Water and Environment Support
in the ENI Southern Neighbourhood region

Regional training on Water Accounting / RW-2-REG

FAO work on water accounting in the Near East & North Africa region

12/10/2020, Virtual Training

Presented by: Domitille Vallée, Chief Technical Adviser (project NENA-WePS), FAO-RNE, Cairo, Egypt

Thanking Charles Batchelor, FAO

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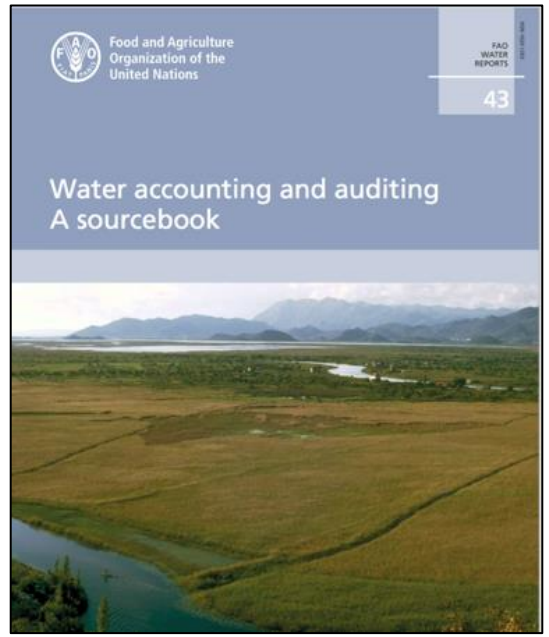
Water Accounting in FAO in a Snapshot

- Water accounting and auditing (WA&A) -vital component of planning procedures for water resource management, particularly under conditions of water scarcity and in the face of increasing risks and uncertainties.
- FAO promotes flexible, problem-focused, WA&A approaches that align with the needs and priorities of key stakeholders, but it also recognizes the merits of standardized approaches that support objective comparisons over time and space.
- Work started in the 90s 'while doing water resources assessment (ex. Malta). Ongoing now in different regions of the world. More – FAO water webpage -http://www.fao.org/land-water/water/water-management/water-accounting/en/
- 2016, FAO Water Report 43 "WAA source book" sets out the concepts of WA&A and provides practical advice for its planning and implementation. **http://www.fao.org/3/a-i5923e.pdf**
- 2017, FAO led a partnership to inform policy makers on the relevance of WAA (white paper on *water accounting for water governance and sustainable development*- http://www.fao.org/3/I8868EN/i8868en.pdf) and established a community of practice on water accounting – D group.



Join the community
https://dgroups.org/fao/wateraccounting/

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FAO Near east and North Africa Water scarcity Initiative

In 2013, the FAO launched the **Water Scarcity initiative (WSI)** based on a **Regional Collaborative Strategy and Platforms,** building on a **strategic partnership,**

The **overall goal** is to pursue water and food securities for sustainable development in an environment of mounting water scarcity and climate-related risks.

Focused on **advanced knowledge, joint learning**

Focus areas

- Strengthening **strategic planning** for water resources allocation and management
- Increasing water **efficiency** and **productivity**
- Increasing water supply through the development of **non-conventional resources**
- Managing the risks of **climate change** and **drought**
- Returning **groundwater** to sustainability

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FAO -Water accounting & auditing work in NENA region

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- FAO Regional project the *NENA-WePS project* funded by SIDA
- "Implementing the Agenda 2030 on water efficiency/productivity and sustainability in the NENA region" (2017-2022)

Countries :
Algeria, Egypt, Iran, Jordan, Lebanon, Morocco, Palestine, Tunisia

Output 1 on WAA
"Establishing a robust water accounting system providing the evidence base for the full water budgeting (supply, demand, uses and re-cycling, present and projected) and for monitoring progress in the achievement of the targets while assessing the institutional effectiveness to govern sustainably water resources'.

Know your water
establishing robust water accounting systems

2 ZERO HUNGER
6 CLEAN WATER AND SANITATION

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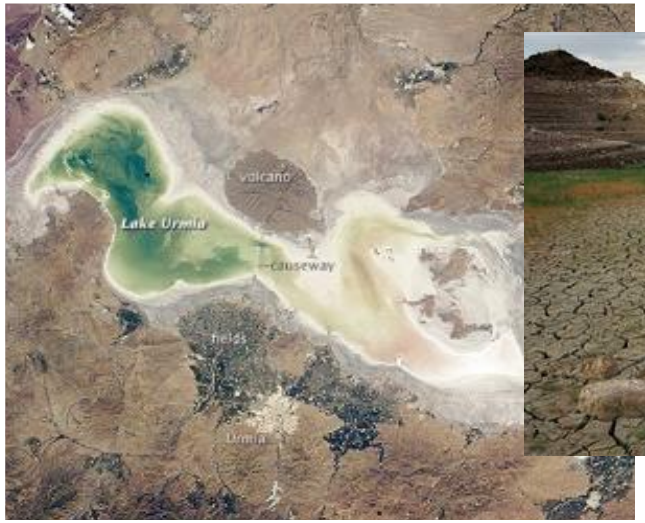
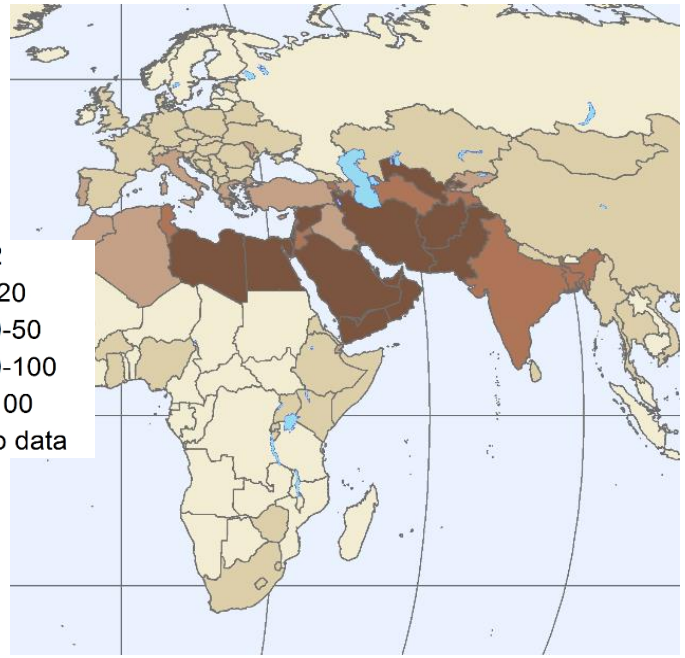
In search for sustainability

Lake Urmie

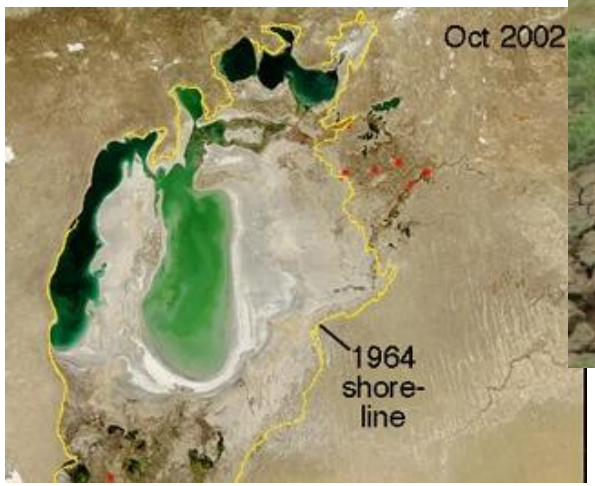


Colorado river

Groundwater abstraction (% of annual recharge)



Aral sea



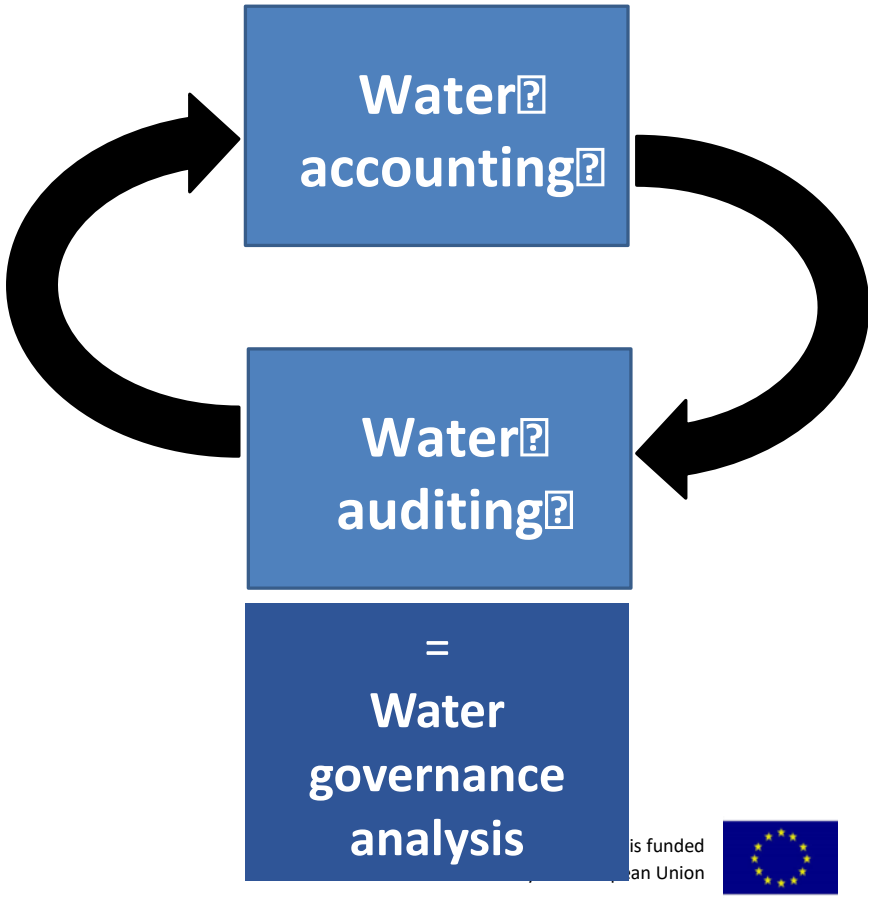
Yellow River

WAA: definitions

Definitions

Water accounting can be defined as the systematic quantitative assessment of the **status and trends in water supply, demand, distribution, accessibility and use in specified domains**, producing information that informs water science, management and governance to support sustainable development outcomes for society and the environment (FAO, 2012, 2016).

Water auditing goes one step further than water accounting by placing trends in water supply, demand, accessibility and use in the broader context of **governance, institutions, public and private expenditure, legislation and the wider political economy** of water in specified domains of interest.



Source: FAO, 2017

An interactive and participatory framework

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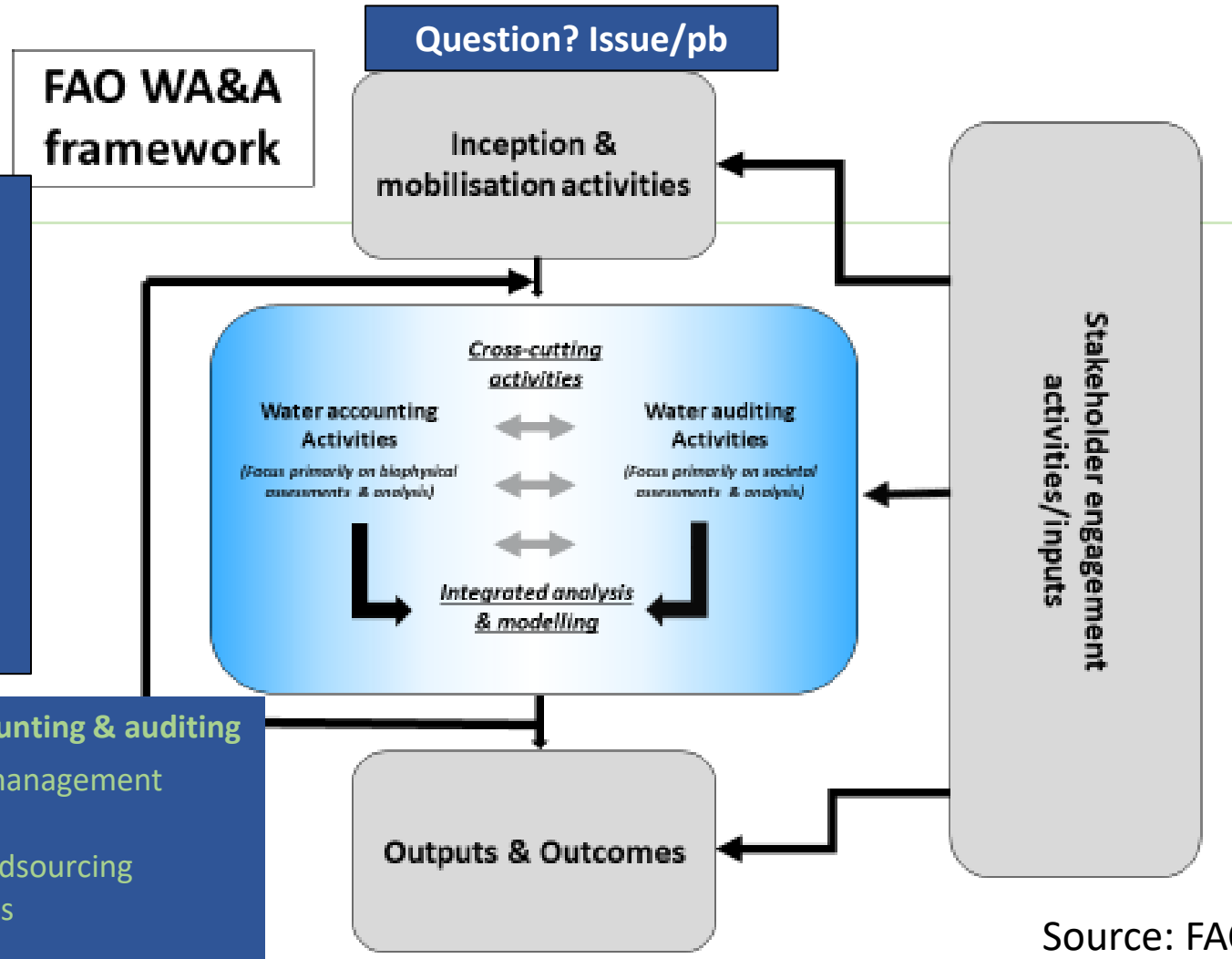
ex. WA models/ tools

- Water balance & fractional analysis
- Hydrological & hydraulic modelling
- Precipitation time series analysis
- Water efficiency & productivity analysis

-ex Integrated: WA+, SEEAW, AWAS etc

Ex. Tools for both Water accounting & auditing

- Data mining & Information management
- Spatial & time series analysis
- Participatory surveys & crowdsourcing
- Scenario building and analysis



ex. Auditing Tools

- Governance assessment
- Political economy analysis
- Stakeholder mapping and analysis
- Policy mapping and analysis
- water tenure assessment

Source: FAO, 2017

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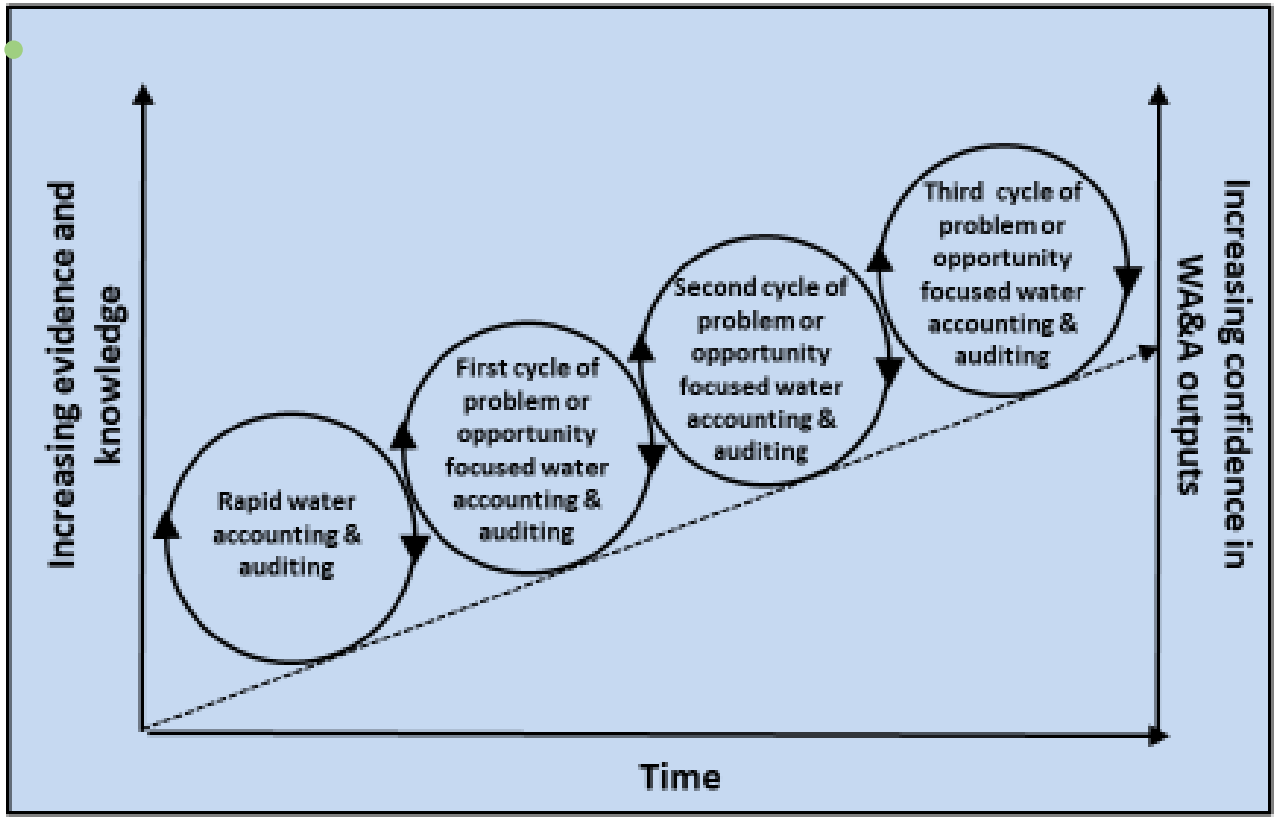
WAA: (1) adopt iterative cycles of learning and adaptation

Focus on problems and/or opportunities of most interest in specified domains

- Concentrate human and financial resources on providing outputs that meet the priority needs of key stakeholders
- Make effective use of existing monitoring systems, information bases etc
- Adopt an iterative adaptive approach aimed at improving confidence in outputs



Source: FAO, 2017

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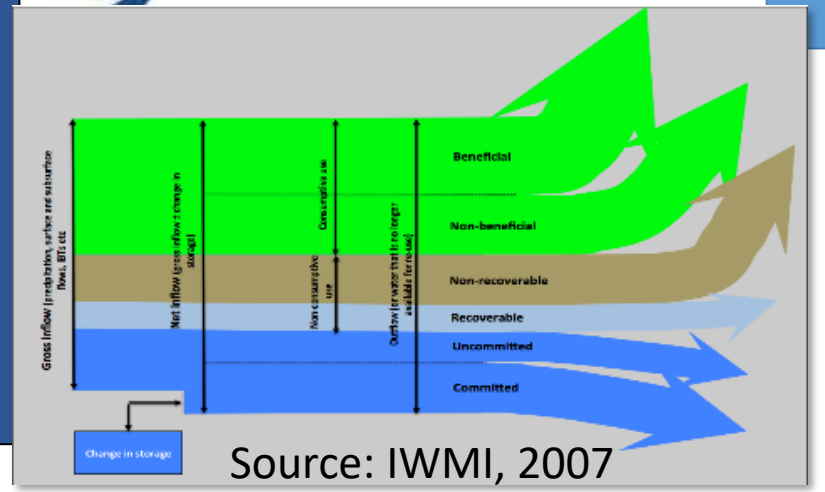
WAA: (2) Understand the consumptive use and the fate of water flows

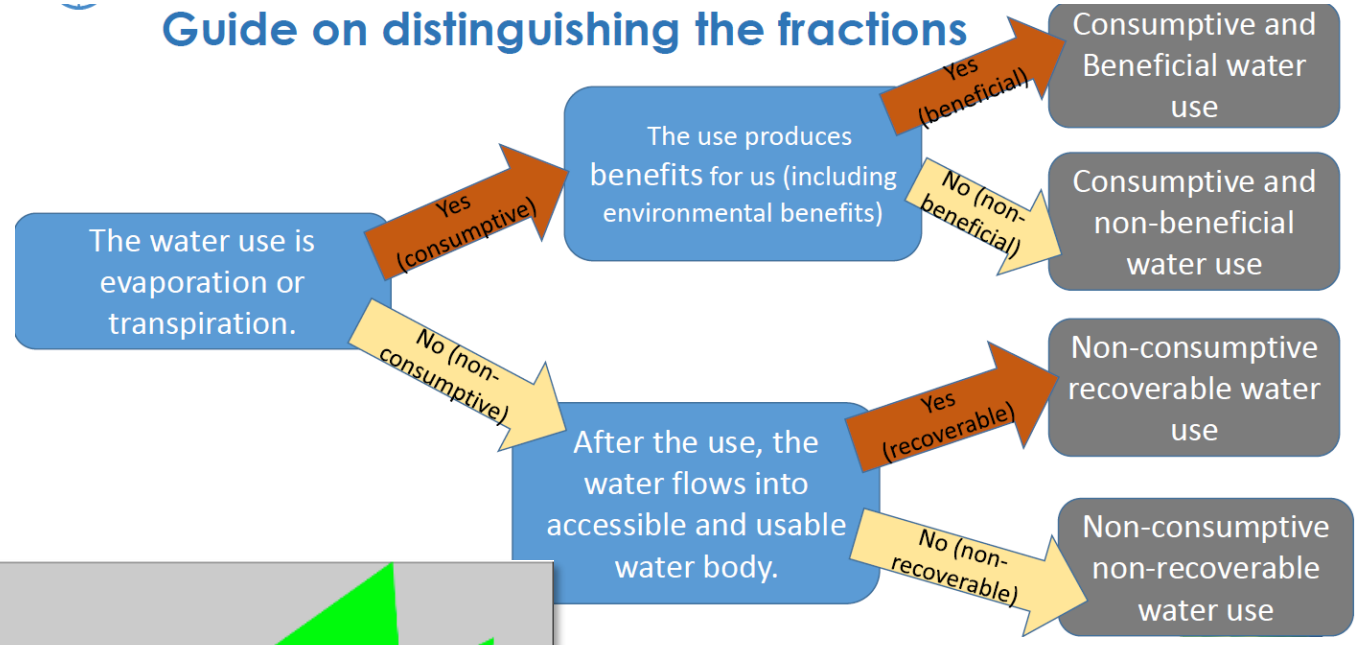
Consumptive and non-consumptive water uses, fluxes and pathways

- When water is diverted and used for agriculture, a fraction of water used is no longer available for reuse locally or downstream because it has evaporated into the atmosphere. This fraction of water use is referred to as the *consumed fraction*;
- The fraction of water that is not consumed is referred to as the *non-consumed fraction* or *return flow;*
- Differentiating between consumptive and non-consumptive water uses (in space and time) is an important part of water accounting.

Source: FAO, 2017



Source: IWMI, 2007

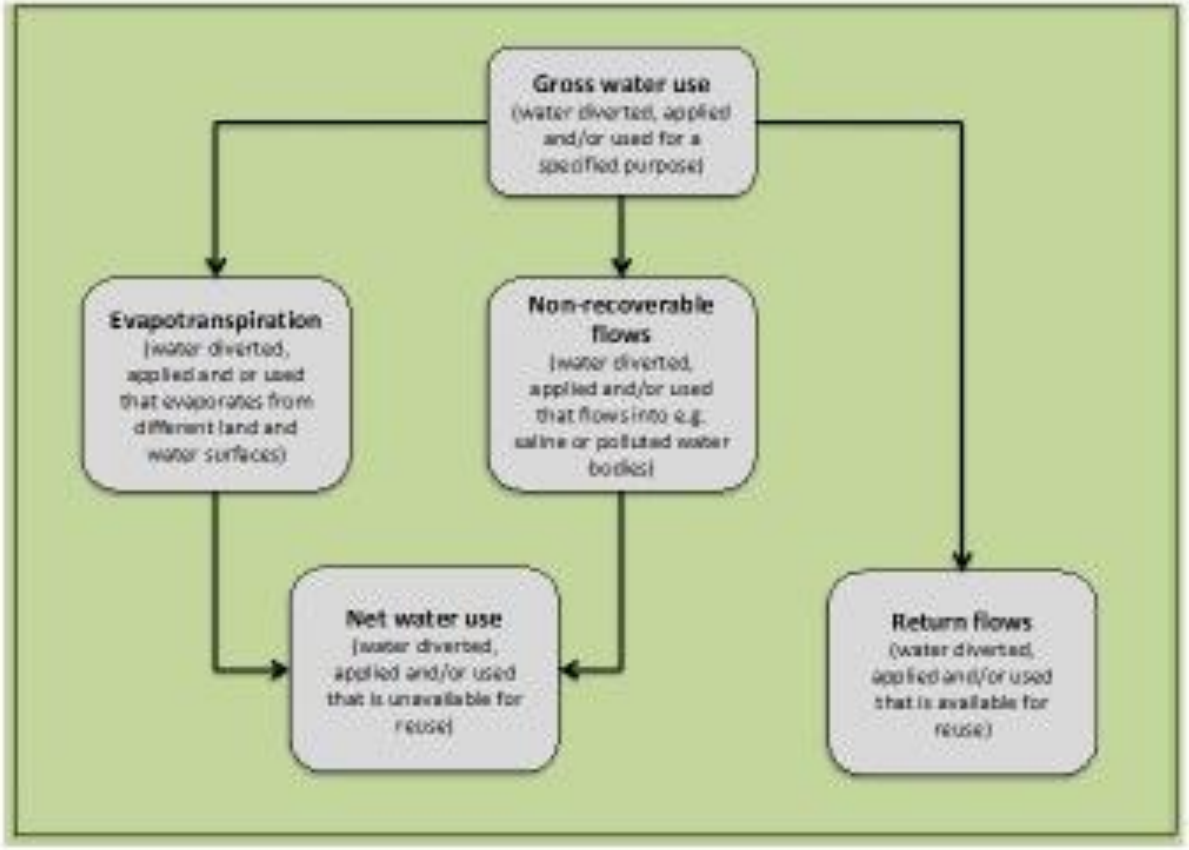


Source: Jiro Ariyama, 2020

WAA: (3) assess returned flows

Gross and net water use (Escriva-Bou, 2016)

- The difference between gross and net water use is referred to as *return flows* i.e. the volume of water that returns to rivers, streams, or aquifers and is available for reuse;
- Return flows can be substantial e.g. when fields are over-irrigated, when deep percolation occurs under reservoirs and canals.



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WA&A: (4) start a process with a first cycle of rapid WA&A

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1. Planning
    1. Identify and engage with key stakeholders according to their levels of power and interest (dialogue)
    2. Preliminary definition of the question/issue/pb (participatory)
    3. Set a multidisciplinary team
    4. Preliminary delineation of biophysical and societal boundaries
2. Information collection and management
    1. review existing knowledge (data and governance aspects)
    2. Categorize information needed using the RIDA framework & assess the quality/accessibility of existing biophysical and societal data
3. Assessment and analysis
    1. Preliminary development of a perceptual model and analysis of the fate of water flows (consumed or not)
    2. Analyze past trends of key data sets
    3. Prepare a preliminary water balance with existing information - reveal gaps, and uncertainties
    4. Imagine impacts of different scenarios
    5. Analyze if the question is answered or need more evidence with “interested stakeholders “
4. Reporting and scenario analysis…present and discuss findings
5. **Start again if needed** ….enter in a new cycle of WA&A…advanced WA&A

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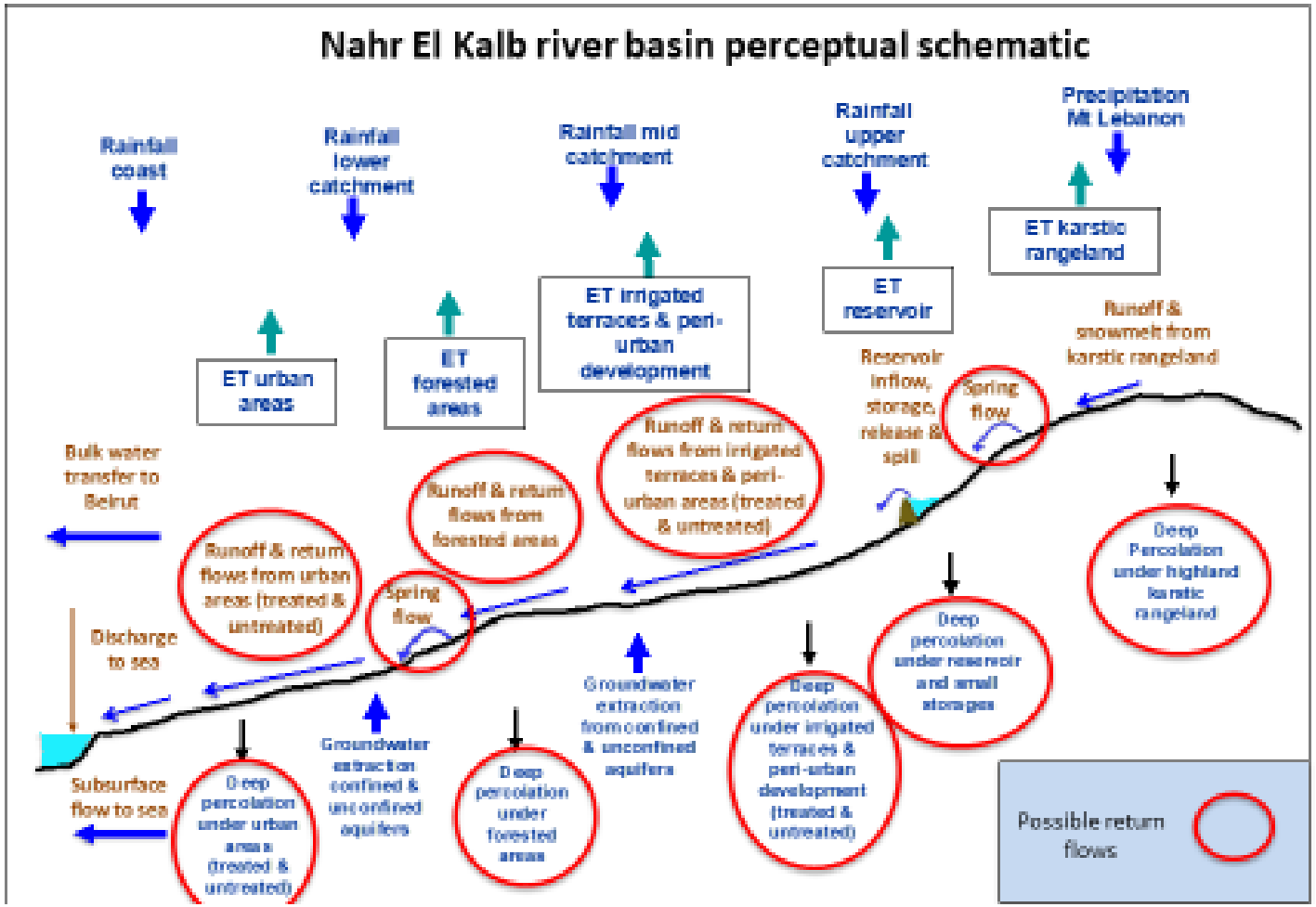
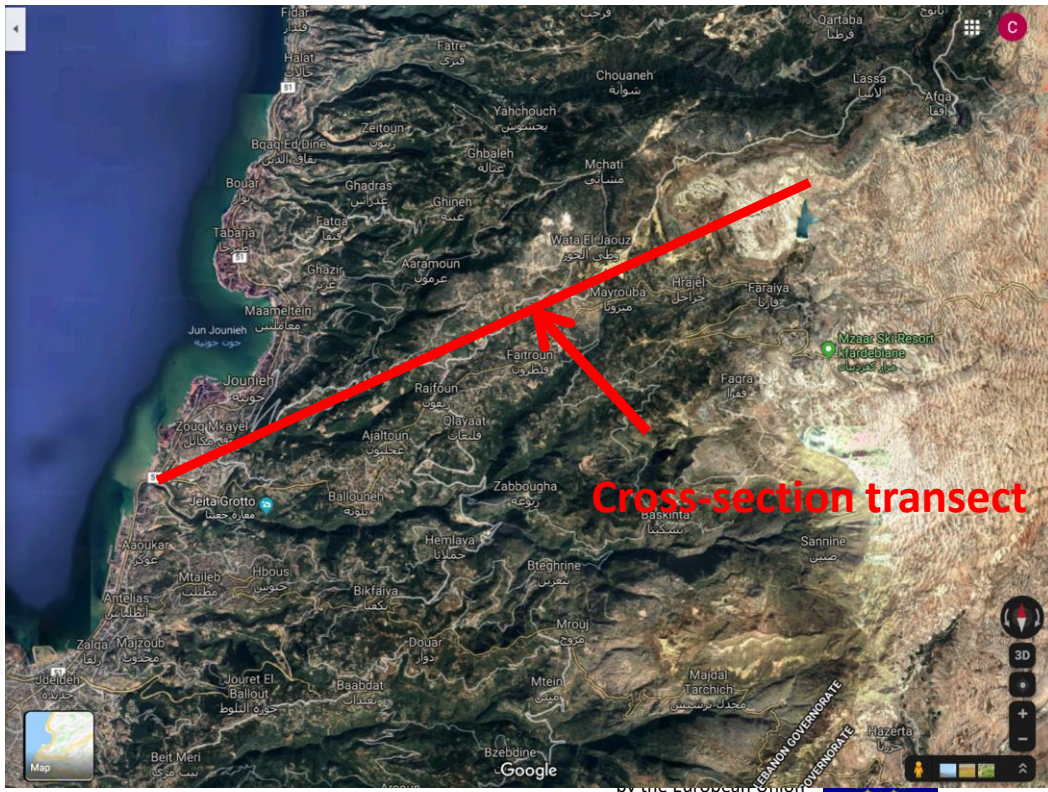
Example: conceptual scheme



Source: Charles Batchelor for RWA on Nakr el Kalb river basin in lebanon, draft report 2019

Lebanon
Nakh el kalb watershed
Issue : risk of drinking water supply from groundwater “unaccounted for” use and pollution



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Example: analyzing trends

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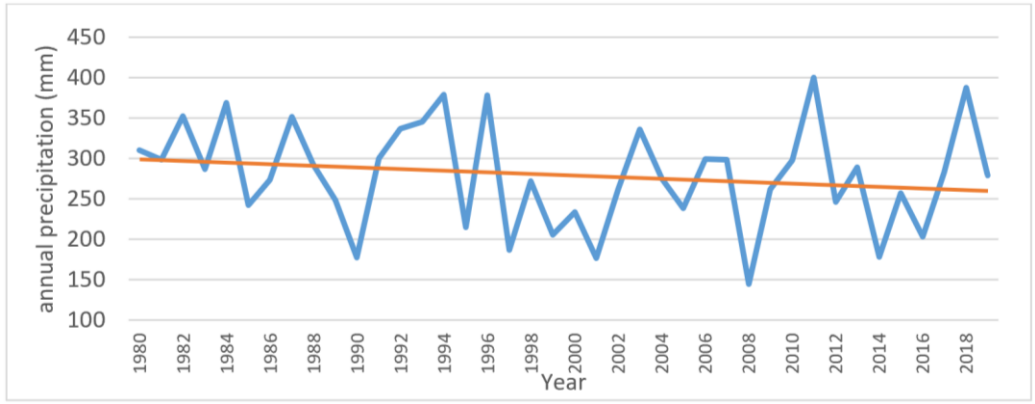
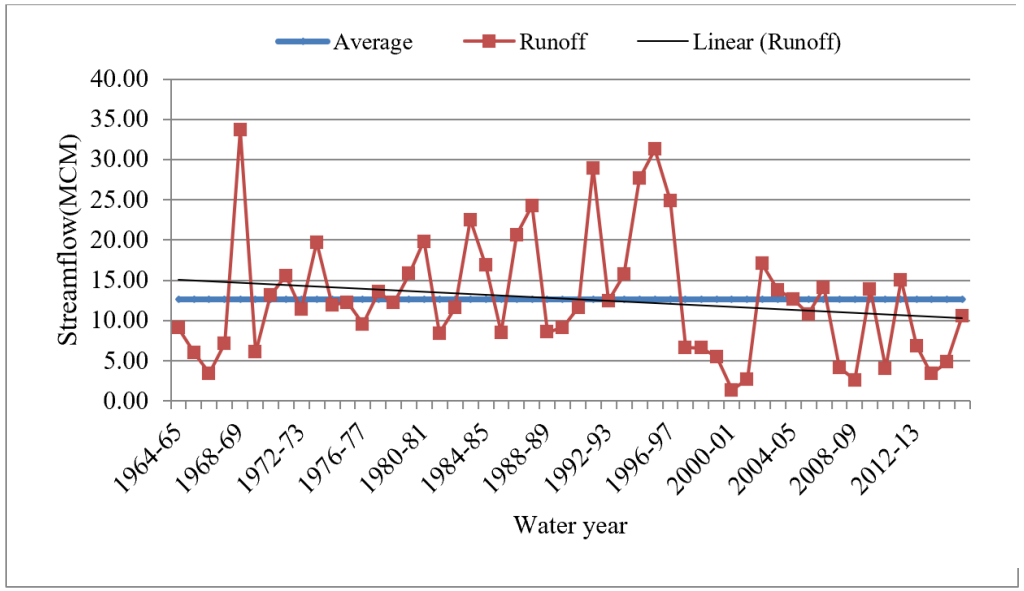
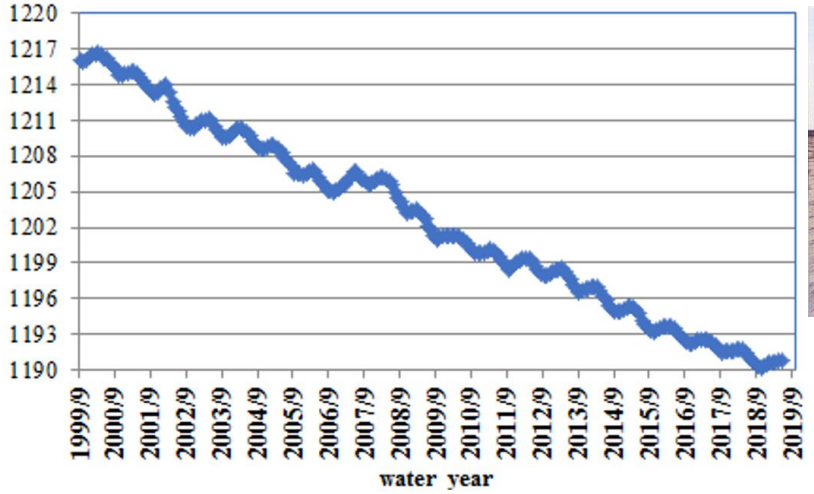


Average long-term annual precipitation (1979-2018)

Iran
Qazvin Irrigation scheme
Issue : over-exploitation of groundwater by agriculture with increased urban demand with reduction of natural recharge



Annual stream flow at Amir Abad hydrometric station



Unit hydrograph of Qazvin aquifer obtained from piezometers scattered across the Qazvin Plain (Aquifer water table is expressed in meters above sea level)

Source: Banafsheh Zahraie, QIN Rapid Water Accounting, IRAN, 7/24/2020

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Example of organizing information using the RIDA framework

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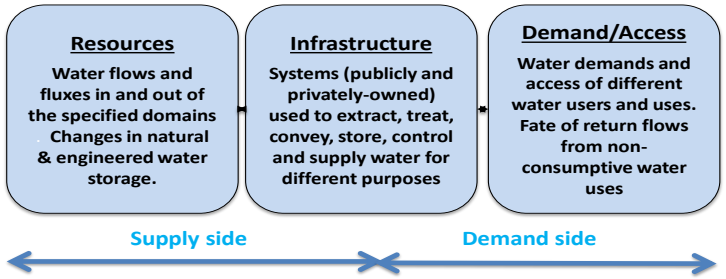
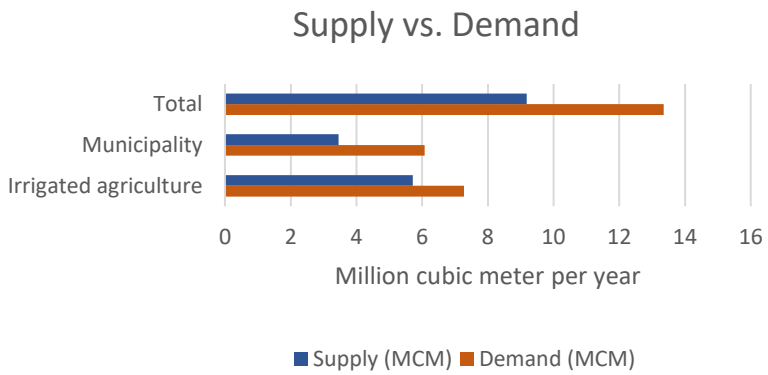
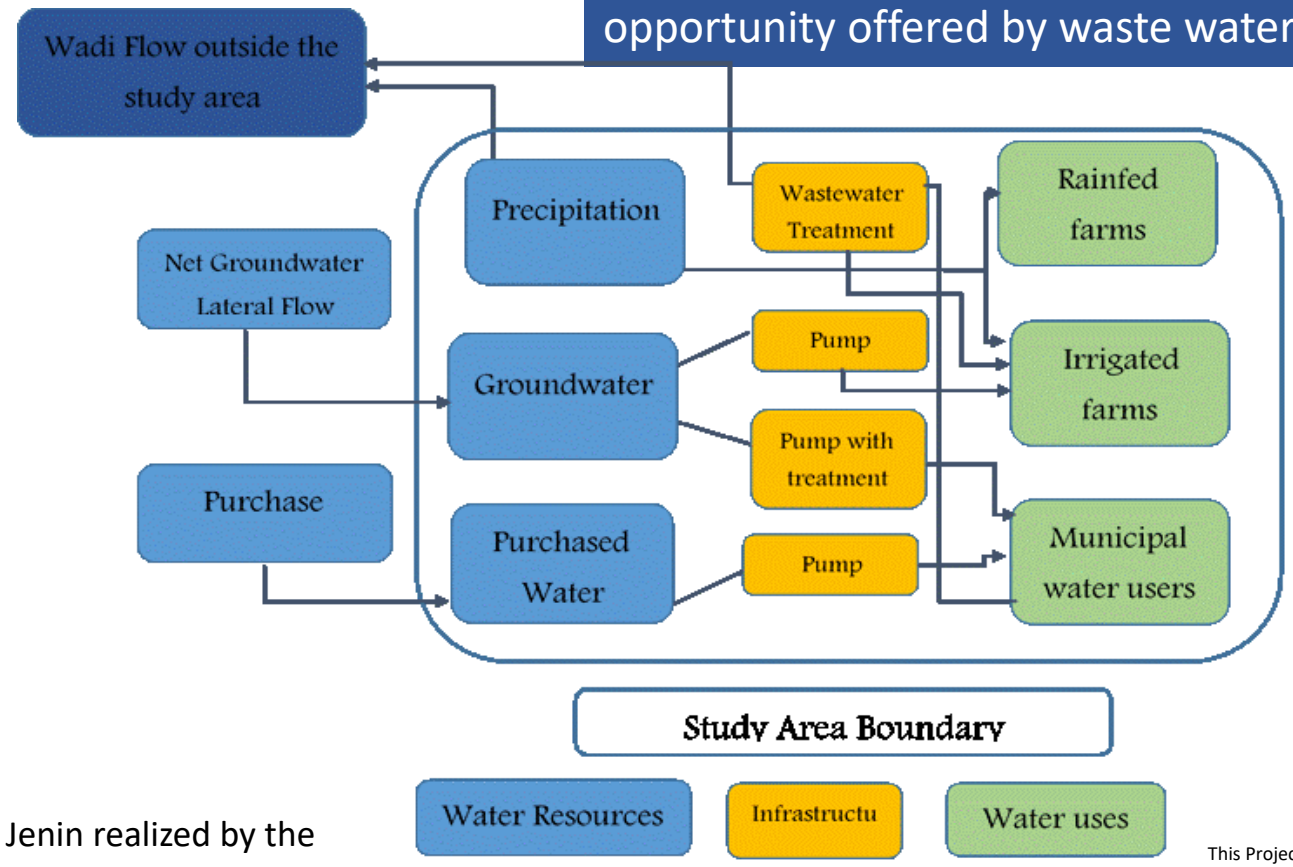
Organized For example by using the Resources, Infrastructure, Demand/Access (RIDA) Framework



Note/. A water supply or delivery systems can be divided into three inter-linked components (i.e. resources, infrastructure, demand/access)..



Palestine
Jenin Aquifer
Issue : gap between supply and demand & opportunity offered by waste water reuse



Source: Project RWA report Jenin realized by the Palestinian WA team)

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Example of analysis of consumptive fractions

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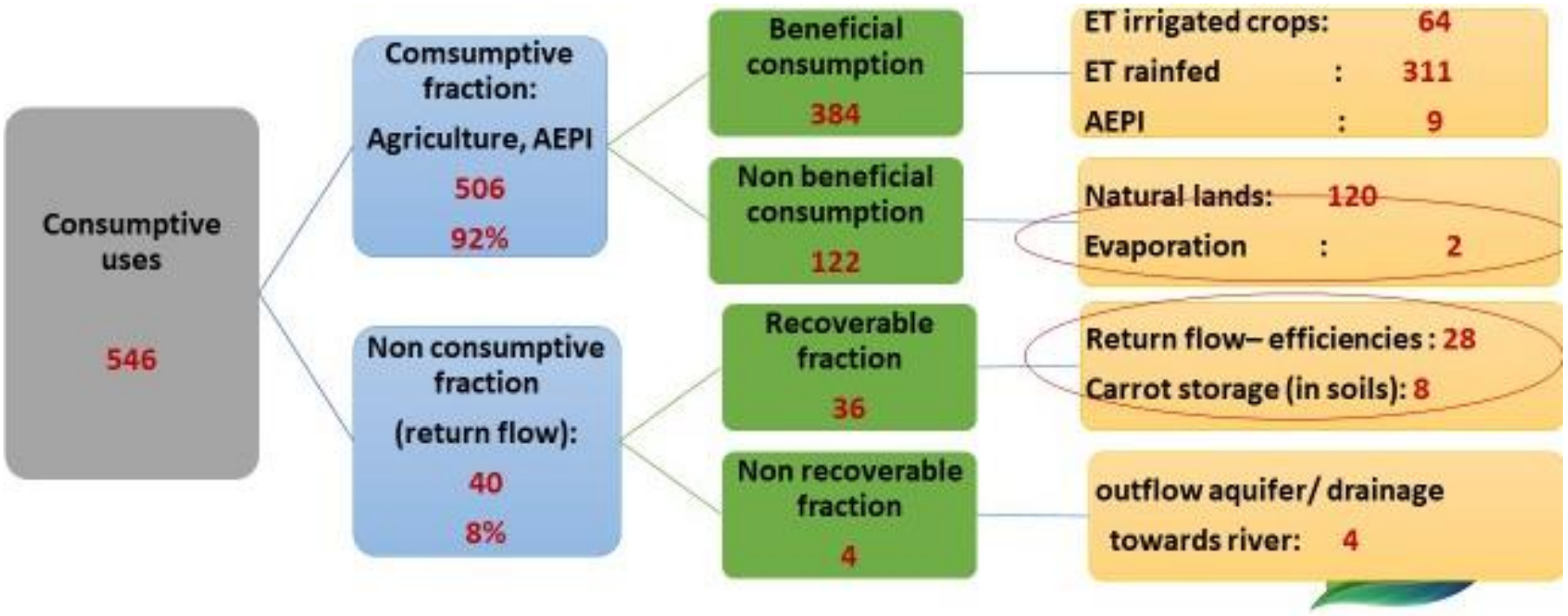
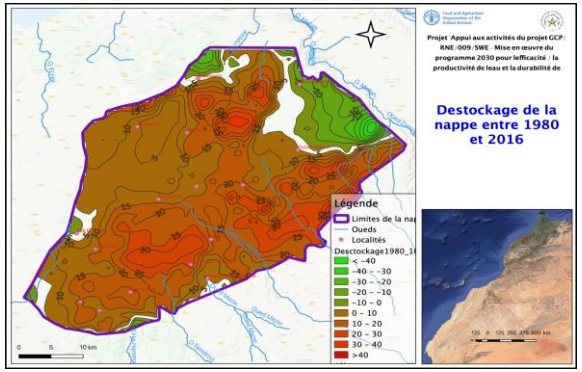
Morocco
Berrechid Aquifer
Issue: over-exploitation of groundwater for irrigation

Fraction of water use (Berrechid Aquifer)





Source: Project RWA report on Berrechid Aquifer, draft (map from ABH Boureregg-Chaouia)

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Quizz 1

- What **fraction of water use is reduced** with the increasing of **water efficiency** with drip irrigation?

Consumed fraction comprising of:

a) ***Beneficial consumption*** e.g. evapotranspiration from an irrigated or rainfed crop (but not the soil).

b) ***Non-beneficial consumption*** e.g. evaporation from bare soil, weeds, roads and reservoirs.

Non-consumed fraction comprising of:

c ***Recoverable fraction***: e.g. deep percolation of excessive irrigation or rainfall to an aquifer

d ***Non-recoverable fraction***: e.g. deep percolation of excessive irrigation or rainfall to a heavily polluted aquifer.

Quizz 2

- What fraction of water use when **reduced** create **water savings** at basin level?

Consumed fraction comprising of:

a) ***Beneficial consumption*** e.g. evapotranspiration from an irrigated or rainfed crop (but not the soil).

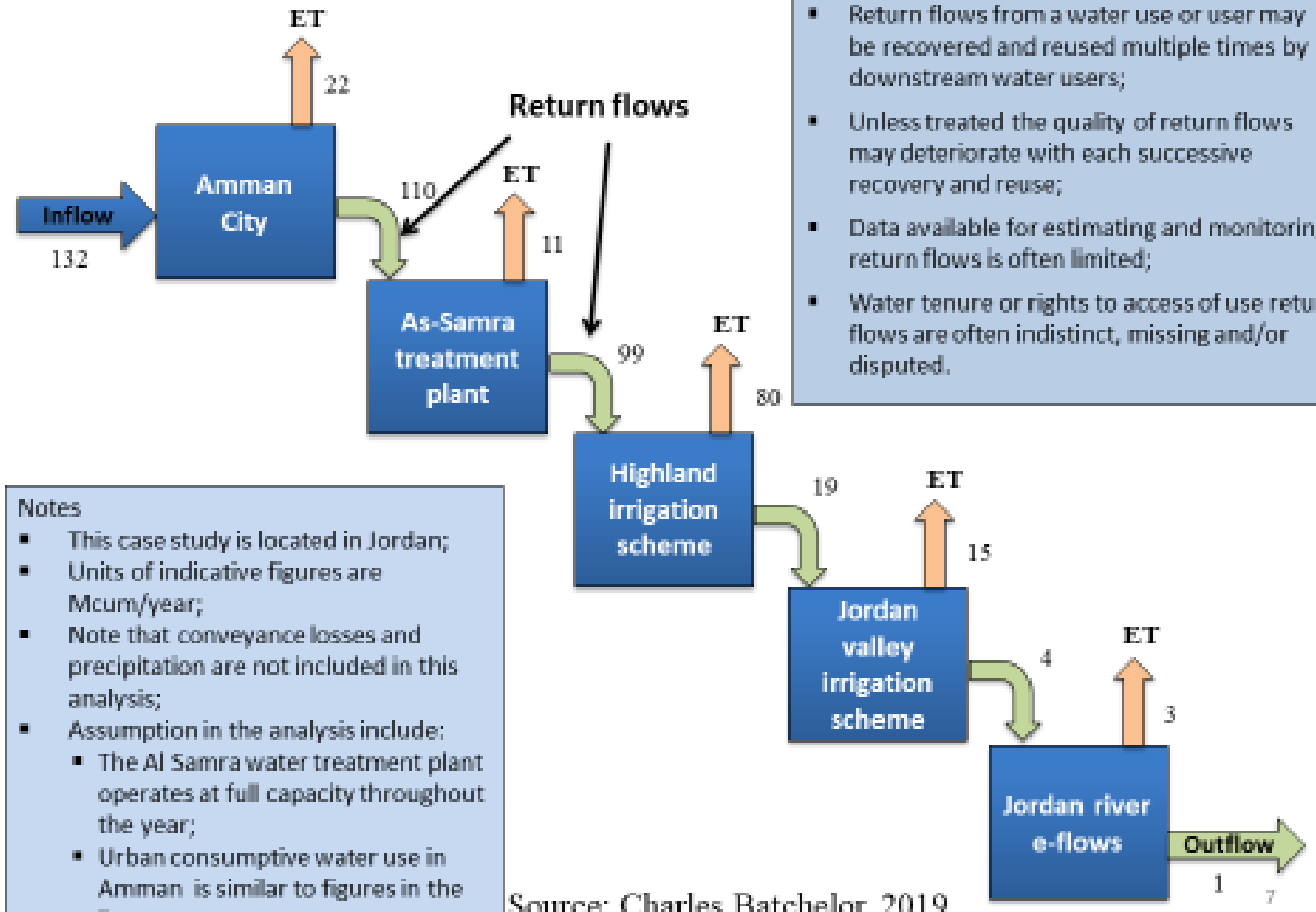
b) ***Non-beneficial consumption*** e.g. evaporation from bare soil, weeds, roads and reservoirs.

Non-consumed fraction comprising of:

c ***Recoverable fraction***: e.g. deep percolation of excessive irrigation or rainfall to an aquifer

d ***Non-recoverable fraction***: e.g. deep percolation of excessive irrigation or rainfall to a heavily polluted aquifer.

Example on returned flows estimates



Cascades of return flows

- Return flows from a water use or user may be recovered and reused multiple times by downstream water users;
- Unless treated the quality of return flows may deteriorate with each successive recovery and reuse;
- Data available for estimating and monitoring return flows is often limited;
- Water tenure or rights to access of use return flows are often indistinct, missing and/or disputed.

Notes

- This case study is located in Jordan;
- Units of indicative figures are Mcum/year;
- Note that conveyance losses and precipitation are not included in this analysis;
- Assumption in the analysis include:
  - The Al Samra water treatment plant operates at full capacity throughout the year;
  - Urban consumptive water use in Amman is similar to figures in the literature

Source: Charles Batchelor, 2019

Jordan
Al Masharieh irrigation scheme and North Jordan Valley
Issue: gap between supply and demand

Quizz 3

- What is the effect of watershed development (ex.tree planting, in situ and ex situ water harvesting) on return flows to a lower storage?

a. Regularize the flows
b. Increase the return flows
c. Decrease the return flows
d. No effect

- What is the effect of increased waste water reuse on environmental flows?

a. Regularize the provision of env flow
b. Increase the env flow
c. Decrease the env flow
d. No effect

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Water balance analysis for decision support

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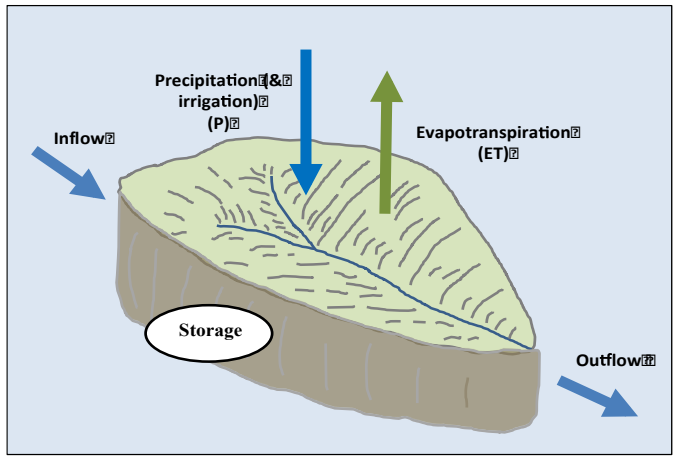


Water balance

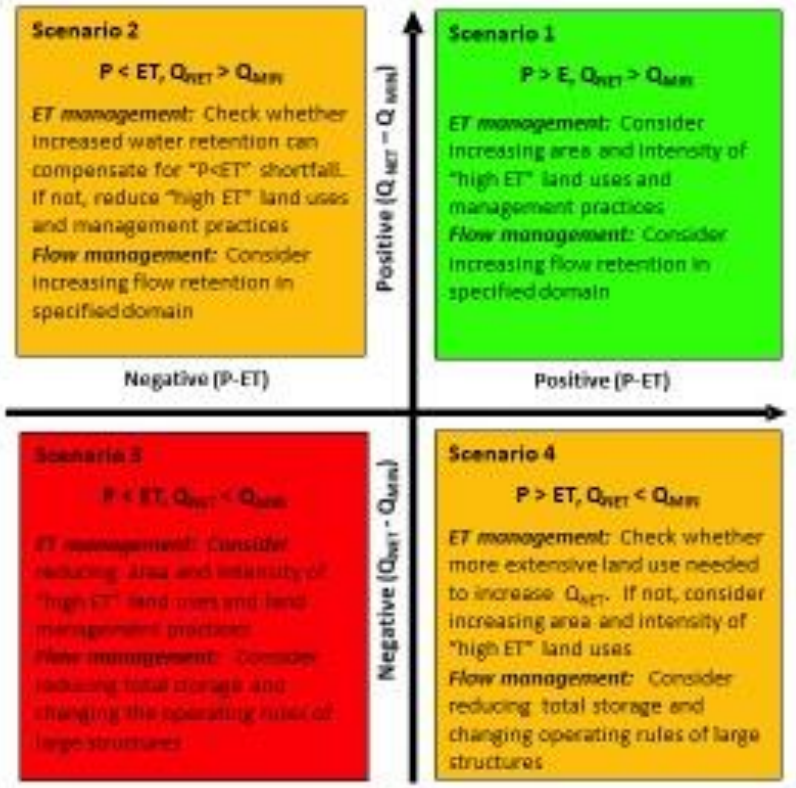
$$P = Q_{NET} + ET \pm \Delta S$$

Where:

P is the volume of precipitation (& irrigation);
Q_{NET} is net volume of outflow;
ET is the volume of actual evapotranspiration
ΔS is the change in the volume of stored water.

The water balance quadrant shown here can:

- Inform decisions related to ET management and flows of surface and subsurface water in and out of a specified domain
- Take explicit account of consumptive and non-consumptive water uses and cascades of recovery and reuse of return flows in a specified domain
- Monitor and map sustainability of water use (in space and time)
- Communicate outputs from water accounting and auditing in easily accessible forms and formats e.g. "traffic-light" maps.



Source: Charles Batchelor, 2020

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WA&A advanced: using advanced technologies and customize

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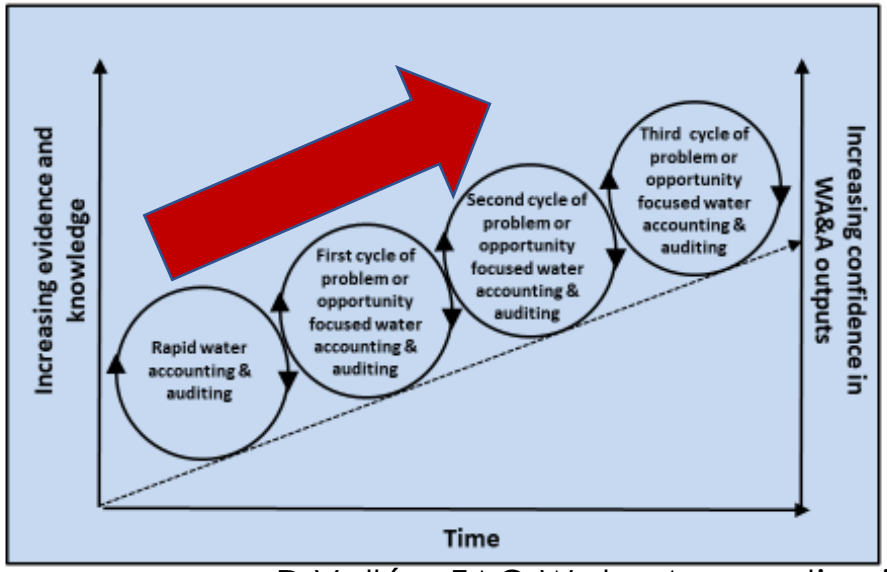
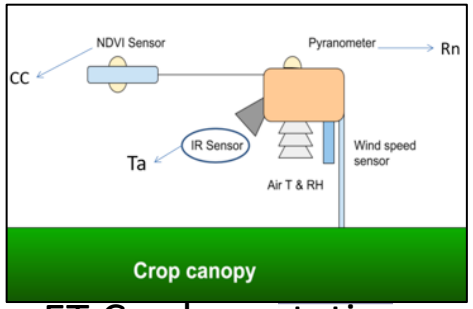
As you move into advanced water accounting where you need to reduce "critical"uncertainties and fill data gaps take advantage of **advances in instrumentation, cyber-technologies, informatics**



- **Possible WA&A advances include:**
  - Emerging satellite technologies and applications;
  - New equipment for ground-based estimation of ET using AquaCrop and field measurement of ET (e.g. Cordoba ET stations);
  - Web-based environmental sensors;
  - Data mining techniques; citizen scientists, crowdsourcing etc;
  - Dashboards, interactive visualisations, smart-phone applications etc.
  - Use of integrated water accounting approaches or tools (SEEAW; WA+…)
  - Develop "country specific models and tools"(ex. Australia water accounting system)



ET Cordova station

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WA&A: optimizing resources to get "sufficient" evidences

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WA&A aims to make efficient use of human and financial resources

- **This is achieved by, for example:**
  - Adopting a ***problem-focused approach*** that focuses on challenges and opportunities for addressing these challenges in a specified domain;
  - Adopting the principle of ***optimal ignorance*** i.e. a focus on the acquisition of data that is needed rather than collecting all the data that may be available;
    - Adopting the principle of ***appropriate imprecision*** **i.e.** a focus on acquiring and analysing data that has an acceptable precision and no more than this.

WA&A aims to be aware of the level of uncertainty of the water balance

Options for managing uncertainty include:

- Seeking to reduce "reducible" uncertainties and to mitigate or quantify "irreducible" uncertainties;
- Rigorously cross-checking and triangulating technical and non-technical evidence and findings;
- Developing protocols that minimise/eliminate subjectivity in, for example, data processing, quality control, analysis and interpretation:
- Ensuring that members of WA&A teams are well trained and well motivated.

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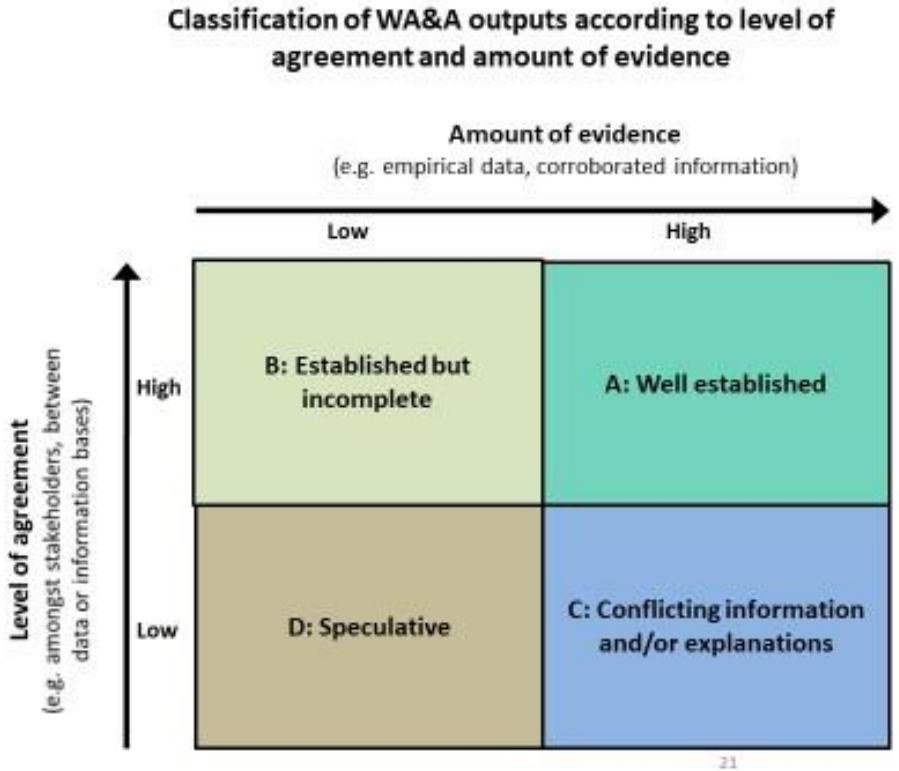
WA&A need to be communicated with key stakeholders

- Develop and implement a communication strategy from the beginning of a WA&A process or programme;
- Base the strategy on needs assessments of key stakeholders;
- Recognise that some sensitive information may require restricted access;
- Recognise that information to be communicated is often contested and/or rejected.
- Reveal the level of confidence in the WA on the basis of the information available



Source: Charles Batchelor in FAO 2017

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Project NENA-WepS: key activities for WA&A

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	Algeria	Egypt	Iran	Jordan	Lebanon	Morocco	Palestine	Tunisia
Track A: Crop mapping								
In-country crop mapping & GIS capacity building							✓	✓
Sub-regional crop mapping capacity building	✓	✓		✓	✓	✓	✓	✓
Track B: Evapotranspiration validation								
Assessment of ET existing estimation methods in use	✓	✓	✓	✓	✓	✓	✓	✓
Assessment of ET estimation needs requirements	✓	✓	✓	✓	✓	✓	✓	✓
Capacity building on ET measurement	✓	✓	✓	✓	✓	✓	✓	✓
Piloting ET Cordoba Stations	✓	✓		✓	✓	✓		✓
ET measurement network piloting		✓		✓	✓	✓		✓
Track C: Water accounting implementation								
WA basics capacity building	✓	✓	✓	✓	✓	✓	✓	✓
Cycle of rapid water accounting in a pilot area	✓	✓	✓	✓	✓	✓	✓	✓
Advanced water accounting capacity building (ongoing)	✓	✓	✓	✓	✓	✓	✓	✓
Cycle of problem-focused water accounting in a larger pilot area				✓		✓	✓	
Discussions on institutionalising water accounting		✓		✓	✓	✓	✓	✓
Planning of second cycle of WA started		✓	✓	✓	✓	✓	✓	✓

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Project NENA-WepS: key trends revealed by the RWA

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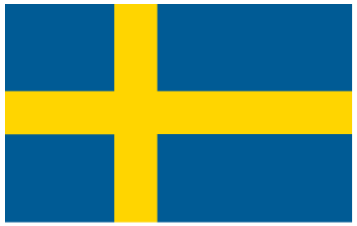
	Hamiz, Algeria	Zankalon, Egypt	Qazvin, Iran	Mashare, Jordan	Nahr El Kalb, Lebanon	Berrechid, Morocco	Al Moqatta, Palestine	Jendouba Tunisia
Increasing water scarcity	✓	✓	✓	✓	✓	✓	✓	✓
Increasing water pollution	✓	✓	✓	✓	✓	✓	✓	✓
Increasing urbanisation	✓	✓	✓	✓	✓	✓	✓	✓
Climate change	✓	✓	✓	✓	✓	✓	✓	✓
Increasing groundwater overdraft	✓	✓	✓	✓		✓	✓	
Increasing water productivity				✓	✓	✓	✓	
Decreasing biodiversity	✓	✓	✓	✓	✓	✓	✓	✓
Reducing e-flows	✓	✓	✓	✓	✓	✓	✓	✓
Increasing inter-sectoral competition for water	✓	✓	✓	✓	✓	✓	✓	✓
Increasing political economy issues	✓	✓	✓	✓	✓	✓	✓	✓

Food and Agriculture Organization of the United Nations

This presentation is based on activities implemented under the project "Implementing the 2030 Agenda for water efficiency/productivity and water sustainability in the NENA countries", which is funded by the Swedish International Development Cooperation Agency.



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Water and
Environment Support
in the ENI Southern Neighbourhood region

Thank you for your attention!