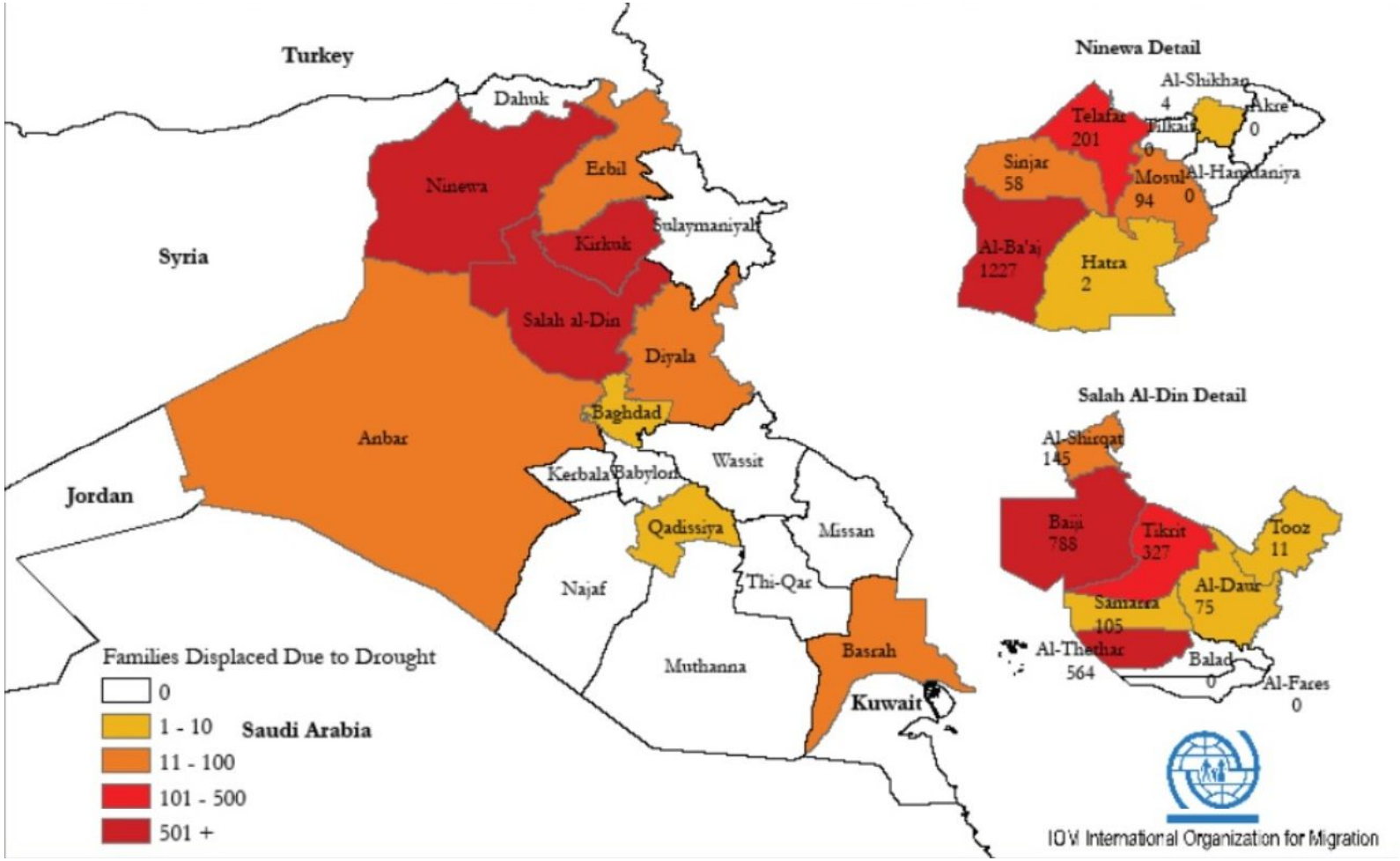
Lebanon - لبنان 12th November 2012 www.escwa.un.org

Lebanon’s stream of rubbish - لبنان ilndation-elaof.blogspot.com
2009-11 how-to-make-bucket-margarita.html 2, 2009 12 November 2012
www.escwa.un.org



Iraq - Displaced families due to Drought

July 2010 www.escwa.un.org

Economic and Social Commission for Western Asia

www.escwa.un.org

Energy

- Energy efficiency
- Access to modern energy services
- Renewable energies
- Advanced/cleaner fossil fuels
- Rural electrification
- Sustainable energy use in transport

Water

- Integrated water resource management (IWRM)
- Management of shared water resources
- Improved water supply and sanitation

Productive Sectors

- Competitiveness and productivity of SMEs
- Environmentally sound technologies
- Sustainable agriculture and rural development
- Trade and environment

Cross-cutting issues:

- Climate change adaptation and mitigation
- Sustainable consumption and production
- Green economy

Sustainable Development and Productivity

www.escwa.un.org

- Status and Trends
- Availability vs. Use and Demand
- Renewable vs. Non-Renewable
- Population Growth and Agriculture
- Pollution – Reduction of Available Resources
- Virtual Water
- Water Imports and Transfers
- Desalination
- Transboundary Water and Aquifers
- ... and Climate Change

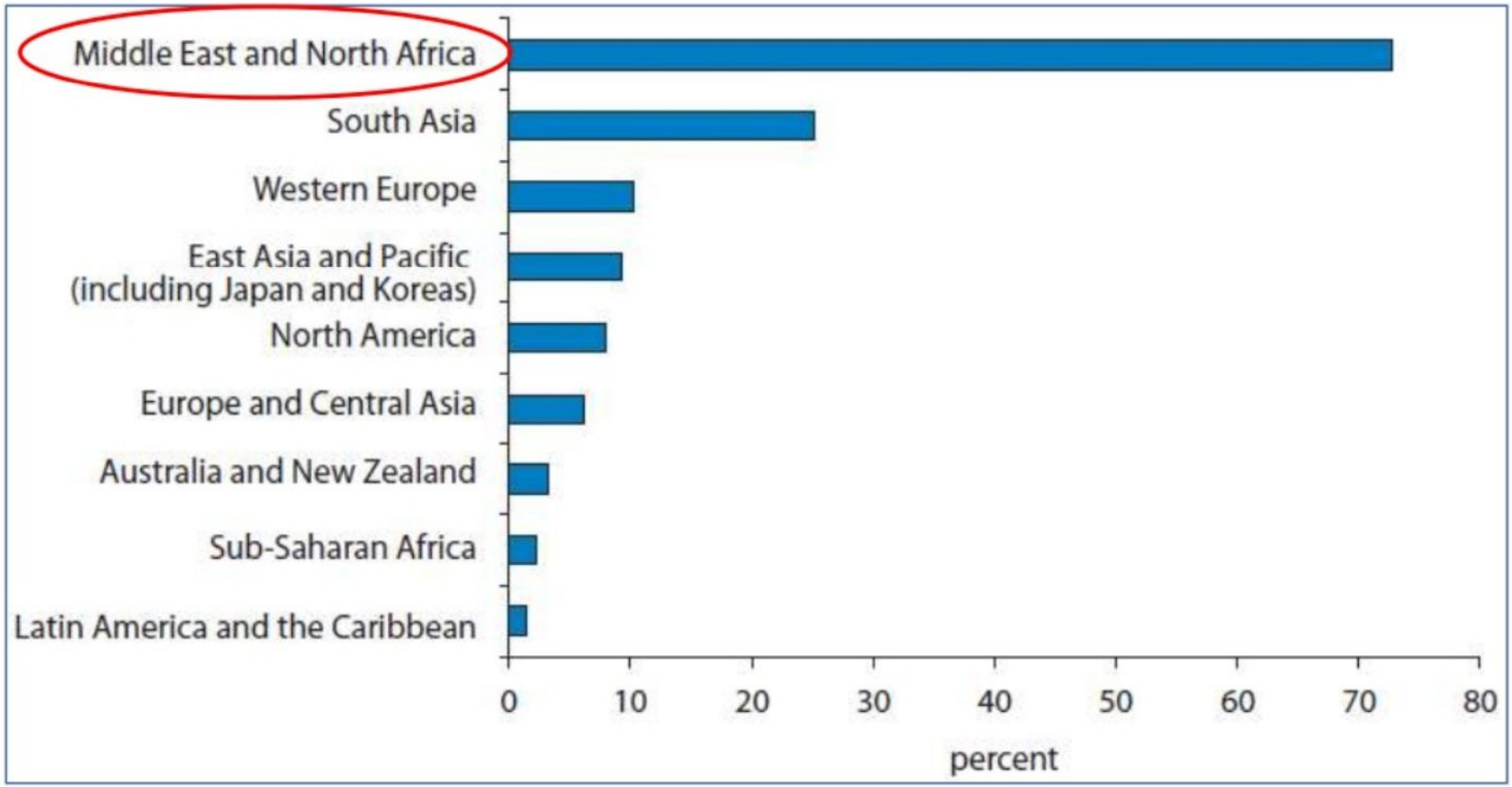
Water - Challenges

www.escwa.un.org

FAO AQUASTST, WB 2007

Actual Renewable Freshwater Resources in Regions

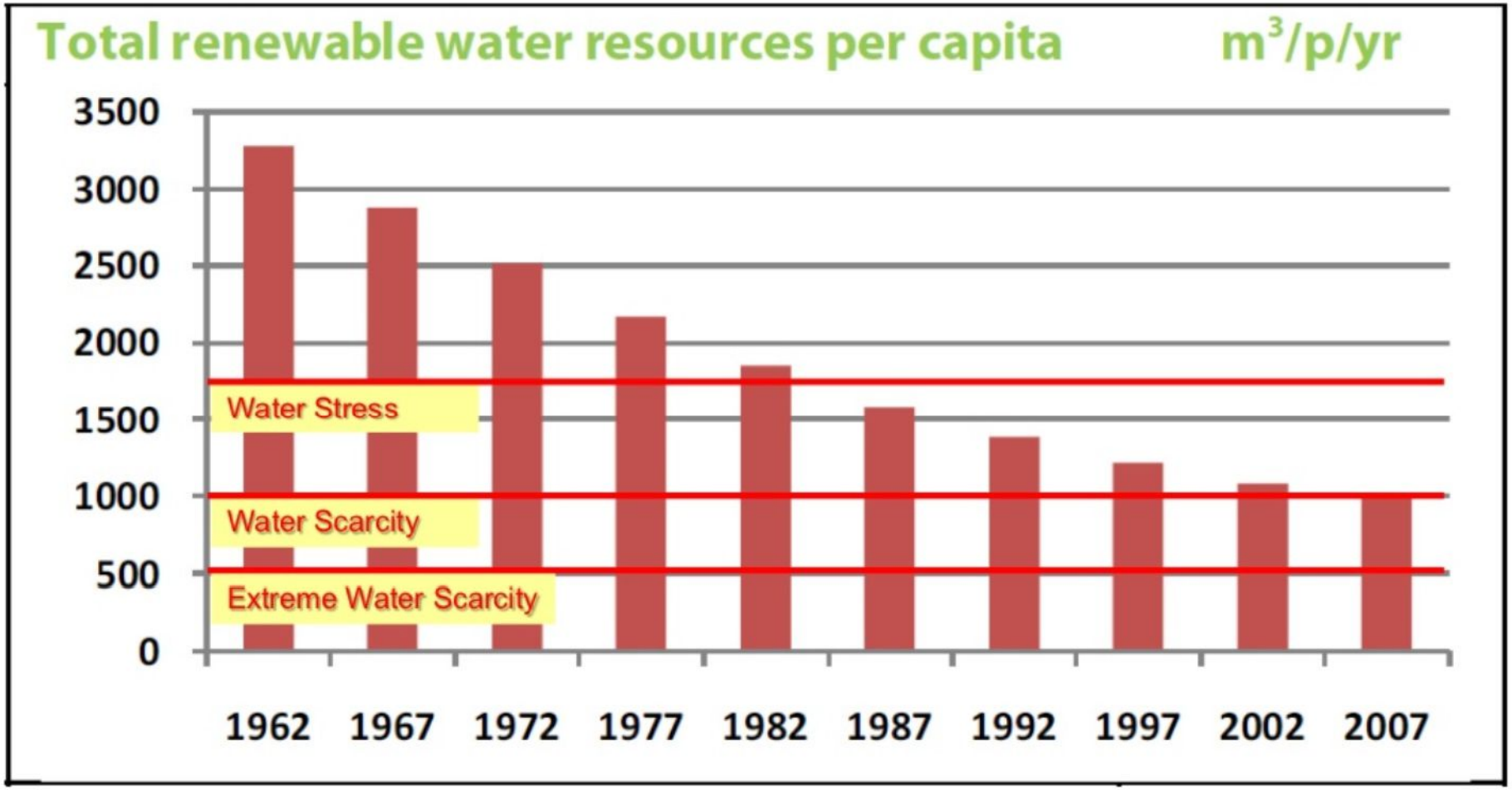
per capita **www.escwa.un.org**



FAO AQUASTAT data 1998-2002, WB 2007

Total Renewable Water Resources Withdrawn in Regions

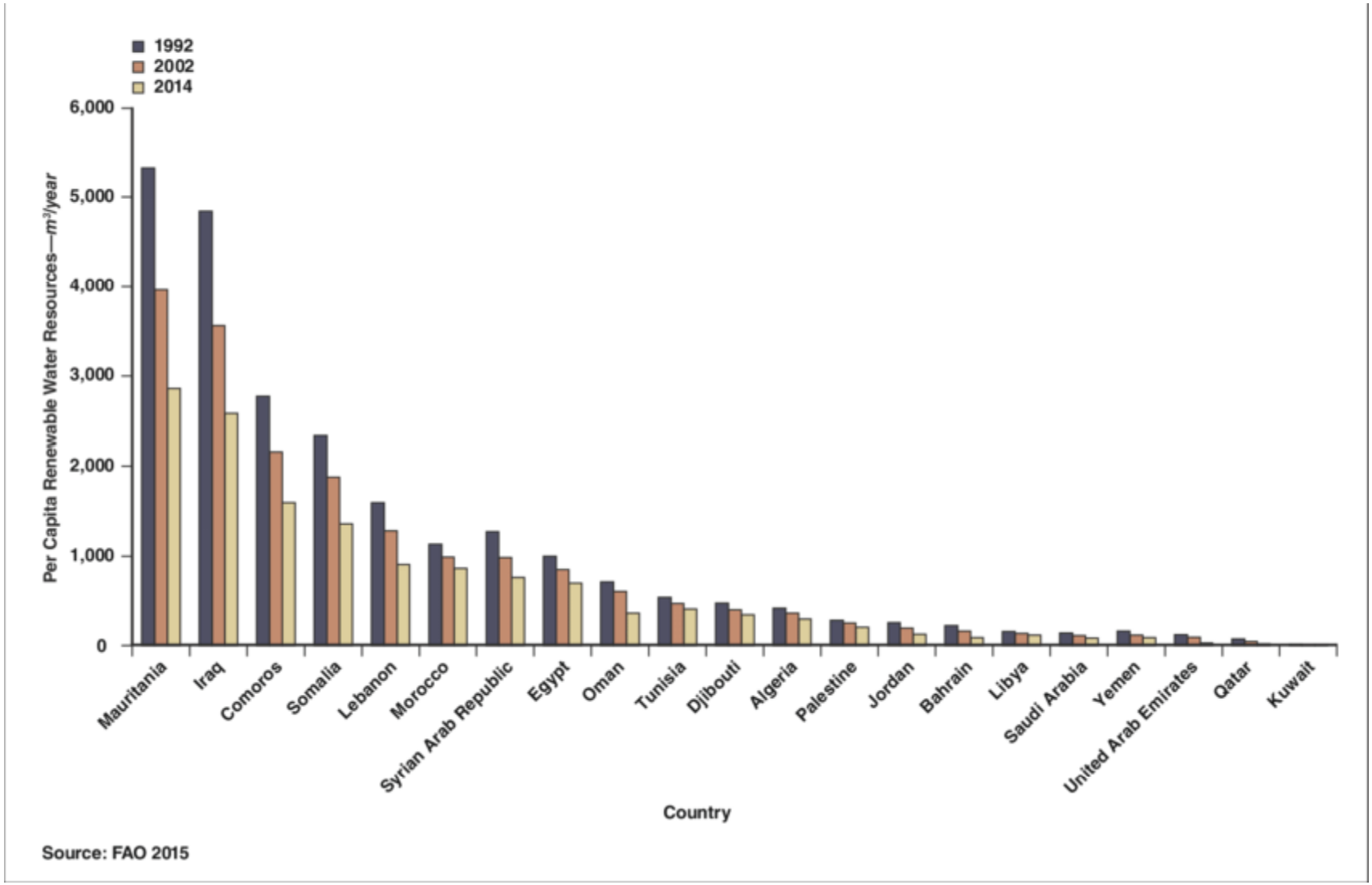
www.escwa.un.org



ESCWA, 2009

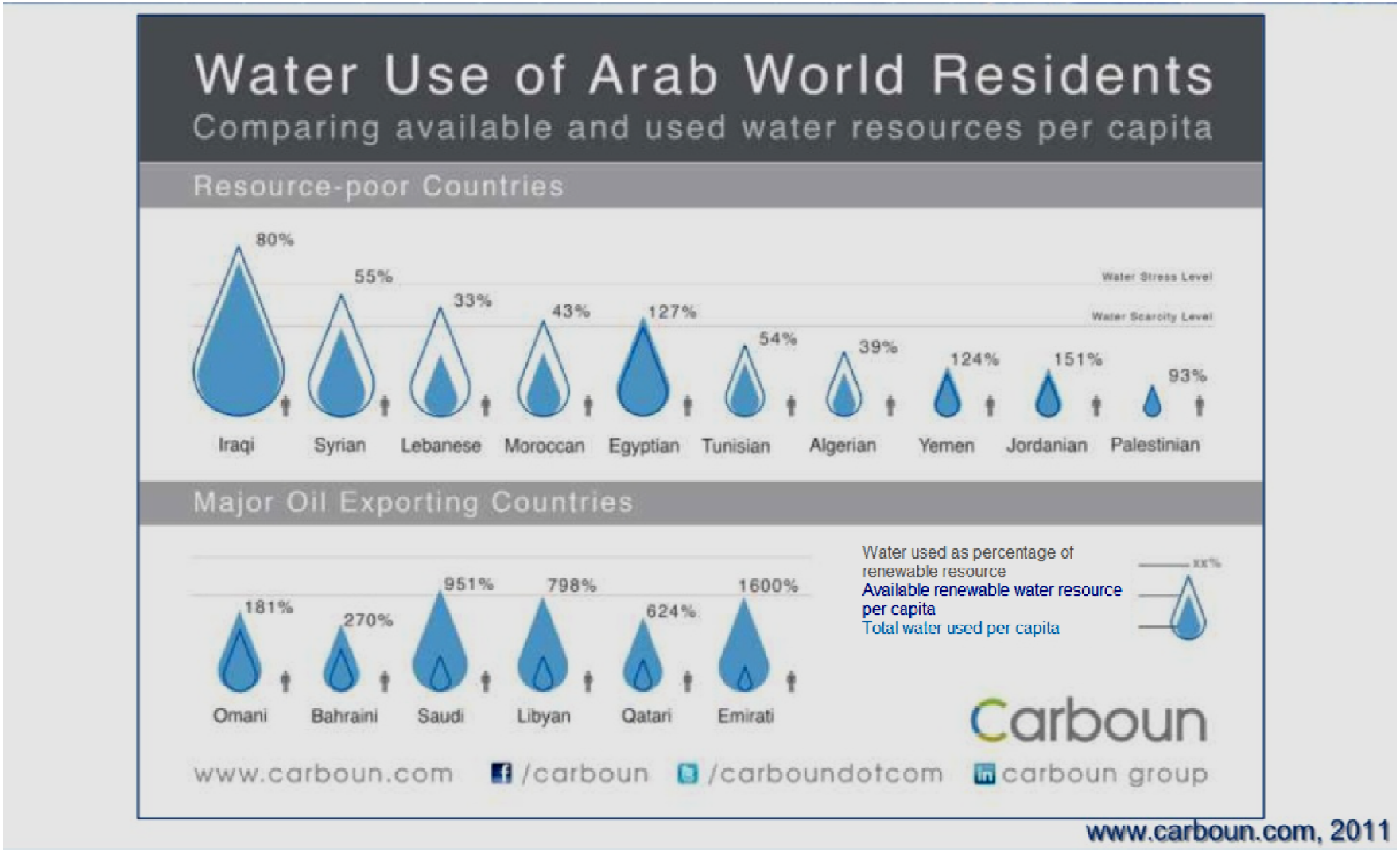
Total Renewable Water per Person in ESCWA Region

www.escwa.un.org



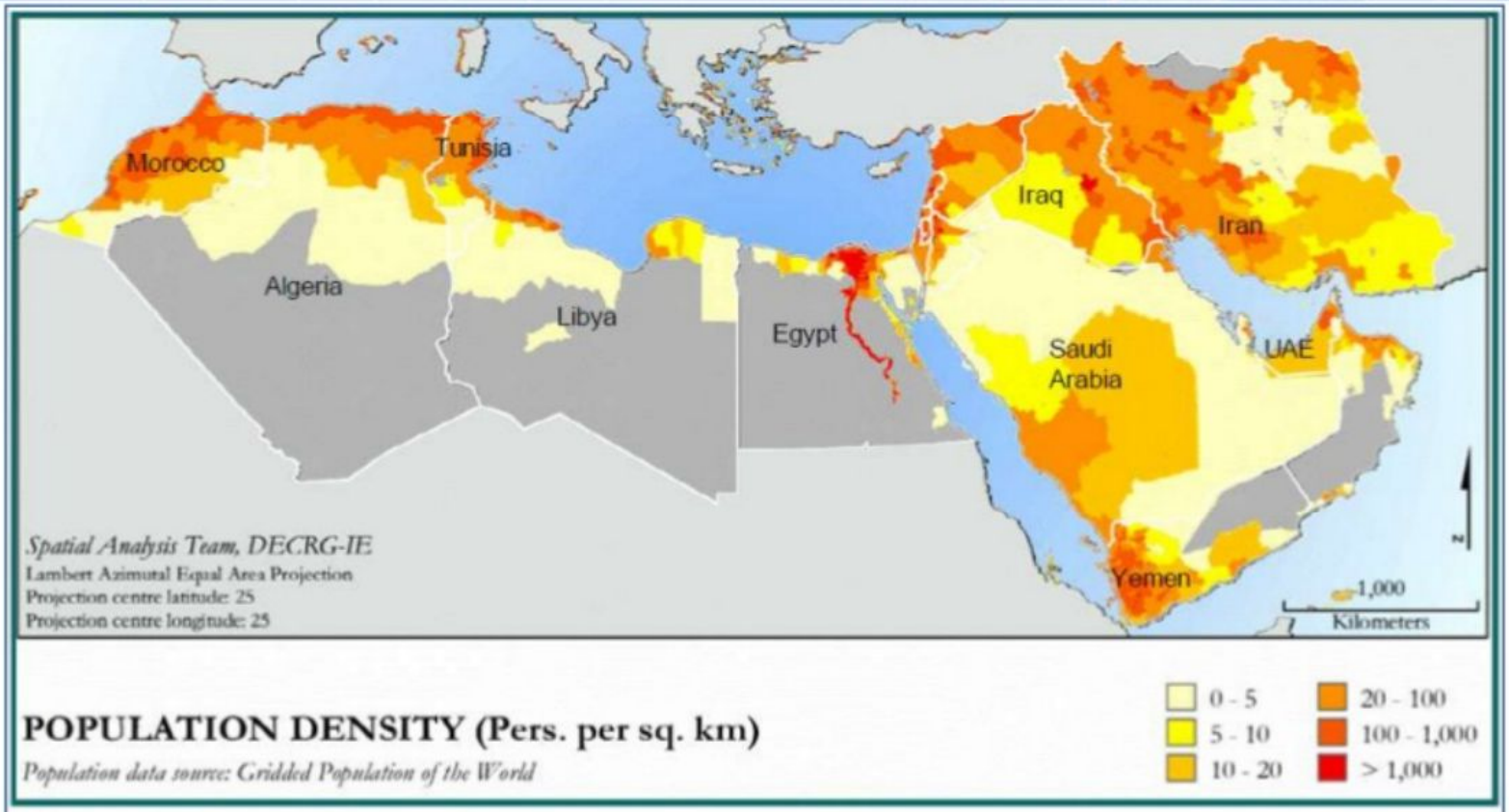
Total renewable water resources per capita

1992 2002 2014



Renewable Water Available and Used in Arabian Region

www.escwa.un.org



Population Growth (6% of world population):

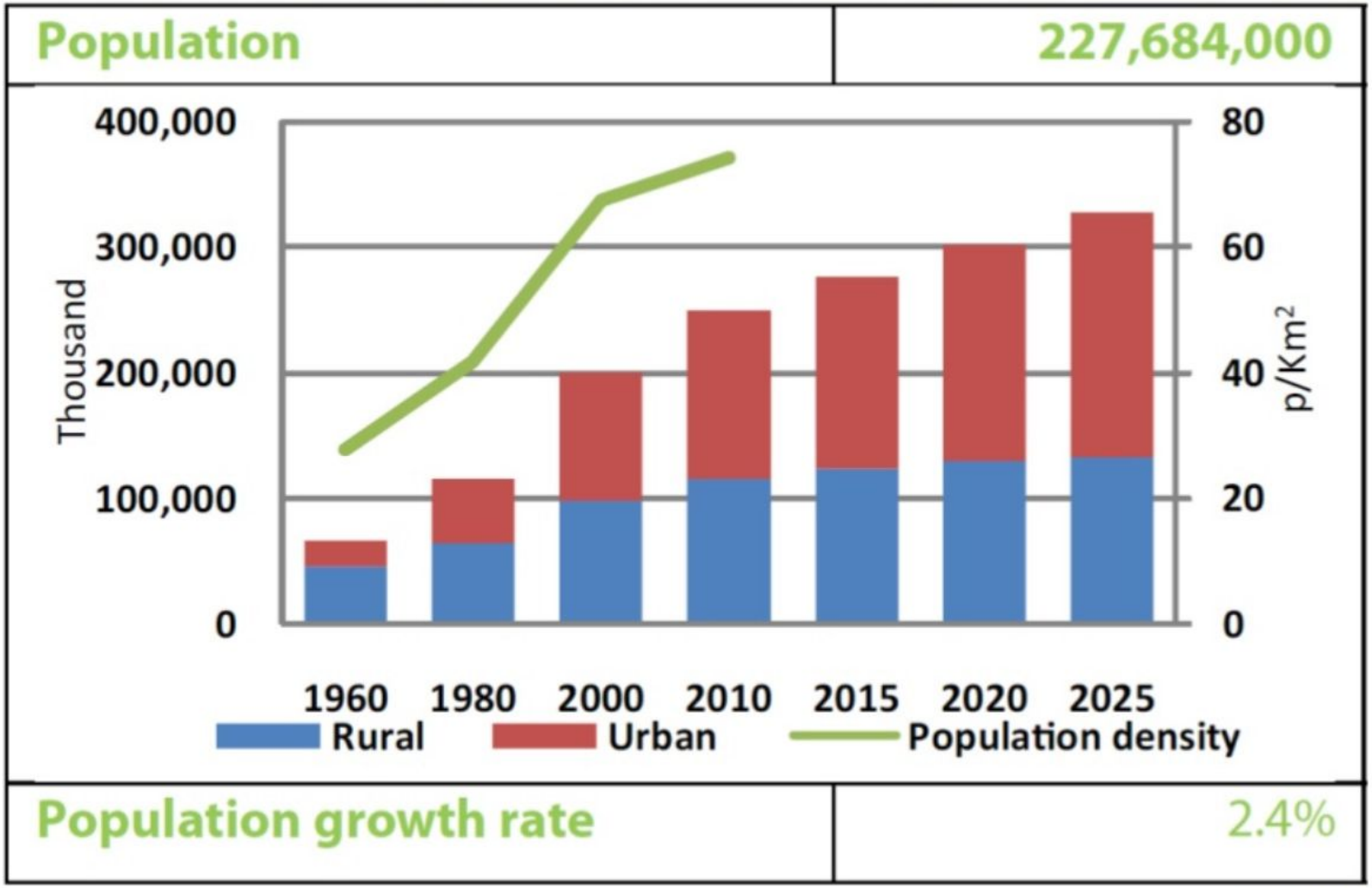
1980: 150 million people 2007: 317 million people

2015: 395 million people (*more than Europe*)

GDP *less than* Spain and Italy

ICBA, Barghouti, 2009

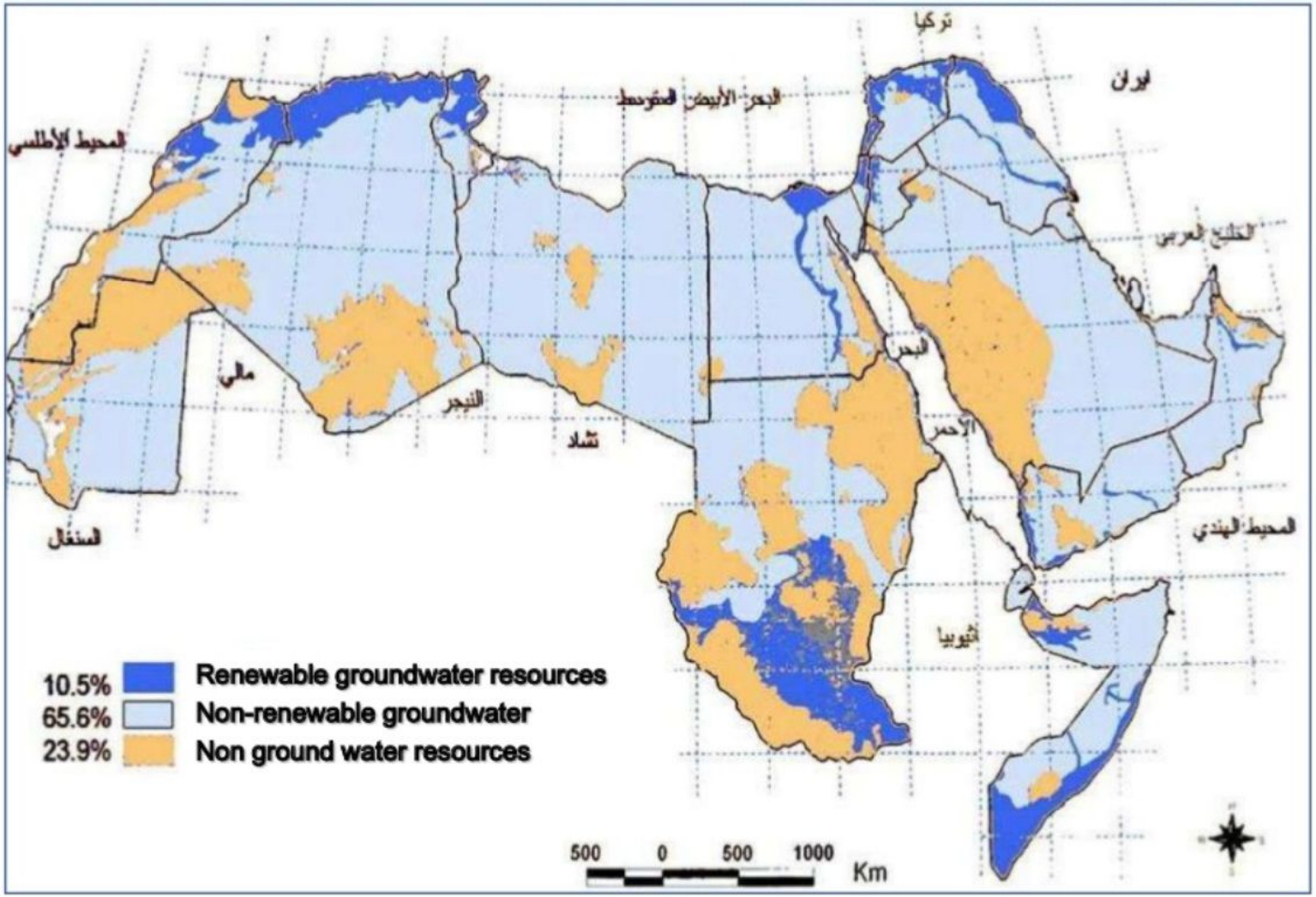
Rate of Population Growth in Arabian Region www.escwa.un.org



ESCWA, 2009

Rate of Population Growth in ESCWA Region

www.escwa.un.org

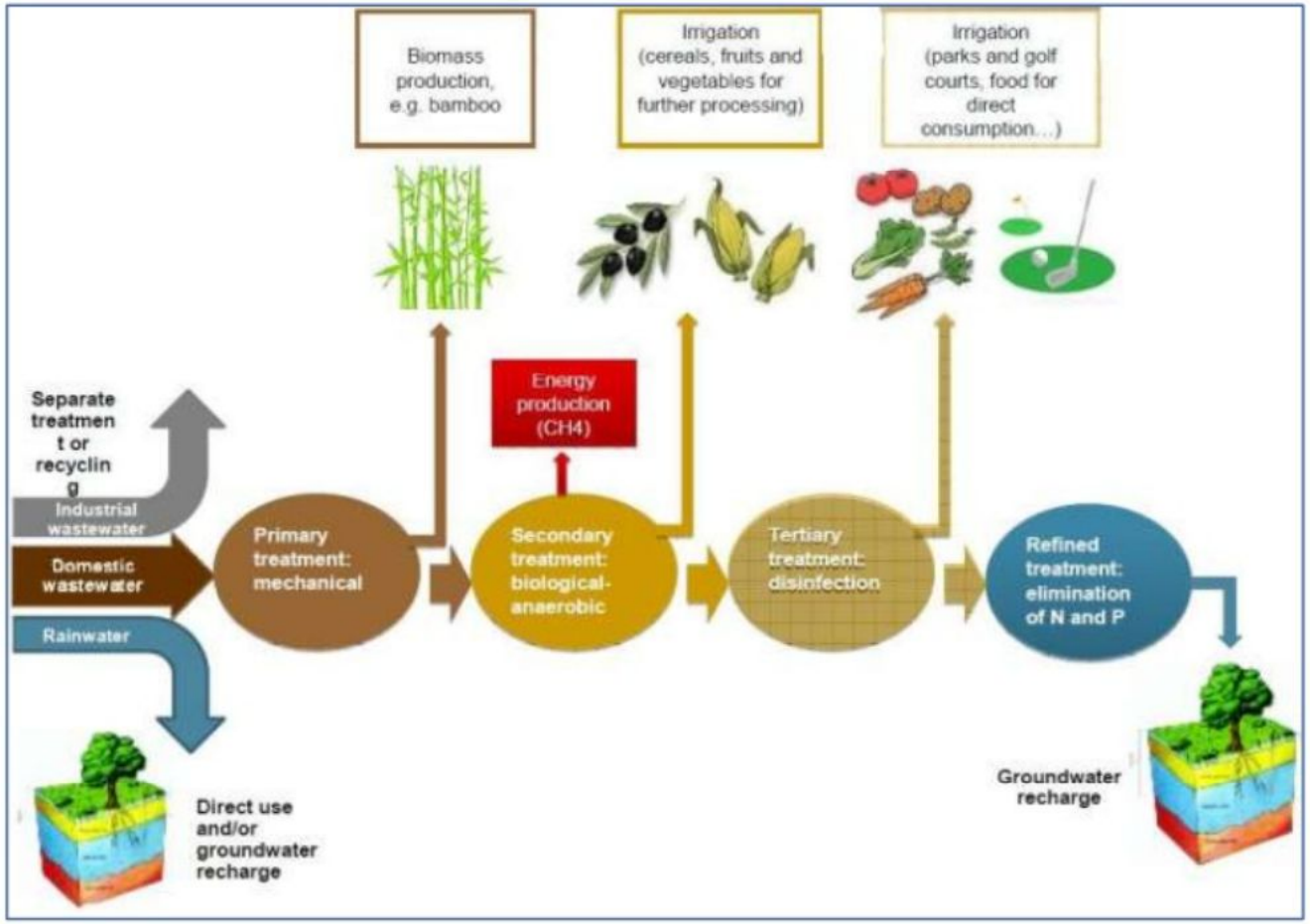


ESCWA, 2009

Renewable and Non-Renewable Groundwater

www.escwa.un.org

- Reuse: water and (treated) waste water

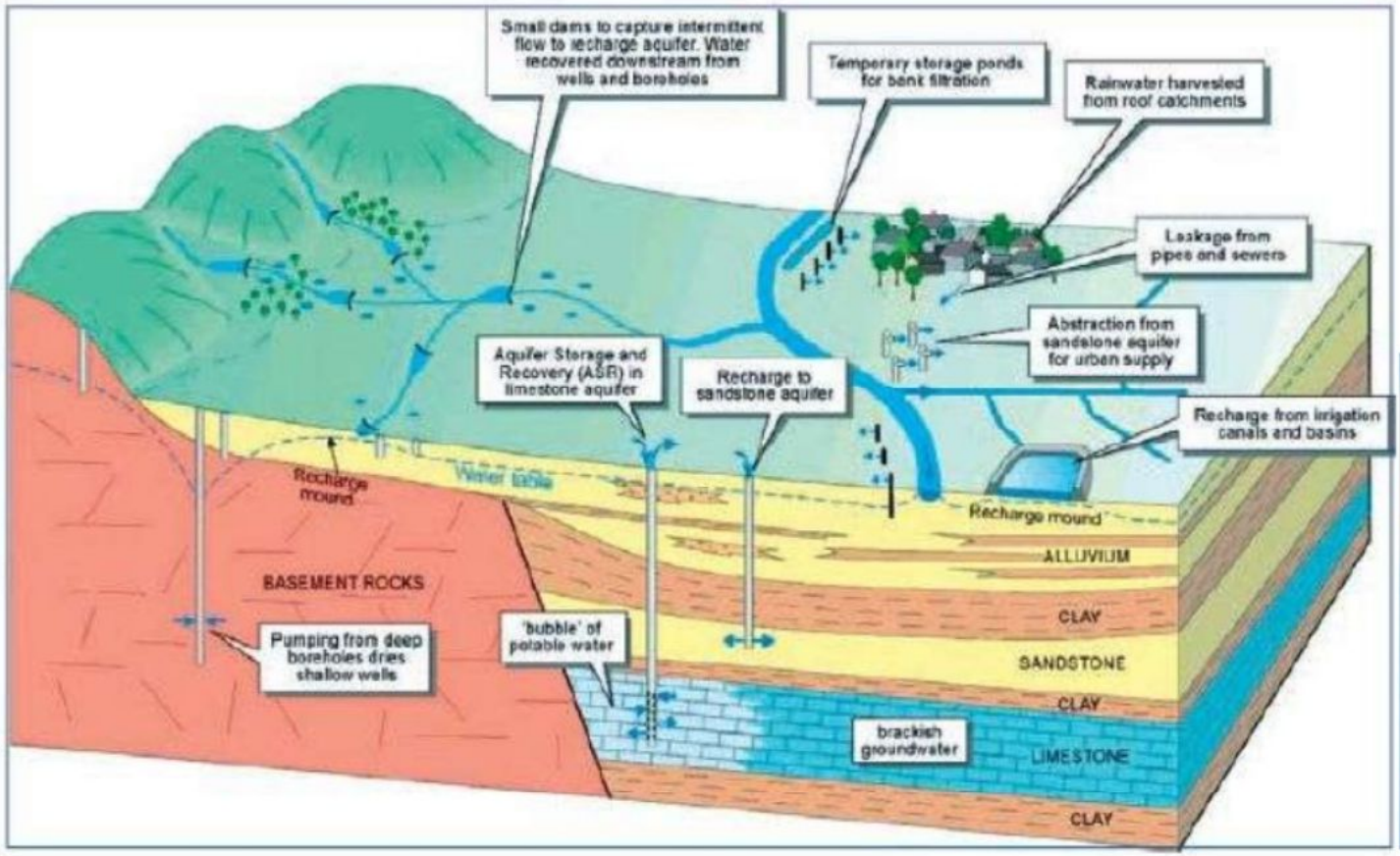


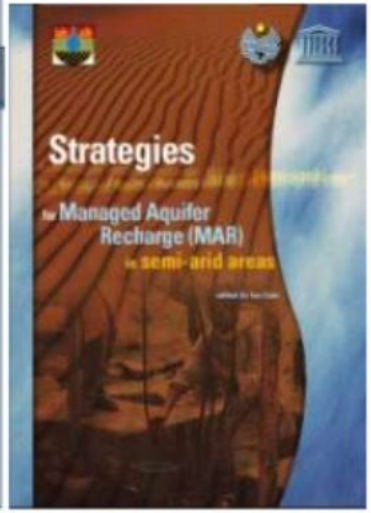
AlBaz, GIZ, 2011

Solutions - Reuse

www.escwa.un.org

- Storage: Managed Aquifer Storage



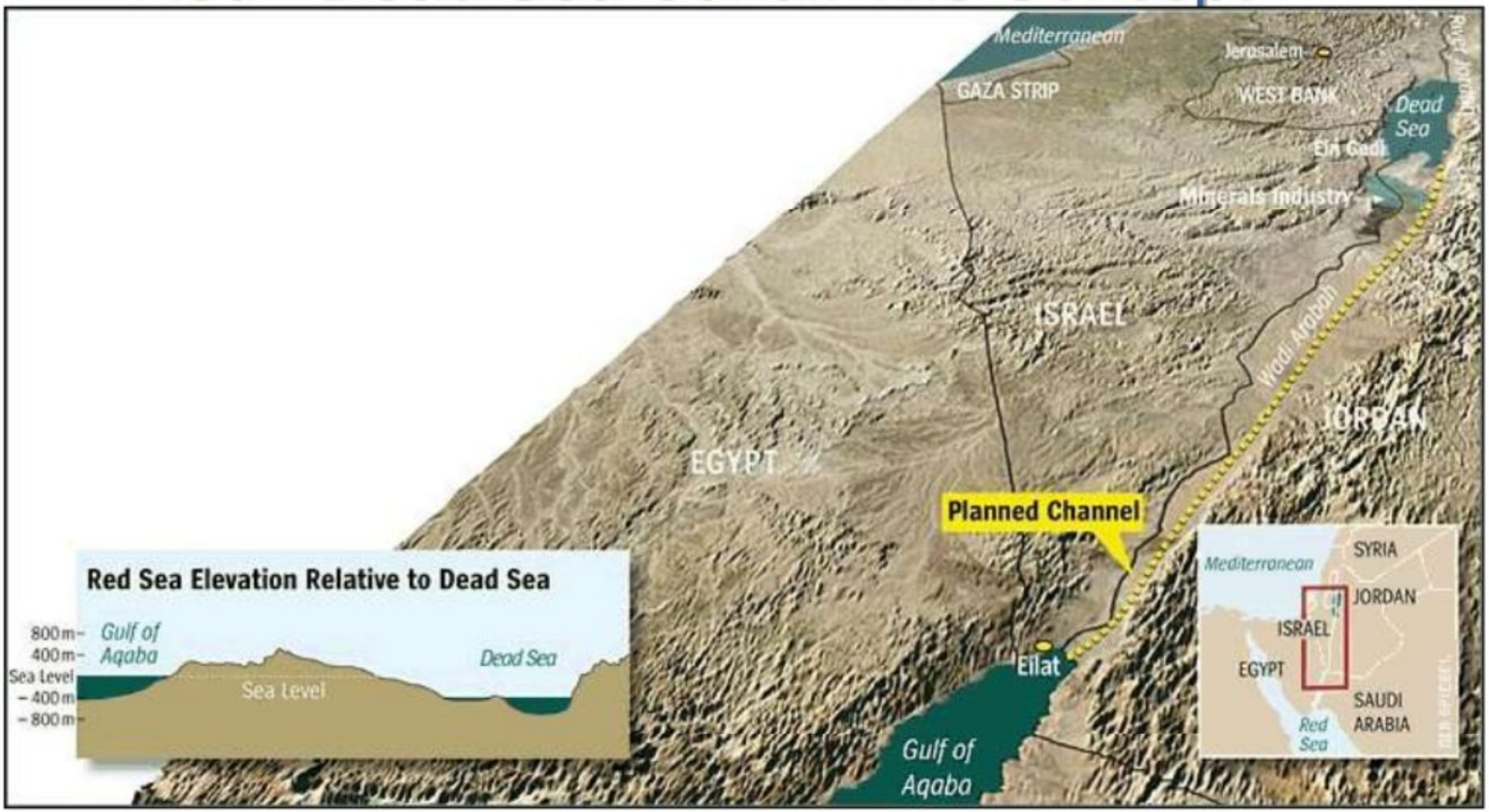


UNESCO, 2005

Solutions -Managed Aquifer Storage

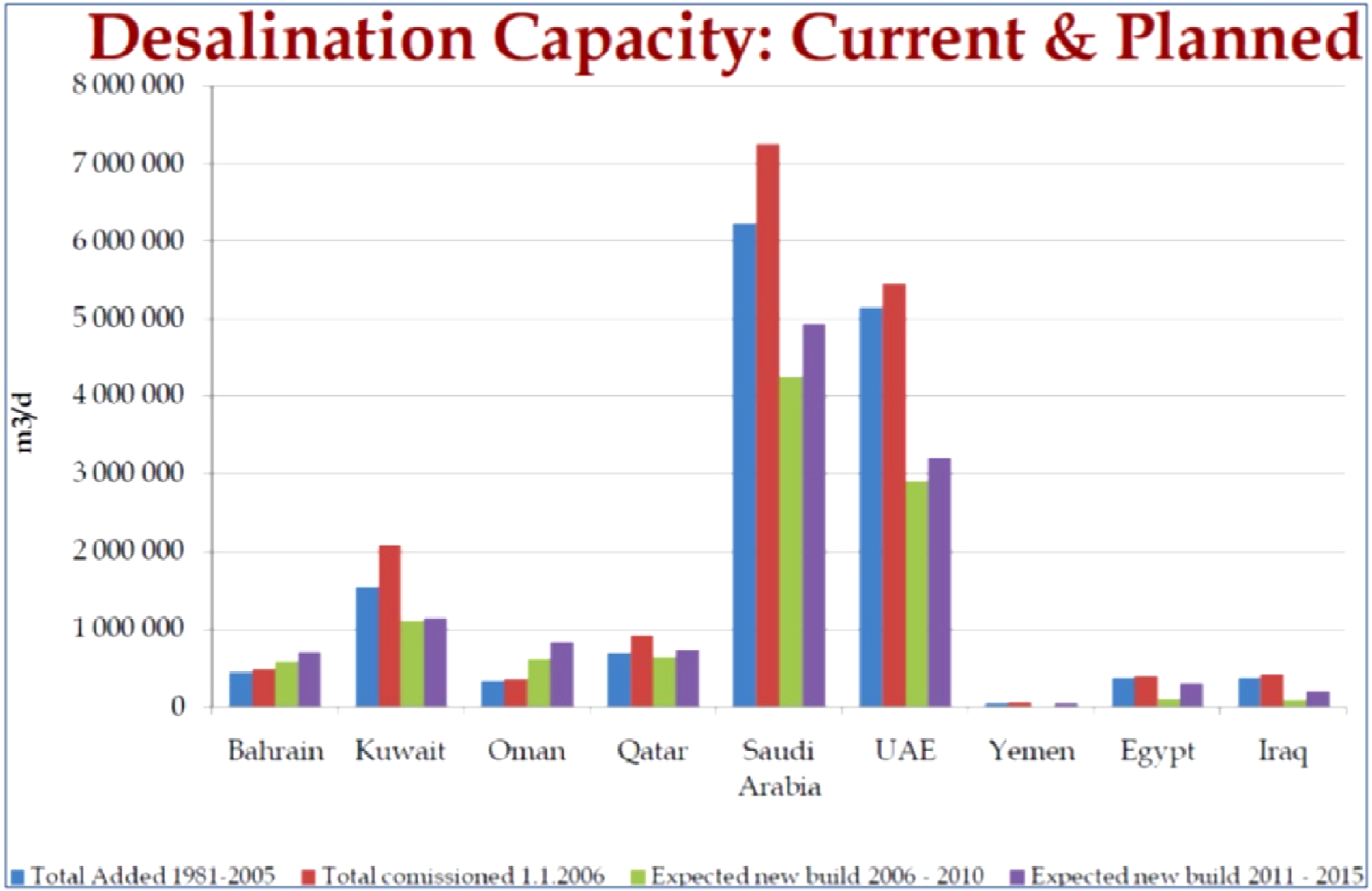
www.escwa.un.org

• Red - Dead Sea Canal: The Concept



Solutions -Imports and Transfers

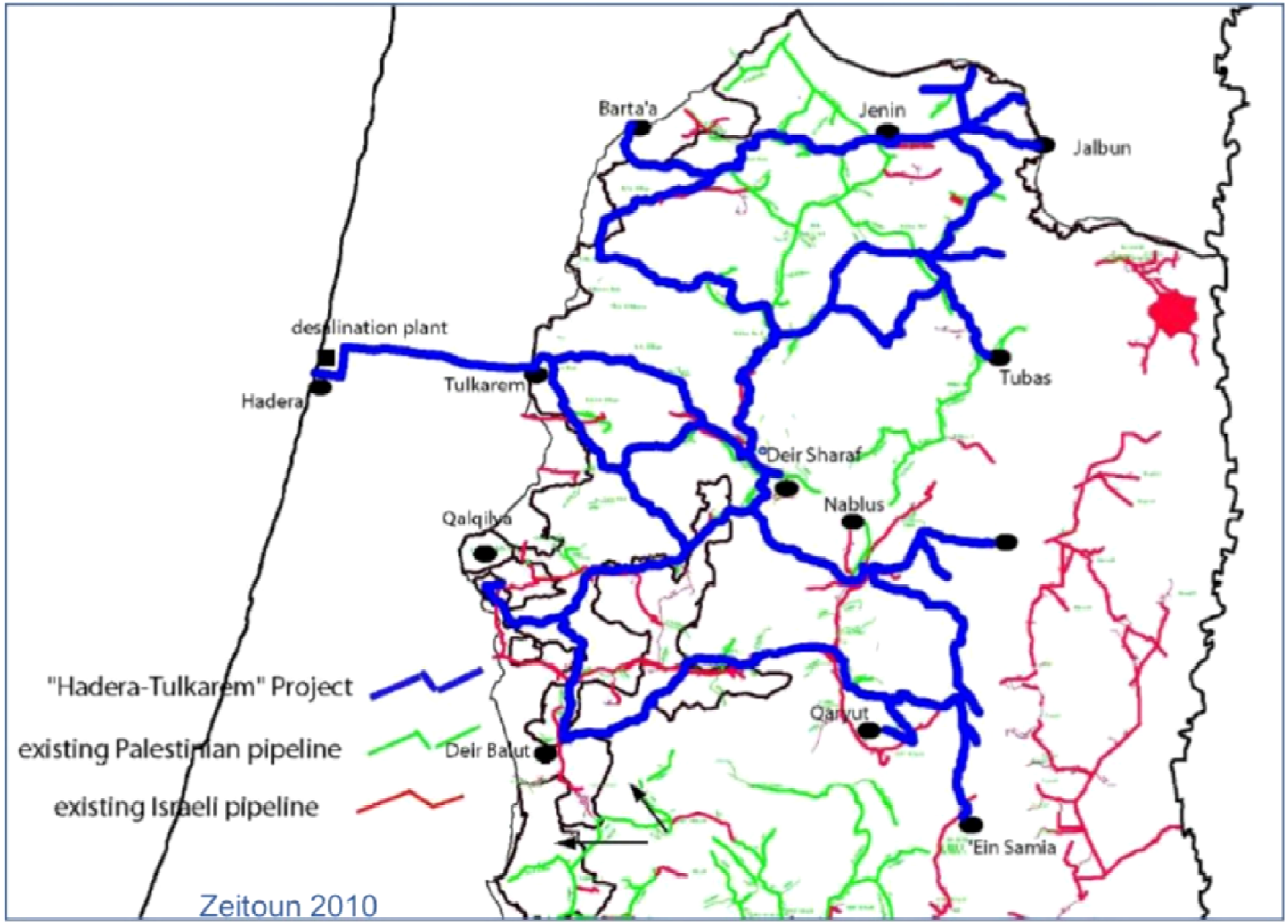
www.escwa.un.org



ESCWA, 2009

Solutions - Desalination

www.escwa.un.org

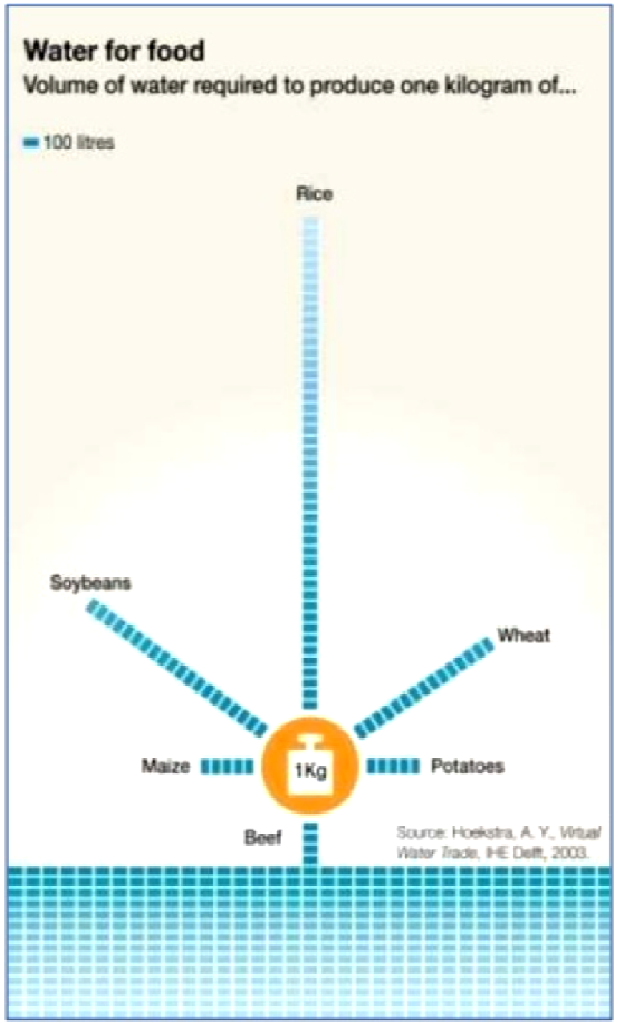


Desalination for the West Bank

www.escwa.un.org

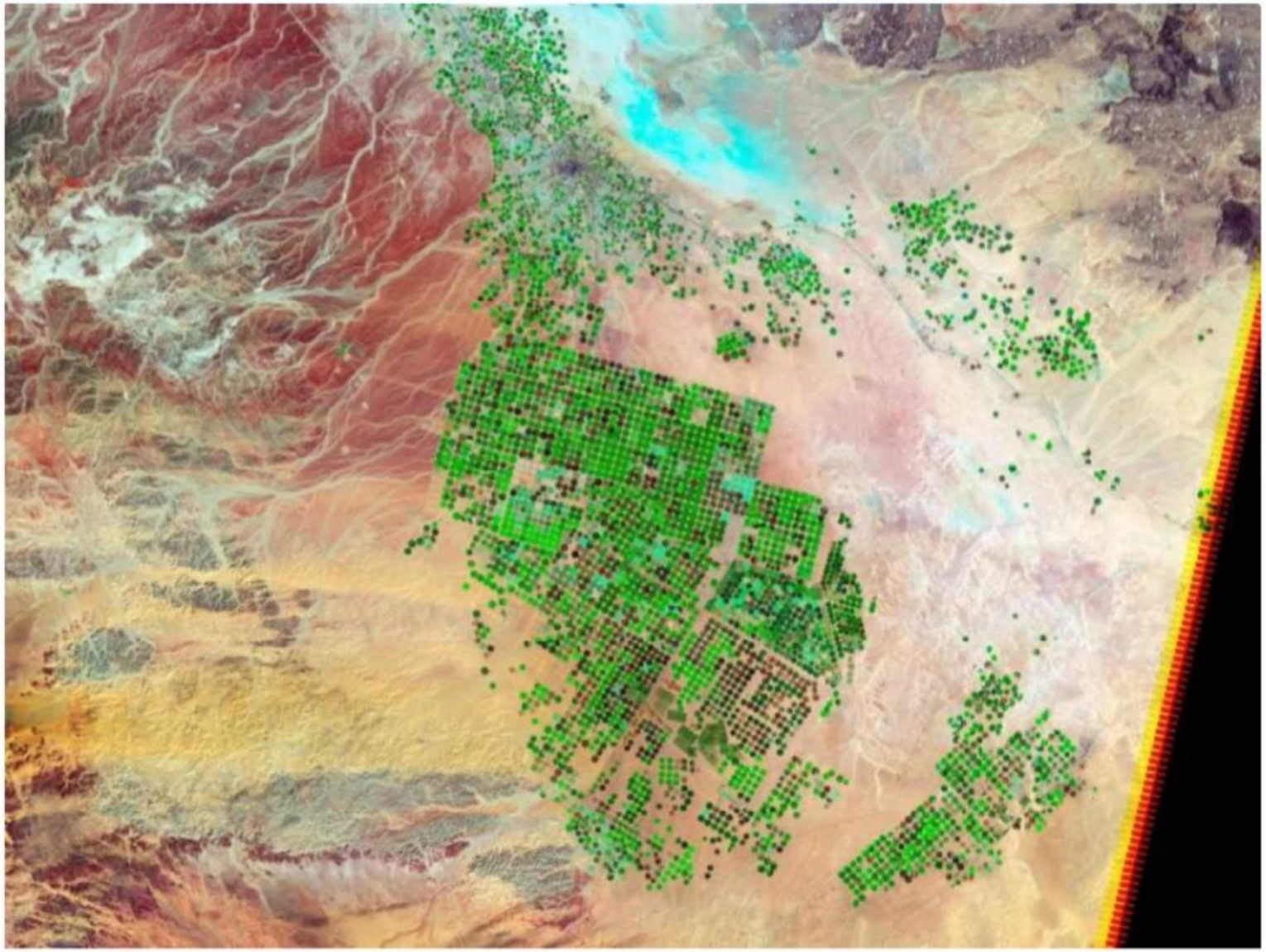
Food Security

- Food security vs. food self-sufficiency.
- Food security vs. internal agricultural production.
- Food security and non-renewable groundwater resources.
  - A recent World Bank study on water economics in the Middle East and North Africa estimates that groundwater resources depletion has substantially reduced GDP in some countries, by 2.1% in Jordan, 1.5% in Yemen, 1.3% in Egypt, and 1.2% in Tunis.
- Food security and virtual water - implications for:
  - Trade
  - Rural development, including women & youth
  - Foreign revenue reserves
  - Sustainability



Water and Food

www.escwa.un.org



1991

2000

2012

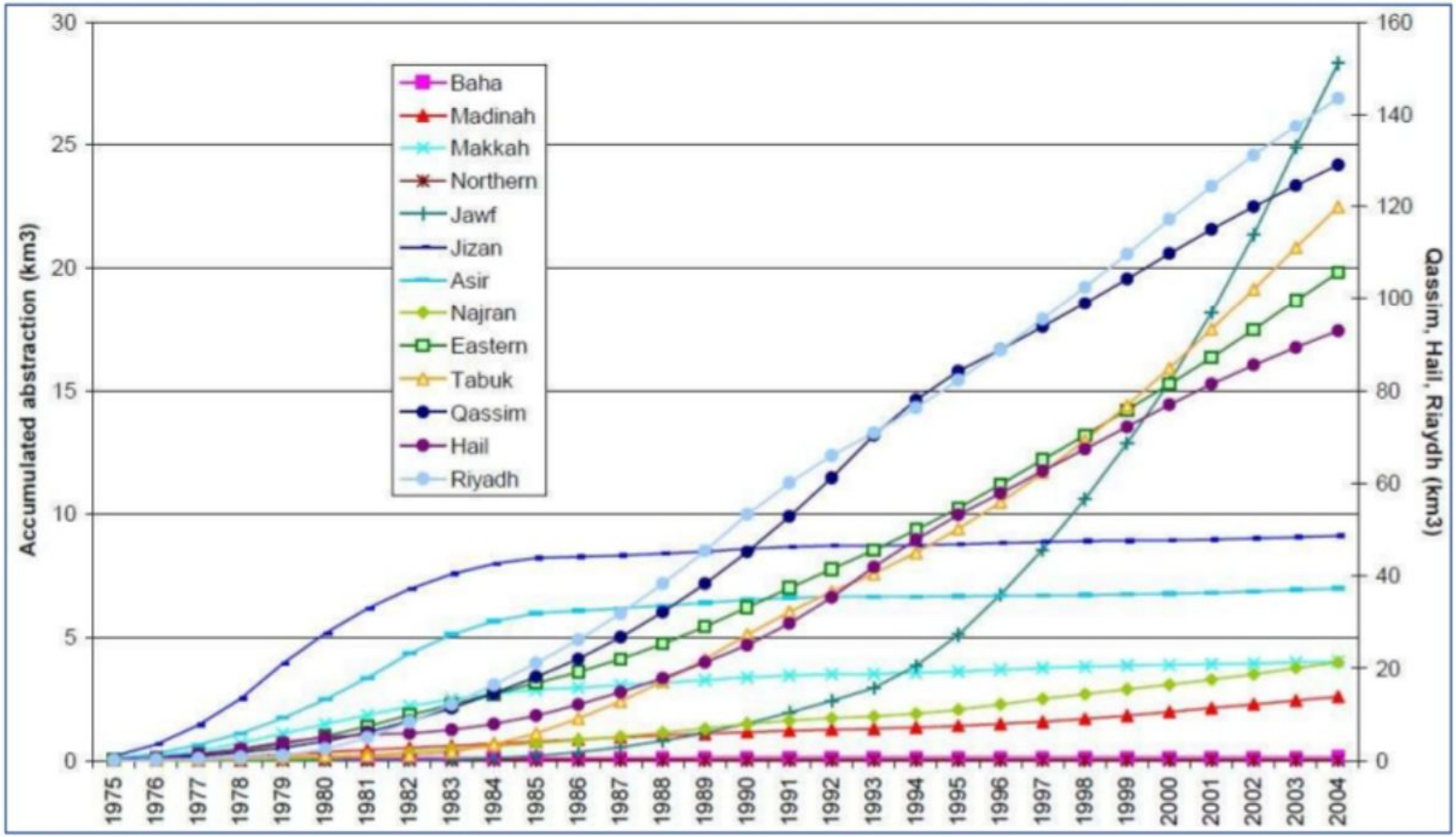
Wadi Al-Sirhan, Saudi Arabia

www.escwa.un.org

FAO AQUASTAT, 2008

Irrigated Agriculture in Saudi Arabia

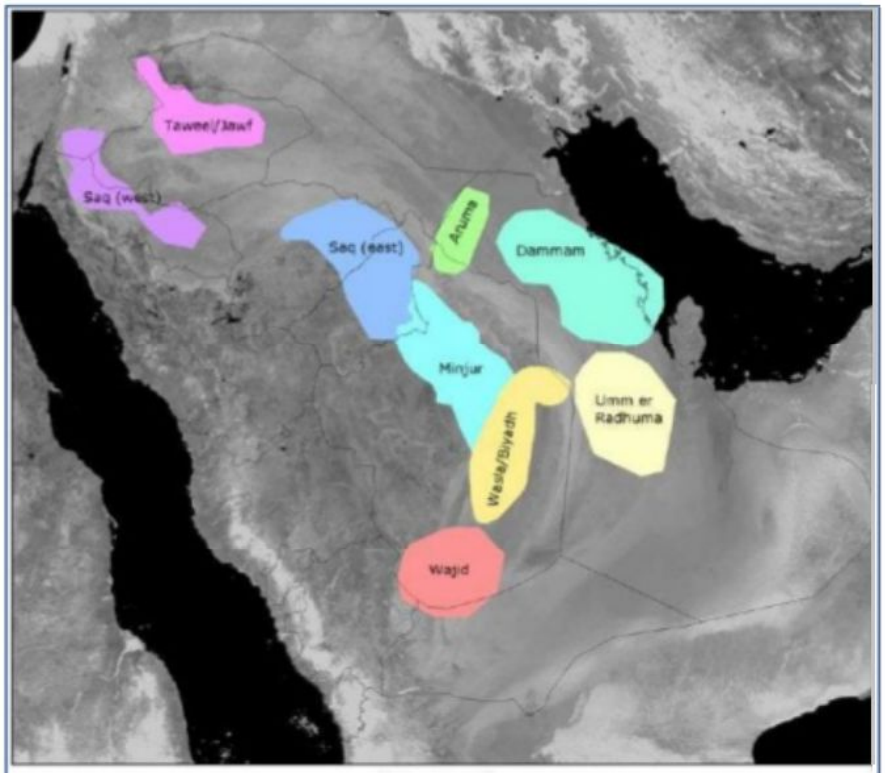
www.escwa.un.org



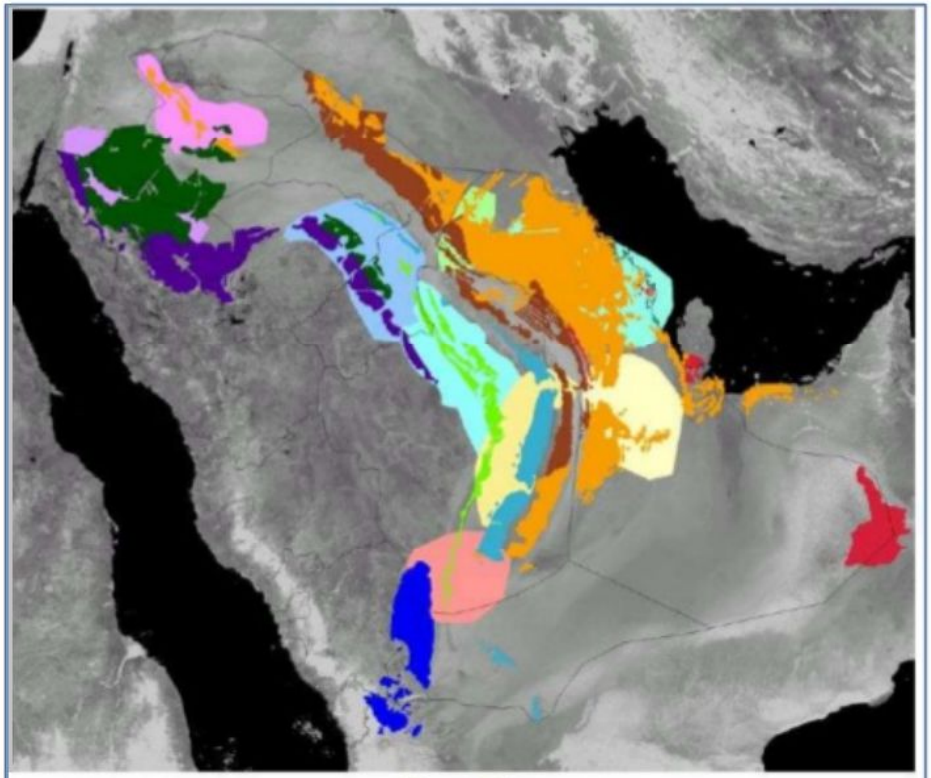
Accumulated 30 year groundwater abstraction, 1975 - 2004 per Region for KSA (WaterWatch, 2006)

Accumulated GroundWater abstraction

www.escwa.un.org



Part A



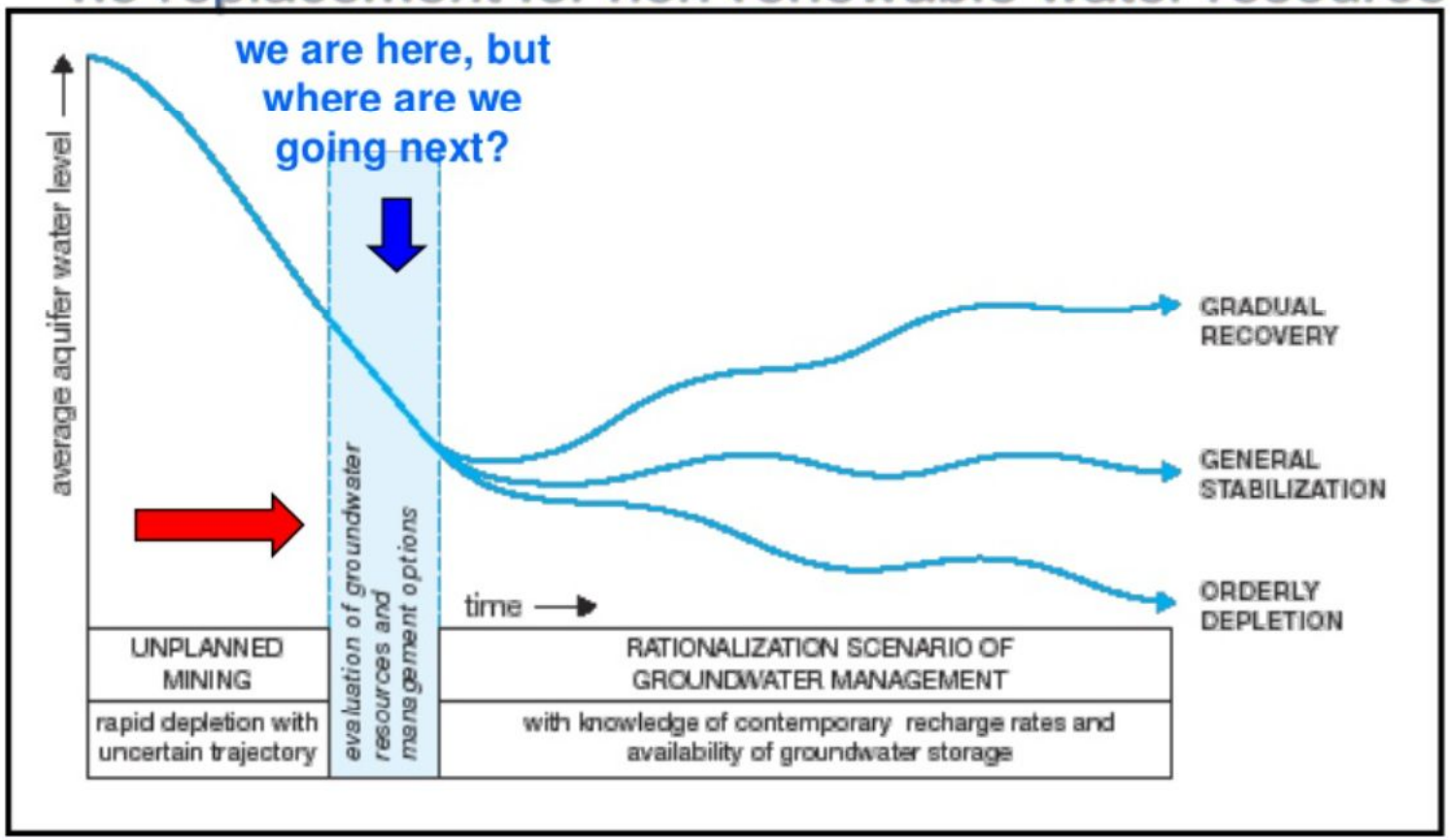
Part B

Location of aquifer utilisation zones (A) and outcrop areas and subsurface extent (B) of principal aquifers (WaterWatch, 2006)

Aquifer location and utilization areas

www.escwa.un.org

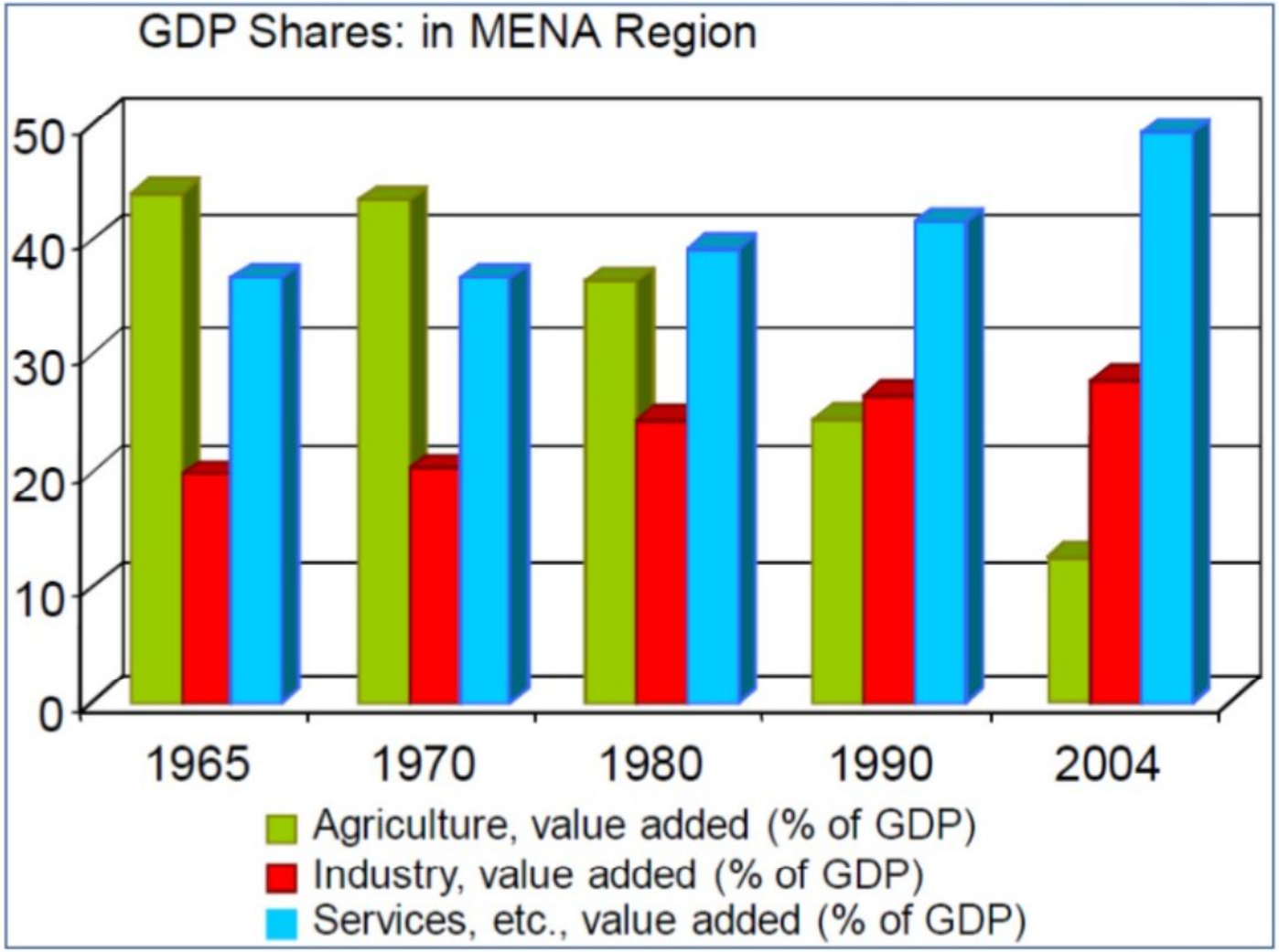
- Immediate gains vs. long term benefits
- No clear "Exit Strategy",
  no replacement for non-renewable water resource



after
Al Zubari, 2010

Sustainability and Non-Renewable Groundwater

www.escwa.un.org



ICBA, Barghouti, 2009

Declining Shares of Agriculture in GDP

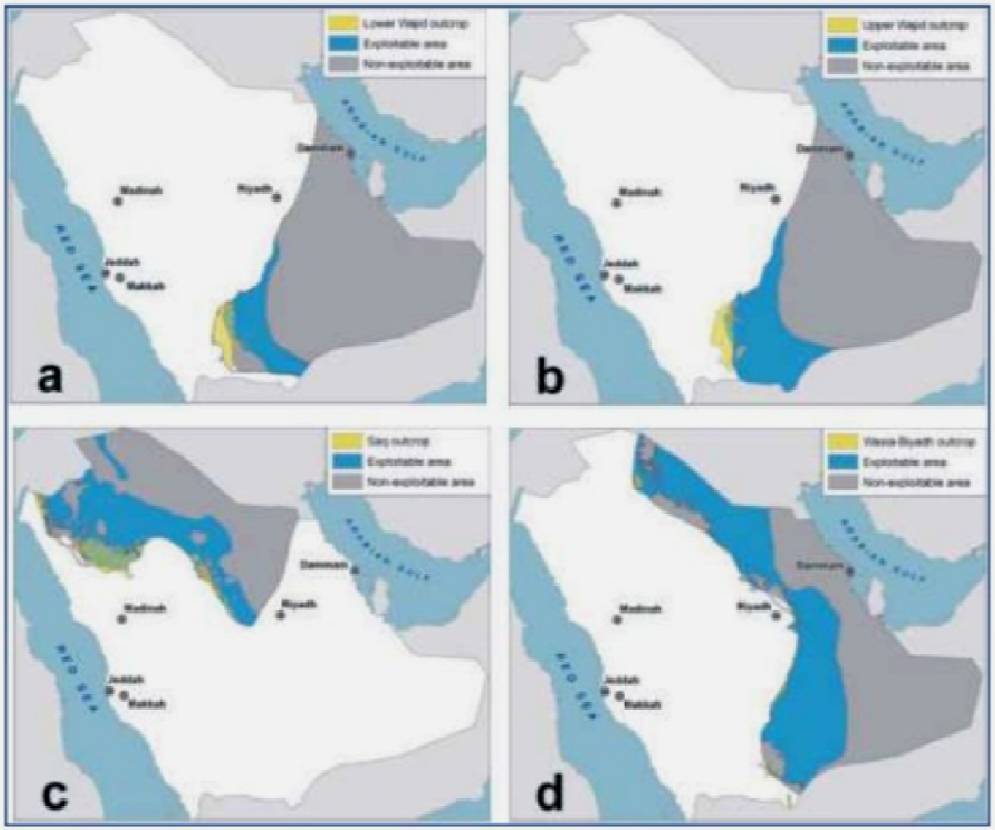
www.escwa.un.org

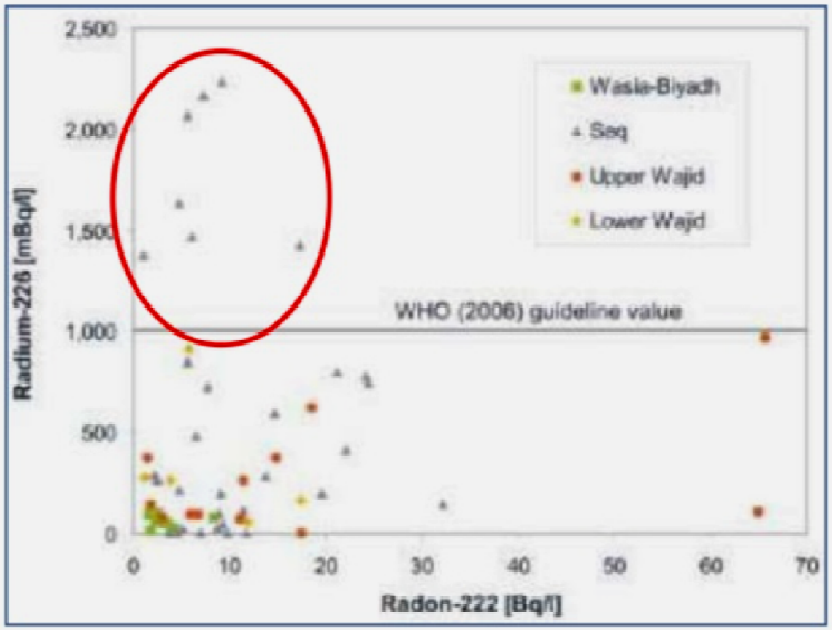
Countries	Barriers to imports	Domestic price support	Subsidized credit	Energy subsidies
Algeria	✓	✓	✓	✓
Bahrain	✗	✗	✓	✓
Djibouti	✓	–	–	–
Egypt	✓	✓	✓	✓
Iran	✓	✓	✓	✓
Iraq	✗	✓	✓	✓
Jordan	✓	✓	✓	✓
Kuwait	✗	✗	✓	✓
Lebanon	✓	✓	✗	✓
Libya	✓	✓	✓	✓
Morocco	✓	✓	✗	✗
Oman	✗	✓	✓	✓
Qatar	✗	✗	✓	✓
Saudi Arabia	✓	✓	✓	✓
Syria	✓	✓	✓	✓
Tunisia	✓	✓	✓	✗
United Arab Emirates	✗	✓	✓	✗
West Bank and Gaza	✓	✗	✗	✗
Yemen	✓	✓	✓	✓

WB, 2007

Perverse Incentives for Excess Irrigation

www.escwa.un.org

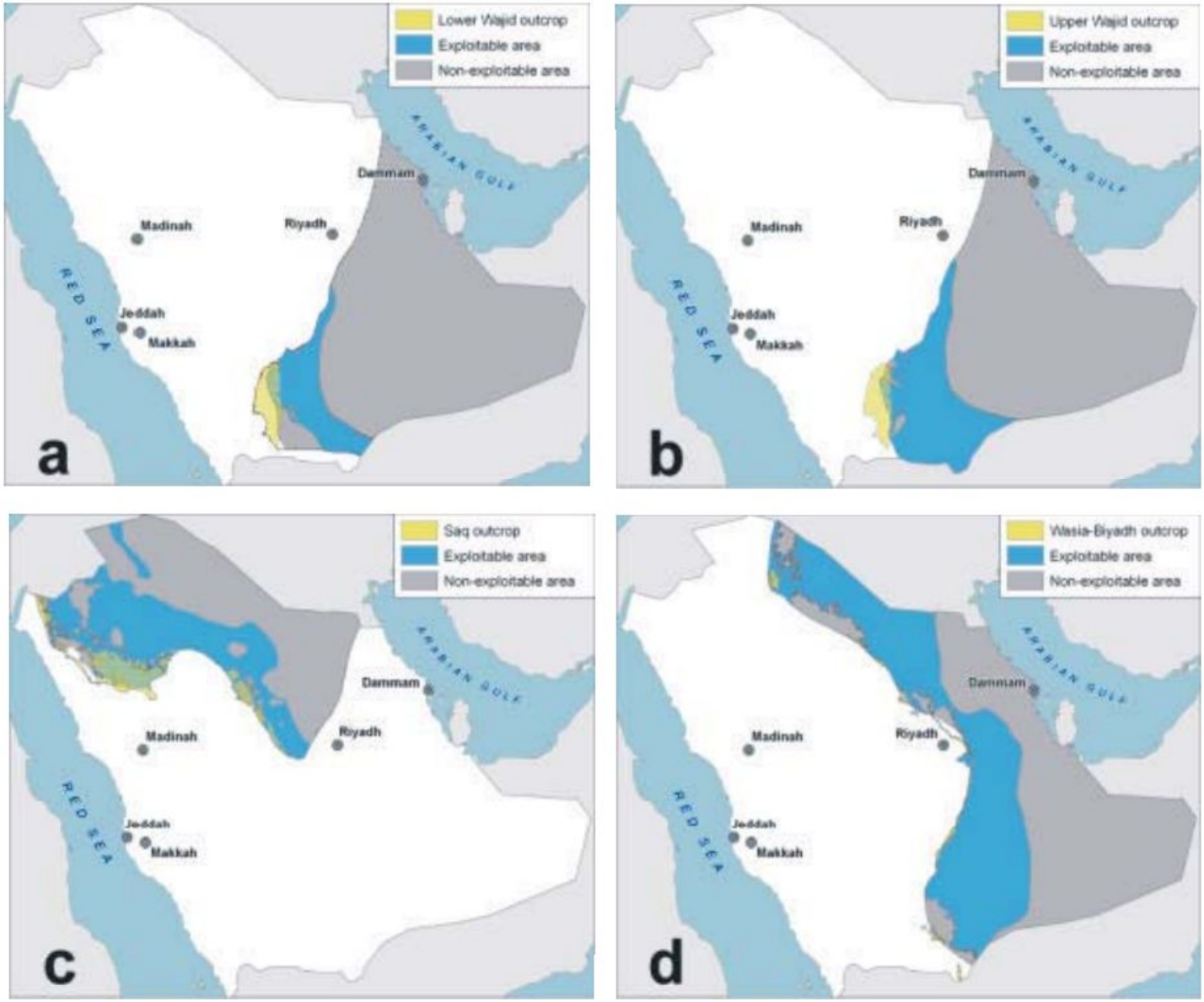




Spiegel Online, 05 Nov 2012:
www.spiegel.de/wissenschaft/natur/radioaktive-strahlung-im-grundwasserin-nahost-und-nordafrika-a-854588.html
Schubert et al., 2011: www.psipw.org/attachments/article/300/IJWRAE_1(1)25-32.pdf

Radioactivity-related Cancer Risk from Groundwater in the Middle East 2011

www.escwa.un.org



Maps showing the outcrop and exploitable as well as non-exploitable areas of the major Saudi Arabian sandstone

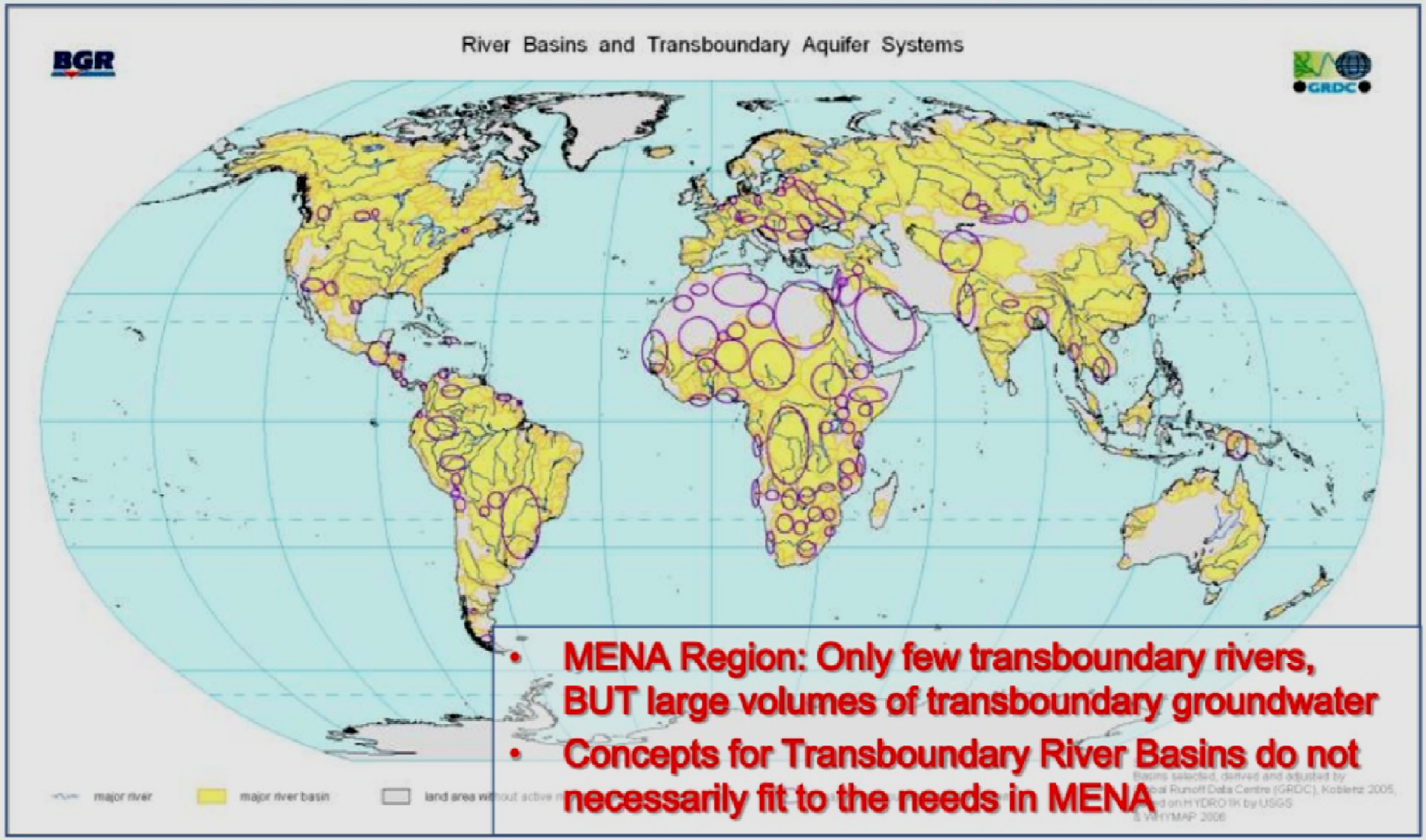
www.escwa.un.org

Scarcity	Solution	Potential outcome
Scarcity of accountability for achieving sustainable outcomes	• Efficient allocation • Transparent, inclusive decision-making • Access to justice	• Water allocated to highest-value use • Allocation system responsive to variations of supply and demand • Environmental issues properly considered • Equitable allocation and service provision
Scarcity of organizational capacity	• Integrated planning • Effective regulation of service providers • Demand management	• Sustainable public investment • Reliable services
Scarcity of physical resource	• Engineering, infrastructure • Water technology	• Efficient storage and distribution • Supply augmentation

WB, 2007

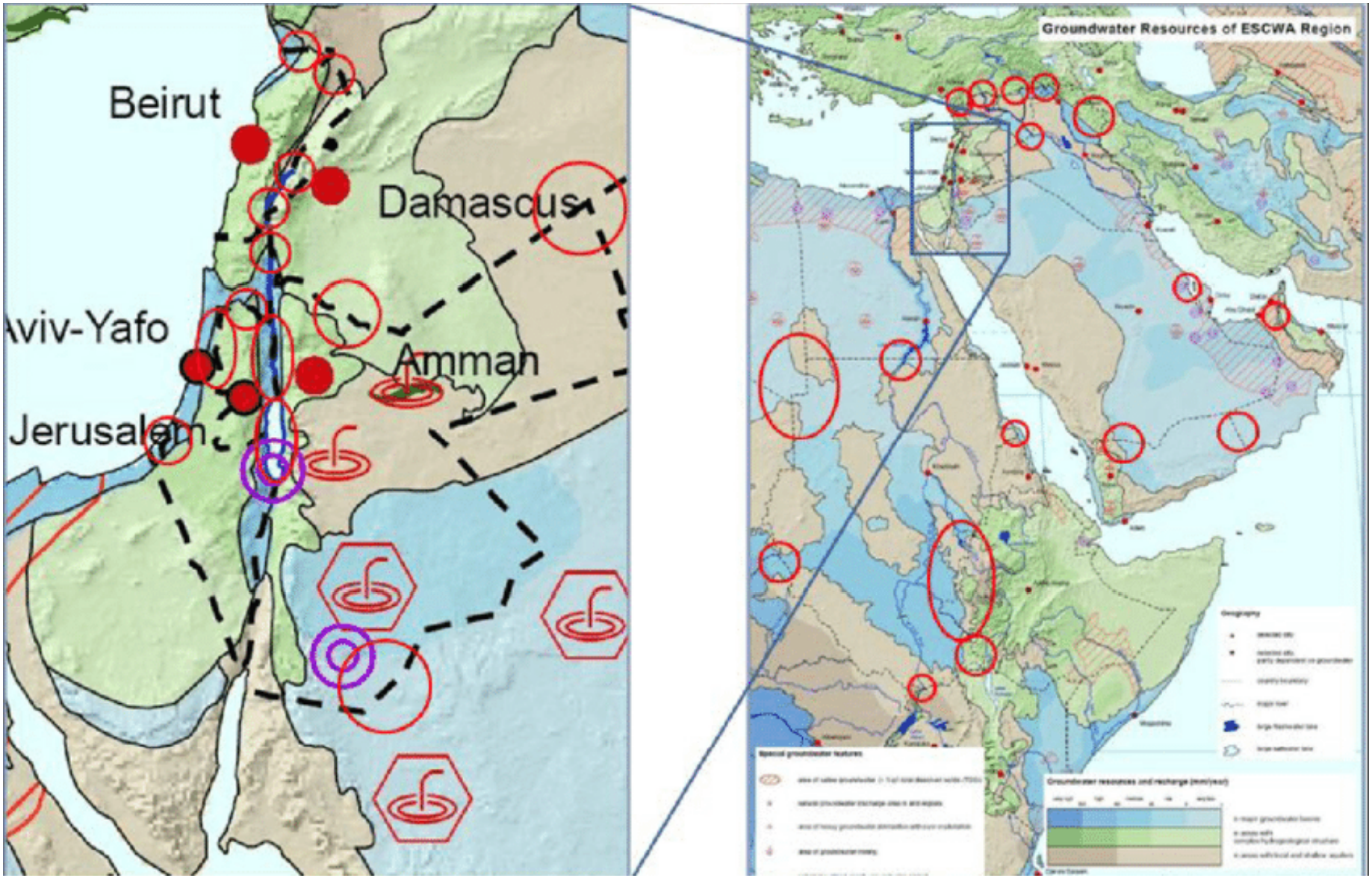
Three Levels of Scarcity

www.escwa.un.org



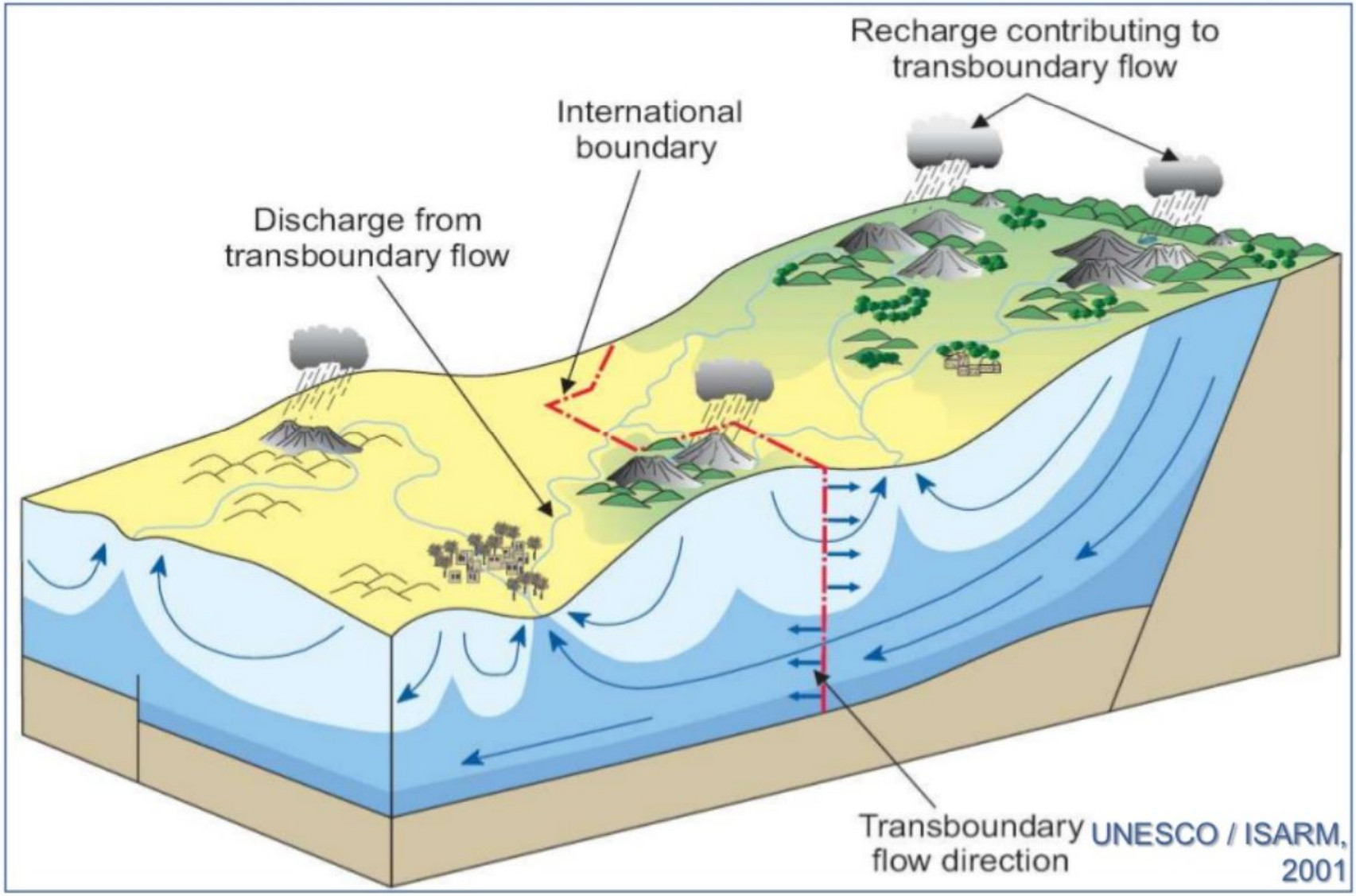
Trans-border Aquifers worldwide

www.escwa.un.org



Proven and potential trans-boundary shared aquifers between ESCWA member countries

www.escwa.un.org



Trans-boundary shared aquifers

www.escwa.un.org

- 9 chapters on shared surface water basins and 18 chapters on shared aquifer systems follow a standardized structure and methodology.
- More than 400 pages of detailed information with over 50 new maps and around 200 figures, tables and boxes.

Saq-Ram Aquifer System (West)

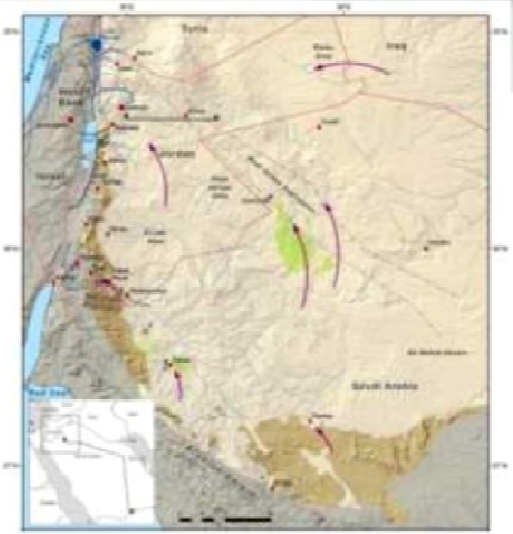
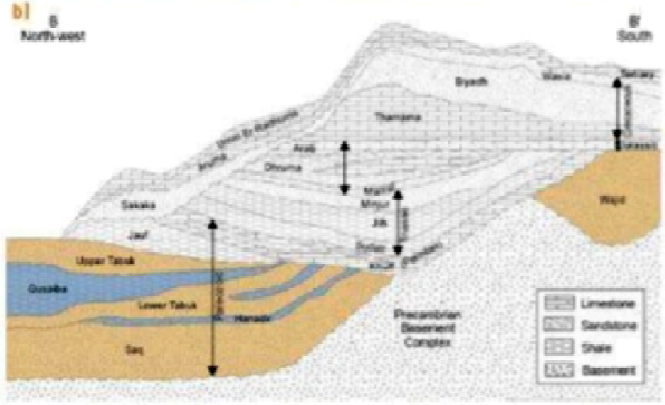


Figure 1. a) Geological cross-section of subsurface stratigraphy of the Ram Aquifer System and overlying formations, b) position of the Saq Aquifer System in relation to major aquifer systems in Saudi Arabia



Source: Modified by ESCWA-BGR based on (a) Margane et al., 2002; (b) Alsharhan et al., 2001.

Trans-border Aquifers Mid East

www.escwa.un.org

1. Equitable and Reasonable Utilisation
2. Obligation not to Cause Significant Harm
3. General Obligation to Cooperate
   - Regular Exchange of Data and Information
   - Bilateral and Regional Agreements & Arrangements
4. Environmental Protection
   - Protection and Preservation of Ecosystems
   - Prevention, Reduction and Control of Pollution
5. Monitoring and Management

Limited Sovereignty of Riparian / Aquifer States

Trans-border Water Cooperation Principles

www.escwa.un.org

Jordan River Basin www.escwa.un.org

- 4 of 5 riparians officially support the 1997 UN Watercourse Convention

LEBANON 1997 UN Watercourse Convention

SYRIA 1997 UN Watercourse Convention

ISRAEL NO agreement

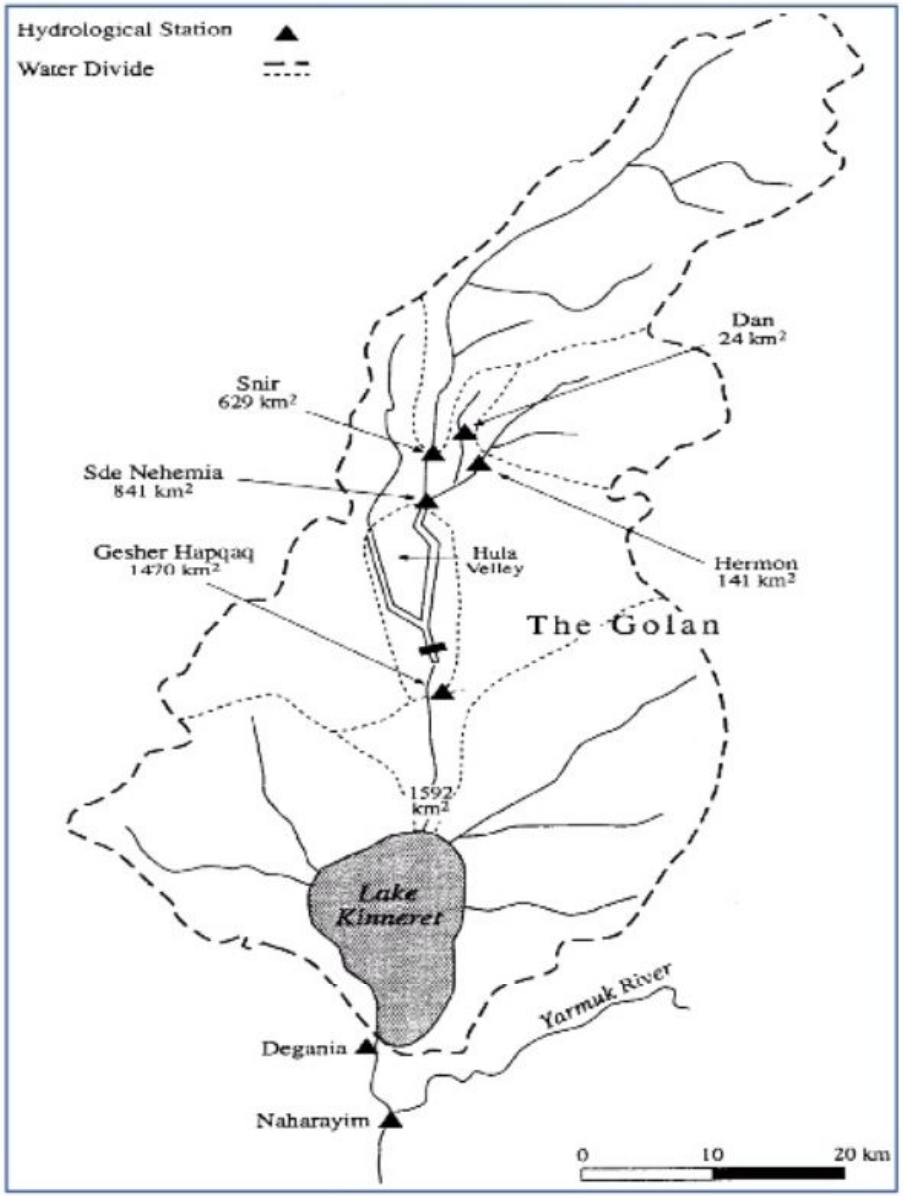
Jordan River Basin 1997 UN Watercourse Convention

PALESTINE 1997 UN Watercourse Convention

Jordan River Basin www.escwa.un.org

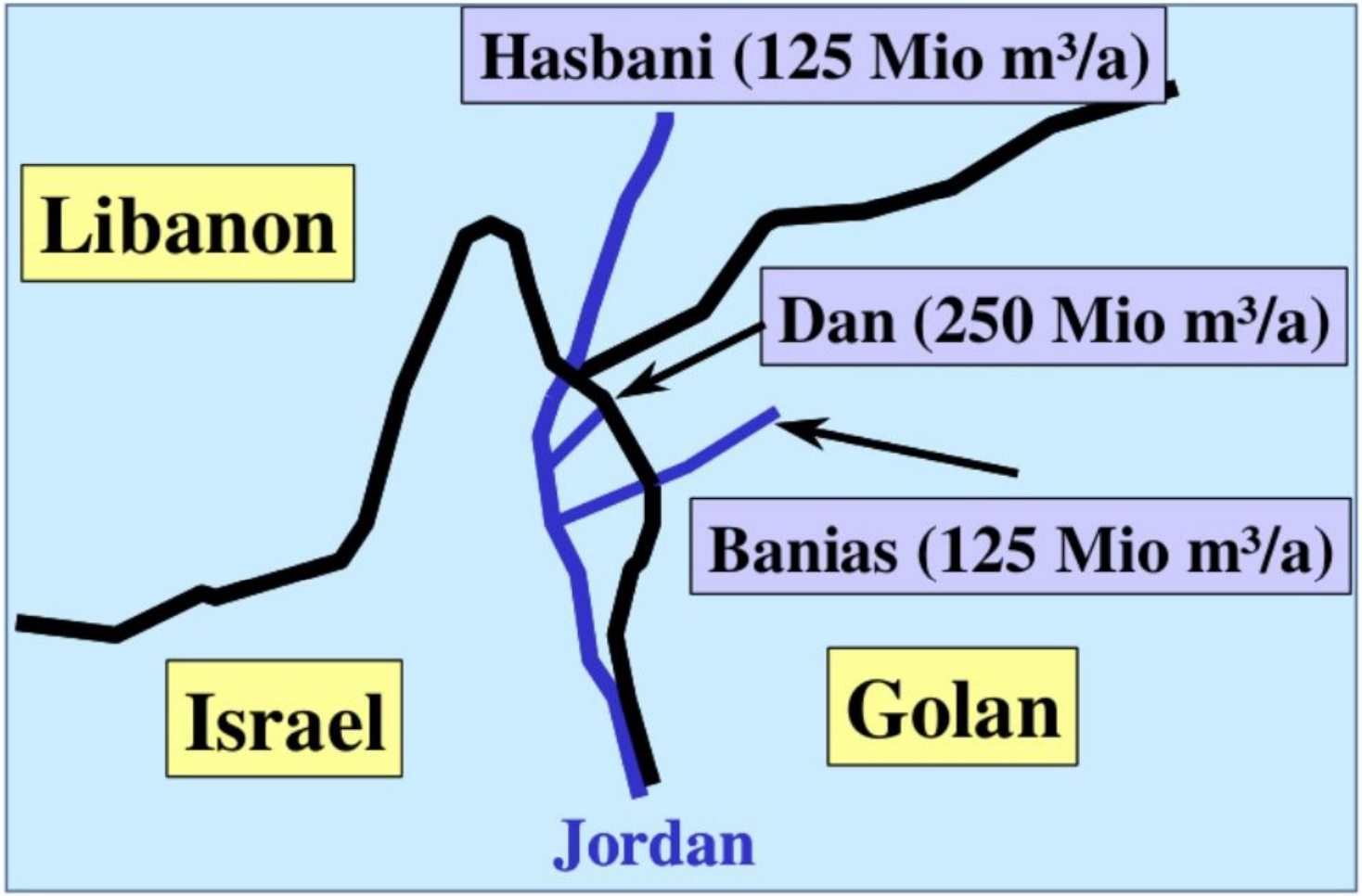
Welcome to Jordan www.escwa.un.org

Jordan by Clement Tonmolini www.escwa.un.org



Klein, 1998

Upper Jordan Basin Springs www.escwa.un.org

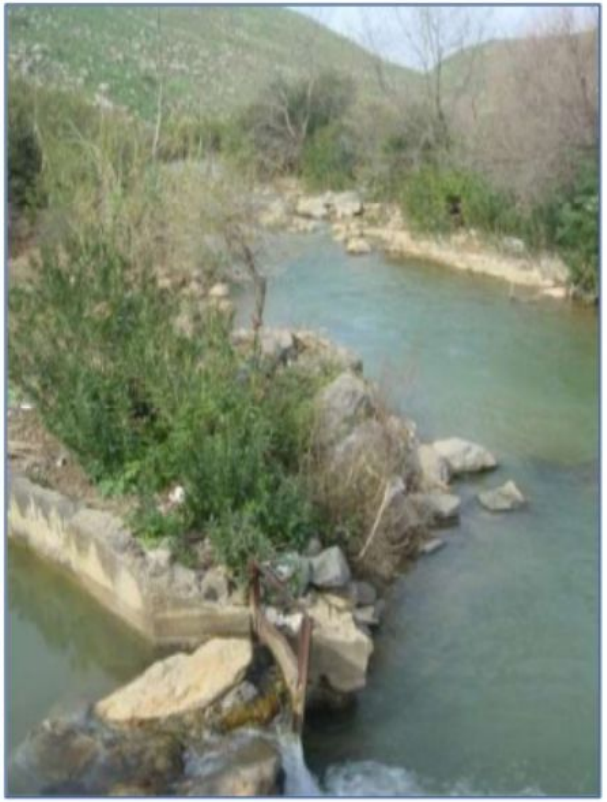


Upper Jordan River Basin Springs www.escwa.un.org

Hasbani Springs

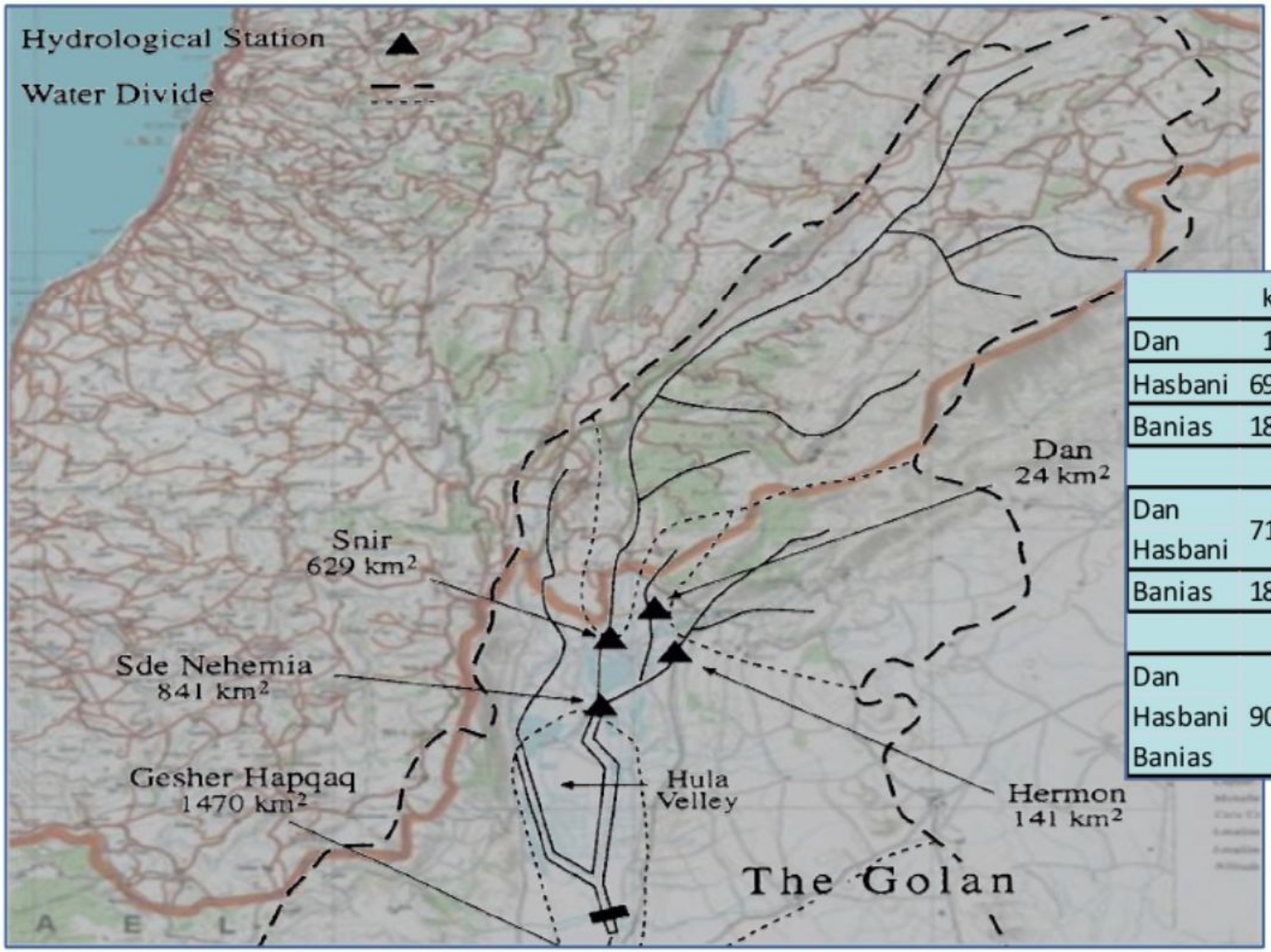
Hasbani River www.escwa.un.org

- Ouazzani Spring, Hasbani River



Ouazzani Springs Hasbani River

www.escwa.un.org

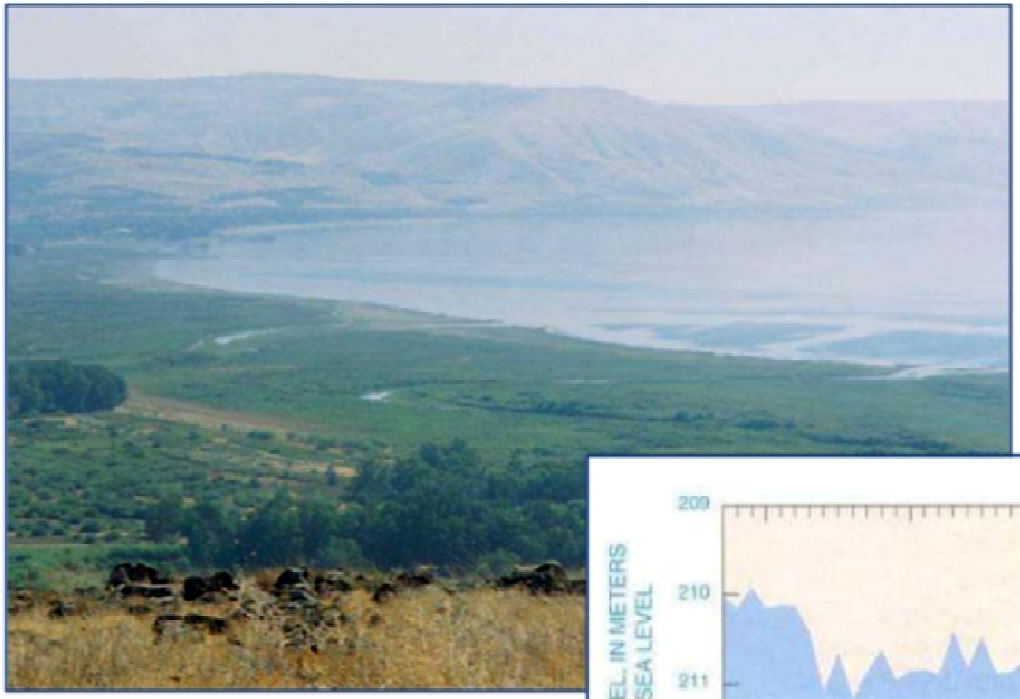


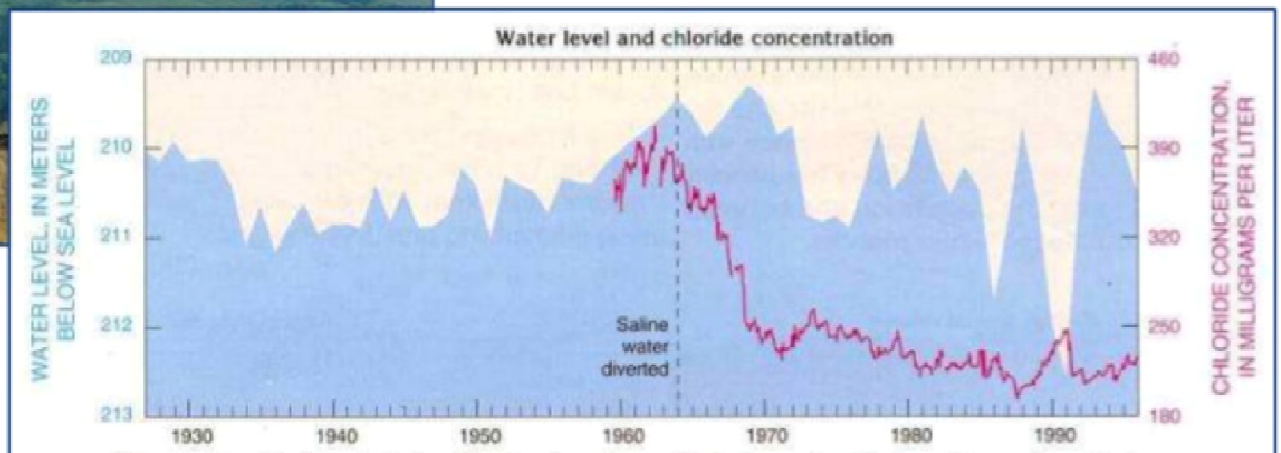
	km²	MCM/y	mm/y
Dan	17.60	228	12,954.55
Hasbani	698.00	122	174.79
Banias	189.00	113	597.88
Dan Hasbani	715.60	350	489.10
Banias	189.00	113	597.88
Dan Hasbani Banias	904.60	463	511.83

Klein,1998

Upper Jordan River Basin Springs

www.escwa.un.org





Historically, chlorides in Lake Tiberias have been high due primarily to saline springs that discharge to the lake. Saline springs were diverted from the lake into the lower Jordan River beginning in 1964, resulting in much lower chloride concentrations in the lake. The chloride concentration in the lake also is dependent on the volume of freshwater inflow, as seen from 1988–91, when water level and inflow declined and salinity increased; and in 1992 when very high inflows led to declines in salinity.

Lake Tiberias

www.escwa.un.org

Zeitoun. 2010

Lake Tiberias - Discharge to Lower Jordan river

www.escwa.un.org

… in 2008:
1.20 m wide

Mouth of Jordan river - at Dead Sea

www.escwa.un.org

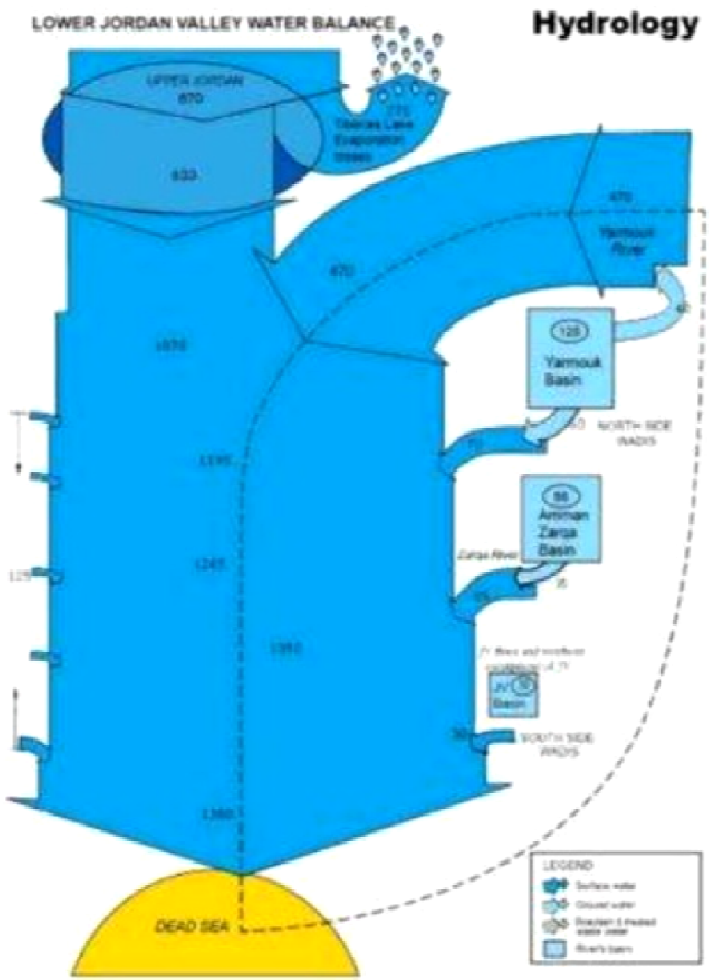


Figure 8: Water balance scheme of the JRBJ (~1900)

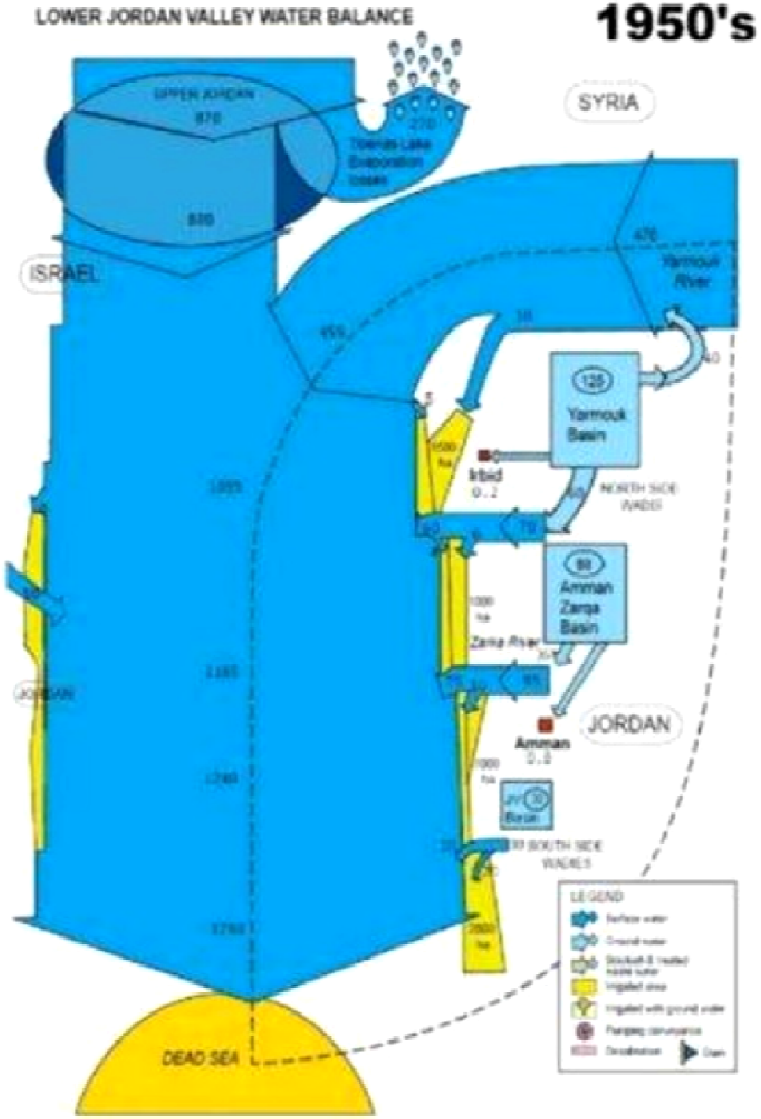


Figure 9: Water balance scheme of the JRBJ (1950)

Moelle. 2000 ?

Hydrology of Jordan river '50s www.escwa.un.org

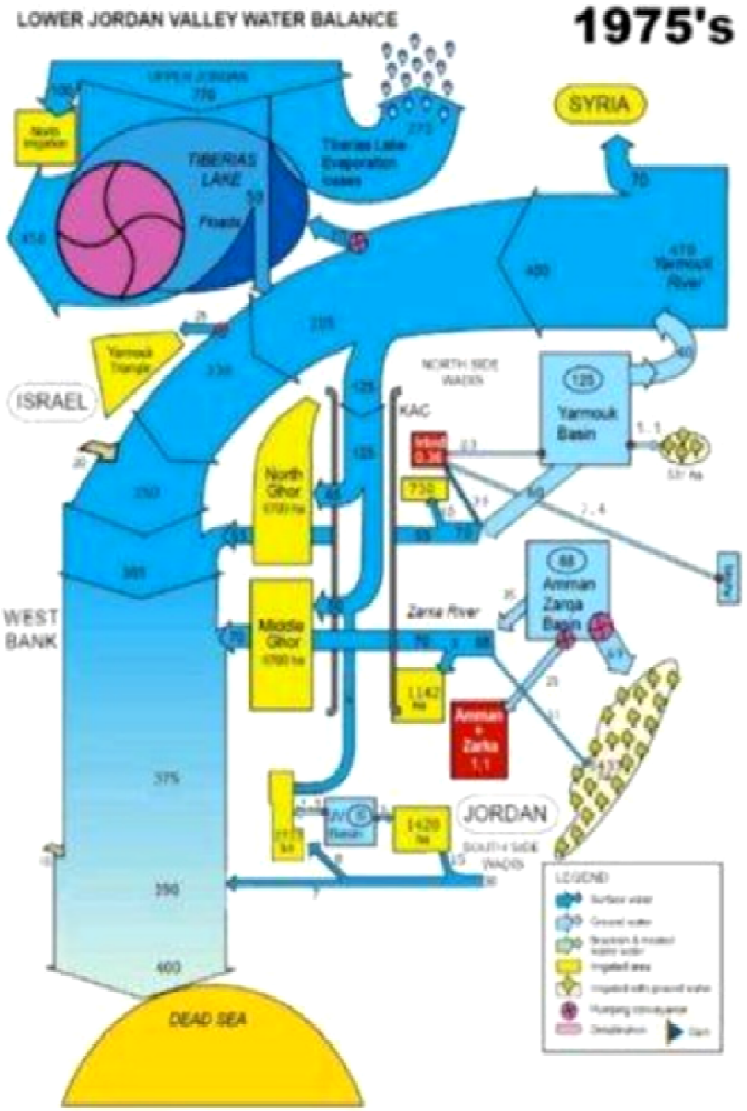


Figure 11: Water balance scheme of the JRBJ (1975)

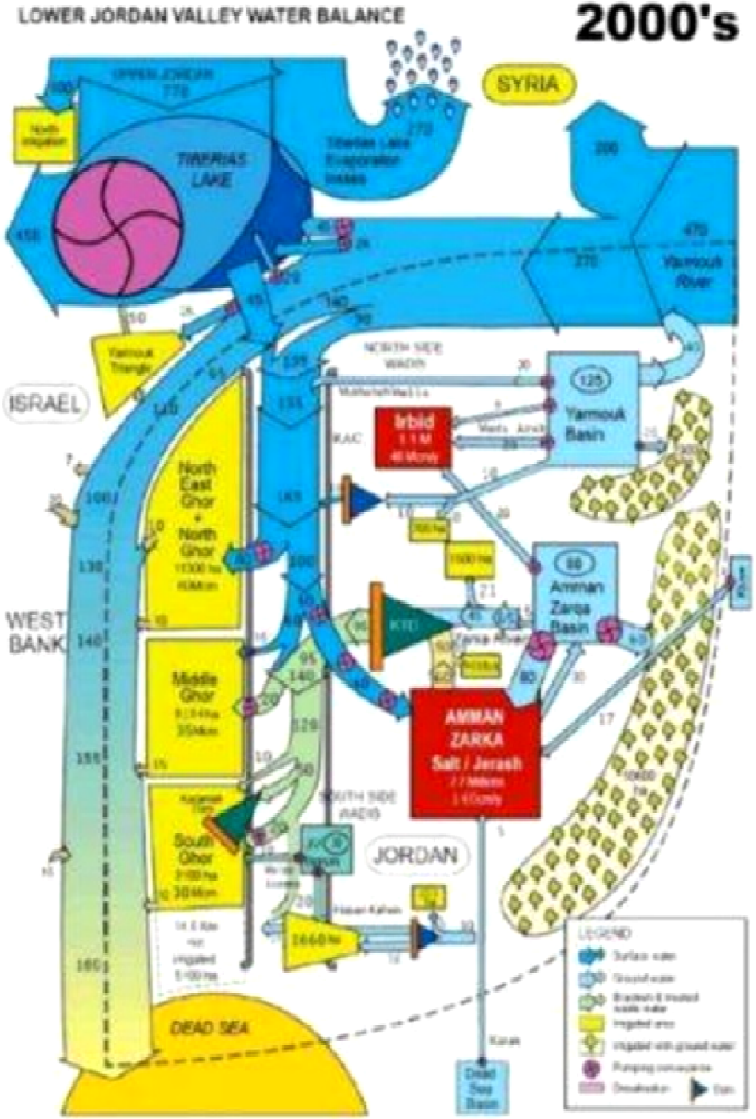
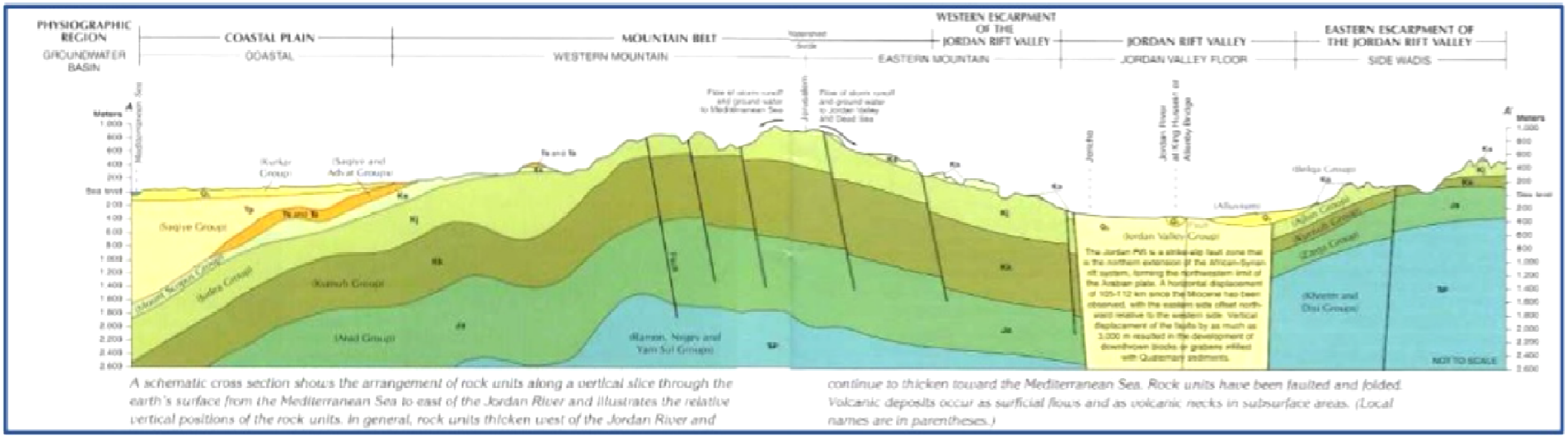


Figure 15: Water balance scheme of the JRBJ (2000)

Moelle. 2000 ?

Hydrology of Jordan River 75's - 00's www.escwa.un.org

- Geological Cross Section from West to East



A schematic cross section shows the arrangement of rock units along a vertical slice through the earth's surface from the Mediterranean Sea to east of the Jordan River and illustrates the relative vertical positions of the rock units. In general, rock units thicken west of the Jordan River and continue to thicken toward the Mediterranean Sea. Rock units have been faulted and folded. Volcanic deposits occur as surficial flows and as volcanic necks in subsurface areas. (Local names are in parentheses.)

Israel - Palestine Mountain Aquifers

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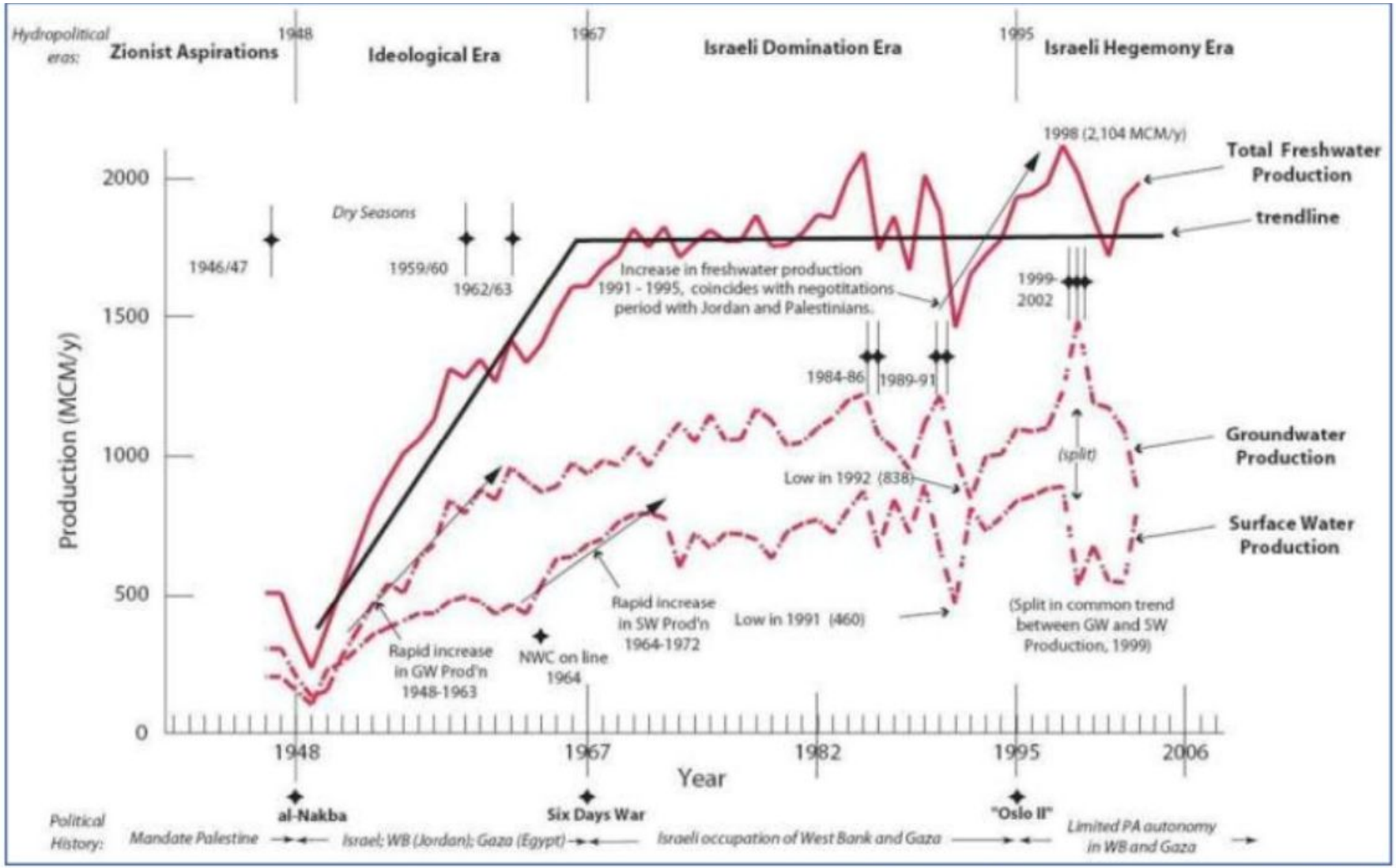

Zeitoun, Messerschmid, Attili, 2009

Historical Surface & Groundwater Use Israel - Palestine

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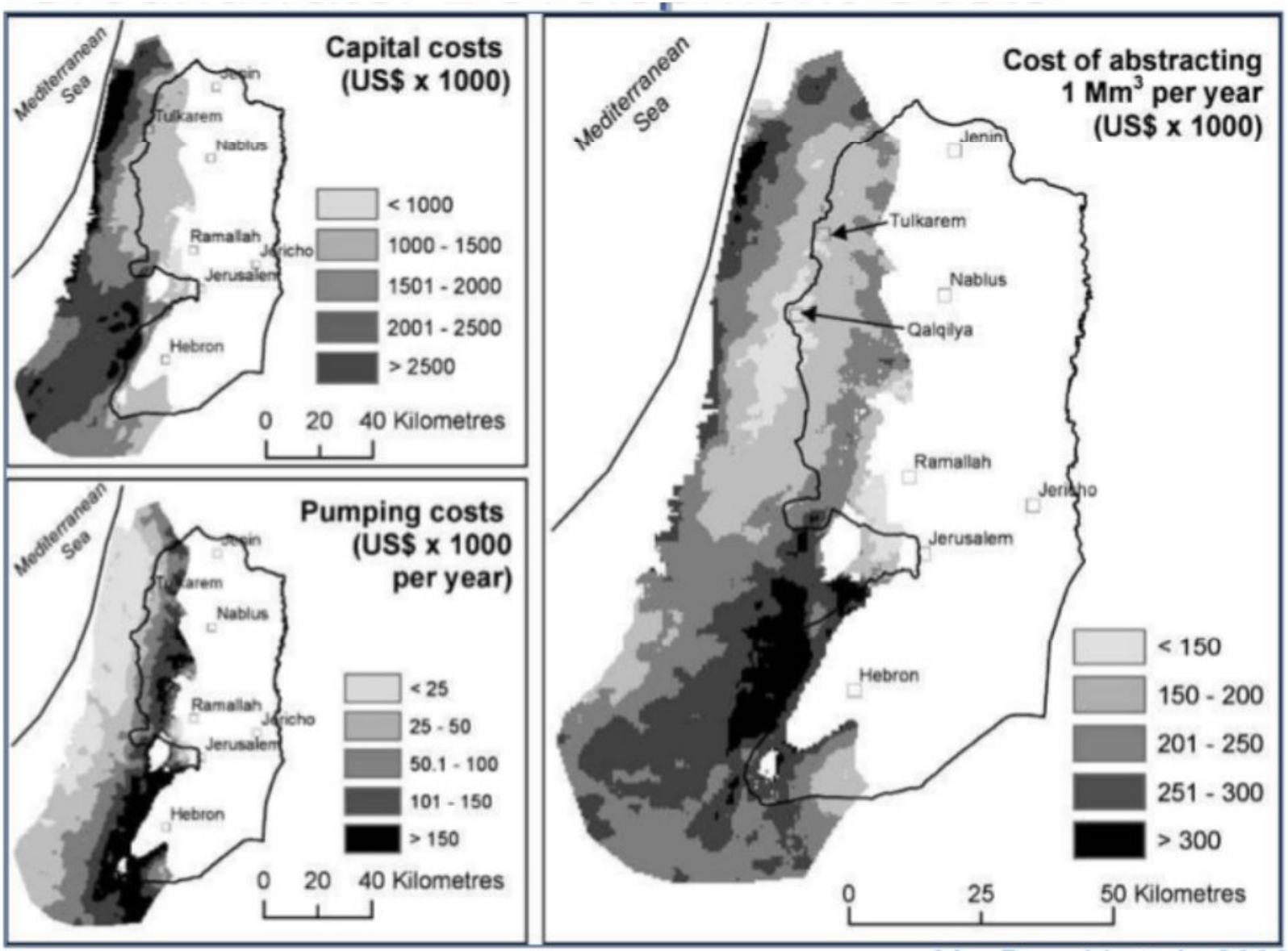

MacDonald et al., 2009

Groundwater Development Costs Israel - Palestine

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- Coupled with **excessive population growth** and **rising living standards**,
  climate change will **exacerbate water scarcity conditions** across the Arab world.

- Persistent **reduction of total annual precipitation** coupled with **rising temperatures** will **reduce water availability**.

- **Higher temperatures** will influence **water quality** and may cause additional **sanitation problems**

Potential Impacts of Climate Change

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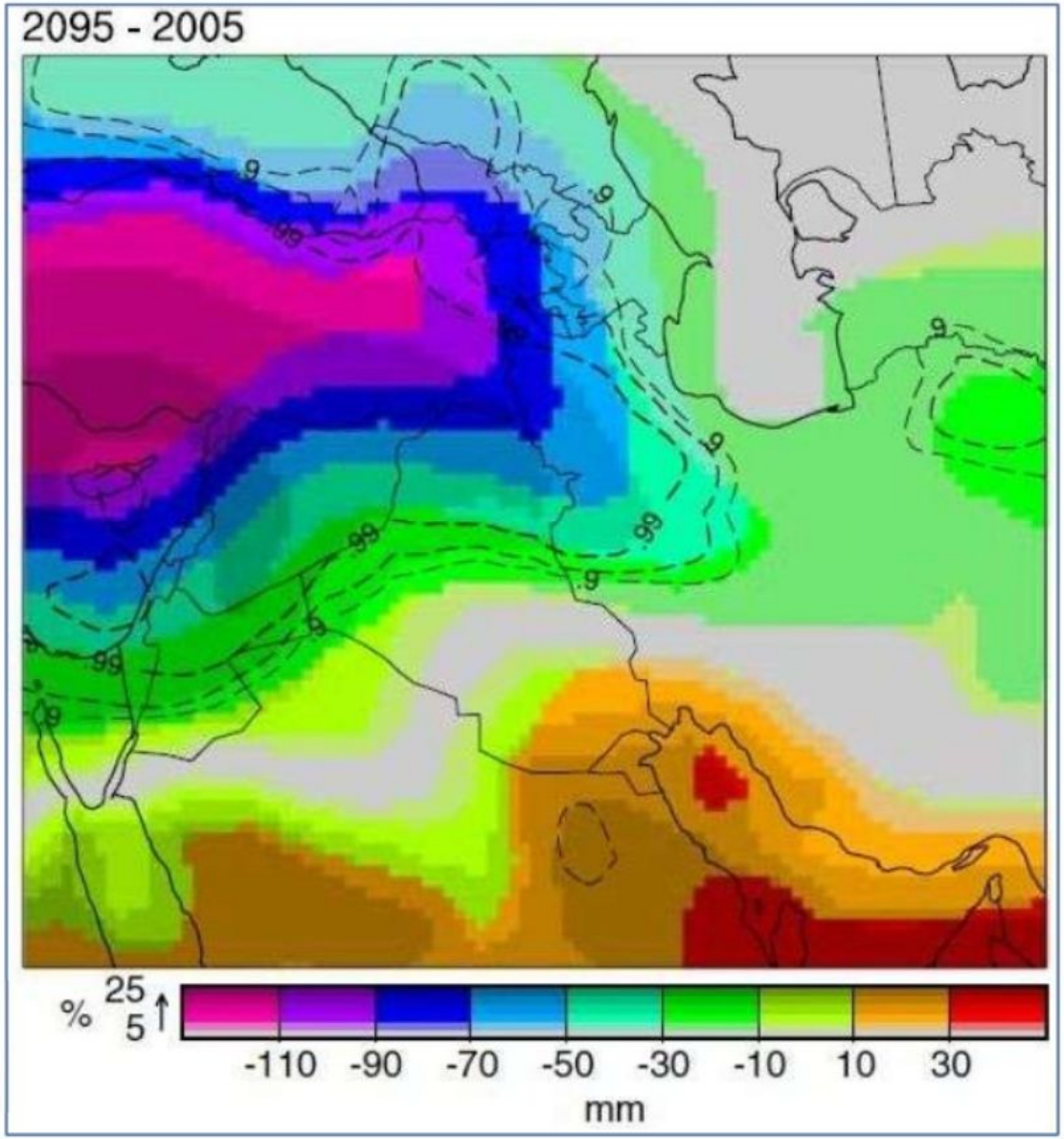
- Changes in water availability
  - Increase system resilience through surface / underground storage and transfer capacity
  - Shift form surface to underground storage where applicable to reduce evaporation losses
- Urban drainage networks - new dimensions
  - Sewage systems, storm runoff
- Desalination - higher temperature in feed water may increase algae growth and risk of closure of plant intake
  - Improve intake procedures
  - Increase storage and transfer capacity
- Infrastructure failures
  - Higher flooding intensities, frequencies
  - Higher temperatures,
- Changes in hydraulic patterns and temperatures
  - Loss of snowpack storage in Lebanon, Oman, etc.
- Groundwater recharge changes, impacts on spring and river discharges
  - Increase managed aquifer recharge schemes
  - Better monitoring and scientific understanding of recharge mechanism for predictive planning of alternatives, before springs cease
- Seawater level rise
  - Increasing groundwater salinisation

Potential Impacts of Climate Change part 2



Hue shows change in mm/y. Saturation / intensity shows the change as percentage of 2005 PPTN.

Evans, J.P., 2009. 21st Century Climate Change in the Middle East.

Precipitation Change

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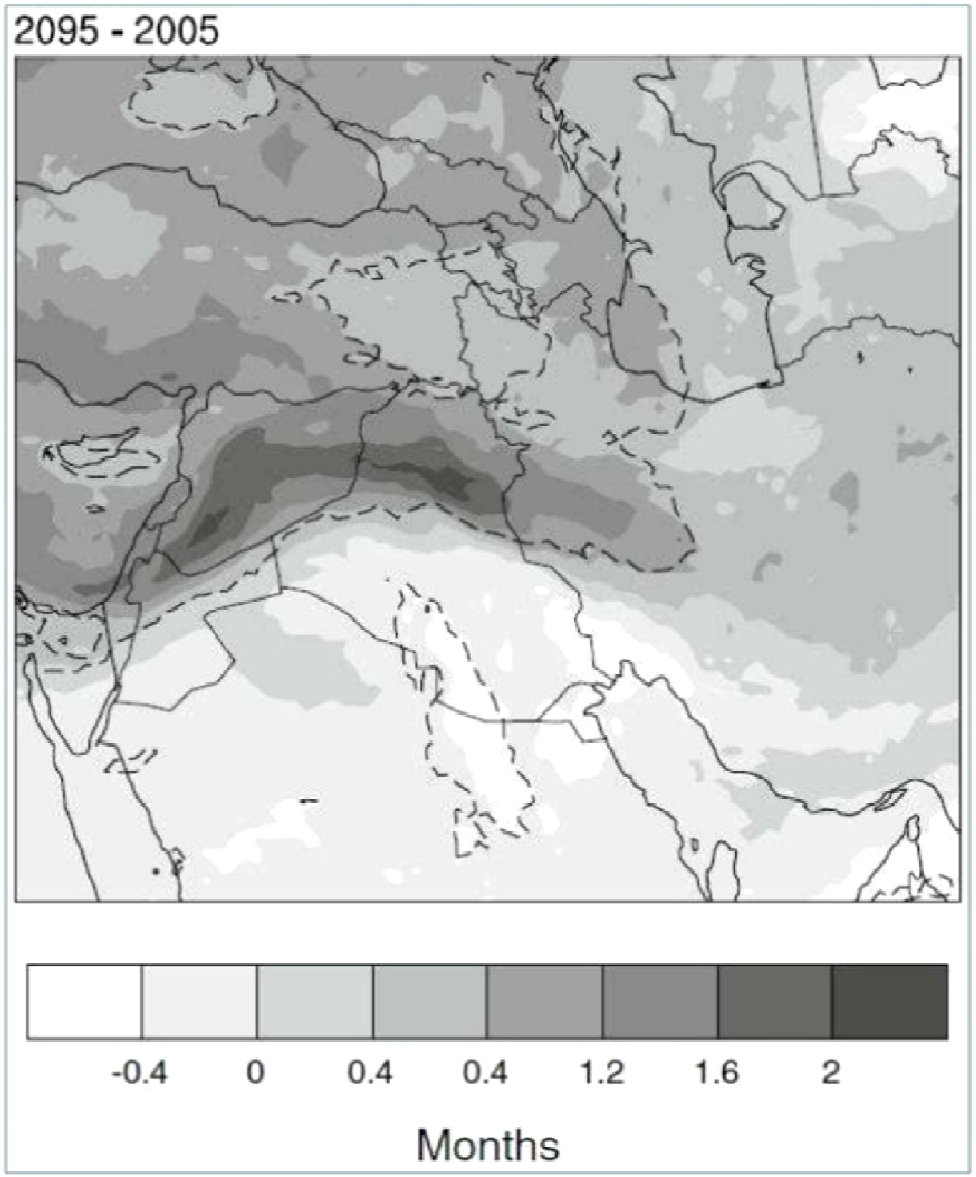

Evans, J.P., 2009.
21st Century
Climate Change in the
Middle East.

Length of Dry Season Change

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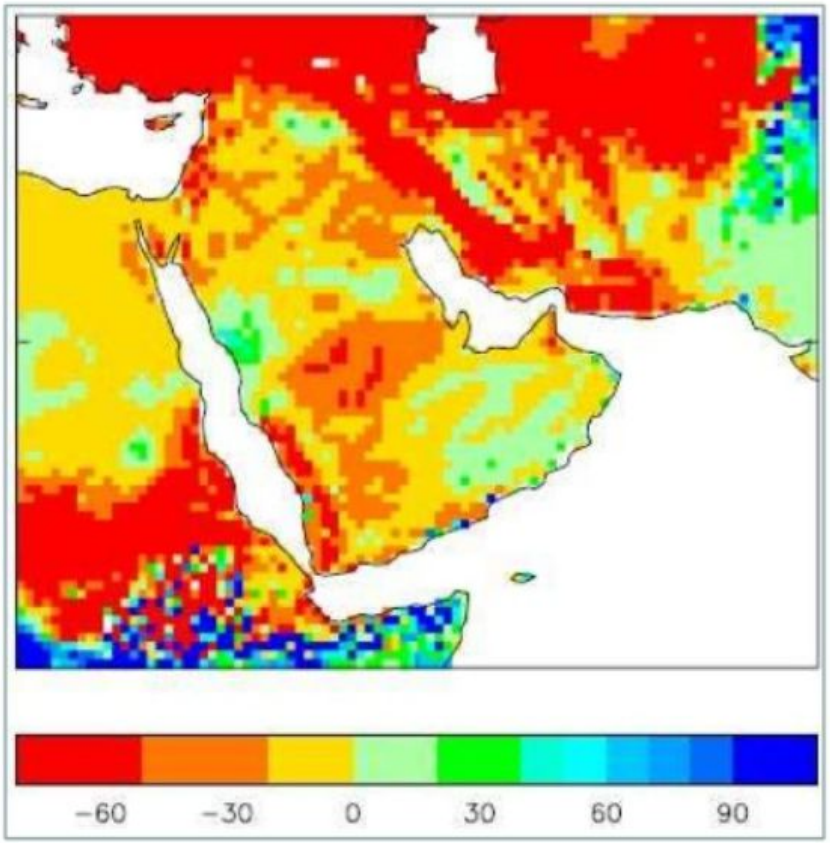
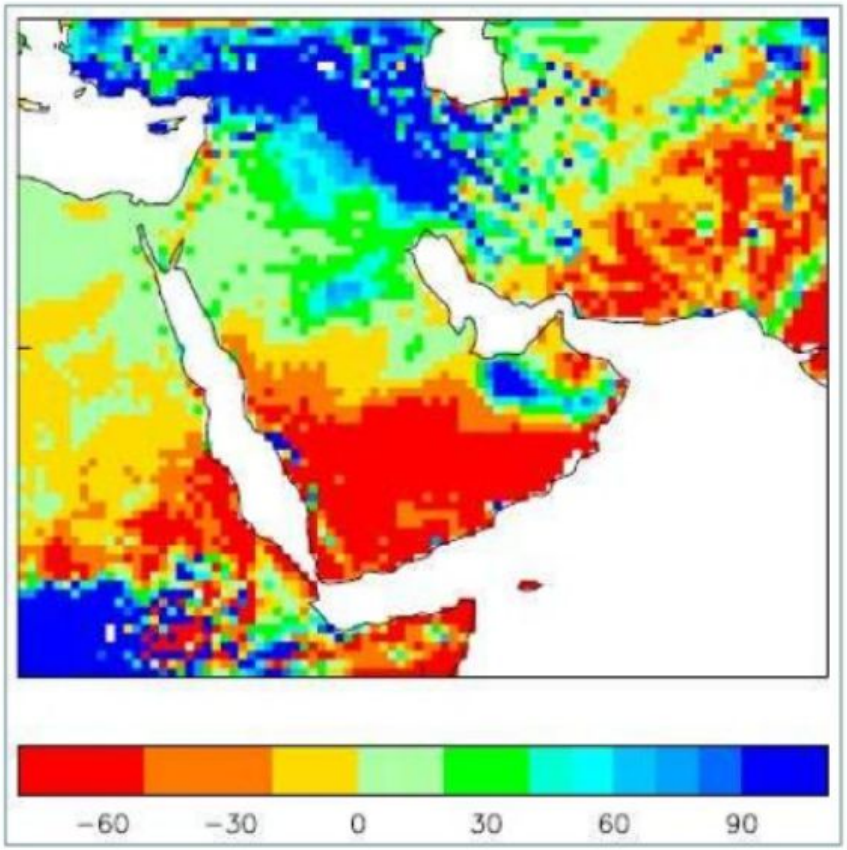
Mar to May 2070



Sep to Nov 2070



Hemming, D. et al., 2007. Environmental Stresses from Detailed Climate Model Simulations for the Middle East and Gulf Regions. Defense and Security Implications of Climate Change – Gulf Region

RCM Seasonal Precipitation Arabian Region

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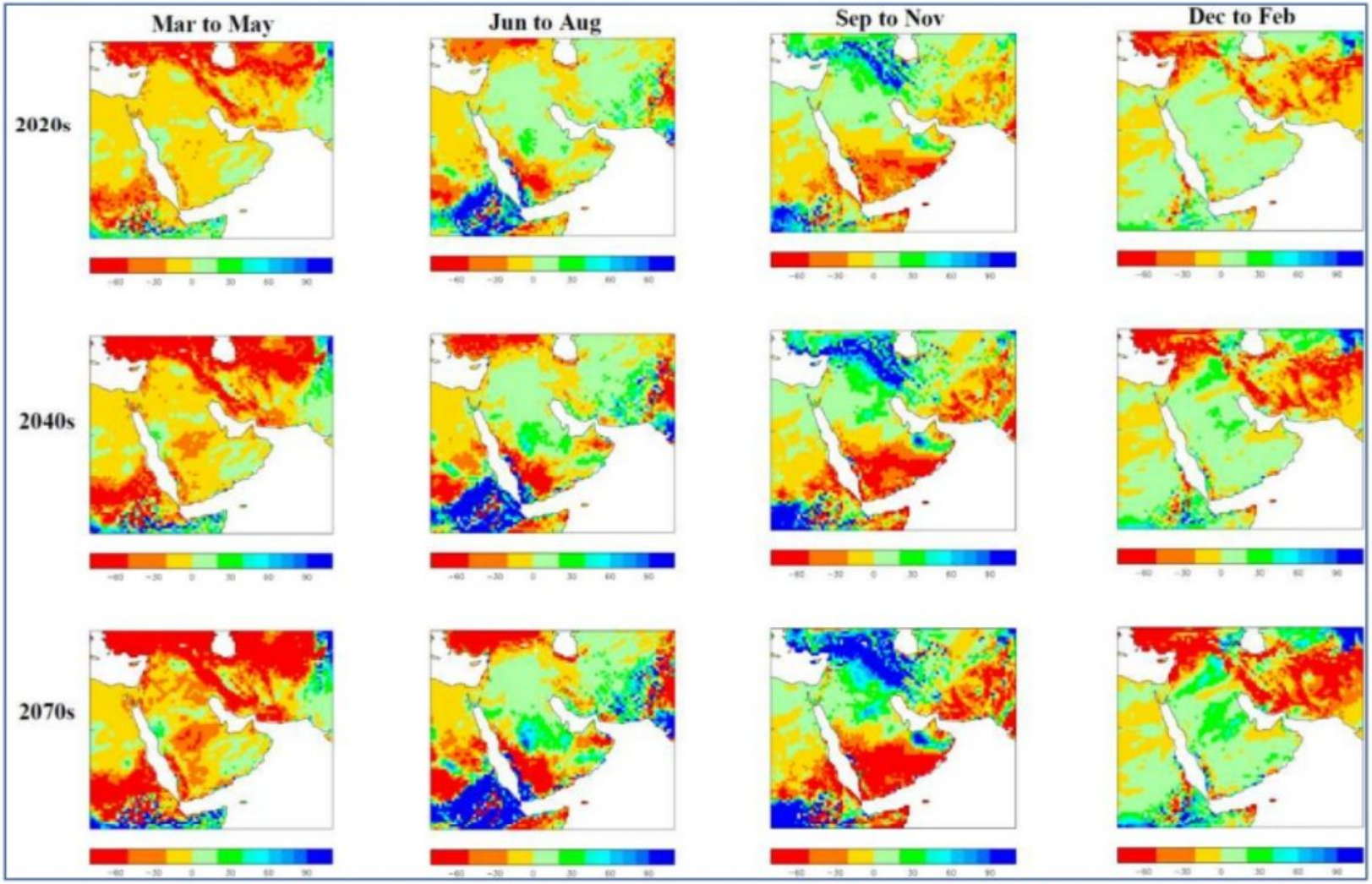
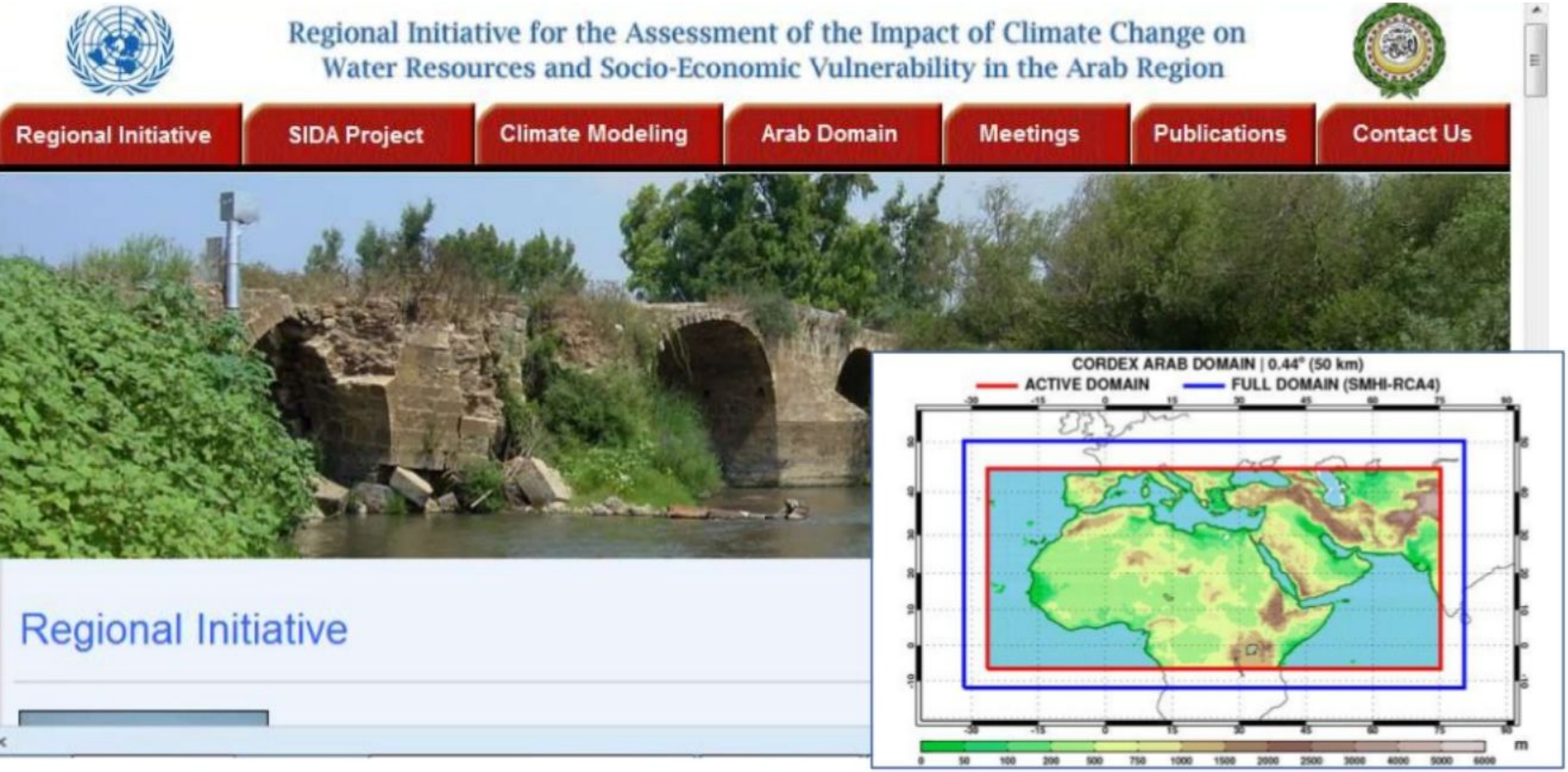
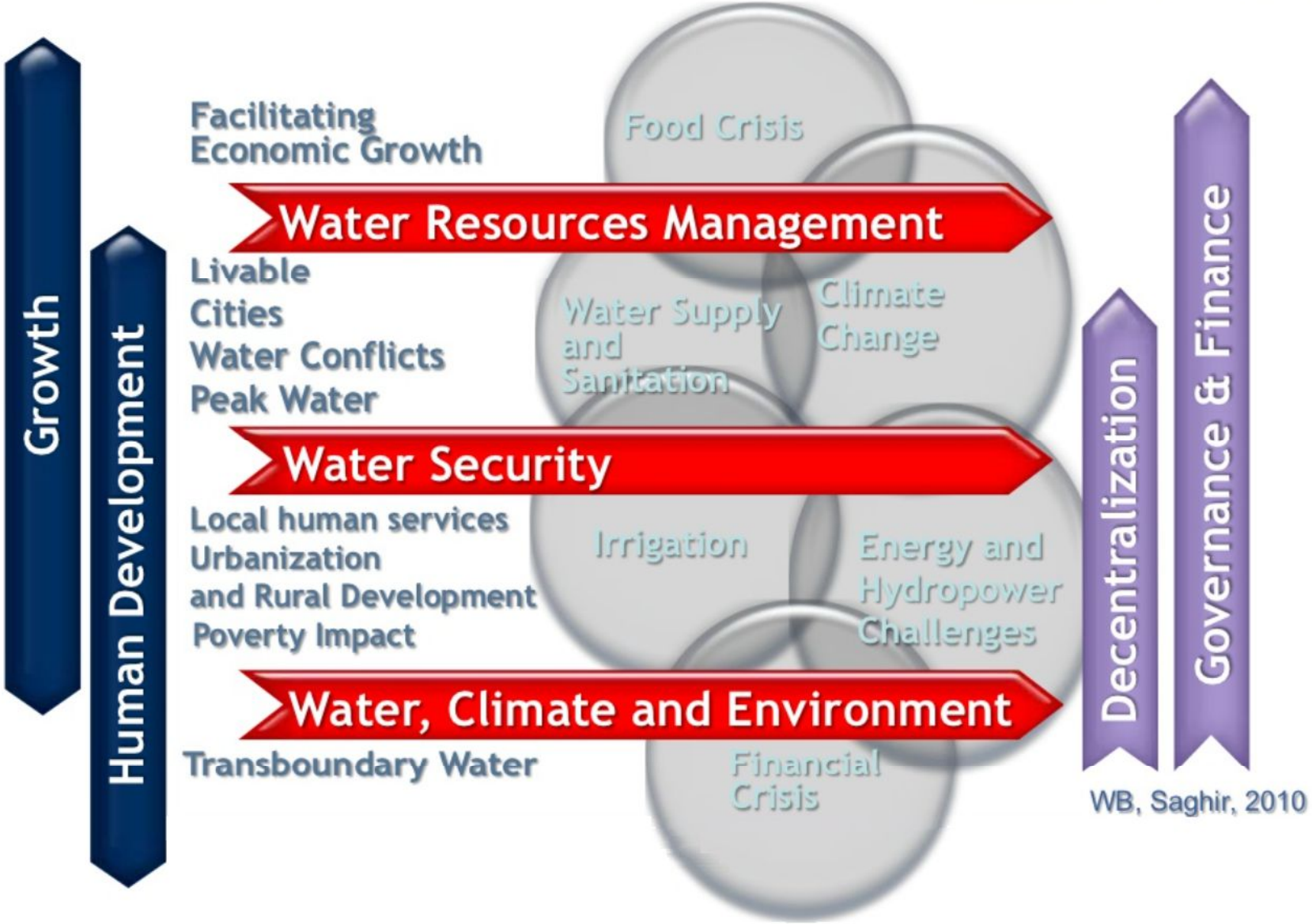


Hemming, D. et al., 2007. Environmental Stresses from Detailed Climate Model Simulations for the Middle East and Gulf Regions. Defense and Security Implications of Climate Change – Gulf Region

Changes in RCM seasonal precipitation Arabian Gulf Region www.escwa.un.org



Regional Initiative for Change of Water Resources and Social Economic Vulnerability www.escwa.un.org



Water - Key Development Issues www.escwa.un.org

- Water is everybody's business.
- Goal of many countries:
  National water strategy for water security,
  enough water for all demands.
- Countries in the region are largely unable to sustain their water needs only from within their national boundaries.
- All countries are already net water importers through food imports – virtual water.
- Largest water consumer is agriculture, although rarely economically viable nor socially necessary.

Water - Main Messages www.escwa.un.org

- Urgent need to change water, agriculture and population policies with regard to water consumption and protection.
- Surface and groundwater is often transboundary, i.e. (needs to be) shared between neighbouring countries.
- Effective und sustainable management of transboundary water needs willingness to cooperate for a more equitable sharing of the benefits from the common resource.
- Without cooperation, without innovative integration of economic tools, social justice and environmental sustainable approaches, without regional and bilateral agreements on water, the region may actually slowly move towards a mass suicide.

Water - Main Messages www.escwa.un.org

بير تشرب منه لا ترمي فيه حجر

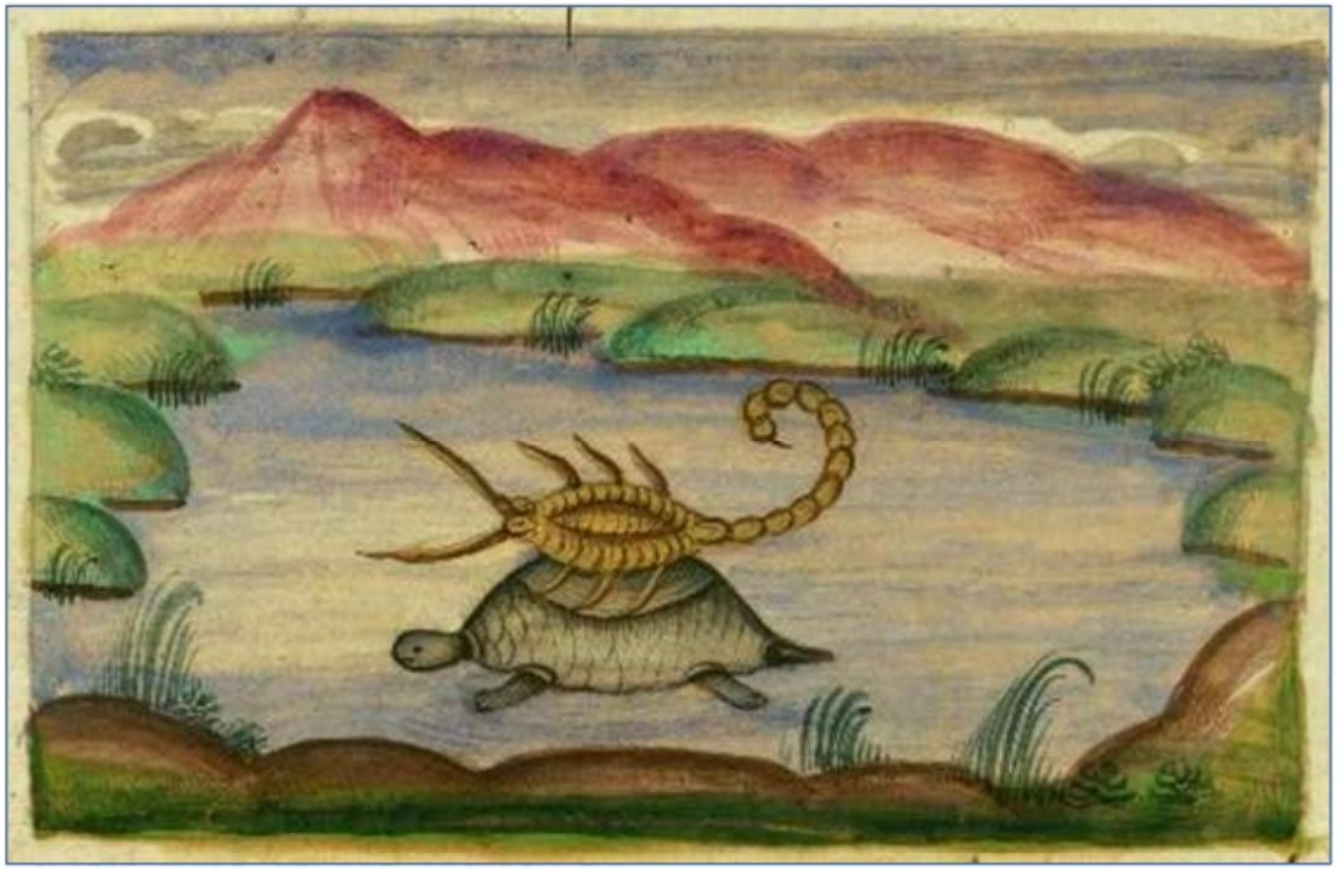
Bīr tishrab minhu lā tarmī fīhi ḥajar

Arabic Proverb
(literally)

'Into the well from which you drink do not throw stones'

[Care for the water upon which you depend]

Hope - More optimistic view www.escwa.un.org



http://www.flickr.com/photos/medmss/5887746629
http://en.wikipedia.org/wiki/The_Scorpion_and_the_Frog

Hope - Less optimistic view

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