : - (Wastewater Reuse) - Sea Water Spring			180 (385)
Total Non Conventional Water			565 (Mm3)

Effect of climate change: Lebanon

- ▶ Prediction for Med. region: warming ranging between 2°C - 4°C.
- ▶ Precipitation will range between 50-60 days rather than 80 to 90 days.
- ▶ Dramatic consequences on the renewable annual water volume which mainly depends on snow melt.

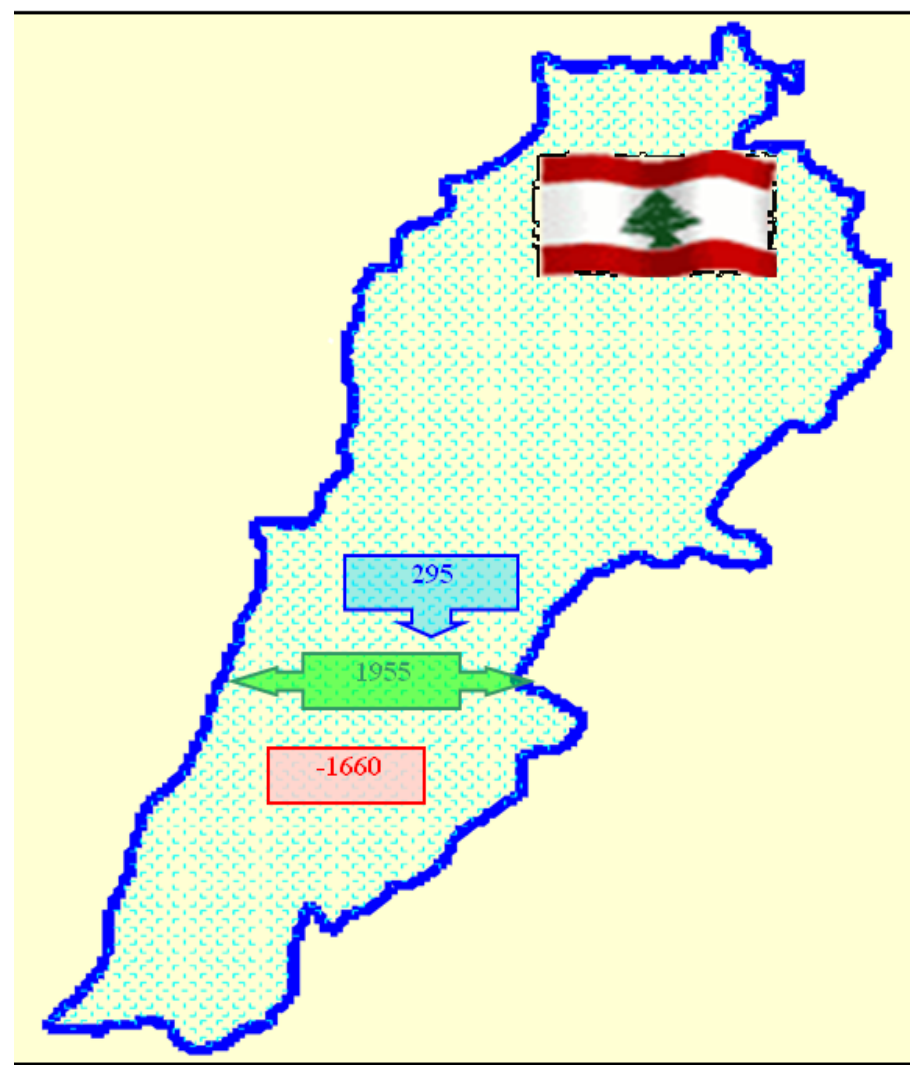
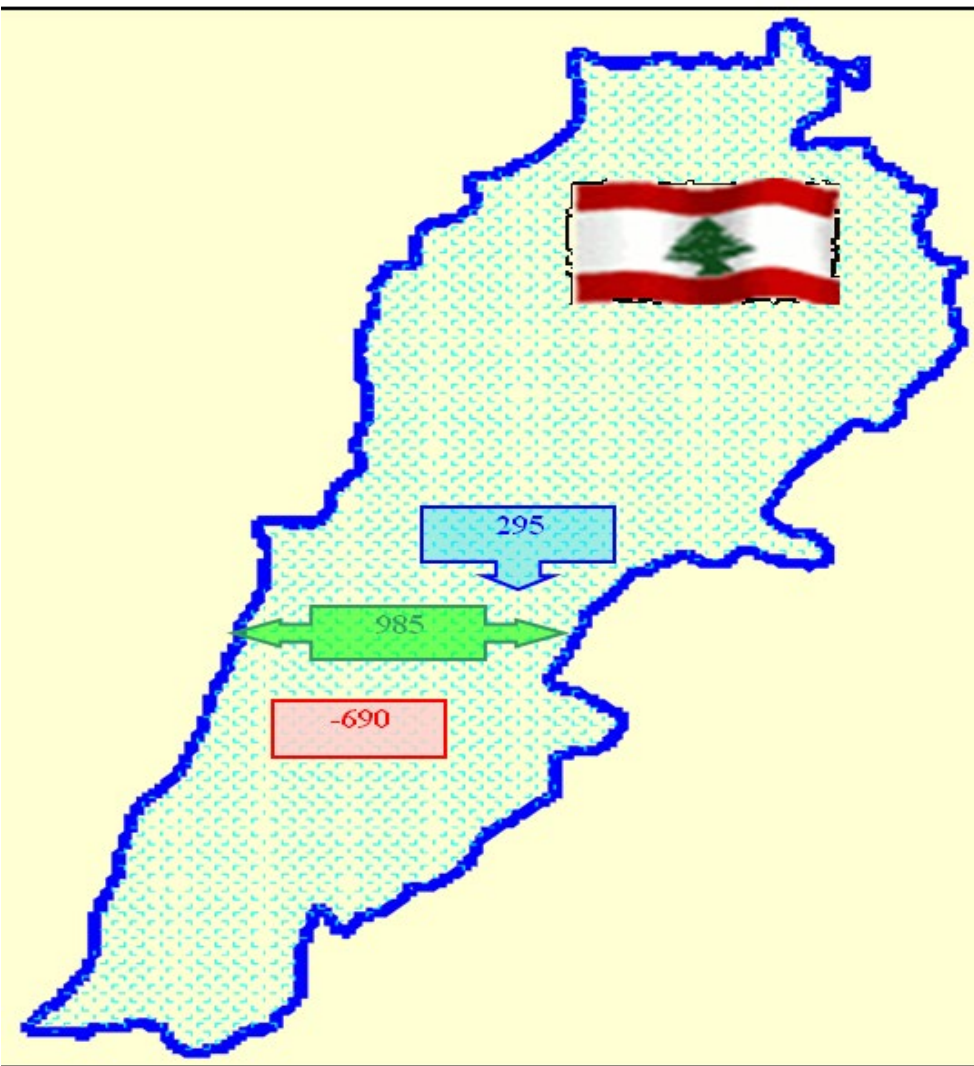
	Initial Conditions	Warming 2°C	Warming 4°C
Water from snow melt	1200 Mm³	700 Mm³	350 Mm³
Total renewable water	2700 Mm³	2200 Mm³	1850 Mm³

Water Balance

July-October (Millions of m³)

Year 2010

Year 2040



Available resources



Water needs in all sectors



Deficit



Water resources challenges in Lebanon

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

The current situation :

❑ **Limited Water Resources**, with additional stress exacerbated further from the consequences of **climate change** , **mass population** movements(Syrian refugees), Increase in water demand across sectors, Irrigation is a highly water consuming, Inadequate water supply systems and water use

❑ **Environmental dilemma**

Pollution of water resources:

- ❖ Haphazard dumping of solid and liquid wastes in the Environment
- ❖ Discharging of un-treated or partially treated wastewater into water bodies
- ❖ Excessive use of fertilizers and pesticides

Water resources challenges in Lebanon

❑ Lack of Data

The lack of a comprehensive hydrologic and water resources management system at the national scale is the result of:

- ✓ Inaccessibility to hydrological and meteorological data,
- ✓ Absence of integrated open source hydrological-water resources models,
- ✓ Fragmented and outdated information regarding water budget and water resource, and
- ✓ Inadequacy in the development of management and planning

Impact of the Current Economical Crisis on the Water Sector

- ❖ The water & wastewater sector is currently facing various challenges at multiple levels and a serious budget deficit
- ❖ Increased cost of operation and maintenance of water and wastewater facilities and infrastructure due to devaluation of the Lebanese Lira and huge cost of Fuel
- ❖ Disruption of plans and projects in the sector due to the lack of funds
- ❖ Increased shortage in staff
- ❖ Poor performance of facilities related to power shortages
- ❖ Reduced accessibility of population to safe water sources
- ❖ In July 2021, UNICEF reported that water supply system in Lebanon is on the verge of total collapse, due to shortages in funding, fuel and other supplies such as chlorine and spare parts
- ❖ It has been described by the World Bank as among the worst economic and financial crises worldwide since the 1850s

Key Laws and policies in Lebanon

The Strategies

- **10-year Strategy Plan** that called for a holistic consideration of water resources within a complete policy and planning cycle;
- **National Water Sector Strategy** (NWSS, 2012) that aligns with IWRM principles
- **NWSS 2020 Review:** This review started in June 2019 with the aim to integrate the wastewater strategy into the new NWSS and mainstream climate change into it while considering the Water Code 192/2020 provisions,

Water demand in Lebanon : IWRM

Two scenarios



~~Water Stress~~



Sustainable management -
IWRM



850 Mm³

+

565 Mm³

+

≈ 400 Mm³

Stockages Dams
and hill lakes

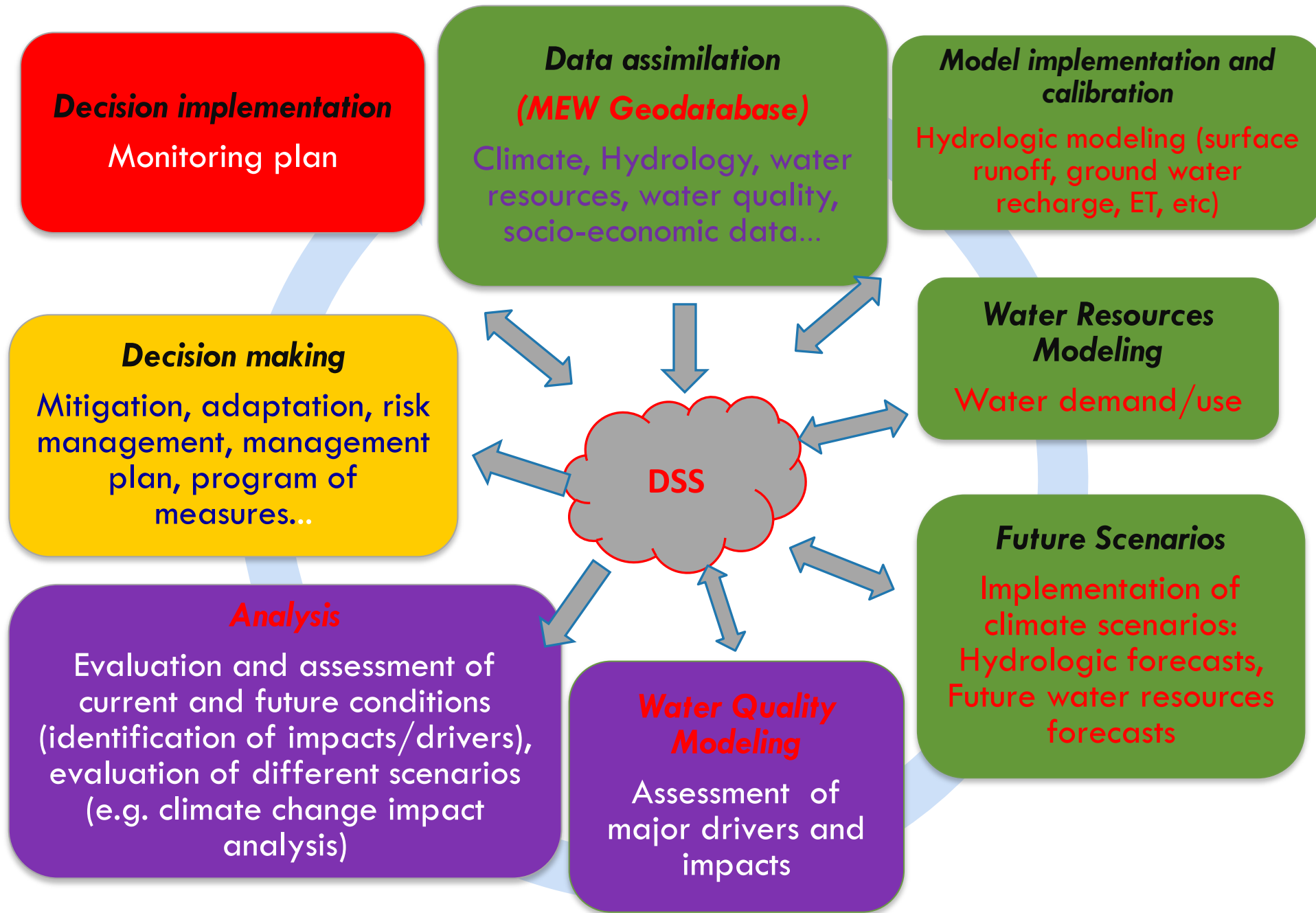


Non Conventional

Network efficiency
Potable water 50% → 80% 2040
Irrigation: - new techniques
Water establishment-
Ministry of Agriculture-

Hydraulic Balance

MEW INTEGRATED DSS



GW-Base[®] 8.0

Features:

- Map display
- Basic station data
- Water level data
- Logger data
- Sample and analysis data
- Geological data
- Climate data
- Evaluations
- Reports

WEAP Model Interface

WEAP: LebWaterResources

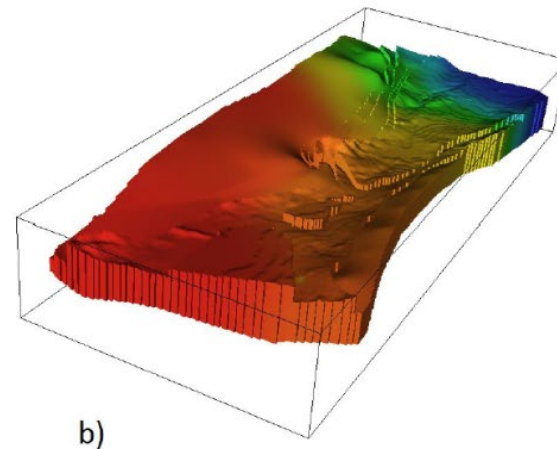
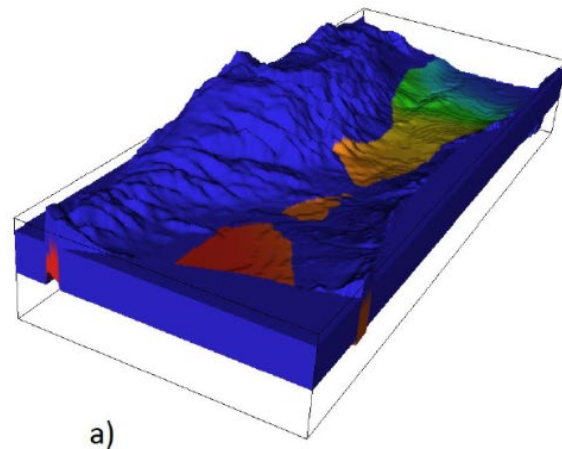
Area Edit View Schematic General Help

Schematic

- River (18)
- Diversion
- Reservoir (25)
- Groundwater (16)
- Other Supply (12)
- Demand Site (10)
- Catchment (16)
- Pump/Infiltration (32)
- Transmission Link
- Wastewater Treatment Plant
- Return Flow
- Run of River Hydro (2)
- Flow Requirement
- Streamflow Gauge

Country

- om_rivers_main_Project
- om_rivers_sub_Project
- sl_rivers_Project
- lebanon_Project



WEAP-GWBase Lebanon 2014

MODFLOW Cell Head

From 2012 | Month June | Scenario Fixed Irrigation | Layer 2

Results to Map

- MODFLOW Cell Head
- Demand Site Coverage
- Demand Site Outflow to Flow
- Demand Site Storage
- Infiltration/Outflow Flow
- Link Water Quality
- MODFLOW Conductivity Head
- MODFLOW Pumping Depth
- MODFLOW Backflow Depth
- Wet Cell
- Return Link Flow
- Return Link Quality
- Streamflow
- Supply Requirement
- Transmission Link Flow
- Demand Demand

Call Attribute

- W - Well
- R - Recharge
- D - Drain
- I - River
- H - Conductivity Head
- F - Flow
- A - City

WEAP 1.046 Area: Ghazalbeck (1/1/2014) 2012-2012 (monthly) Results View Licensed to RISE, Germany, until December 31, 2014

Constraints still facing the progress of the water sector in brief

- ❖ 90% of rainfall occurs within a period of 3 months
- ❖ Lebanon’s soil geological nature (Karstic)
- ❖ Groundwater is still the major source used for water supply due to not implementing surface water storage infrastructures(Dams, Hill Lakes etc,)leading to seawater intrusion due to over exploitation of groundwater
- ❖ low number of wastewater treatment plants implemented, so still discharging of untreated or partially treated wastewater into water bodies without benefiting from water reuse as Non-Conventional water resources
- ❖ Haphazard dumping of solid and liquid wastes in the Environment
- ❖ Excessive use of fertilizers and pesticides
- ❖ Inadequacy in the development of management and planning practices due lack of data ,Weak water Sector governance and lack of coordination across the sectors
- ❖ Objectives of the 10-year IWRM strategic plan and NWSS were not met yet
- ❖ Political and financial constraints
- ❖ Etc...

Key Laws and policies in Lebanon

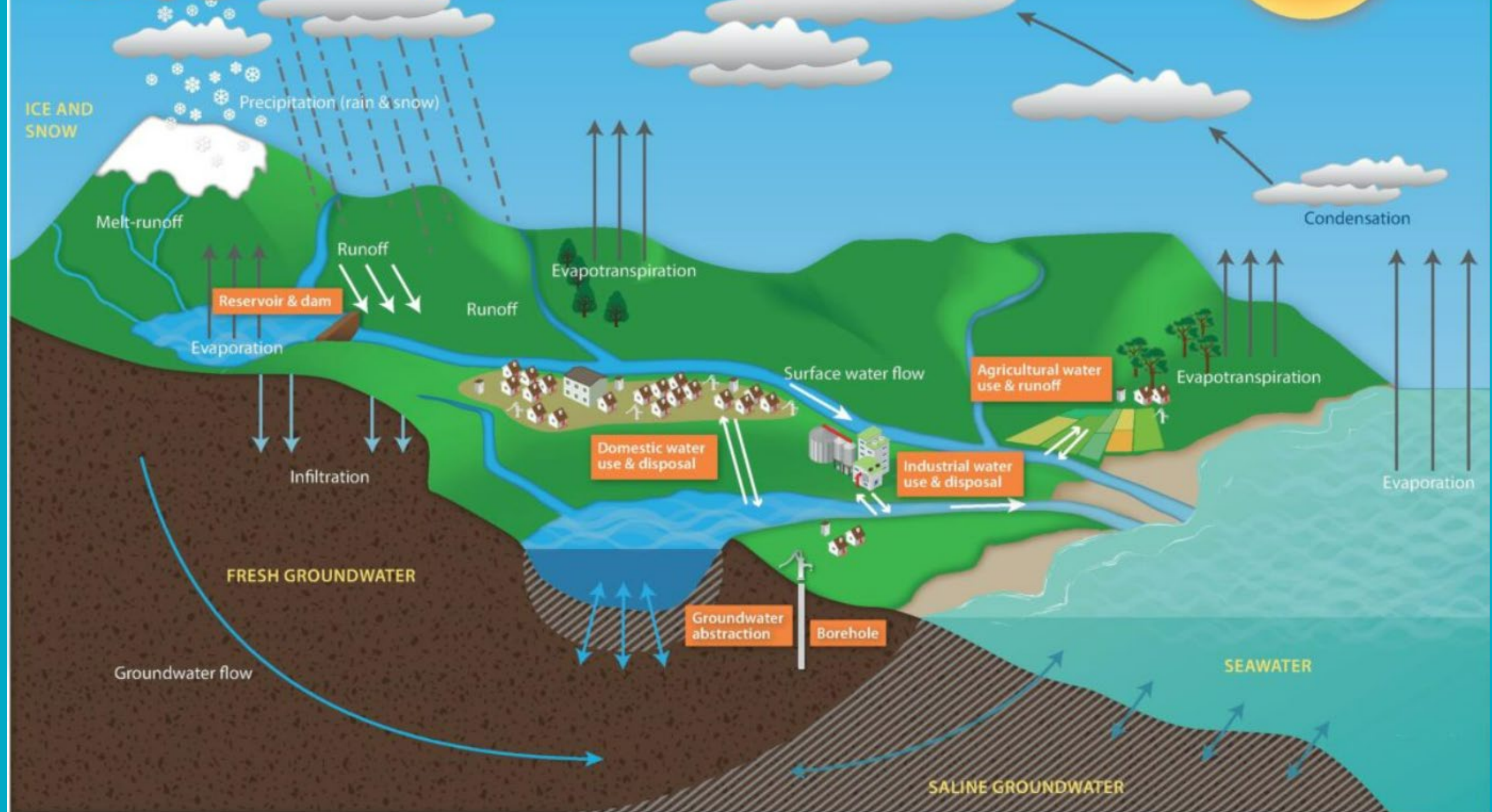
The main legislations governing the water sector are:

- Law 144/1925: the public property law (the protection of public water and its use)
- Decision 320/1926 protection of public water and its use
- Law 221 and its amendments reflect the new vision on water resources management following the requirements of an integrated approach;
- the **Water Code** (law 192/2020) promotes IWRM at river basin level; consolidating the laws governing the ownership, appropriation, utilization, exploitation, development, conservation and protection of water resources. it recognizes development of Basin management plans and master plans, considering the Water Budget by integrating conventional and non-conventional water resources, surface water, groundwater, submarine springs, water reuse, artificial recharge of aquifers where needed.

Conjunctive Water Resources Management

- ❖ conjunctive water resources management” to promote management approaches that treat surface water, groundwater and other components of the water cycle as a single, interconnected resource.
- ❖ The aim of conjunctive management is to ultimately increase the supplies of fresh water that are available for human use, to maximize their economic and social benefits while minimizing risks to the environment and ecosystems both in the short and the long term” (UNESCO 2019, 5). It has the potential to increase the amount of usable water resources available by revealing new opportunities for water use and reuse (UNESCO 2019, 14).

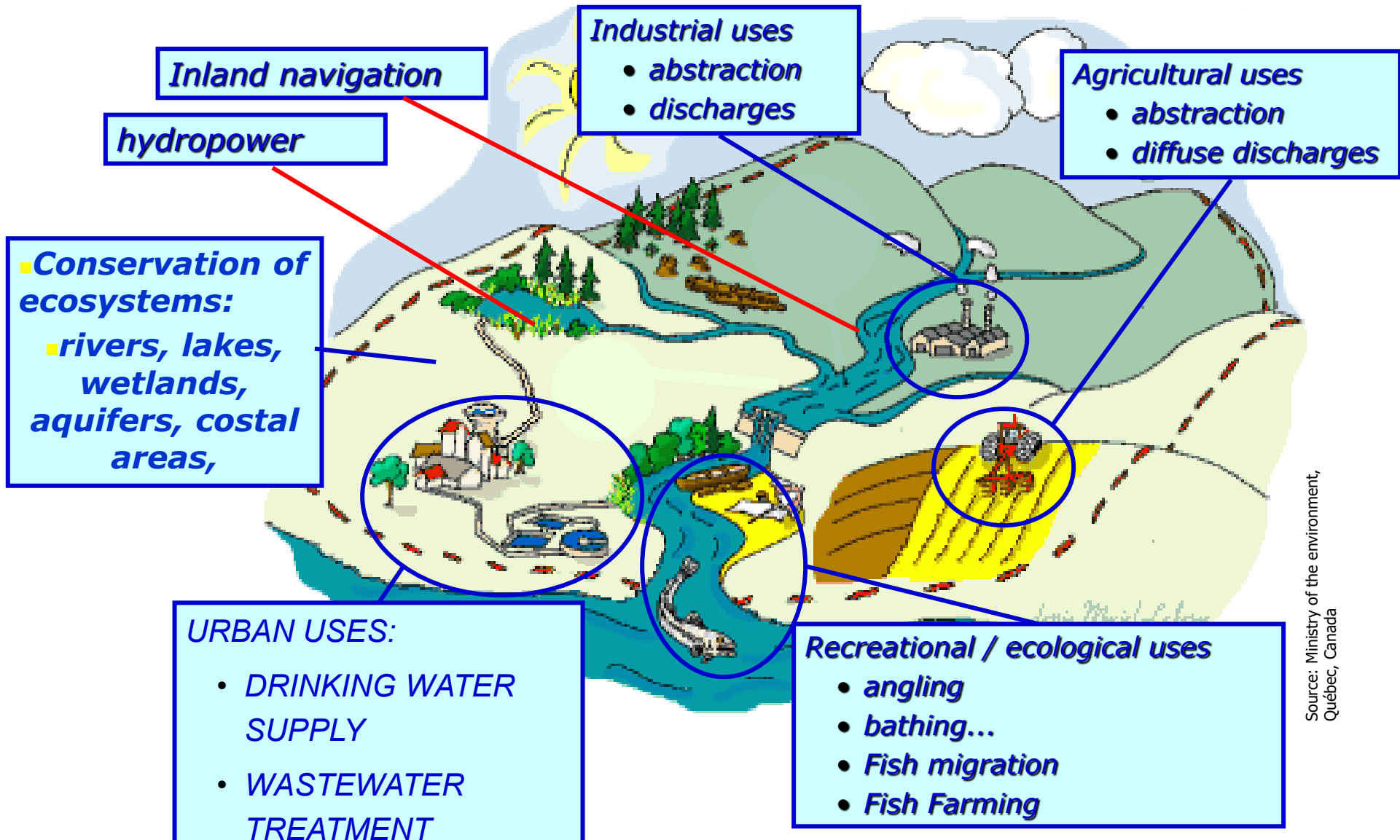




BASIN SOLIDARITY CONCERNS

ALL MAJOR WATER USES

SURFACE
and Ground



Source: Ministry of the environment,
Québec, Canada

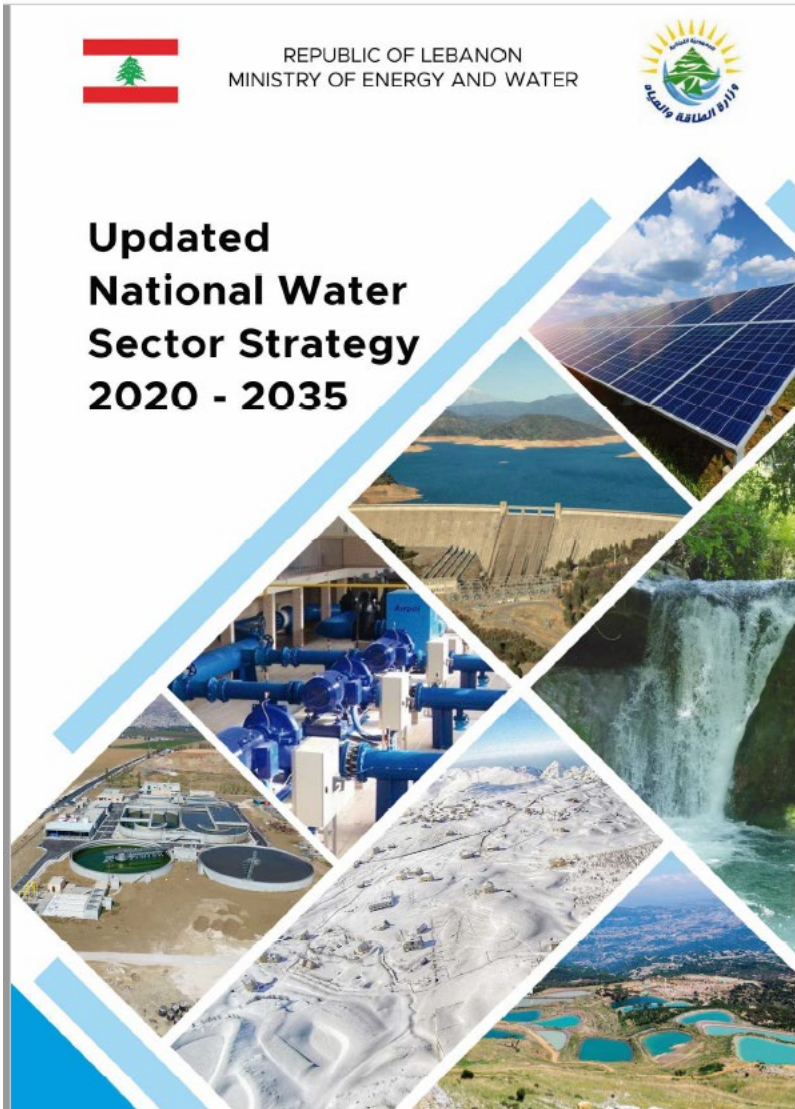
Conjunctive Management in the context of the New Water Code

the Ministry of Energy and Water worked on achieving the recently ratified water code Law 192/2020 whose key features are:

- Promotes IWRM at basin level, and
- Recognizes the development of basin management plans and master plans,
- Calls for the development of water budgets that integrate conventional and non-conventional water resources, surface water, groundwater, submarine springs, water reuse, artificial recharge of aquifers where needed,
- Sets legislation for groundwater protection zones and monitoring of wells, and requirements for integrated monitoring of surface water and groundwater

All the above contribute to a strong enabling environment for the implementation of conjunctive management approaches. the decrees of application for Law 192/2020 (the Water Code) are undergoing

Conjunctive Management in the context of National Water Sector Strategy



Pillar 1: Implementing Reforms and Improving Sector Governance

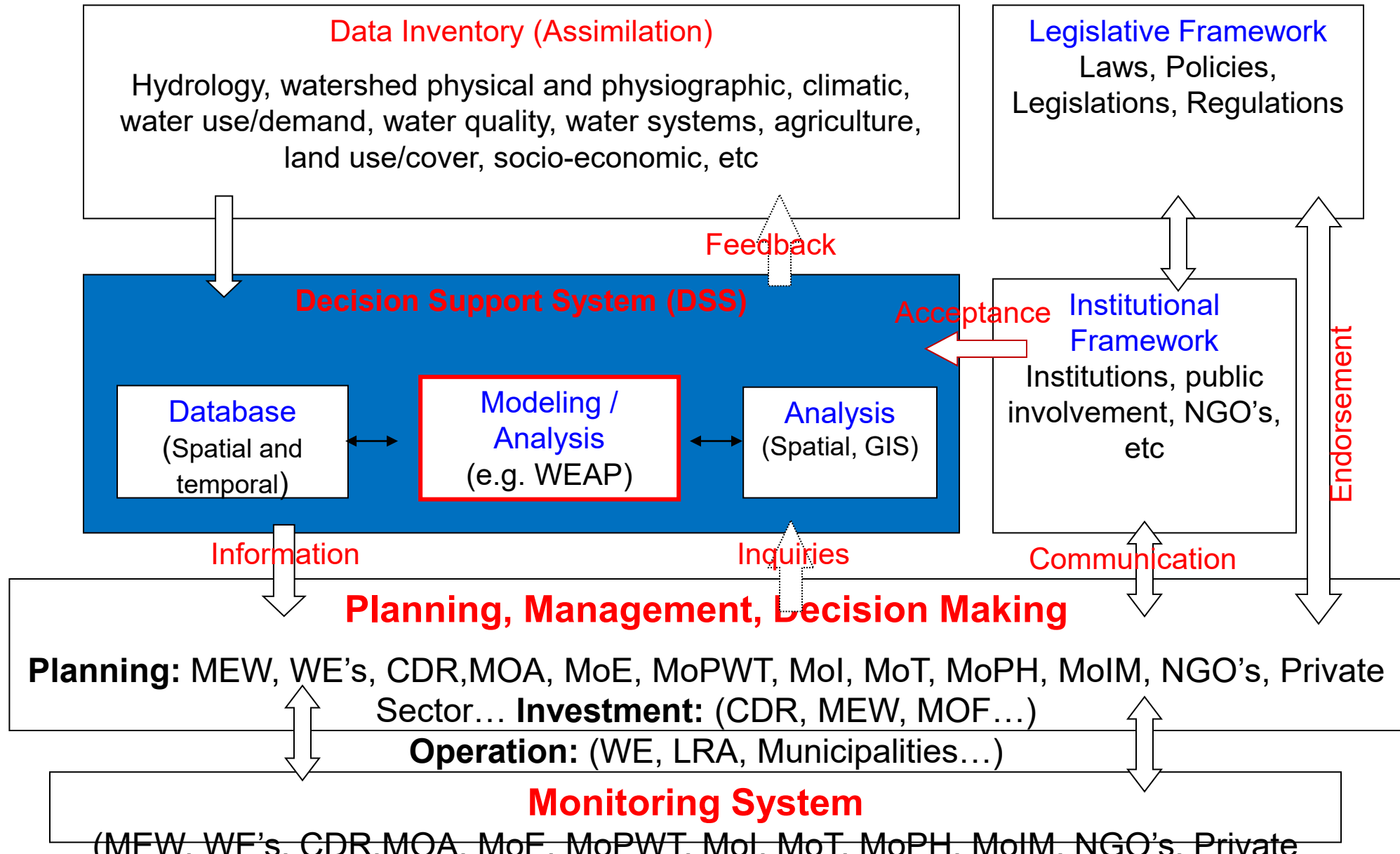
Pillar 2: Integrated Water Resources Management:

Under Chapter 2 “Organizing and Managing Water Resources”, Articles 16 to 23, Law 192/2020 provide extensive details on the methodology to set an **IWRM Master Plan for Lebanon based on Watershed or Basin Schemes** and specifies the requirements for the development of such schemes. The IWRM Master Plan and the Basin schemes are closely interrelated and feed into one another

- ✓ **Integrated Hydrological Information System**(Snow monitoring, surface and groundwater monitoring, water quality monitoring etc.)
- ✓ **Surface and Groundwater resources management**
- ✓ **Non-Conventional water resources**(Artificial aquifer recharge, Water reuse, Rainwater harvesting,)
- ✓ **Disaster risk management**(Flood risk management, Drought mitigation plan.)

Pillar 3: Service Coverage

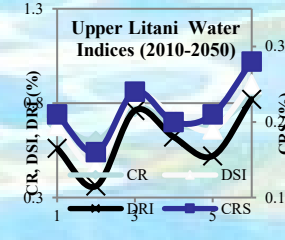
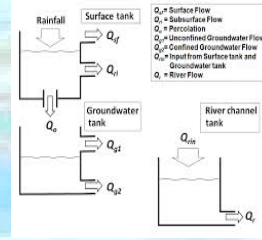
IWRM Conceptual Framework (MEW Lebanon)



Decision Support Systems

Data

Decision



Data

- Historical data
- Monitoring stations
- **Field observations**
- RS datasets
- Statistics and census

Data management system (DMS)

- Hydro database
- Data exporter
- **Data sharing**

Modeling software

- Surface water
- Groundwater
- Water budget

Modeling indicators

- Water
- Shared information

Decision making

- Informed decision

Station data
(climate, streamflow, springs, snow, groundwater)
Management data
Water rights

Looking at trends

Modeling datasets
Future scenarios

Surface and groundwater
planning and
management

Monitoring system

Way Forward

Water code law 192 is a promising law even it still referencing to some old laws and legal pluralism in water management is still dominating, but it is considered as new law based on the new water management effective approaches based on the application of integrated Conjunctive Water resources management at the basin level with a comprehensive hydrologic and water resources management system and related basin master plans and schemes is a good to start, taking into account climate variability which requires:

- The need for decrees of Application for the Law 192/2020 is the first quick urgent step needed to start in order to implement all of the above

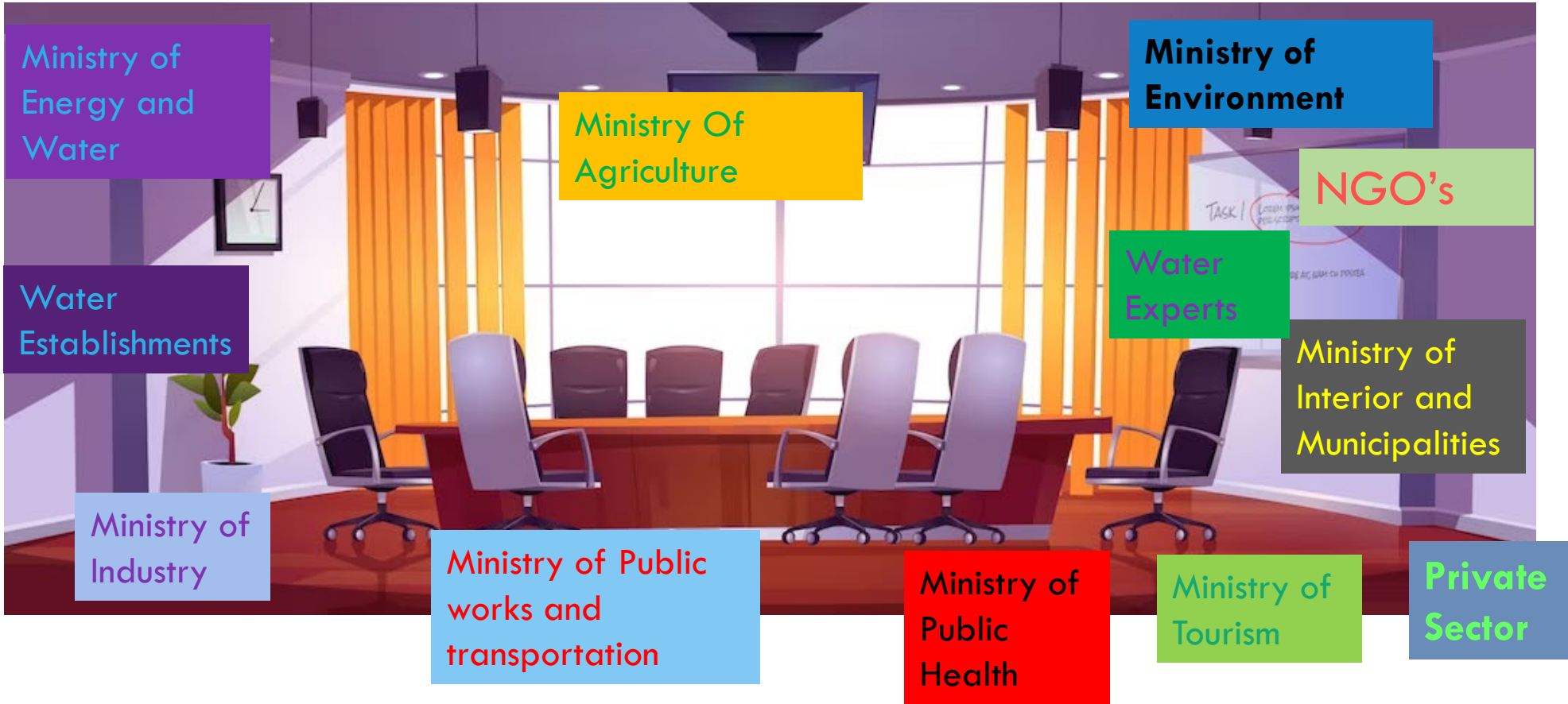
Way Forward

- Implementing ground and surface monitoring system
- Implementation of National Information System is very important
- Action Plans with all related ministries and institutions must be prepared, without forgetting that the setting-up and making operational of a decision support system (DSS) at the River Basin scale with Multi-stakeholder body established leading to the elaboration of a consensual national IWRM action plan with good investment.
- Carrying out National Master plans and basin management plans
- Implementation of Water Demand Management based on conjunctive management strategies to reduce water consumption in the domestic, industrial and agriculture sectors, equitable access to sustainable water supply .
- Implementing Managed aquifer recharge of some selected aquifers

Way Forward

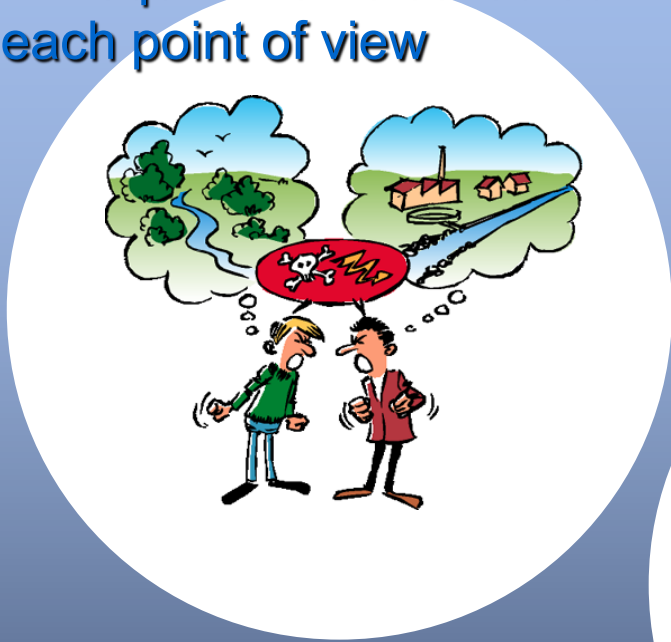
- Establishment of Water User’s Association
- Enforcement of Laws
- Water Awareness
- Applying Polluter Pay Principal
- Enable sustainable mechanisms for collaboration and coordination to improve the sector’s planning and monitoring through the National Water Council

National water Council



Conflicts

requirements collected from
each point of view



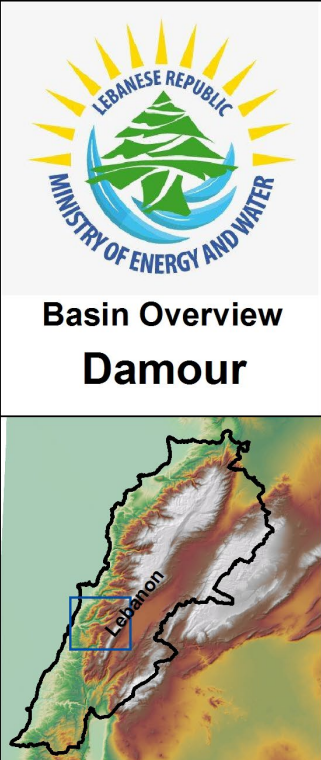
Designing a program

through **dialogue**



Reaching **agreement**
with an ambitious program

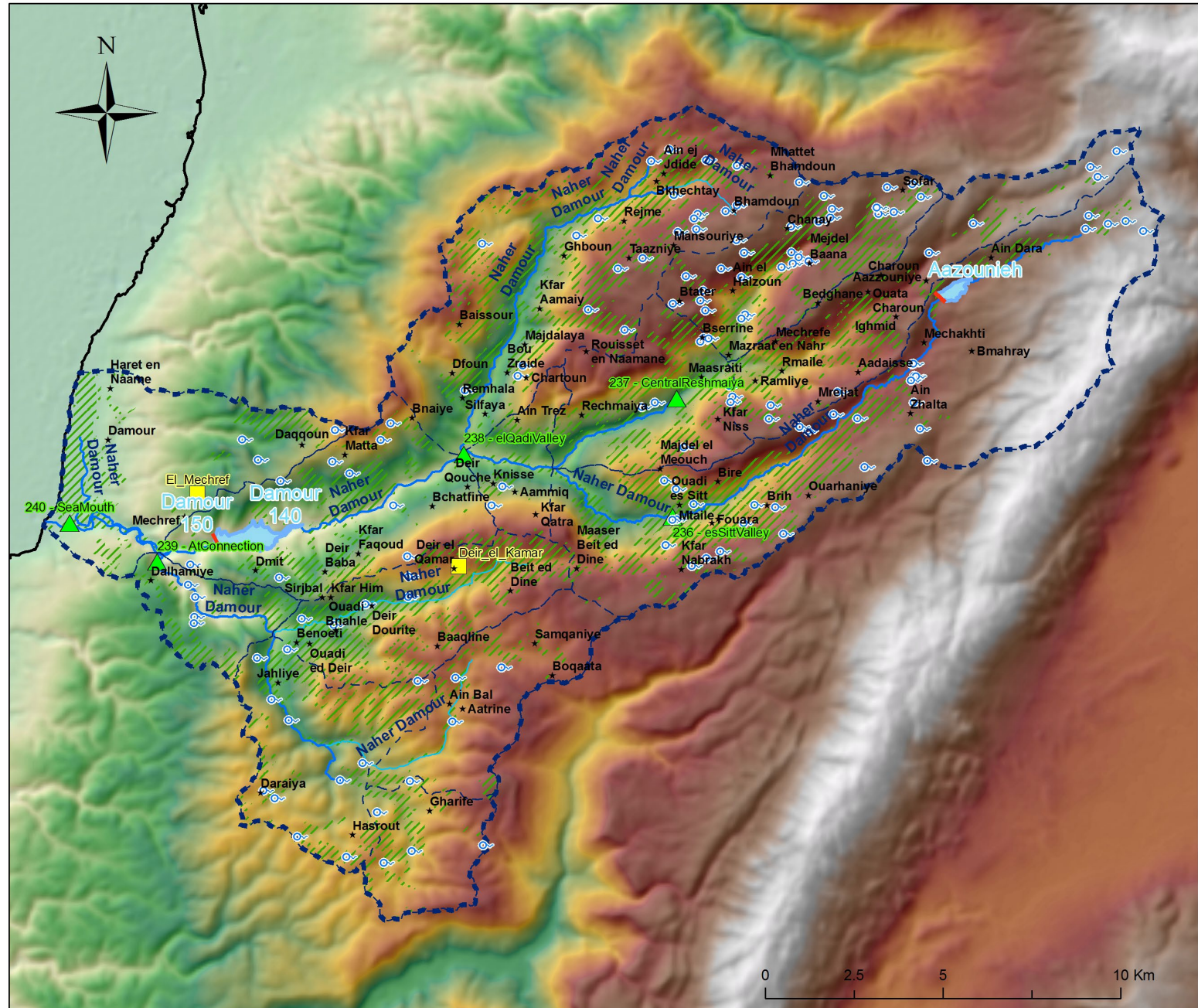




**Basin Overview
Damour**

Legend

- ★ Towns
- Springs
- ▲ Gauging Stations
- Weather Stations
- Dams
- Basin Limit
- - - Watersheds Limits
- River**
- Main
- Sub-Main
- Secondary
- /// Agricultural Land
- Border
- Lakes



Thank you

