EUROPE-INBO 2011

9th International Conference
on the current and future implementation of the European Water Framework Directive

Adaptation to Water Scarcity and Regional Cooperation in the Middle East

Yehuda Shevah

OPORTO, PORTUGAL
27- 30 SEPTEMBER 2011

Global and Regional Warming

1

Worldwide Global Warming

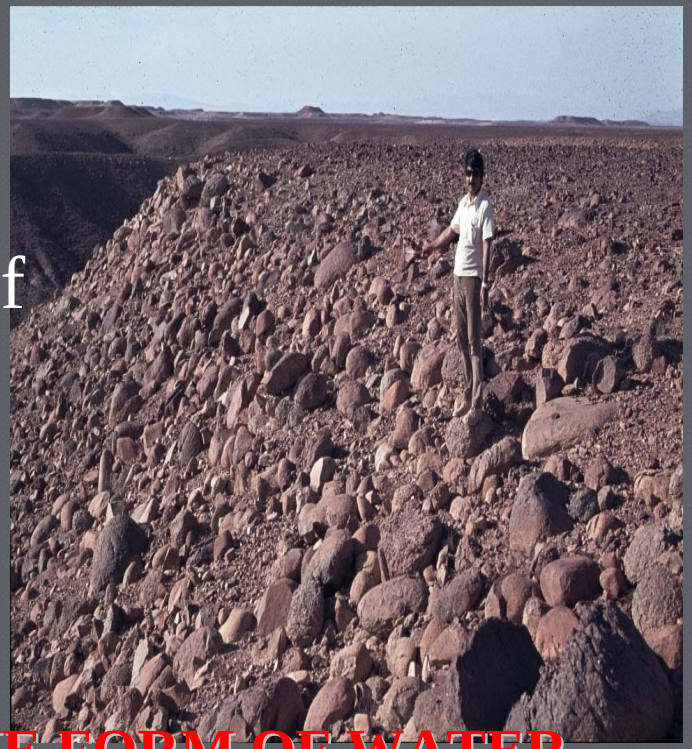
- The first eight months of 2010 tied the for the warmest combined land and ocean surface temperature on record - 14.7 C , 0.67 C above the 20th century average.

- The June–August summer was 16.2 C, 0.60 C above the 20th century average of 15.6 C. Second warmest on record globally and the third warmest August on record, since 1880

NOAA's National Climatic Data Center

Climatic Change and Impact onWater Resources

- higher temperatures
- increase of evaporation
- reduction of the amount of precipitation
- change of seasonal distribution of precipitation



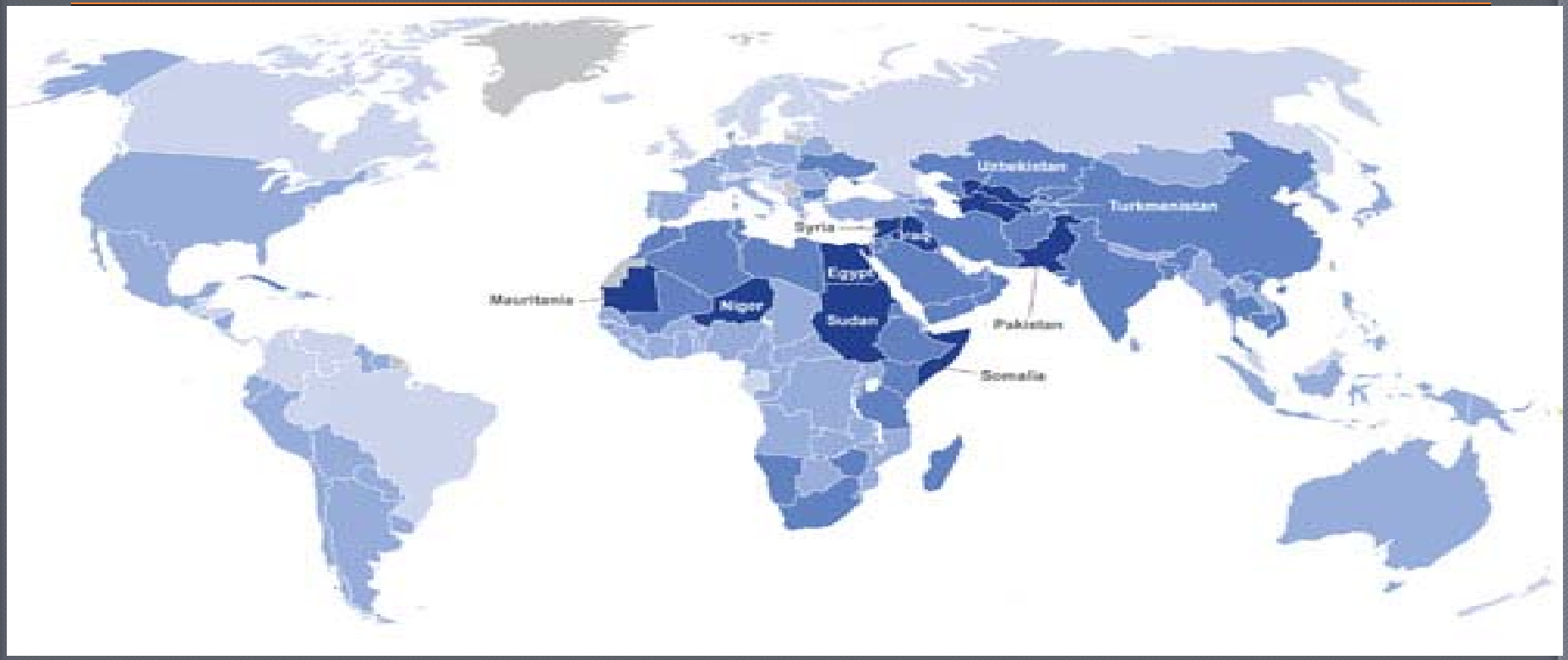
THE IMPACT IS BEING FELT IN THE FORM OF WATER SCARCITY, URBAN CROWDING AND FOOD CRISES

Maplecroft Water Security Risk Index Parameters

- access to improved drinking water and sanitation
- availability of renewable water and the reliance on external supplies
- the relationship between available water and demands; and
- water dependent economy.

Extreme & High Water Scarcity Risk Countries

Water Security Risk Index, © Maplecroft 2011



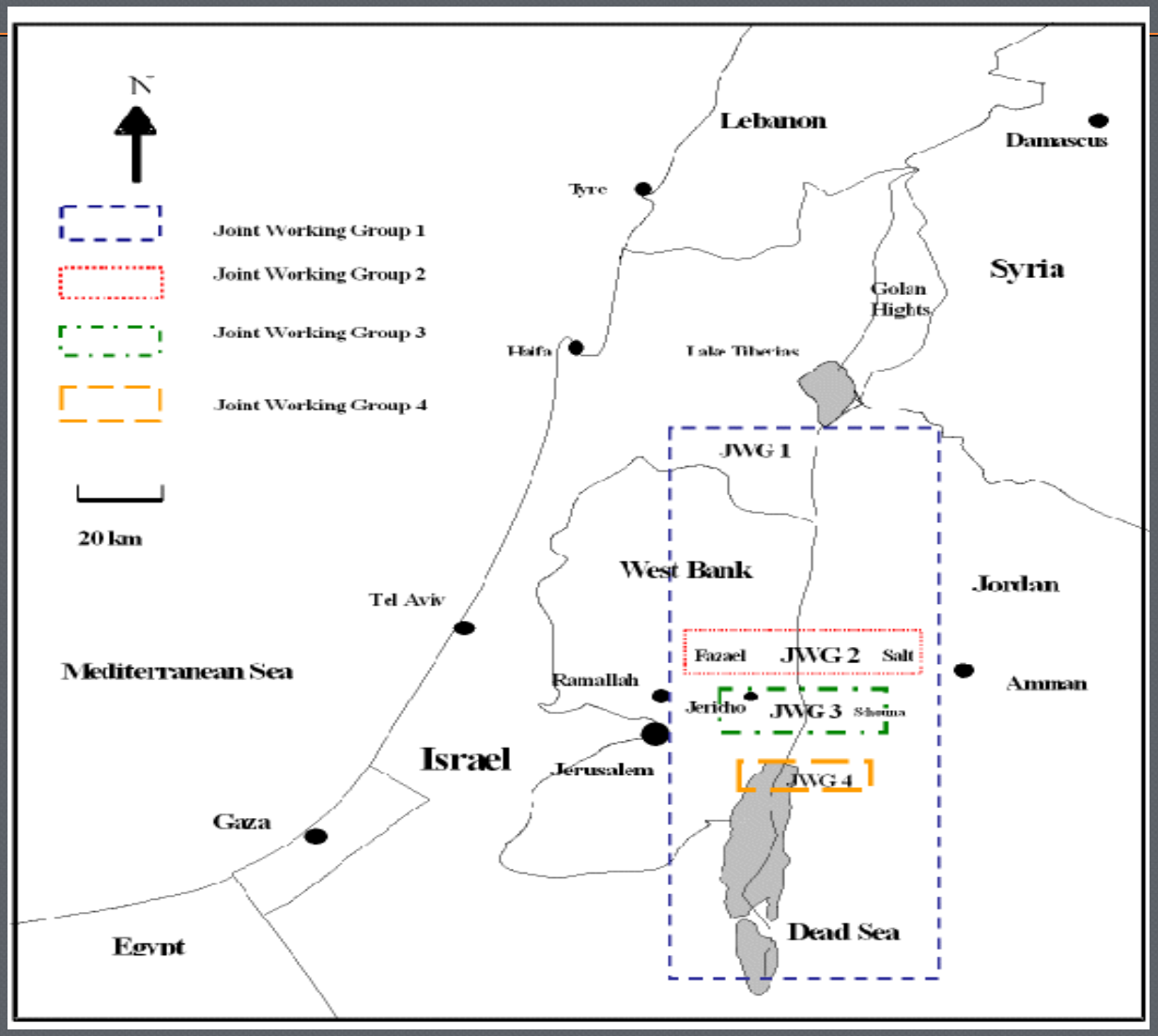
The Index rates the Middle East countries among nations facing “extreme” (Syria and Egypt)and "High" water security risk (other neighboring countries) as having least secure supplies of water.

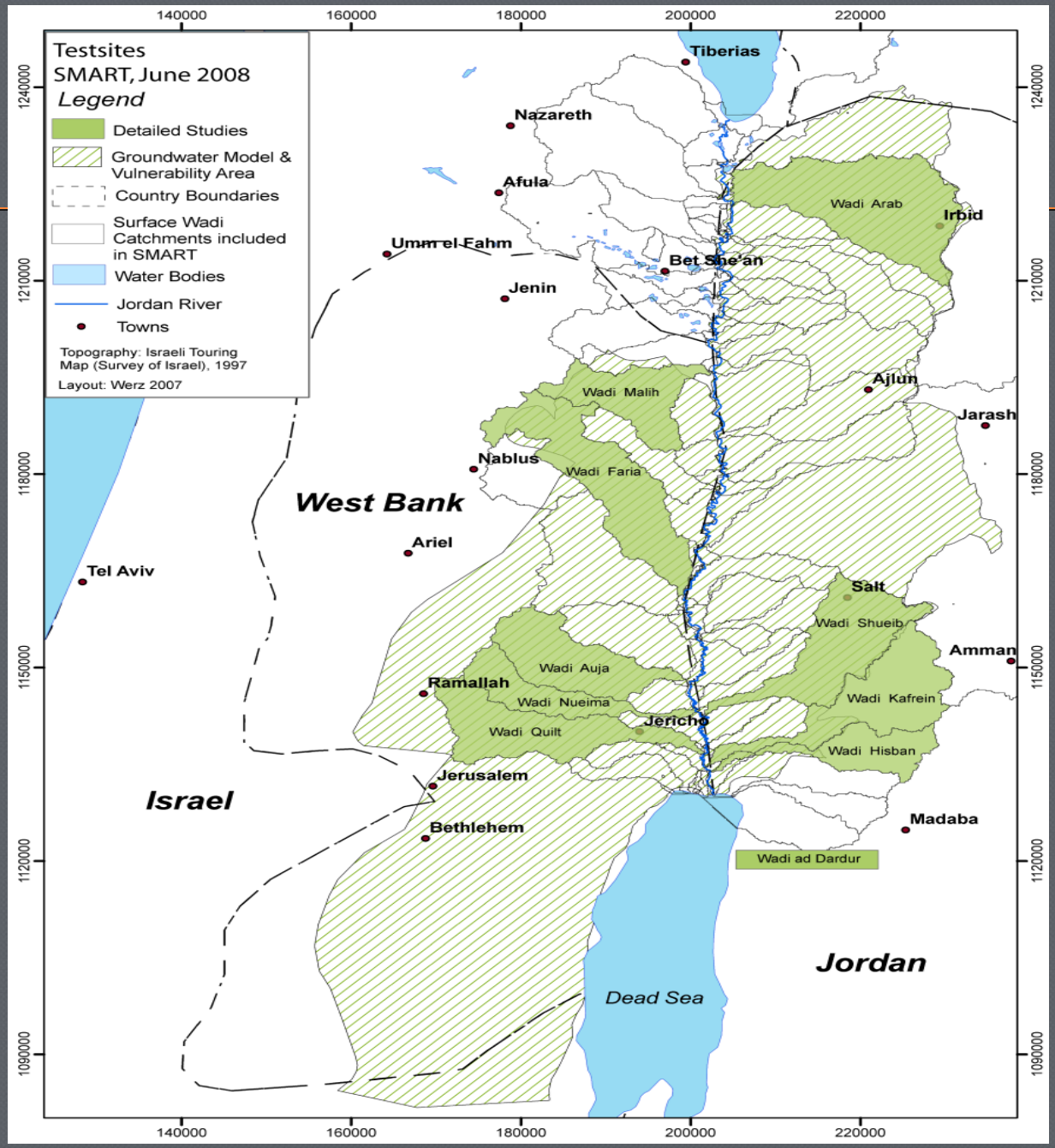
The Project Area

2

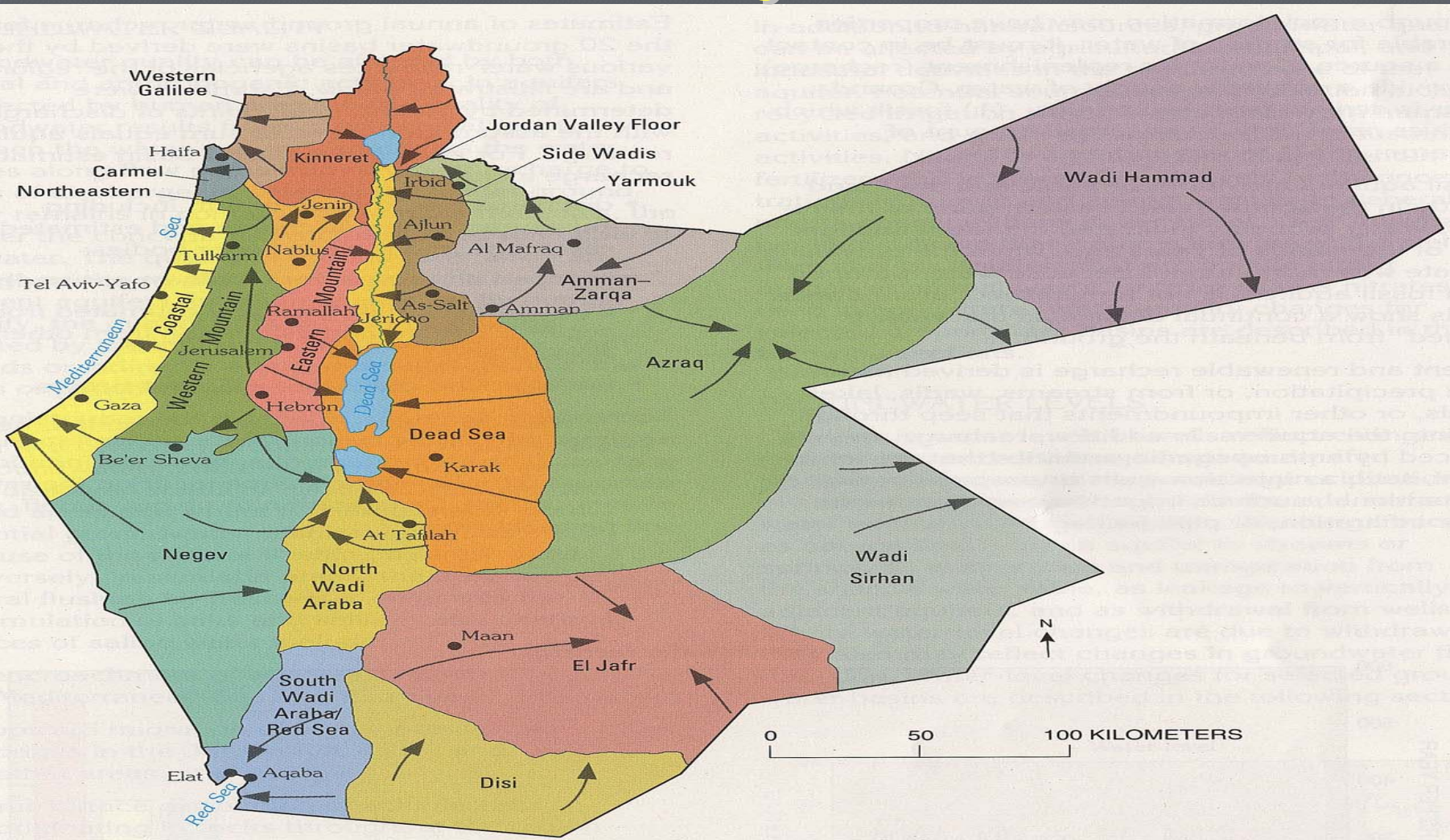
The Project Area
Israel, Palestine and Jordan

Regional Administrative Boundaries




Testsites
SMART, June 2008
Legend
Detailed Studies
Groundwater Model & Vulnerability Area
Country Boundaries
Surface Wadi Catchments included in SMART
Water Bodies
Jordan River
Towns
Topography: Israeli Touring Map (Survey of Israel), 1997
Layout: Werz 2007
140000
160000
180000
200000
220000
1240000
1210000
1180000
1150000
1120000
1090000
Tiberias
Nazareth
Afula
Umm el Fahm
Jenin
Bet She'an
Irbid
Wadi Arab
Ajlun
Jarash
Wadi Malih
Nablus
Wadi Faria
West Bank
Ariel
Tel Aviv
Salt
Wadi Shueib
Amman
Wadi Auja
Ramallah
Wadi Nueima
Wadi Kafrein
Jericho
Wadi Quilt
Wadi Hisban
Jerusalem
Israel
Bethlehem
Madaba
Wadi ad Dardur
Jordan
Dead Sea

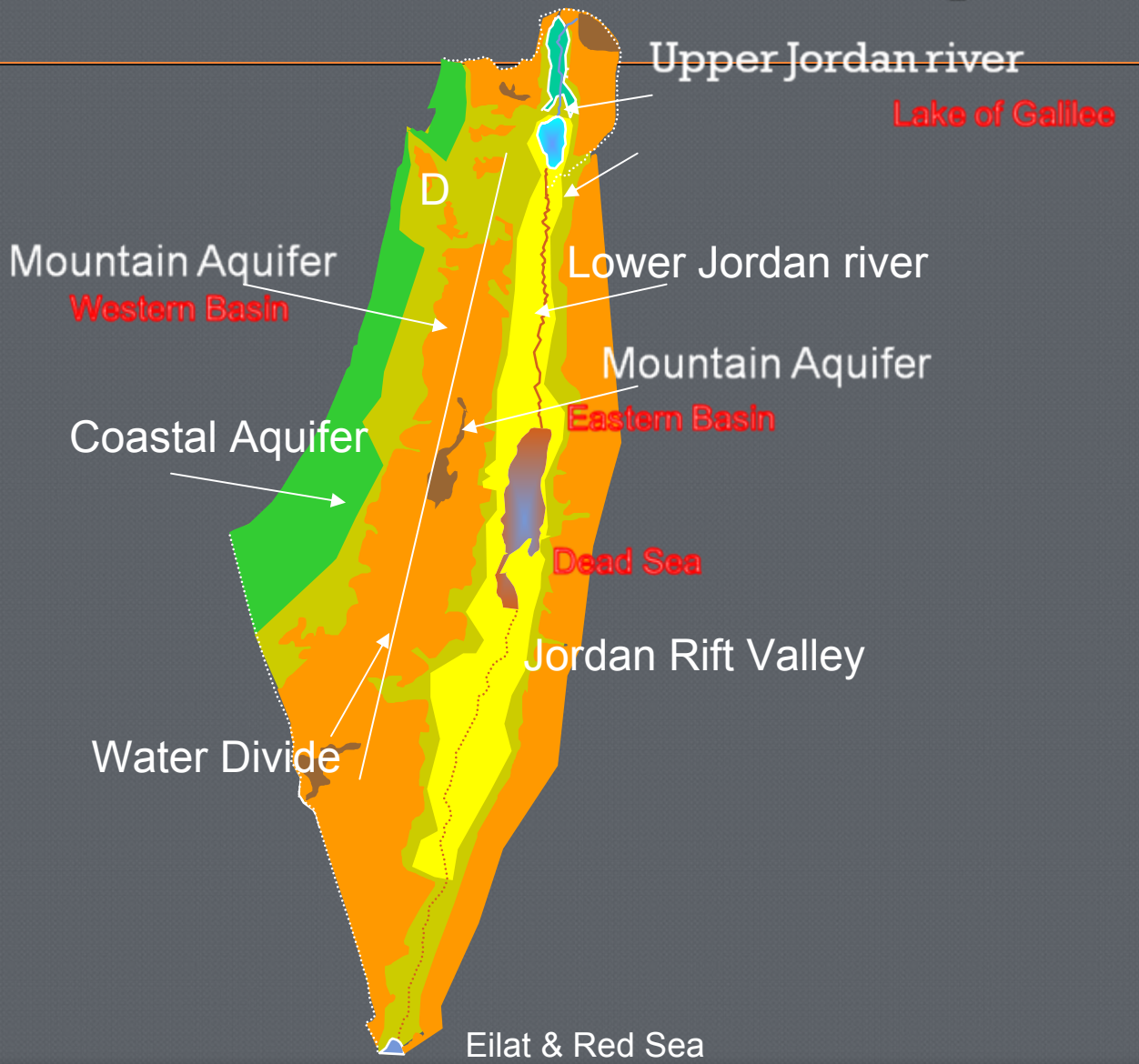
Watersheds Shared Water and Transboundary Resources



Groundwater basins and direction of groundwater movement (indicated by arrows)

Major Shared Water Resources

Lake of Galilee and Groundwater Aquifers



Water Scarcity and Regional Cooperation

3

Regional Water Scarcity and the Needs for Regional Cooperation

The region water resources are under threat due to:

- Rapid population growth increased water demand
- Poor conservation of the environment
- Inadequate treatment of point and non point sources of pollution
- Trans-boundary movement of pollutants.

All these issues:

- Endanger the water resources and the drinking water quality, adding pressure on the scarce water resources.
- Fuelling the conflicting views of the shareholders and threatens the regional stability.

The genuine concern of all parties involved necessitates a secured safe and clean drinking water for all.

Regional Cooperation Initiative

- Water scarcity may however help foster cooperation instead conflicts and instability within a highly volatile situation.
- Cooperation in trans-boundary water resources management could contribute to sustainable management of shared water resources and attempts involving multi-lateral groups receive substantial support from the international community.
- Experts from Europe and the Mediterranean regions and beyond were engaged to share experience and identify the mechanisms to increase effective cooperation in water.

The Working Group represents a wide range of relevant disciplines which working together will focus on a key priority issues.

The Working Group

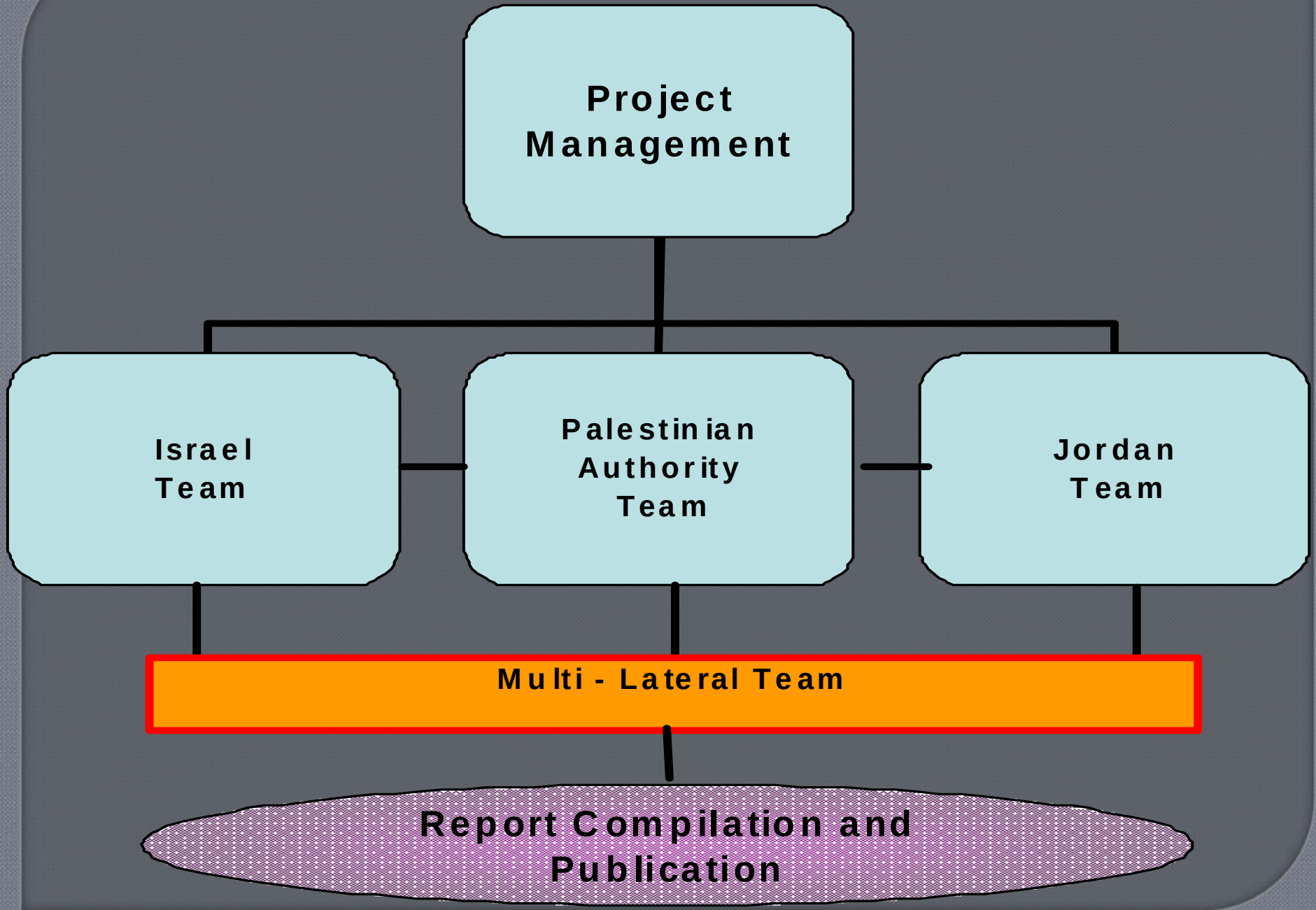
•Israel
•Yehuda Shevah, Consultant - Project Team Leader
•Miriam Waldman, Ministry of Science (ret.)
•Alon Tal, Ben Gurion University
•Clive Lipchin, Arava Institute for Environmental Studies

West Bank and Gaza Strip
•Tamimi Abdel Rahman, Palestinian Hydrology Group - Sub-group Team Leader
•Alfred Abed Rabbo, Bethlehem University, PA
•Hassan Dweik, Al Quads University, PA
•Yousef Abu-Mayla, Al-Azhar University, Gaza - Sub-group Team Leader

Jordan
•Hanan Malkawi, Yarmouk University, Jordan - Sub-group Team Leader
•Abdallah Al-Zoub, Al-Balqa University, Jordan
•Abdul Aziz Al Najjar, Kuwait Chemical Society, Kuwait

International Experts
•Hoetzel Heinz, KIT-University of Karlsrule, Germany - Sub-group Team Leader
•Ameen Farouk Fahmy, Ain Shams University, Egypt
•Kandile, G. Nadia, Ain Shams University, Egypt
•Hemda Garelick: Middlesex University, UK
•Stanley Langer, Science for Development, UK
•Charles Kolb, Aerodyne Research, Inc. USA

Work Organisation



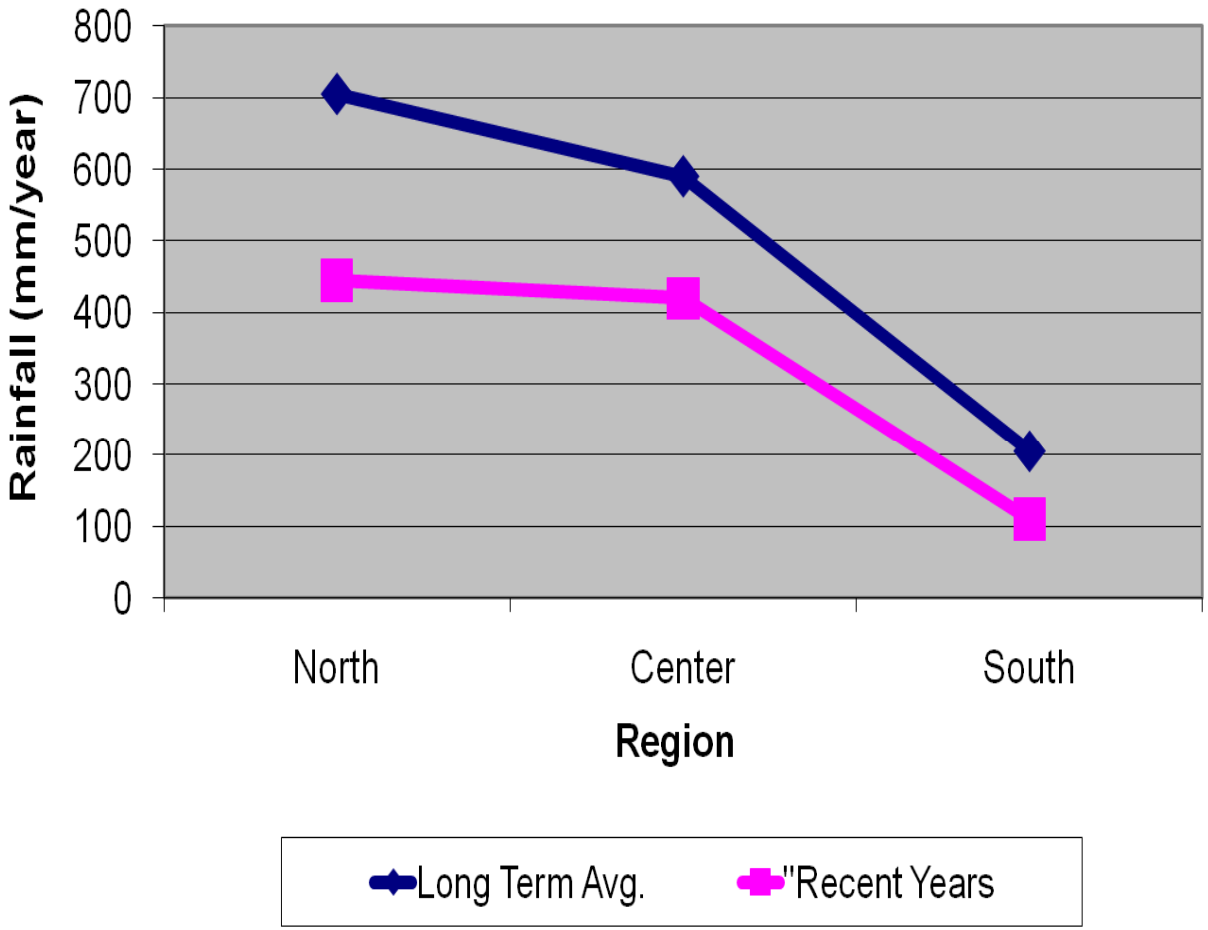
Regional Cooperation Objectives

- Formation of a framework for regional and international co-operation.
- Conducting an independent assessment of current and future water needs in the region, as a cornerstone for sustainable management and development of additional water resources
- Validating basic and baseline data, as an efficient platforms for sharing knowledge in the water sector
- Strengthening and enhancing regional partnership, dealing with existing and emerging causes of water crisis as related to:
  - State of the Art and Equitable management of trans-boundary and shared water resources
  - Potential natural and non-conventional water resources
  - Safeguard of the environment and natural resources
  - Capacity Building
- Confidence building within the region

Water Resources Availability

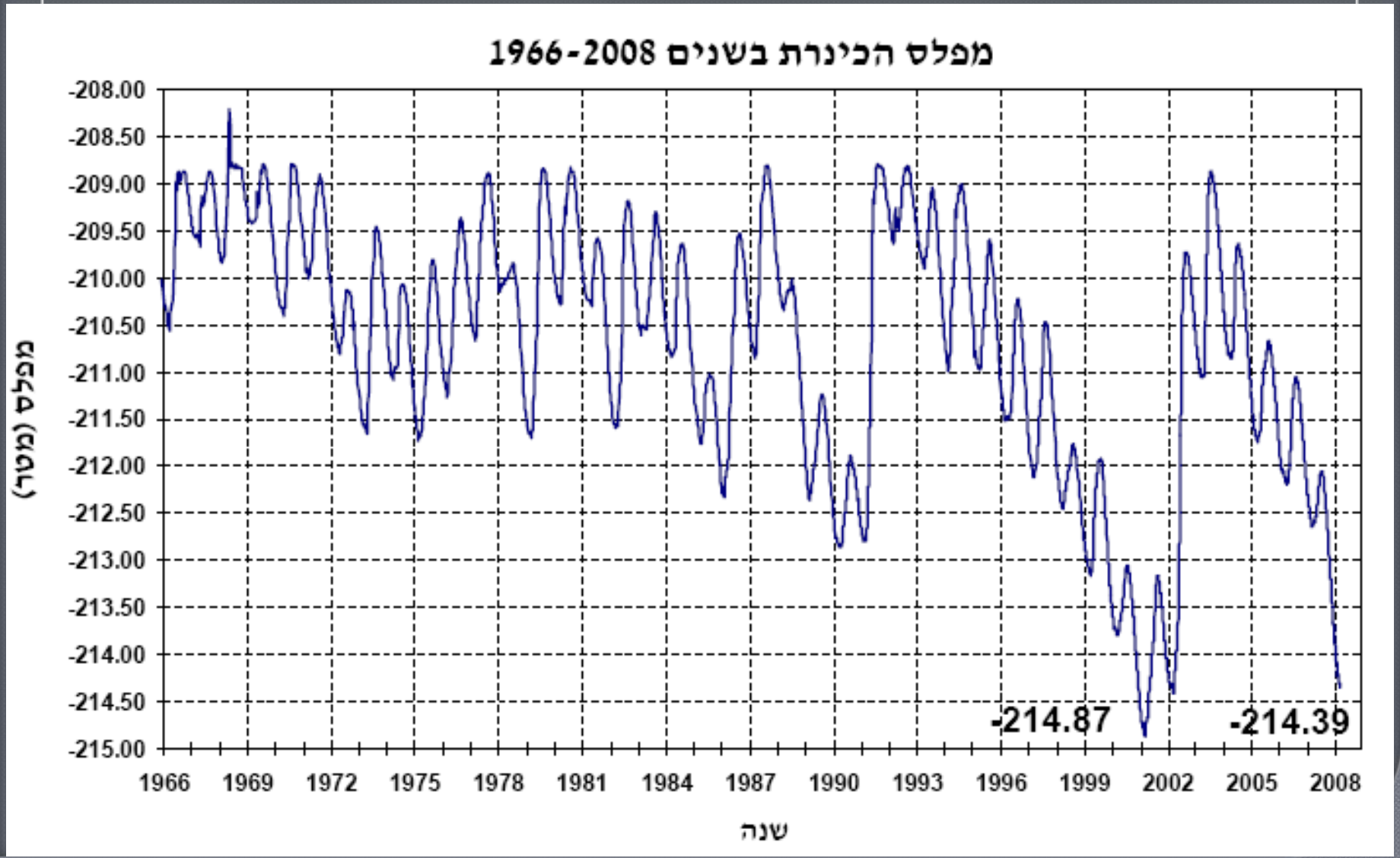
4

Global Warming and Declining Rainfall
(mm/year)

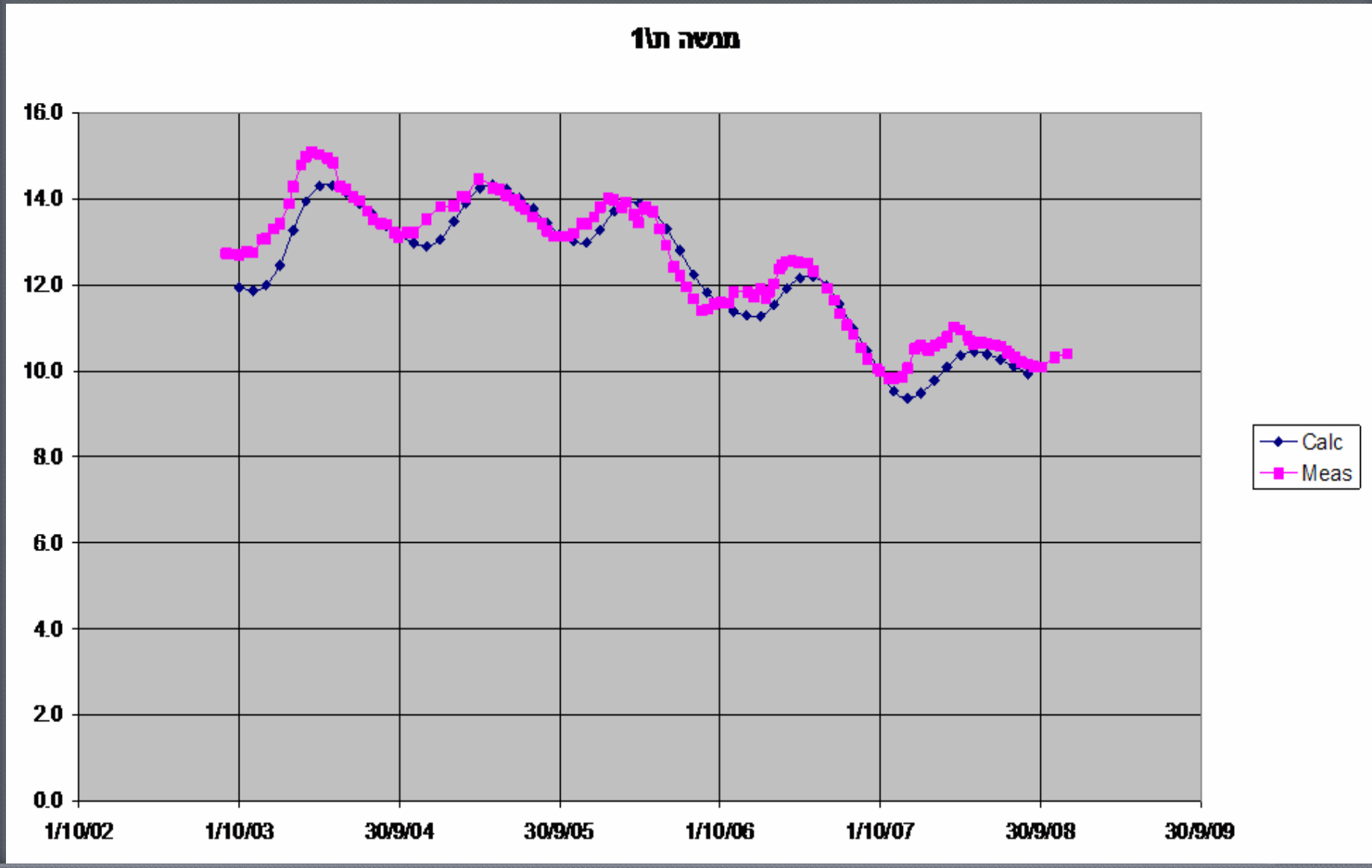


Replenishment of the Surface Reservoirs

Galilee Sea Water Level: 1966 - 2008



Declining Groundwater Table - Mountain Aquifer



Declining Groundwater Table – Coastal Aquifer

Fig. 3: Global Warming and Impact on the Replenishment of Water Resources

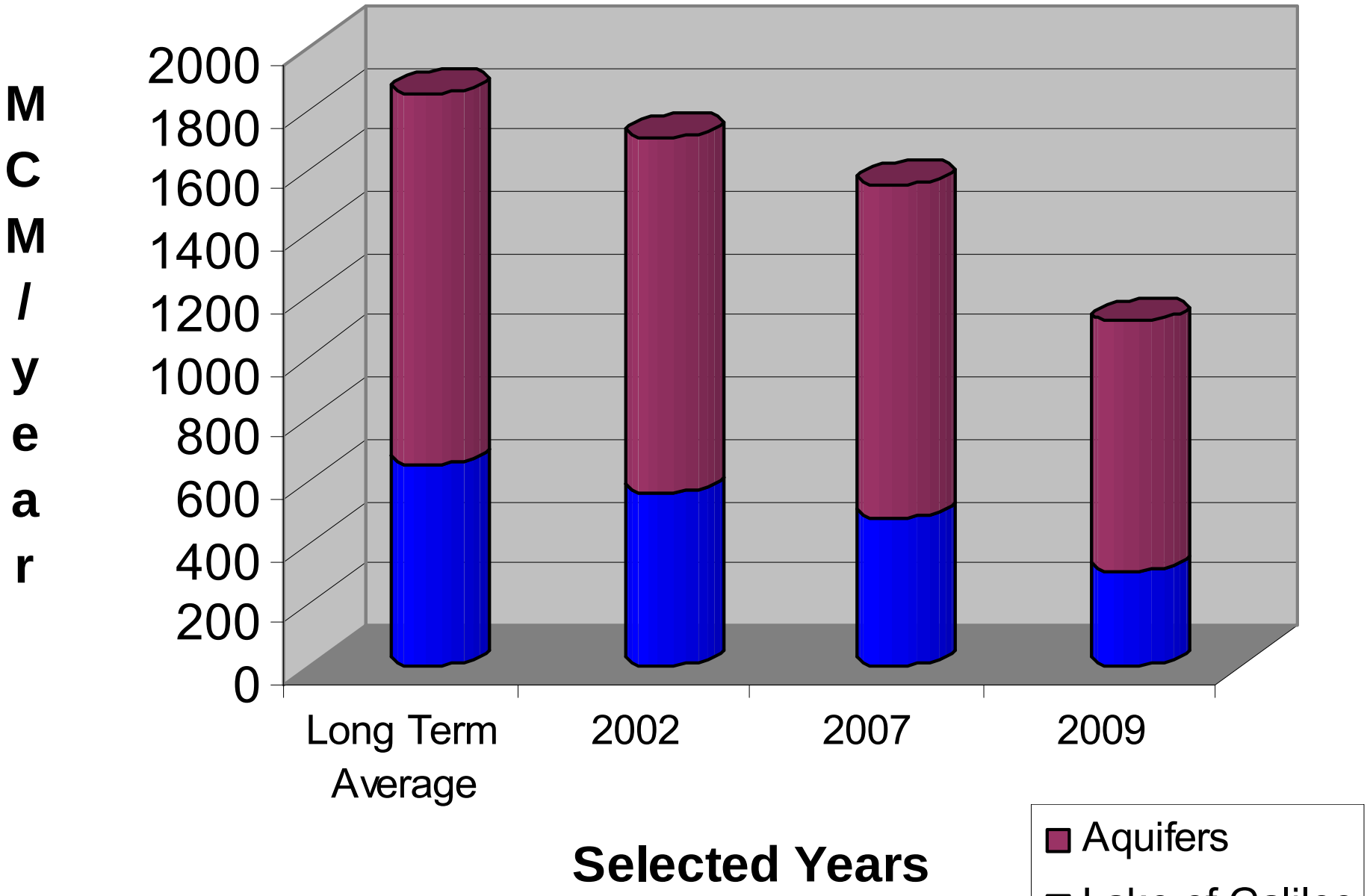
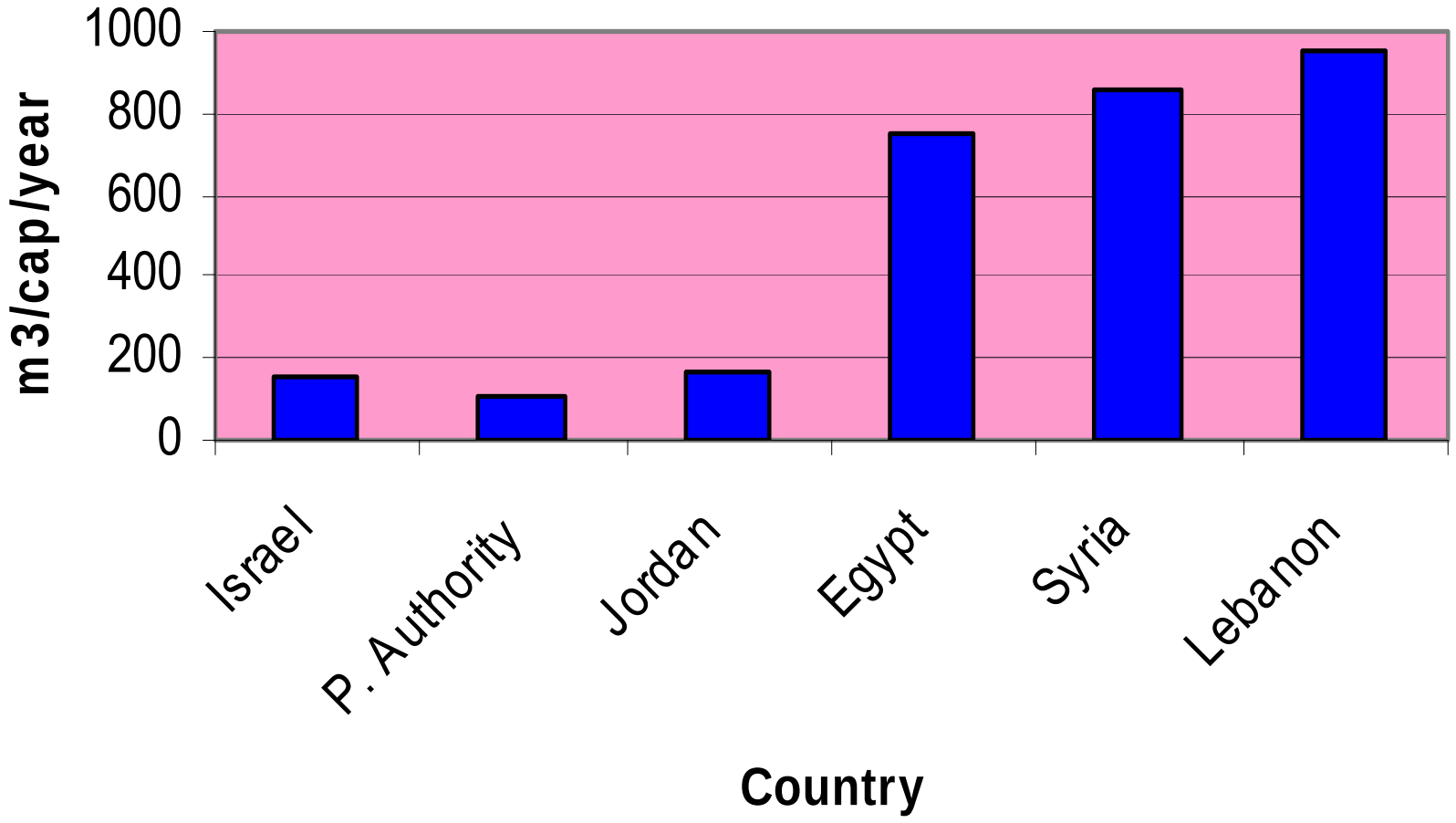


Fig. 2: Water Resources Availabilty in the Middle East Countries, 2008

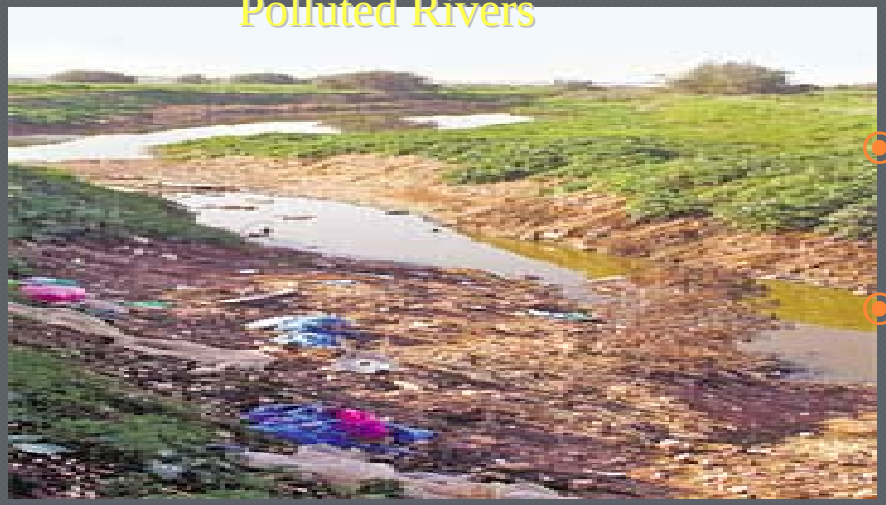


Water Resources Quality

5

Water Quality & Ecology

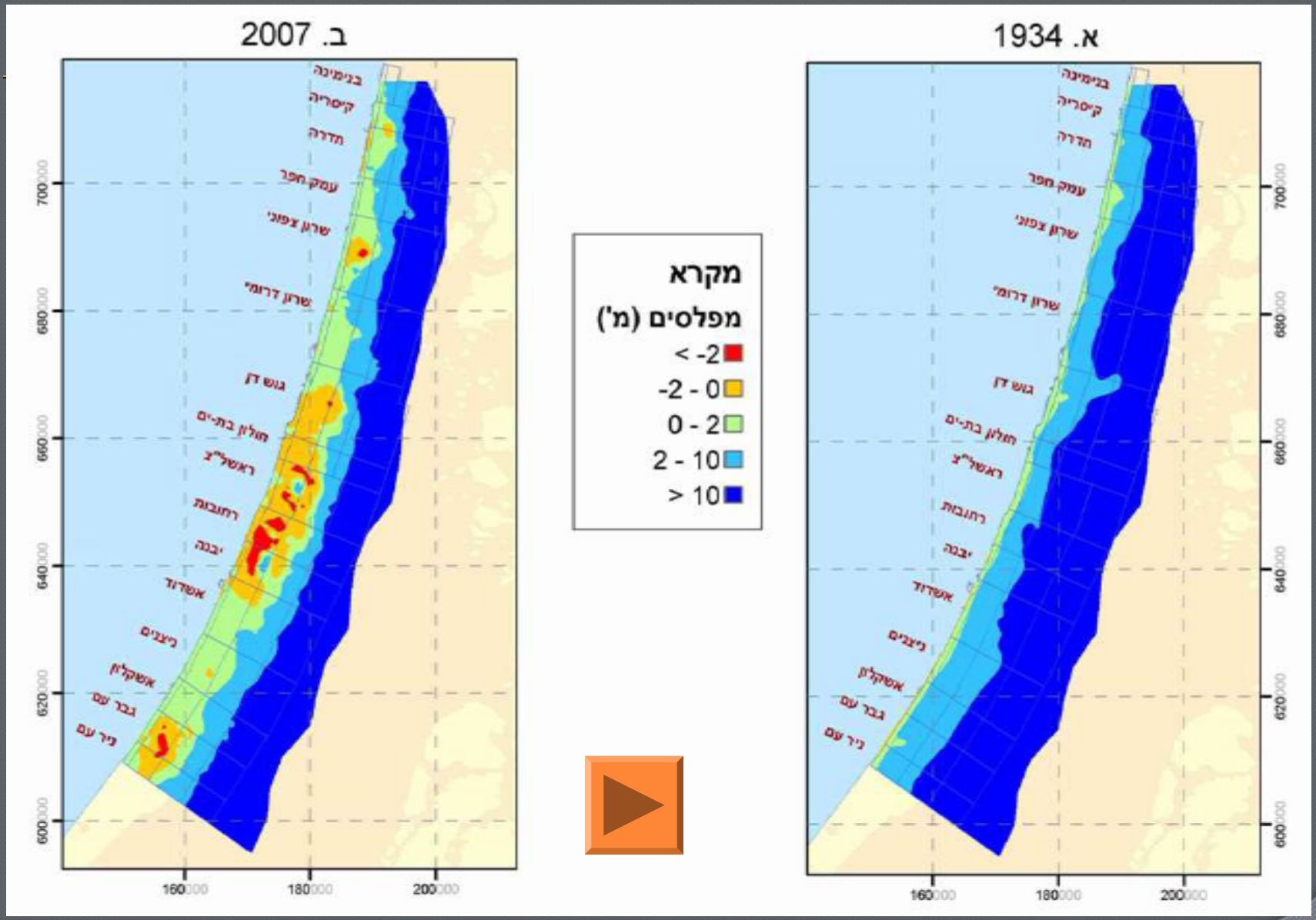
Polluted Rivers



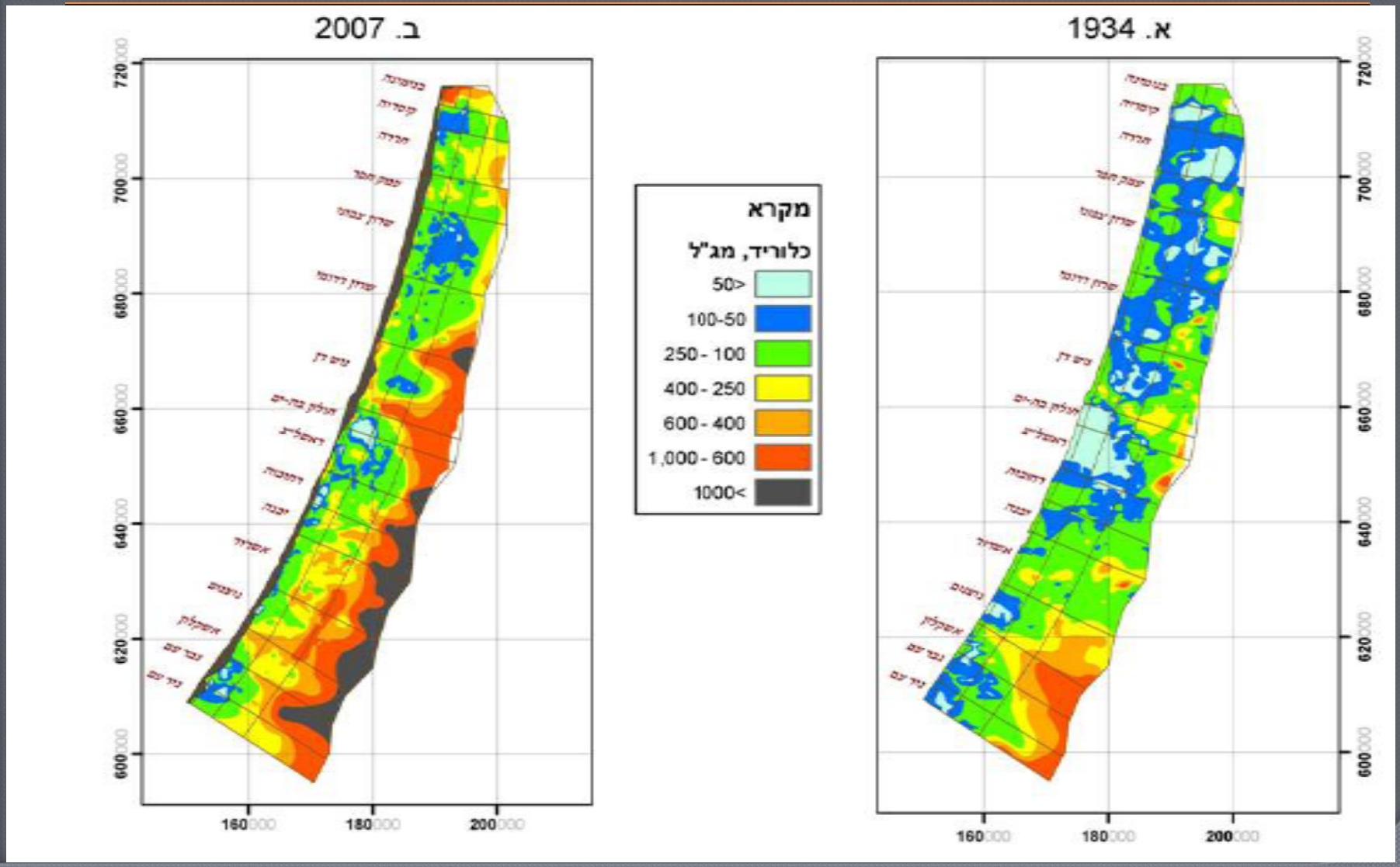
The drastic drop in rainfall in the recent years caused:

- Over exploitation of resources and diminished water quality
- Salt water intrusion into groundwater in coastal regions drying of rivers and lake ecosystems
- The public health is severely affected
- Harming or killing plants and animals in aquatic ecosystems

Coastal Aquifer Water level: 1934 - 2007

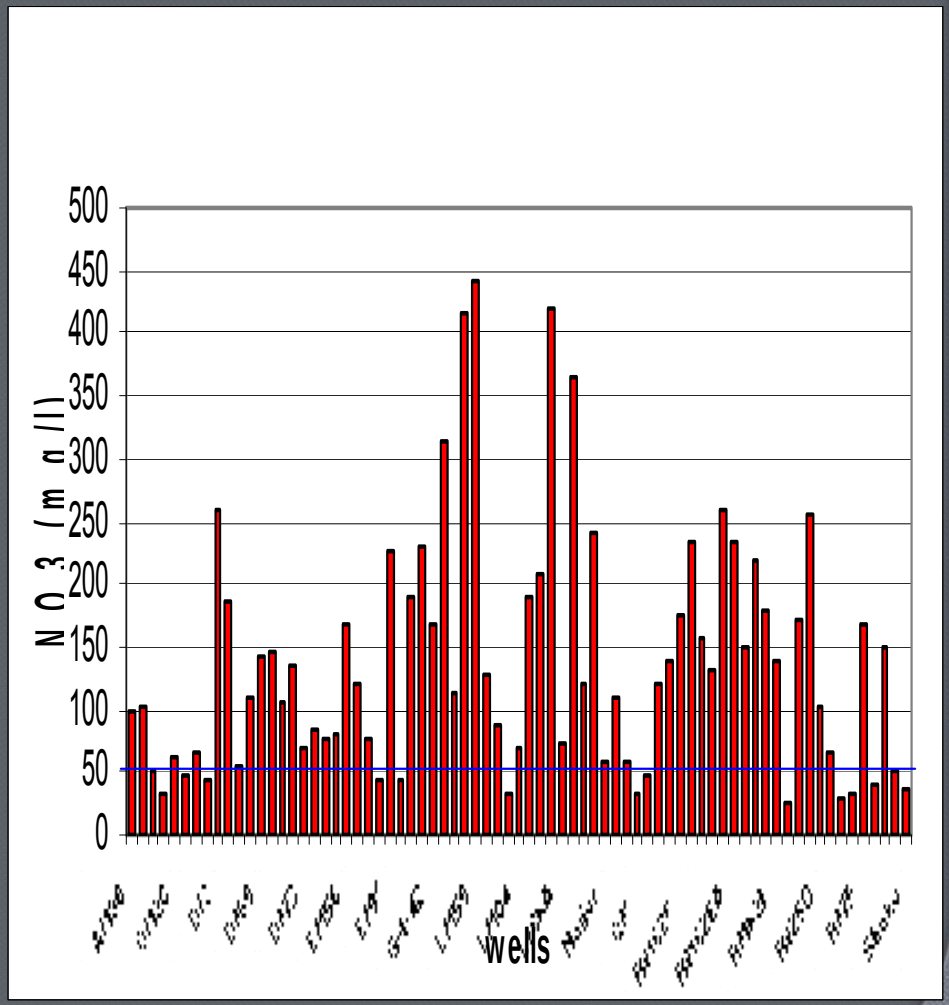


Coastal Aquifer Chlorides Contents: 1934 & 2007

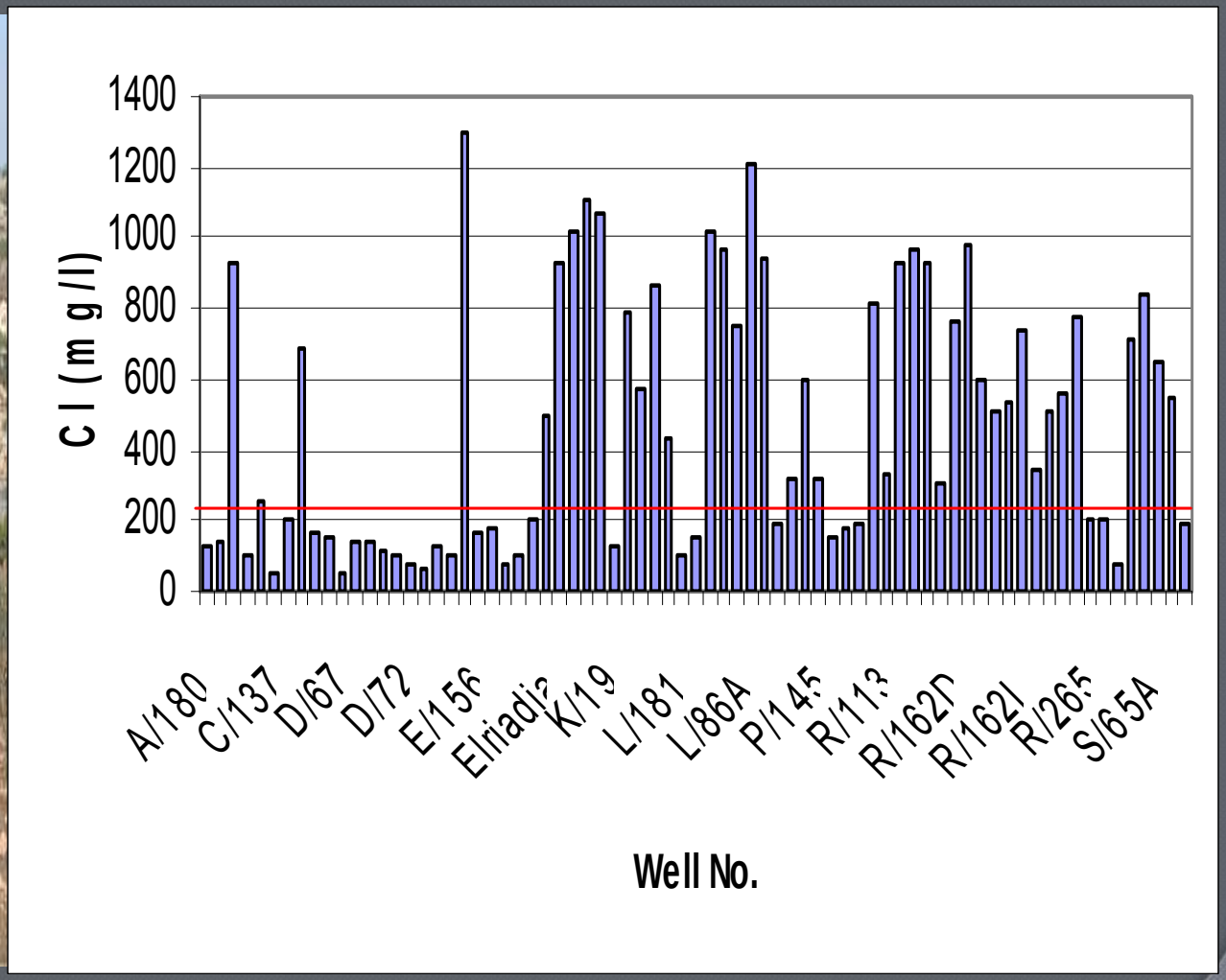


Gaza Strip Aquifer Water Quality Average EC, TDS, NO3 and Cl 2008

E.C (mg/l)	TDS (mg/l(	NO3 (mg/l)	Cl (mg/l)
2144	1339	119	536



Chloride Concentrations in Drinking Water Wells, Gaza, 2004



Water Supply and Water Works

6

Israel National Carrier
Tsalmon Canal and Reservoir

Lake of Galilee Water Treatment Plant

Conjunctive Use of Water Resources
National Water Supply System

The King Abdullah Canal, Jordan Valley

The Tannur Dam, Jordan

The Wehda River Dam, Jordan

Region Accessibility to Piped Water & Improved Sanitation (WHO, 2008

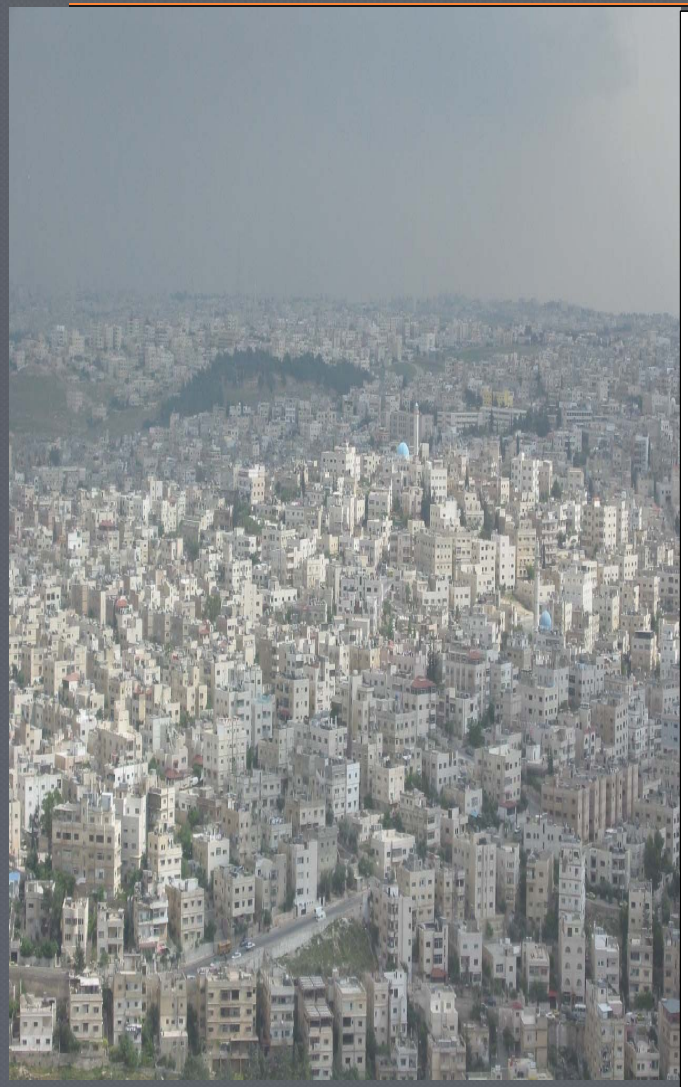
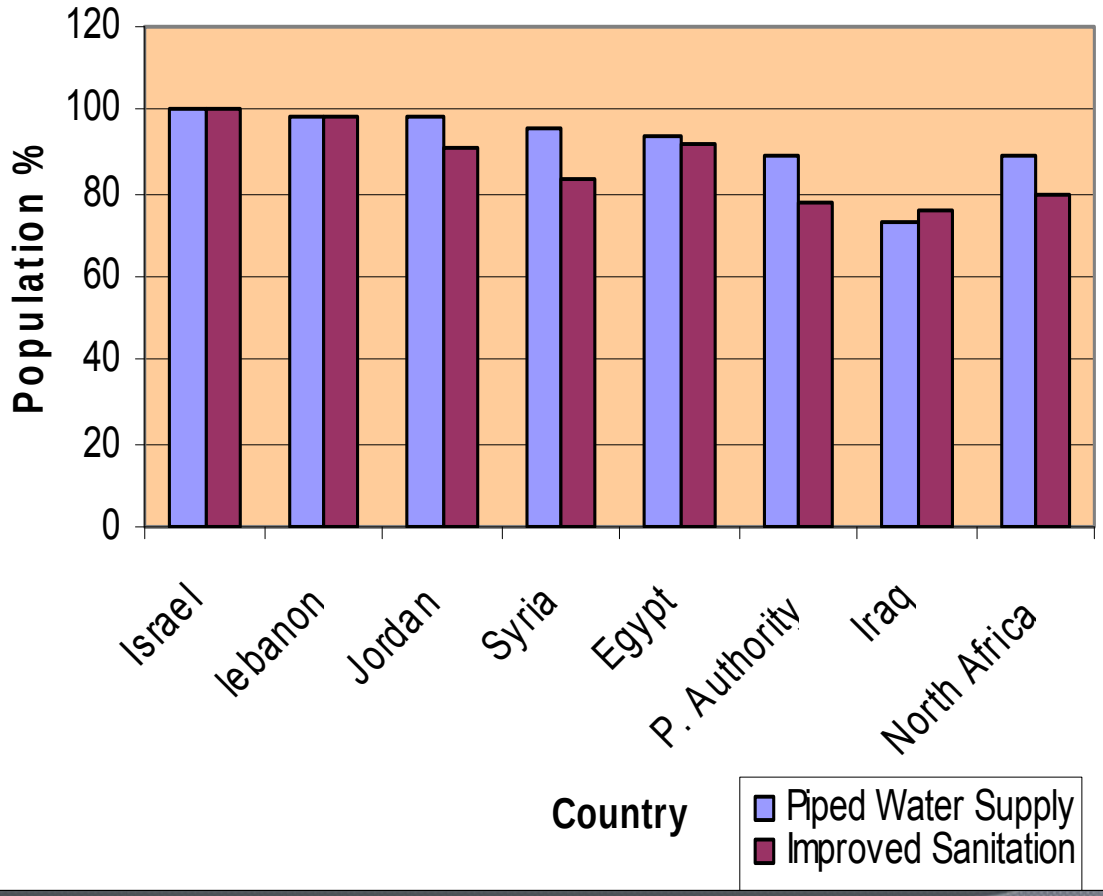
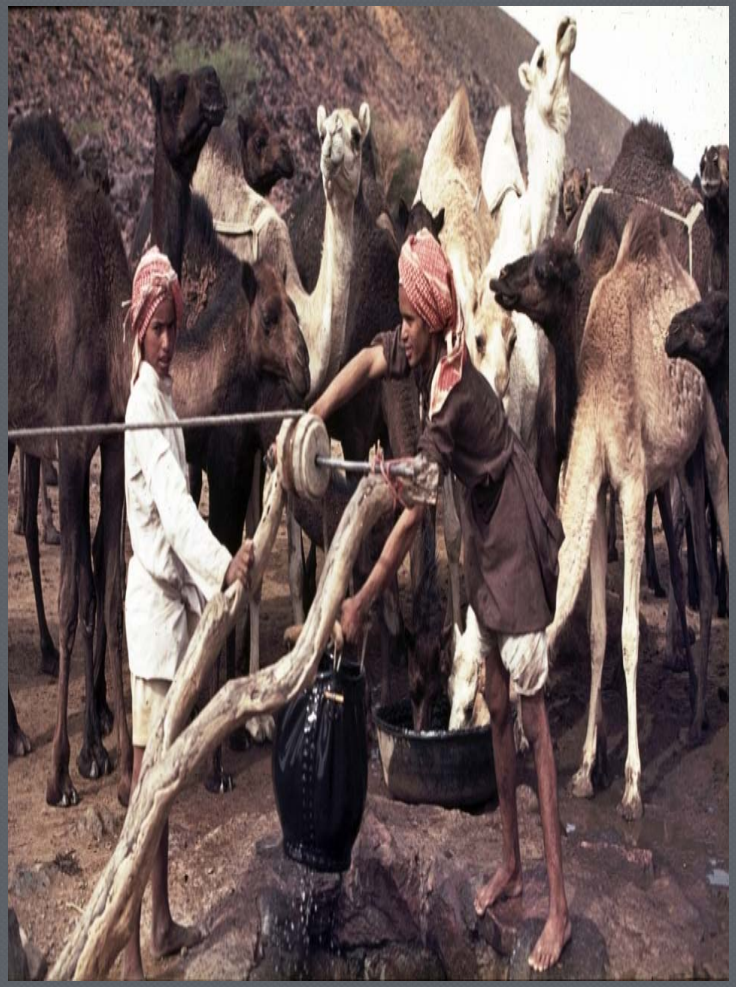


Fig. 4: Accessibility to Piped Water & Improved Sanitation, 2008



Reliability and Adequacy of Supply



While infrastructure of supply is adequate, reliability of supply is deficient

Intermittent supply is common
Running water only on alternate days
In Amman, Jordan, water services operate only for 12 hours in a day.

Excessive leakage and losses in conveyance and networks reduce significantly the supply to the consumers.

Unaccounted for Water is high:
•34% in Palestine,
•25% in Jordan, and
•15% in Israel

The Way Forward

7

TO OVERCOME THE MAJOR CONSTRAINTS

SEMI-ARID CLIMATE:

- Inadequate water resources
- Frequent drought
- A large inter-annual fluctuation

UNEVEN GEOGRAPHYCAL DISTRIBUTION

- 80% of the resources located in north & central regions
- Main demand & 65% of irrigable lands are in the south

DEPLETED & POLLUTED WATER RESOURCES:

- Degradation & stringent standards

INCREASING POPULATION & WATER DEMAND:

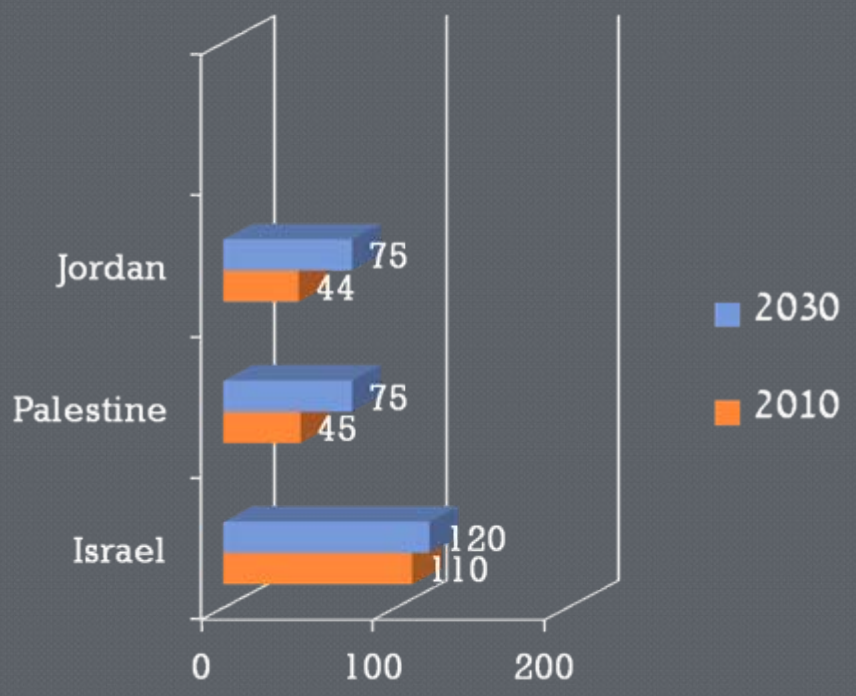
- A widening gap between supply & demand

Existing Regional Water Supply & Demand , 2010 & Projections 2020 & 2040

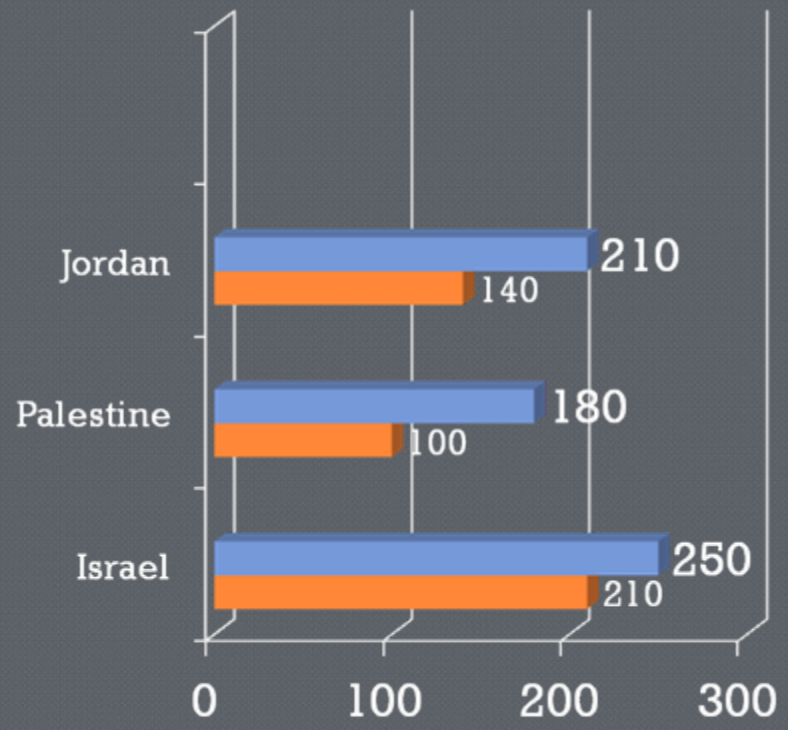
		2010	2020	2040
	Population (million)	18	23	30
Water Demand	Urban Demand	1325	2005	2805
MCM/year	Irrigation – Natural Water	1080	1725	1615
	Irrigation – Marginal Water	700	1205	1860
	Restoration/Replenishment	10	50	70
	Transboundary Supply	-95	-250	-390
	Total	**3020**	**4735**	**5960**
Per Capita	**Domestic**	**73**	**89**	**92**
M3/yr	**Total**	**171**	**221**	**209**
Water Resources	Surface water	543	605	565
MCM/Year	Groundwater	1626	1620	1935
	Wastewater Effluents	615	1140	1860
	Desalination	236	1370	1600
	Total	**3020**	**4735**	**5960**

Current and Projected Level of supply
(M3/Cap/year)

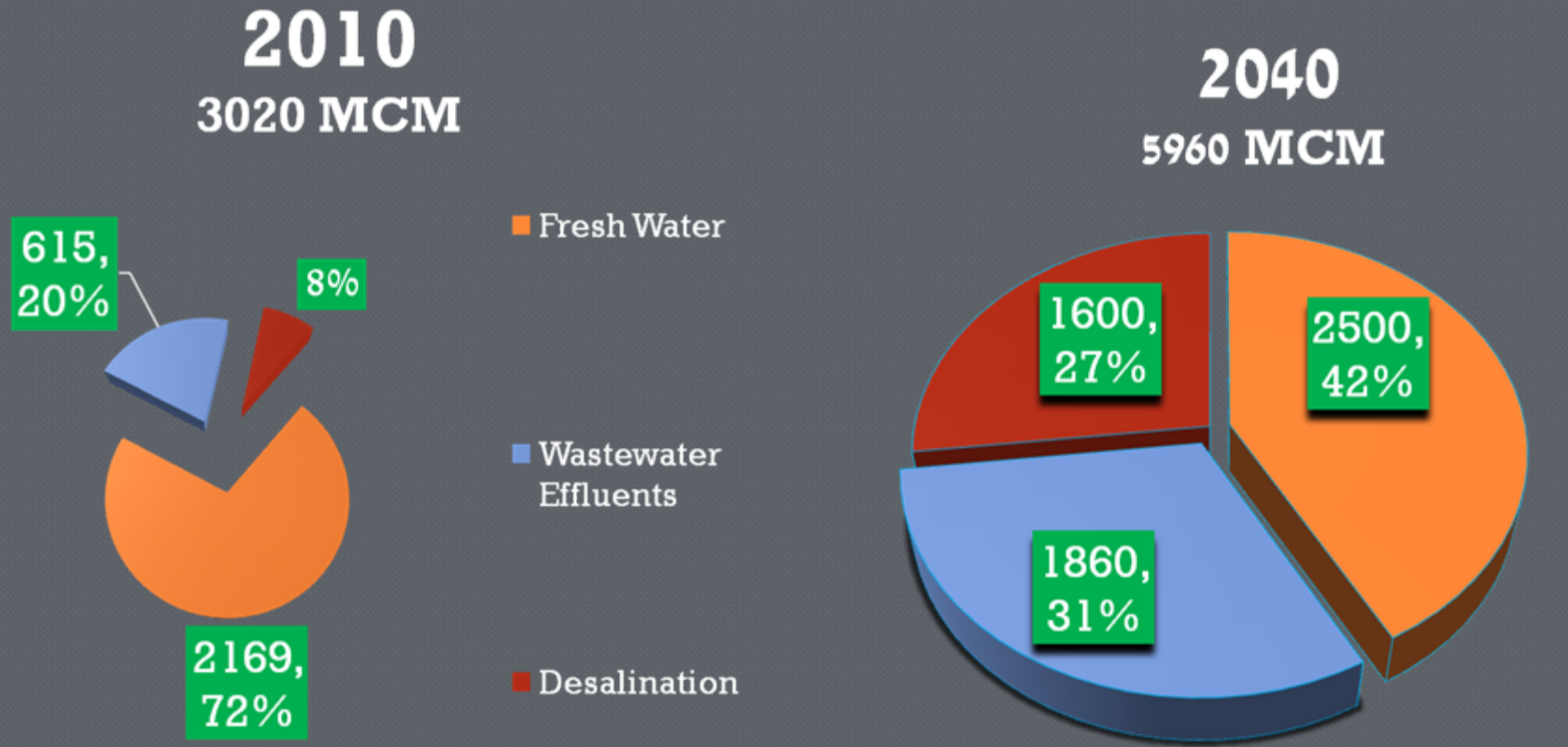
DRINKING WATER SUPPLY (M3/CAP/YEAR)



TOTAL WATER SUPPLY (M3/CAP/YEAR)



Regional Water Supply - 2010 & Projections 2040



Water Scarcity Alleviation
Water Resources Development Options

- Improved Management & Water Conservation
- Improvement of Irrigation Efficiency
- Wastewater Reuse
- Desalination of Brackish and Sea Water

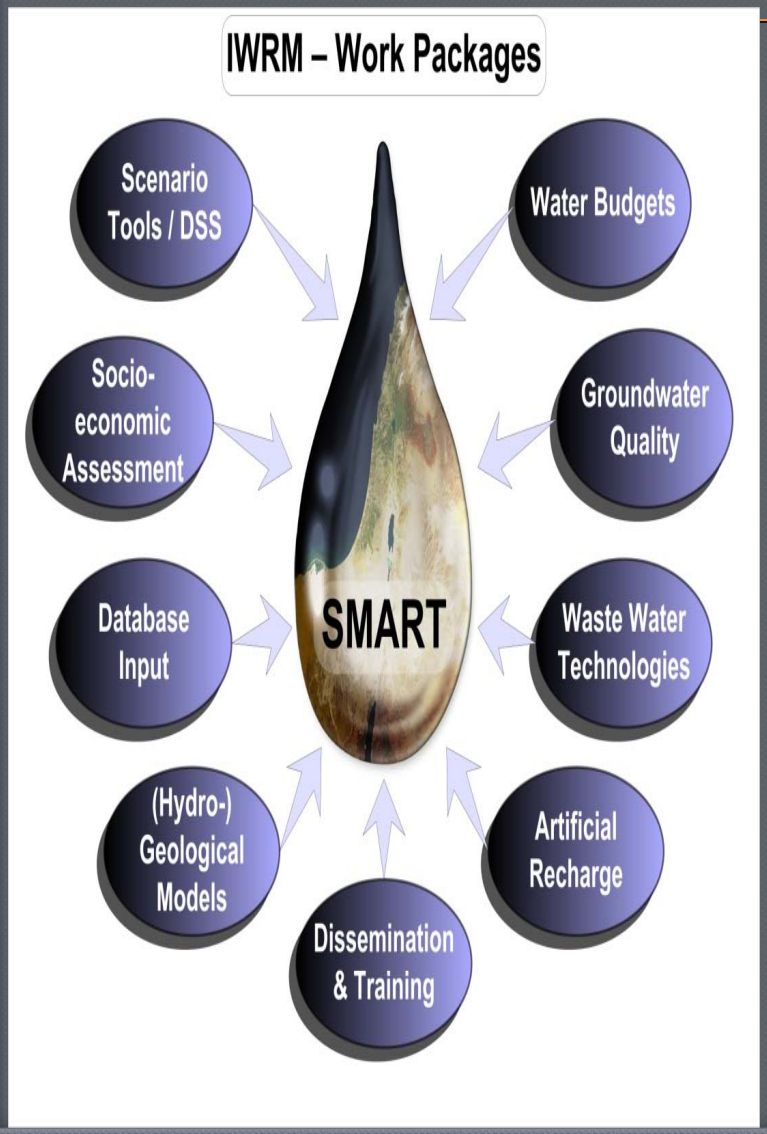
WATER DEMAND MANAGEMENT

7.1

Adoption of the Integrated Water Resources Management (IWRM)

"Coordinated development and management of water and related resources, to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems"

IWRM Principles



Institutional

1. Legislative framework – defining rules
2. Organisational framework
3. Regulatory instruments – allocation and water use limits

Water resources development

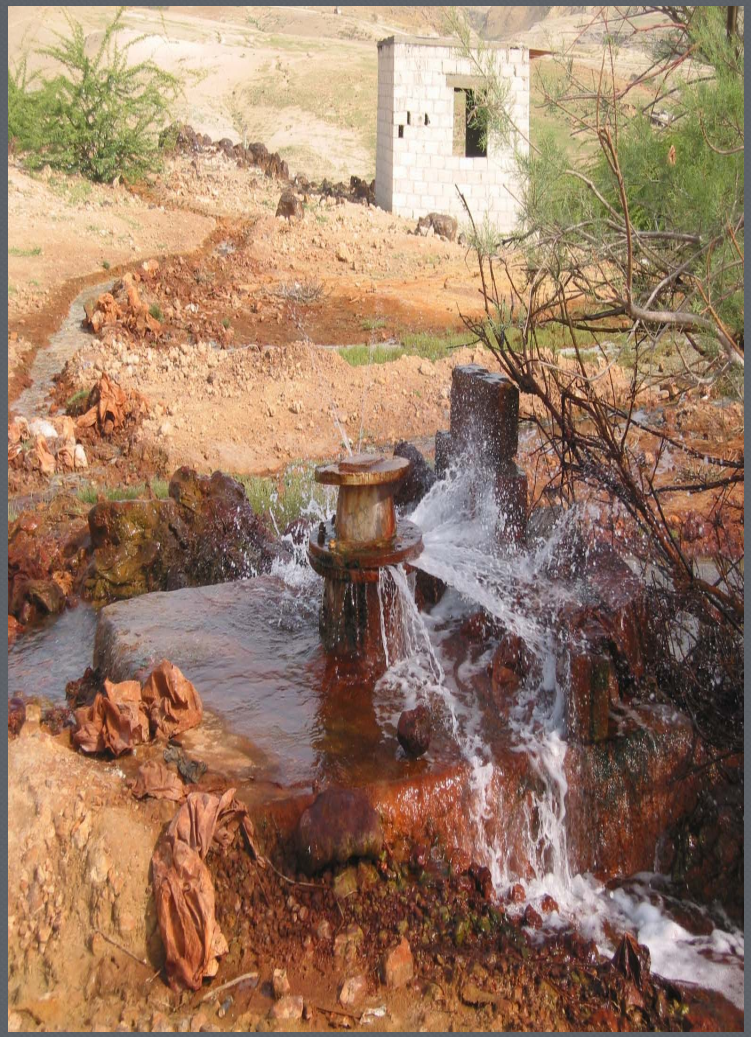
4. Available resources and needs
5. Development options,

Demand management

6. Social change instruments – encouraging water oriented society
7. 8. Economic instruments – cost and prices

Capacity development – awareness raising -information management

Improved management of the Water Supply systems

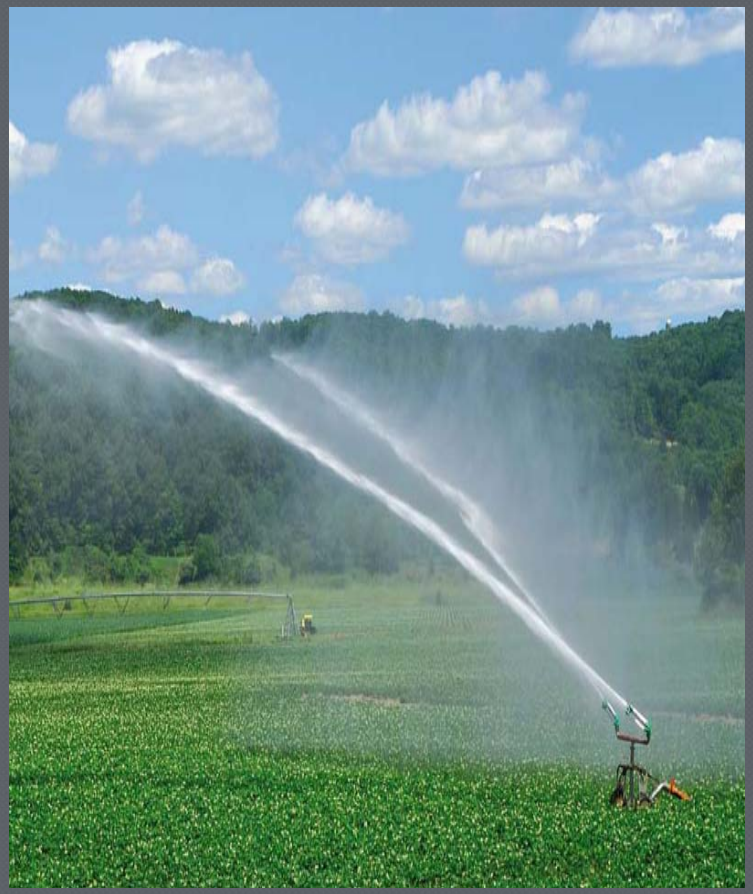


- Efficient Operation of the conveyance and distribution systems
- Adequate preventive, periodic and curative maintenance
- Rehabilitation of the deteriorating infrastructure,
- Imposing tariffs, billing and collect revenues
- Adequate funding,
- Public awareness and education

Improvement of Irrigation

7.2

Improved and Efficient Agricultural Irrigation Systems

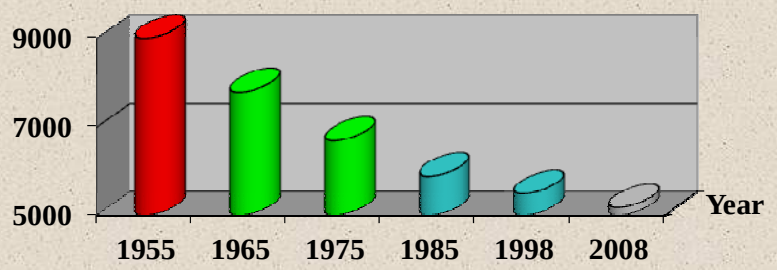


- Production of highly productive crops, less demanding in water
- Use of Improved ultra low volume irrigation techniques,
- Development of salinity tolerant varieties, adjusted to irrigation with brackish and secondary effluents.

Evolution of Advanced Irrigation Systems

TRENDS IN IRRIGATION EFFICIENCY 1950 - 2008

M^3/Ha



Gravity **Sprinkler** **Drip/Automation**

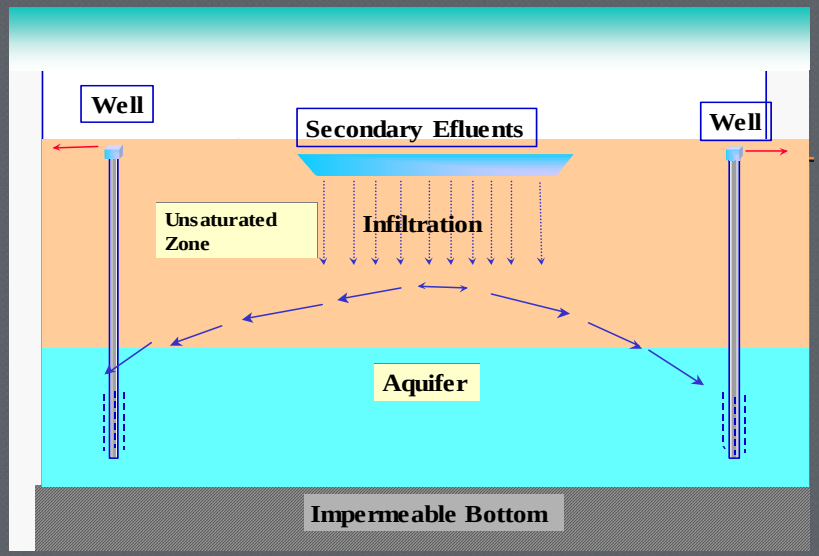
Wastewater Reuse

7.3

Wastewater Reuse

Wastewater recycling is now worldwide recognized as a potential solution to augment water supply under water scarcity conditions.

Wastewater Treatment and Reuse Systems



ADVANCED TREATMENT (Tertiary Effluents):

- Biological Treatment
- Soil aquifer treatment,
- To produce high quality effluent for unrestricted non-potable usages.

SECONDARY EFFLUENTS

- Biological treatment,
- Long detention period, in surface reservoirs,
- To produce effluents for restricted irrigation of non- edible crops.

Wastewater Treatment Systems and Resulting Effluents Quality

Parameter	Raw Swage		Treatment	
	Dan Region	Haifa	SAT	Surface Reservoir
Suspended Solids	**380**	**750**	**0**	**33**
BOD	**430**	**595**	**0.5**	**8**
COD	**1050**	**1400**	**9**	**87**
MBAS	**11**		**0.2**	**0.3**
T. Nitrogen	**62**		**3.6**	**16**
EC	**1820**		**1675**	**2425**
T. Coli.	**$8.2\ 10^3$**			**130**
F. Coli.	**$7.2\ 10^3$**		**0**	**25**

Benefits and Potentioal Risks of Wastewater Reuse

Benefits :

•Available 365 days a year, in reliable and predictable quantities,
•Quantities are not normally reduced during a drought,
•The price is negotiable - Cheaper than fresh water, and
•The environment benefits - no discharge of wastewater effluents into natural water bodies.

Potential Risks and Constraints

•Groundwater pollution and soil salinity
•Potential ill effects and health risk
•Acceptability by consumers
•Institutional and funding constraints - Capital intensive and economic viability
•Risk assessment studies and continuous monitoring systems are required

DESALINATION

7.4

Israel

0.7 Mm^3/d

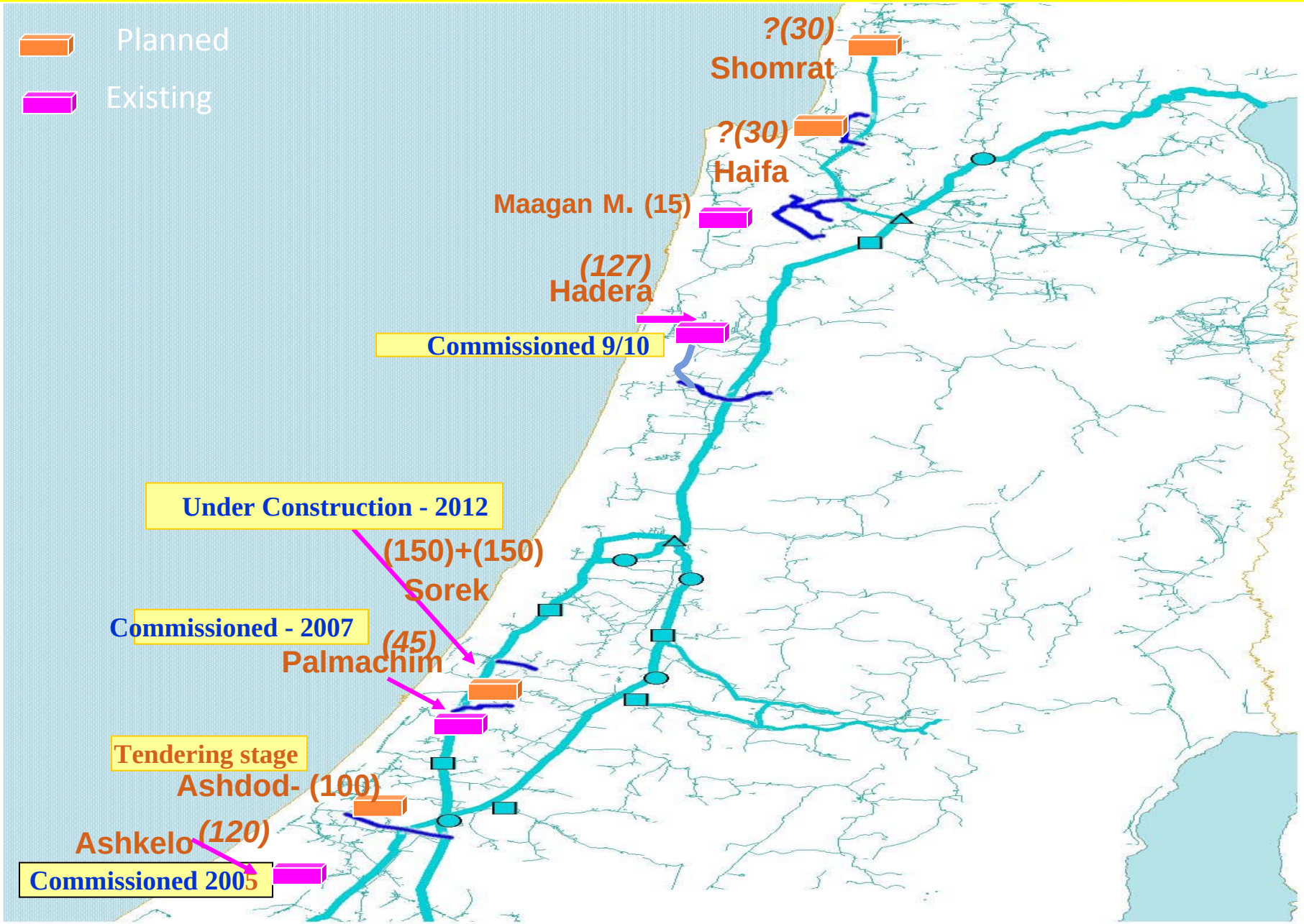
+ 1 Mm^3/d

2.1 – 2.7 Mm^3/d ?

(2020)

	Mm^3/year	m^3/day
Ashkelon	110	301,370
Hadera	127	347,945
Palmachin	34	93,151
Ashdod	100	273,973
Sorek	150	410,959
total	521	1,427,397

Seawater Desalination Plan & Plant Locations and Capacity 2005 - 2020



.ASHKELON SWRO DP 120 MCM

Palmachim SWRO DP 45 MCM

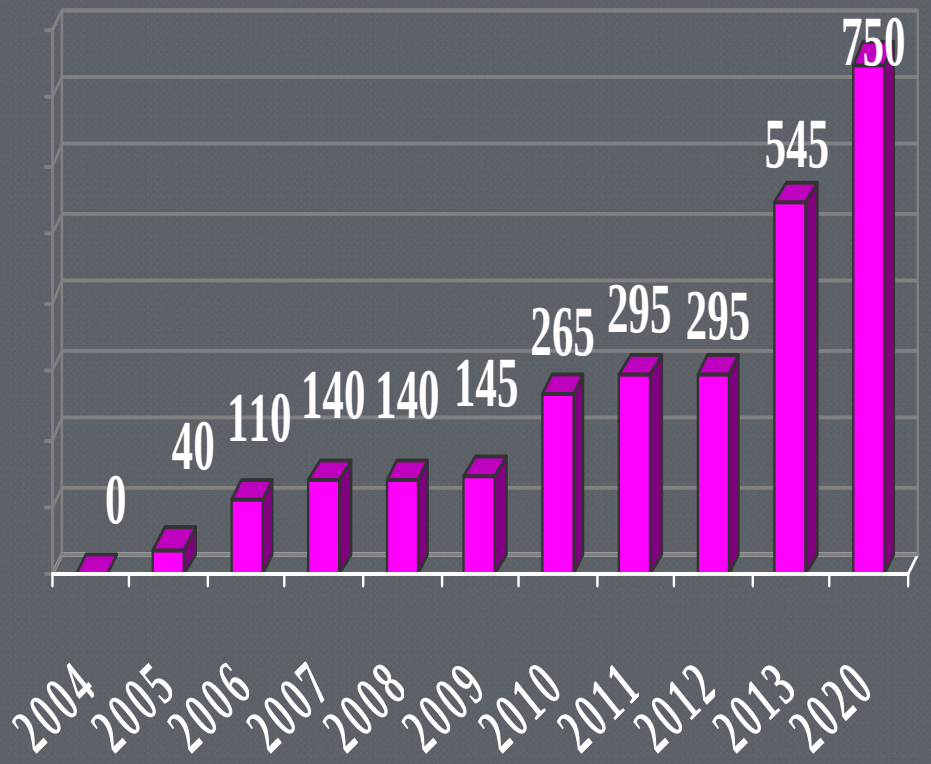
Hadera SWRO DP 127 MCM

Sorea SWRO DP 150 MCM

Ashdod SWRO DP 100 MCM

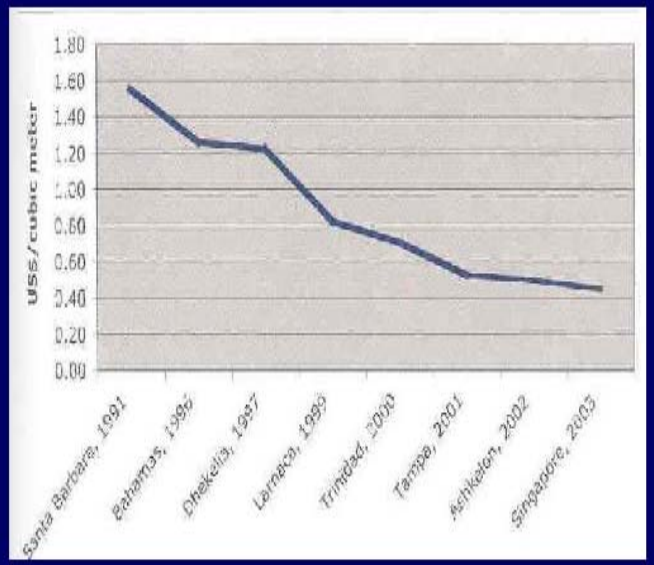
Sea Water Desalination Plan

Pressure Vessels Containing RO Membranes



Evolution of Price for SWRO System

True Cost of Desalinated Water



The cost is reduced to a level to compete with traditional water supply options

WATER AUTHORITY

STATE OF ISRAEL

Water Desalination Prices ($) Per CM

(VAT not included)

Project name	Ashkelon	Palmachim	Hadera	Sorek
Fixed price	0.4	0.35	0.25	0.25
Variable price	0.3	0.45	0.4	0.27
Total price	0.7	0.8	0.65	0.52

Capacity Building

8

Ongoing Regional Training & Research

Jordan, PA and Israel

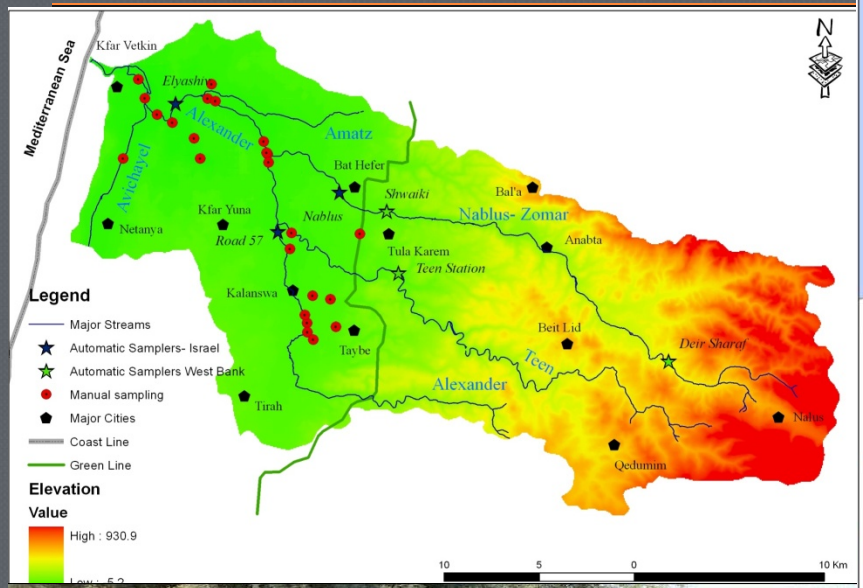
Major Projects

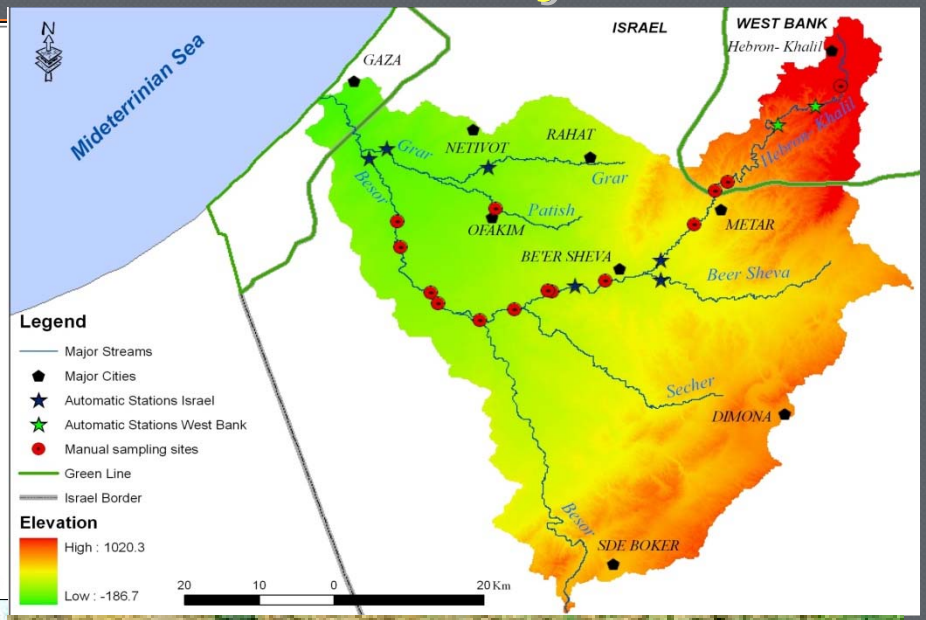
- Regional Water Data Banks Project - RWDBP,
- Middle East Desalination Research Center - MEDRC
- Effects of global climate change on natural ecosystems – SMART/ GLOWA,
- Red Sea –Dead Sea Canal
- Regional Drinking Water Quality Assessment - IUPAC Working Group

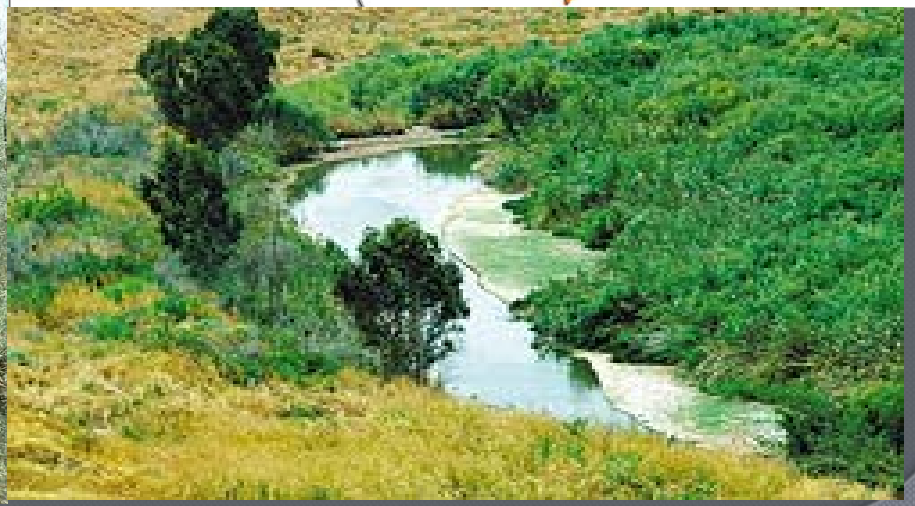
Major Research Areas:

- Data generation, data transfer and joint studies
- IWRM, and trans-boundary - shared water resources Management
- Hydro-geological studies
- Prevention of contamination of resources
- Utilization of marginal water resources (brackish water & effluents)

Trans-boundary Alexander, Nablus, Hebron and Bsor Watersheds Restoration Project

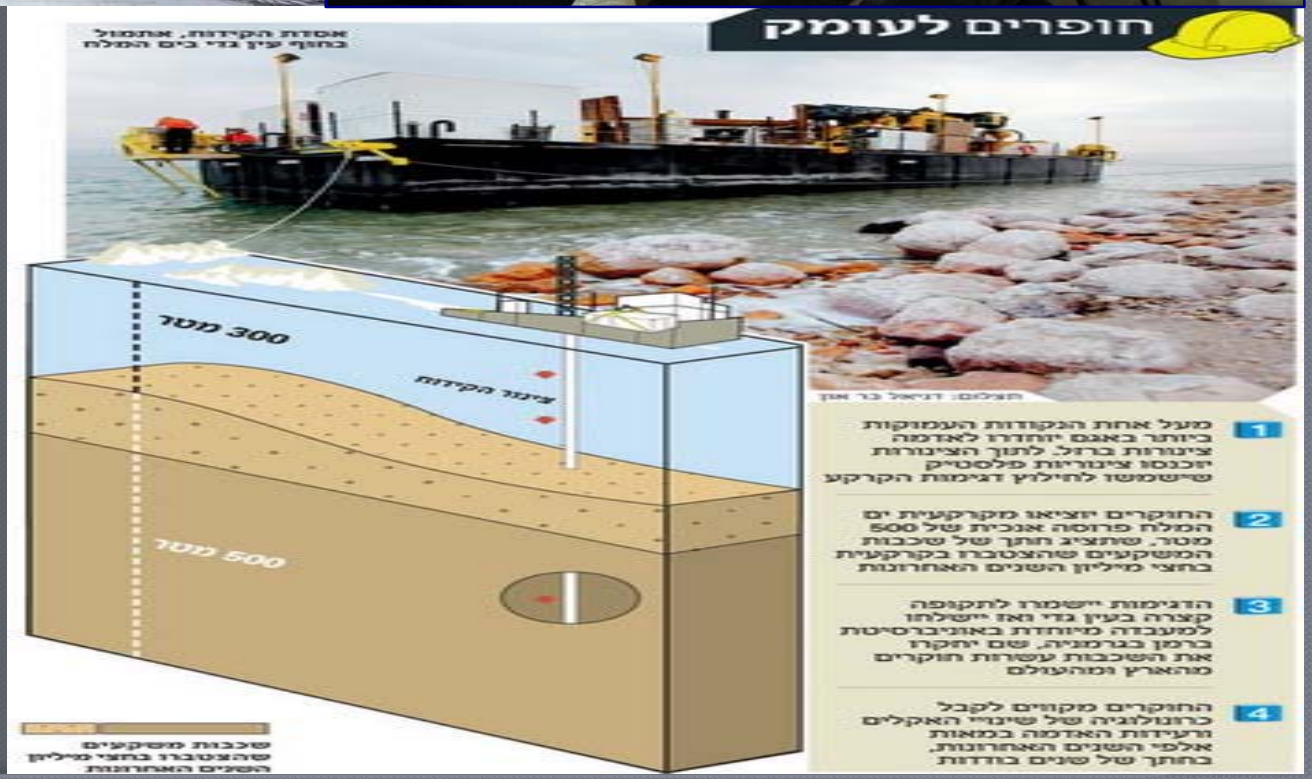






Dead Sea - Deep Core Drilling Project

2.5 million $ project, sponsored by ICDP and carried out by consortium of scientists from Israel, PA, Jordan, Columbia Univ, GFz Potsdam, Norway, ETH Univ, and Japan



CONCLUSIONS

Over exploitation of water resources in the region has reached the point where irreversible damage was done to some of the aquifers, contributing the widening gap between supply and demand which cannot be met without a drastic institutional reform and perceptions of water.

On the demand side, water conservation, efficient O&M of water services, cost recovery and appropriate agricultural and trade policies are essential

On the supply side, recycling of wastewater and desalination emerge as the major options to satisfy current and future water supply. Innovation and the private sector will significantly reduce the cost of water treatment and desalination, rendering non-conventional resources affordable to all

Despite political and economics differences, the regional water crisis may shape a common water policy, selecting joint feasible projects, irrespective of political boundaries, *giving rise to* cooperation and a base for peace

Acknowledgement

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Promoting collaborative and regional environmental studies in the Middle East.


THANK YOU