

GLOWA Jordan River

Integrated Green and Blue Water Management

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Hohenheim, Germany, 15 December 2006



GLOWA

GLOWA Jordan River



Jordan River Basin:

extreme and further increasing water scarcity

transboundary surface and groundwater resources

GLOWA Jordan River:

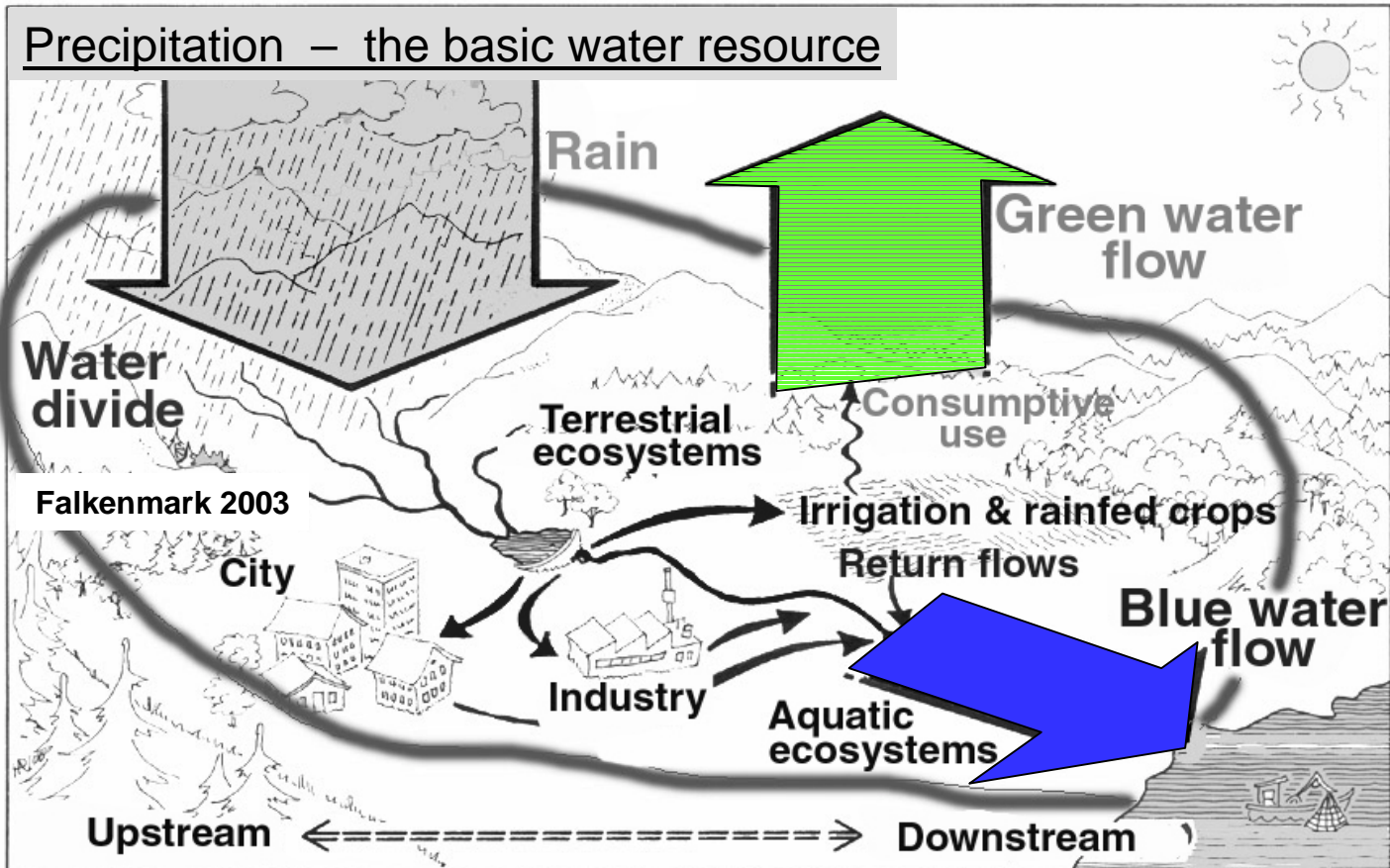
providing scientific support for integrated water management

integrating across disciplines, countries and stakeholders through

- scenario development (SAS)
- WEAP

Green-blue water concept

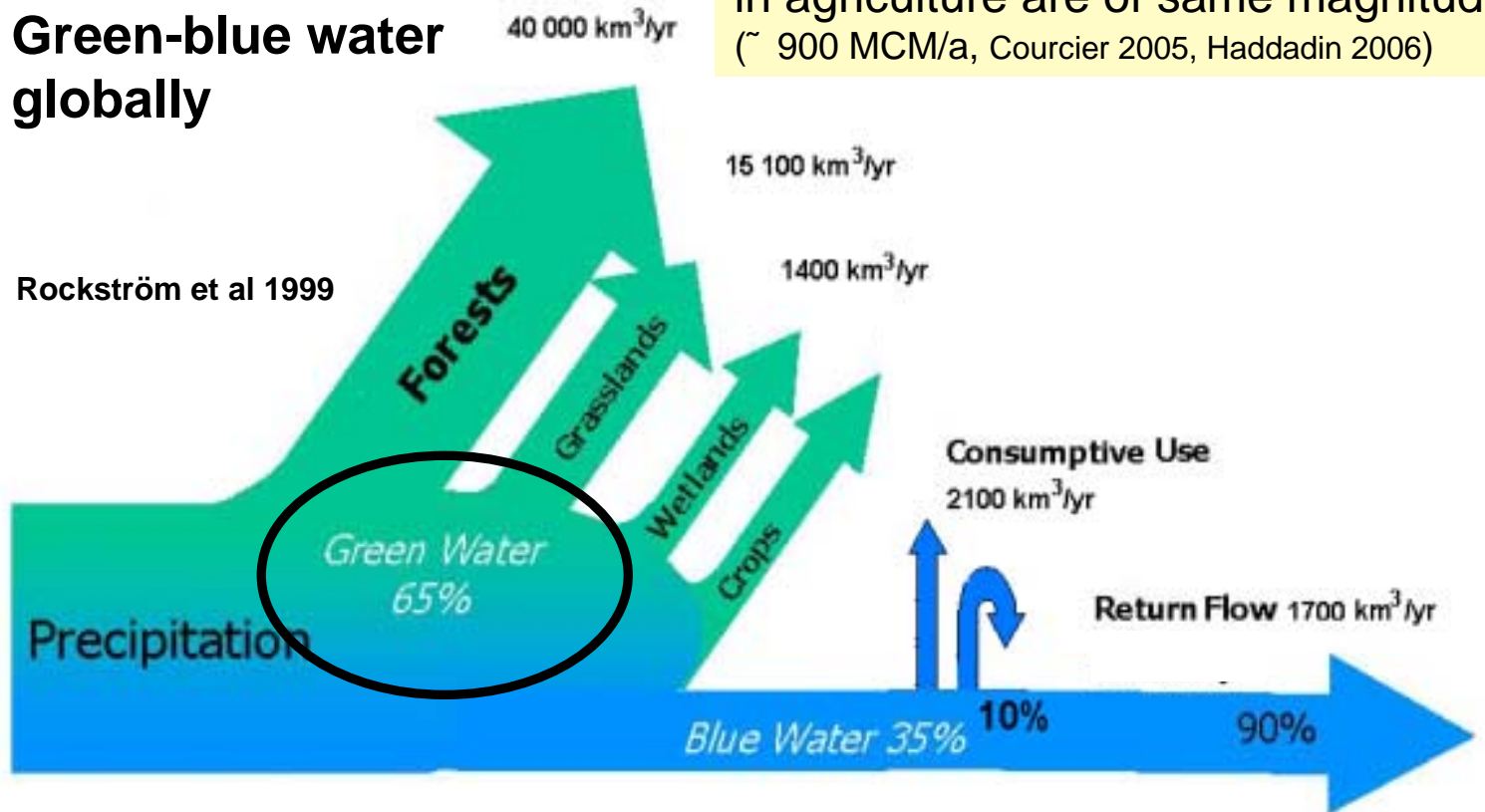
Precipitation – the basic water resource



Green-blue water concept

Green-blue water globally

Rockström et al 1999



In Jordan green & blue water fluxes in agriculture are of same magnitude (~ 900 MCM/a, Courcier 2005, Haddadin 2006)

**Land use impacts
on green and blue water fluxes,
on runoff generation and groundwater recharge,
and on water productivities,
are largely ignored in water management**

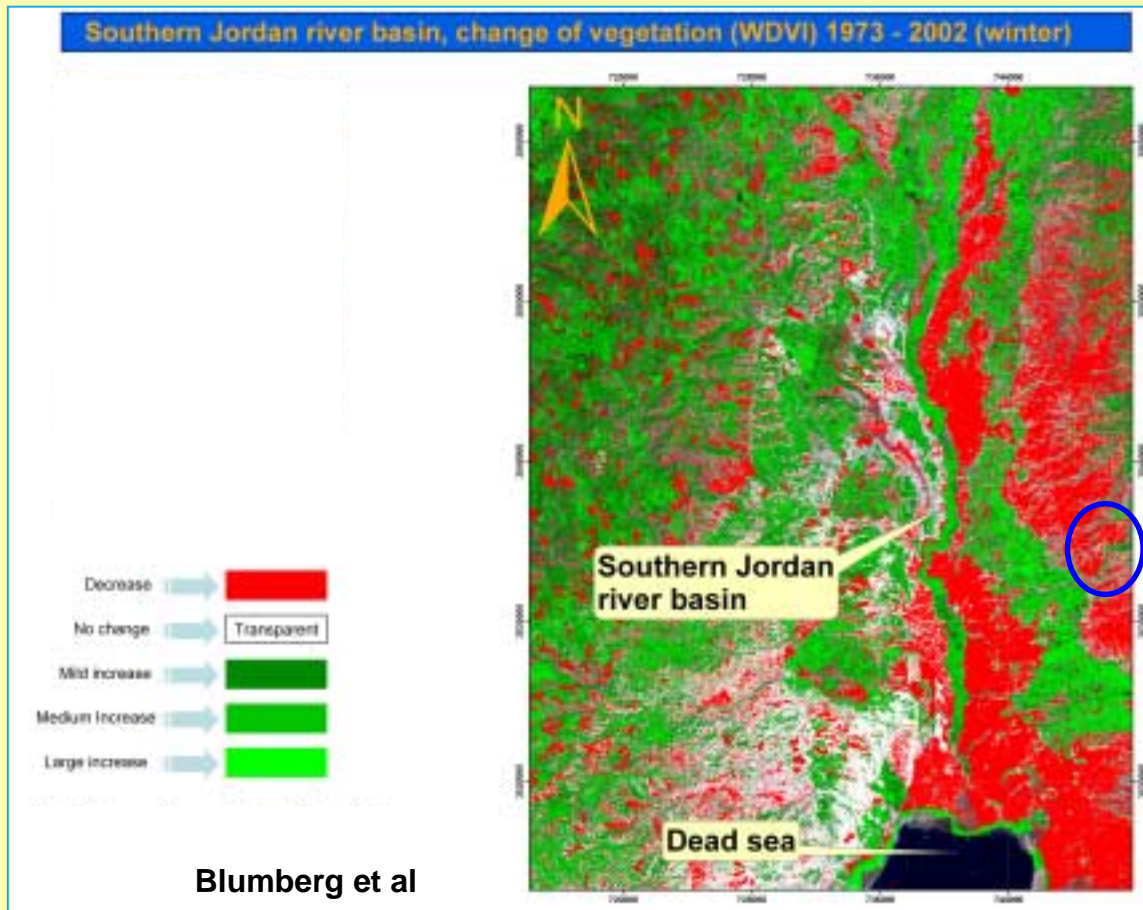
**GLOWA JR quantifies land use change effects
on water resources for:**

- agriculture
- grazing
- afforestation
- urbanization



Land use change in the Jordan River catchment

from space...



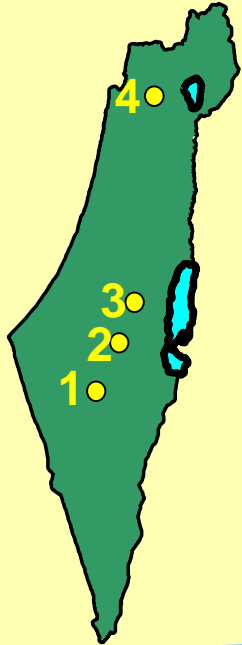
**Land use
change in the
Jordan River
catchment**

**and on the
ground**

**Land use change
grazing – exclusion experiments**



Ecosystem green water productivity



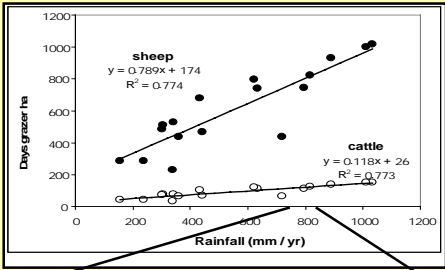
Climate change
space-for-time approach



manipulation of
precipitation



Ecosystem green water productivity



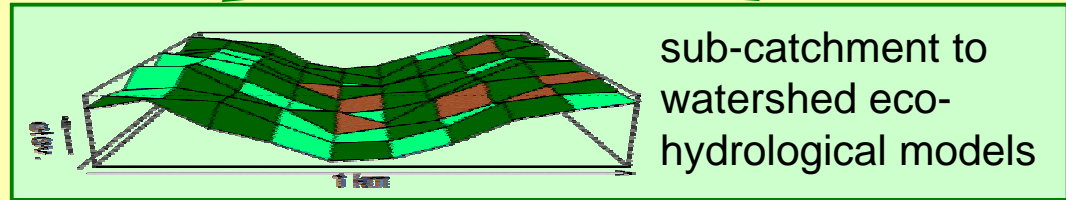
rainfall-productivity relationship

leaf-area-index (3 life-forms)

carrying capacity recovery rate

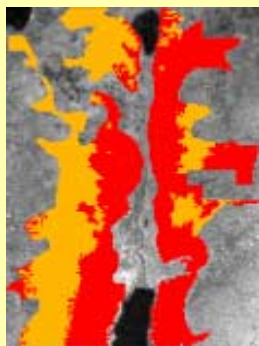
parametrization

validation

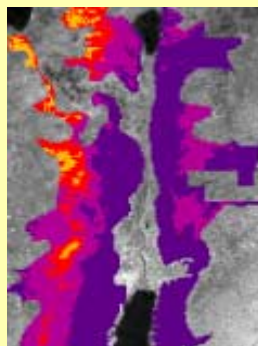


Scenarios of climate and grazing -> simulated biomass change

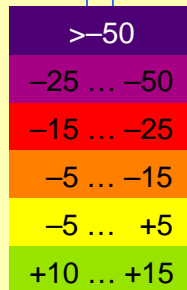
A2 scenario (decrease of MAP)



no grazing



intensive grazing



B2 scenario (increase of MAP)



no grazing



intensive grazing

as LAI further used in SVAT modelling for green water flux simulations

Improving green water productivity in agriculture

field experiments and crop modeling
to assess potential for water savings
and increasing water productivity

1) focus in PA on:

- intercropping and traditional vs. high-yielding crops

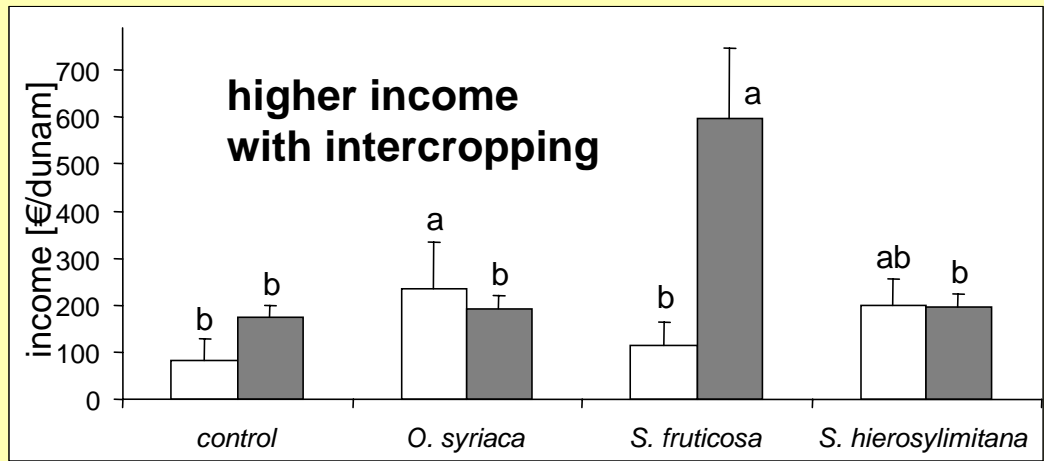
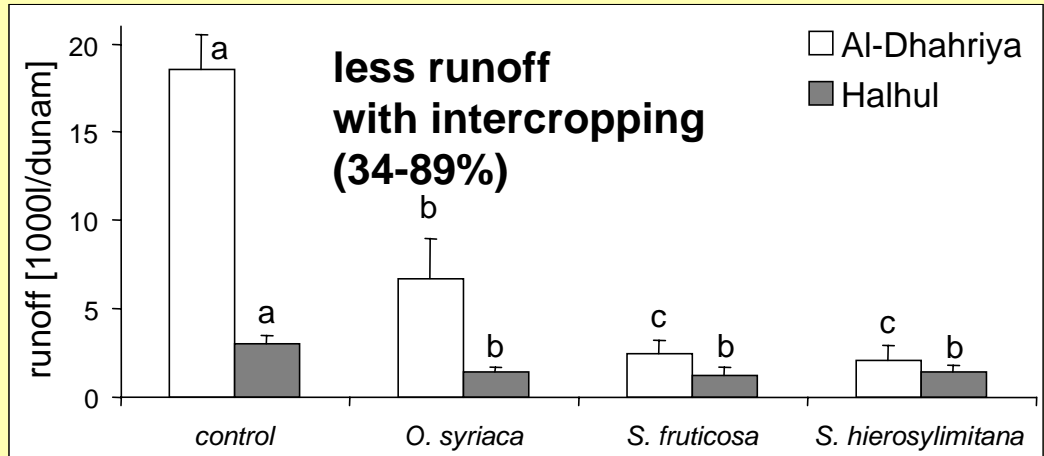
2) focus in Israel on:

- reducing unproductive evaporation, e.g. through soil cover
- increasing run-on (rainwater harvesting)

Intercropping in the West Bank

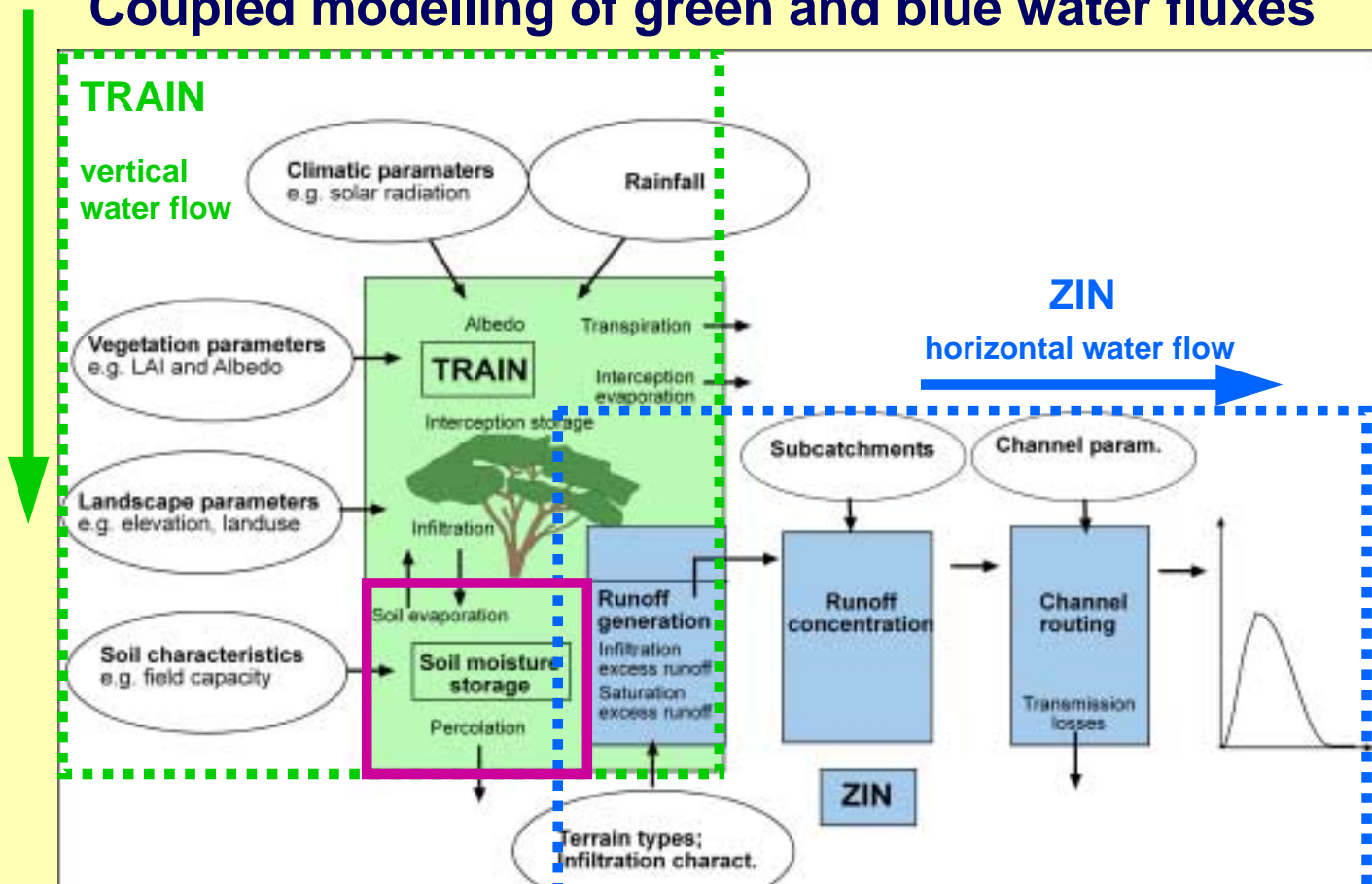


Intercropping



Green and blue water fluxes

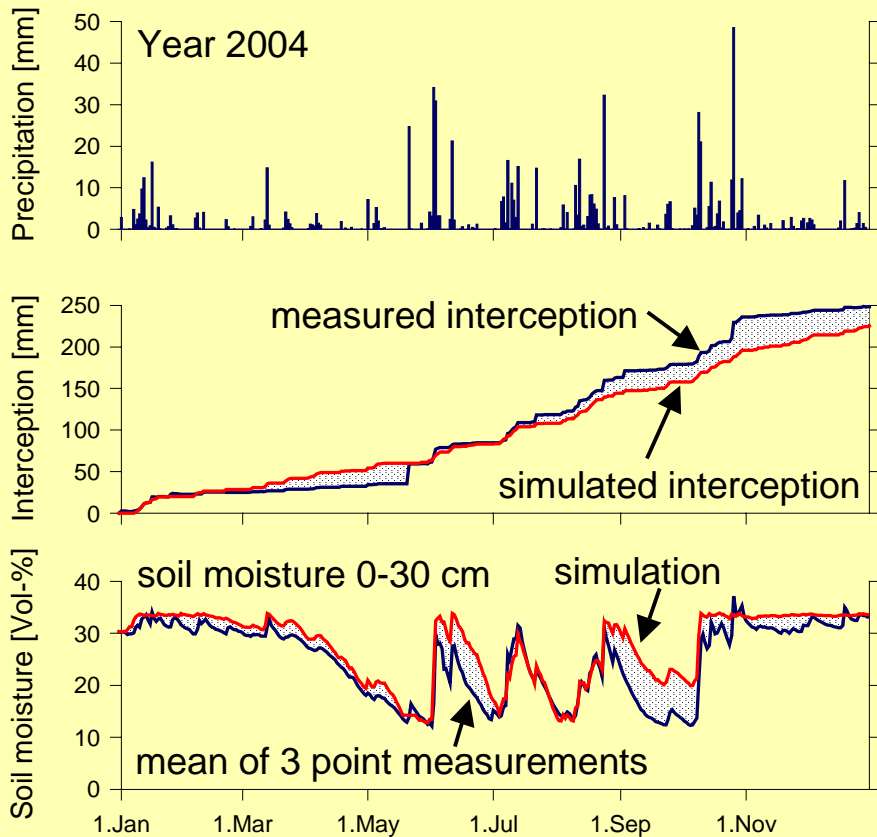
Coupled modelling of green and blue water fluxes



SVAT modelling of green water fluxes

example result

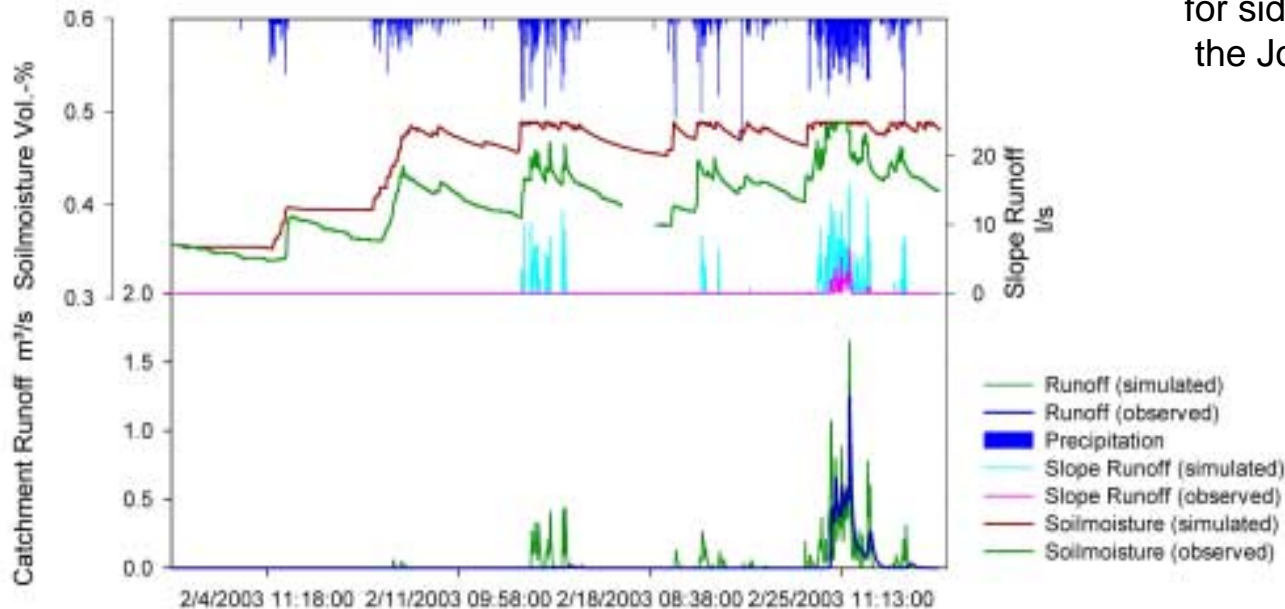
SVAT modeling of
pine forest



SVAT modelling of green water fluxes

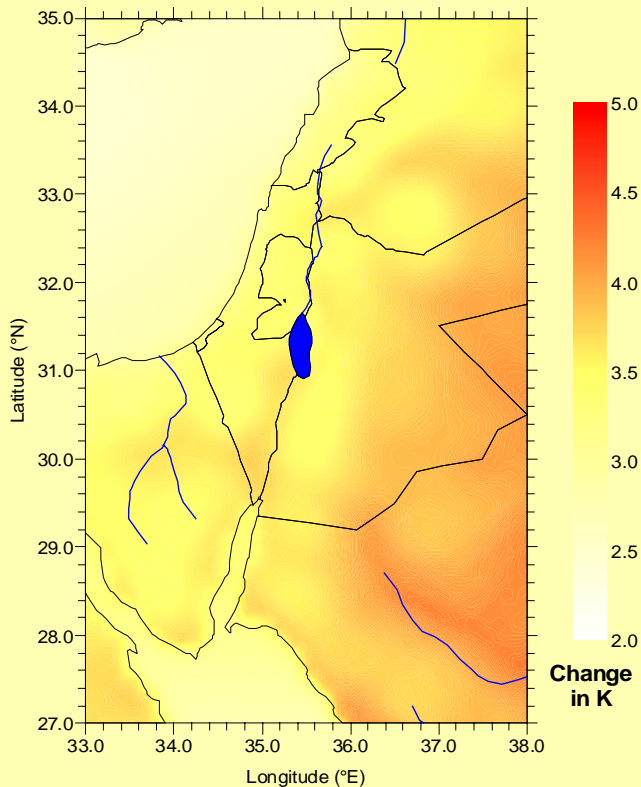
example result

rainfall – runoff model
for side wadi of
the Jordan river

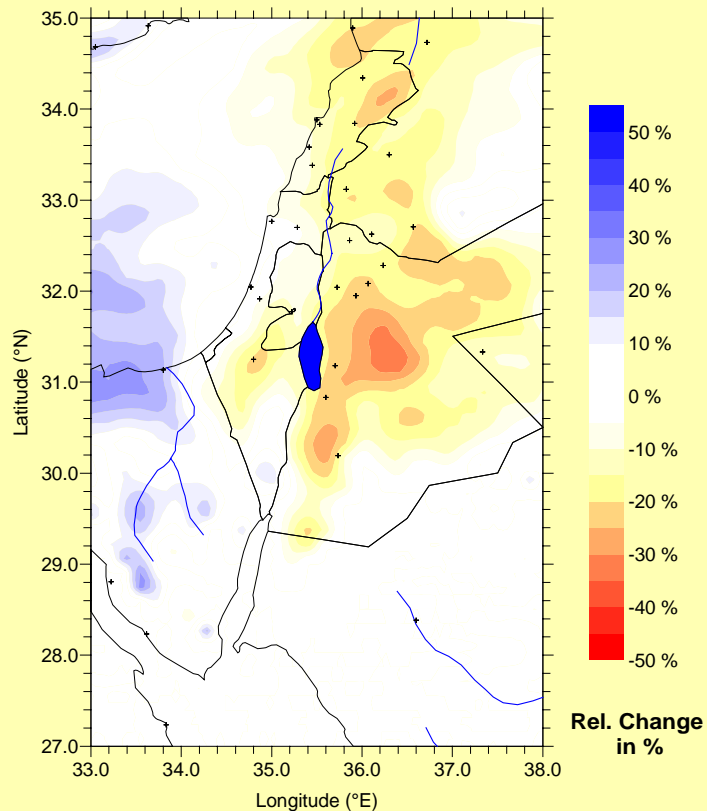


coupling of TRAIN and ZIN underway

Climate change scenarios

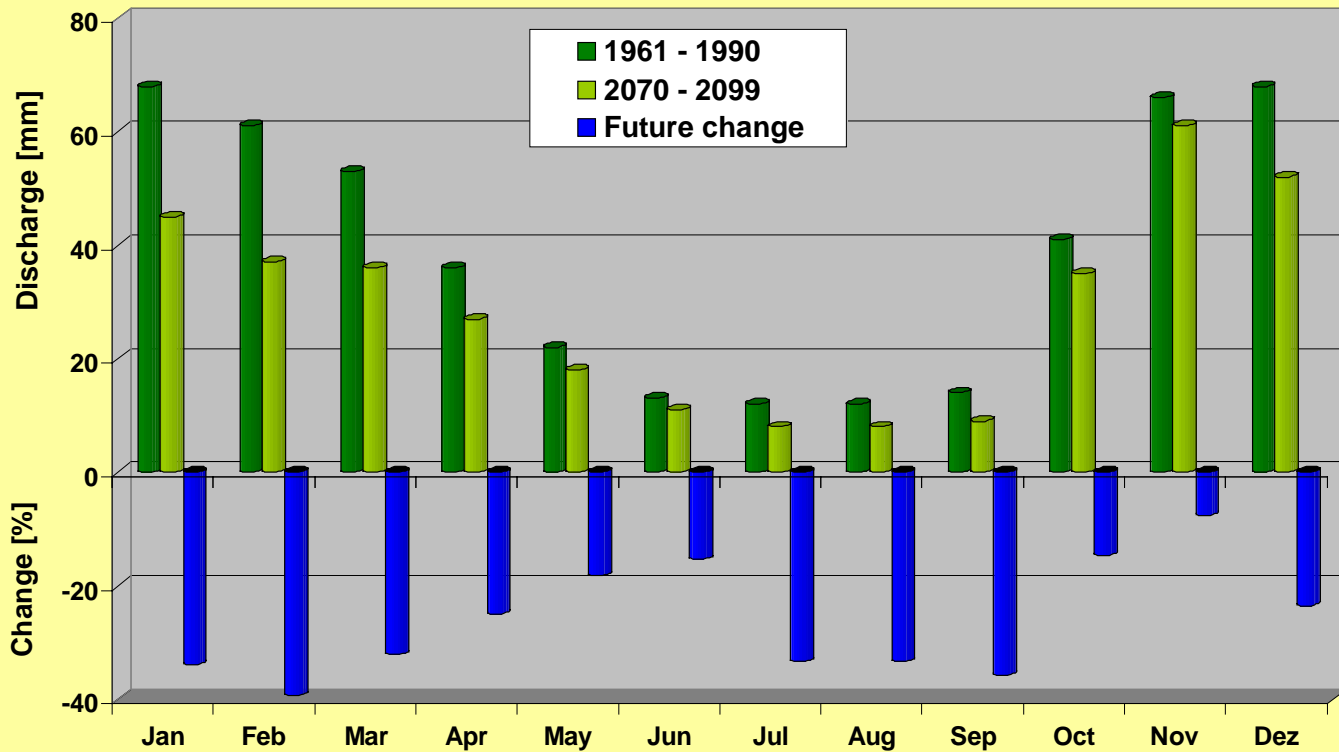


change in mean annual temperature



and precipitation

Climate change effects on blue water fluxes

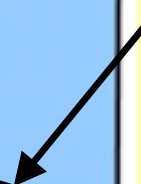


Upper Jordan River


Economics of green and blue water

	GREEN	BLUE
Water Flow		
Water Use		
DIRECT	ECONOMIC USE Rainfed food, timber, fibres, fuelwood, pastures, etc.	ECONOMIC USE Irrigation, industry and domestic uses
INDIRECT	ECOSYSTEM SERVICES Terrestrial biodiversity, climate regulation, etc.	ECOSYSTEM SERVICES Aquatic biodiversity, recreation, etc.

**initial focus:
blue water for
irrigation**



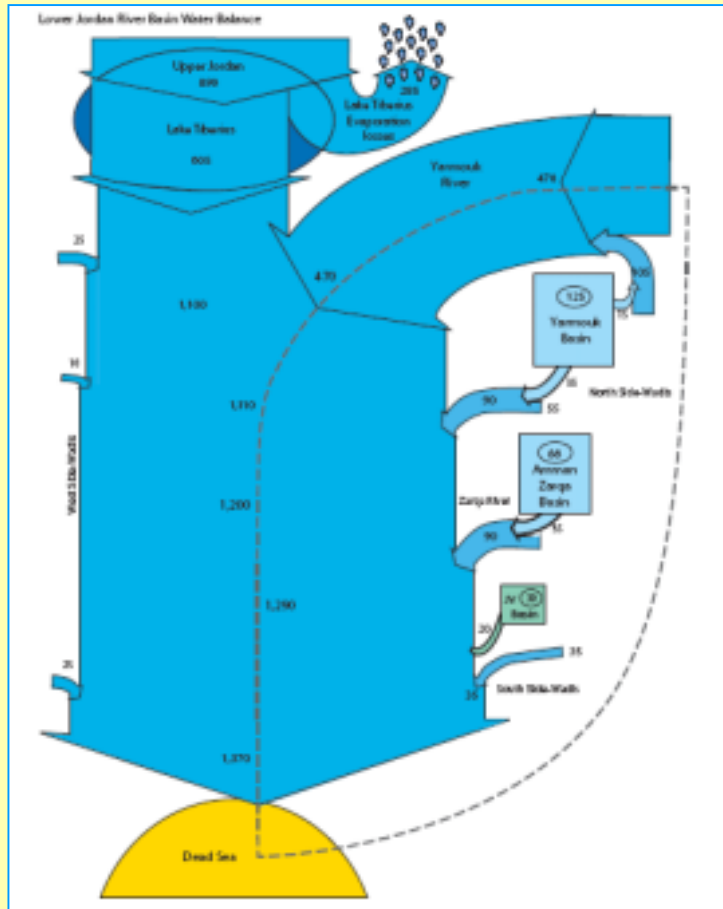
**next:
productivity of
green and blue
water in all its uses,
including
ecosystem goods
& services**



Socio-economic tools in GLOWA JR

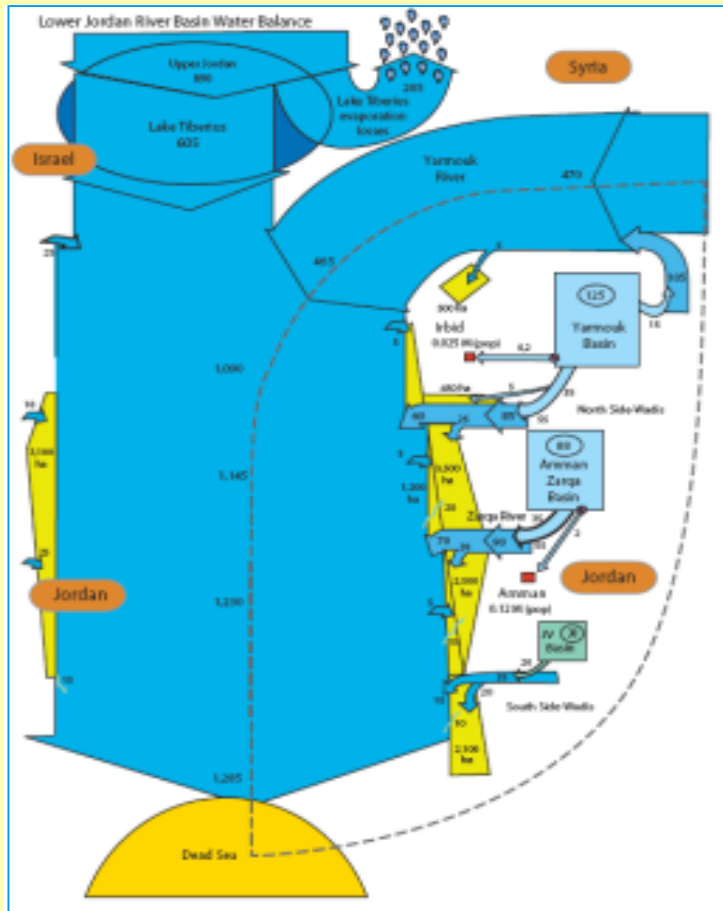
- production function models for key crops and regions
- economic optimization models for different farming systems
- willingness to pay analyses for different land uses
- analyses of adaptive land & water allocations in agriculture

The Jordan River system



natural

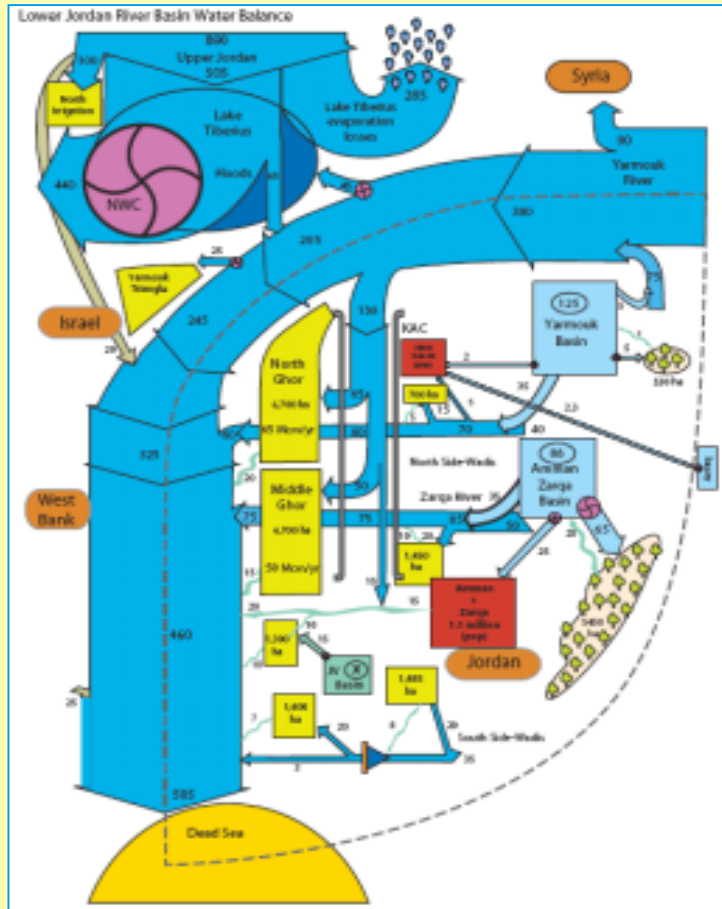
The Jordan River system



1950

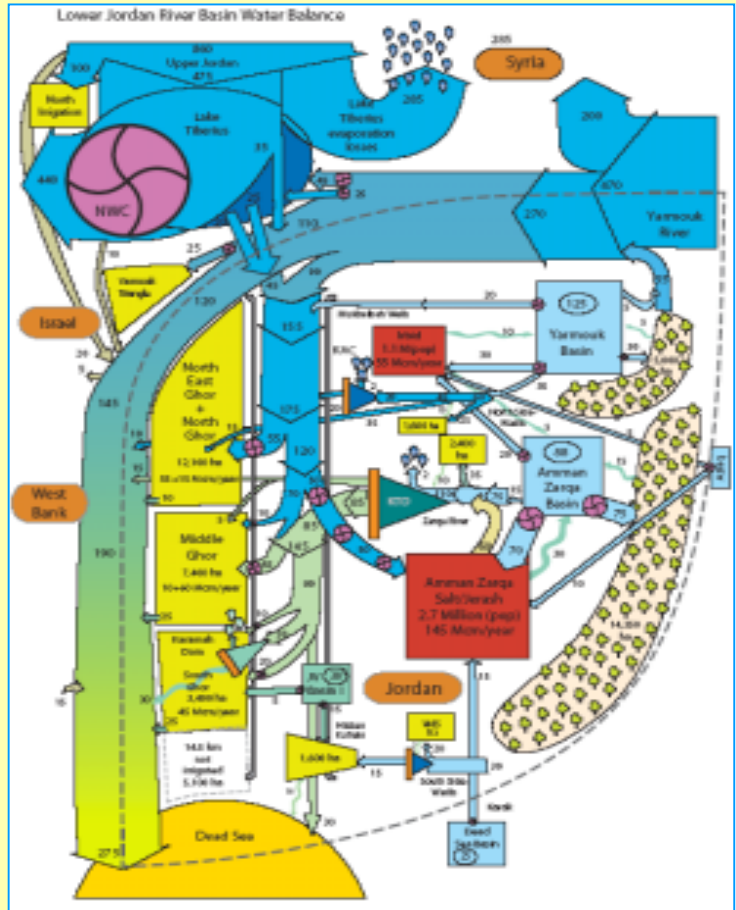
The Jordan River system

mid 70s

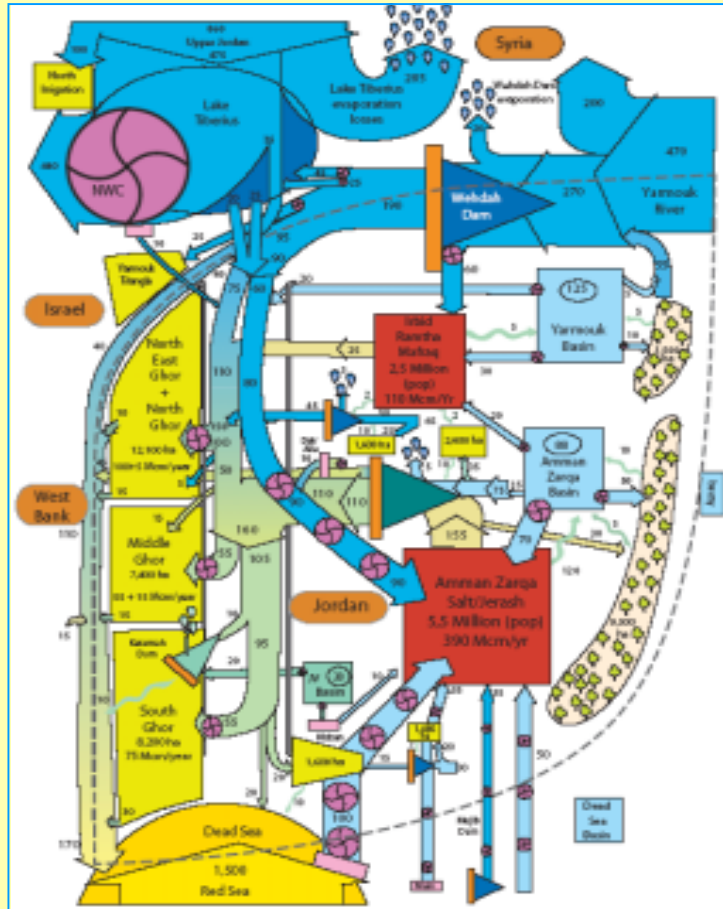


The Jordan River system

2000



The Jordan River system

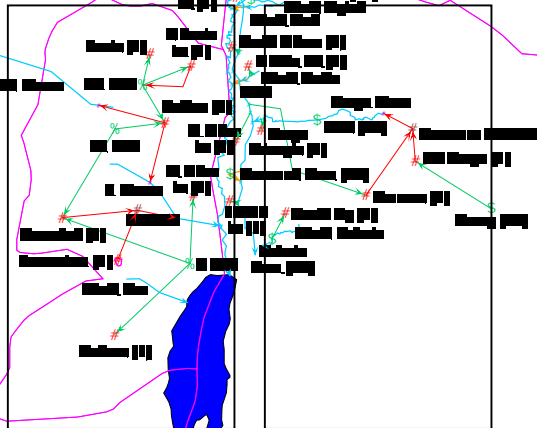


2025 ?

WEAP in GLOWA JR representing:

**3 sub-systems -> as a basis for simulating the
er system**

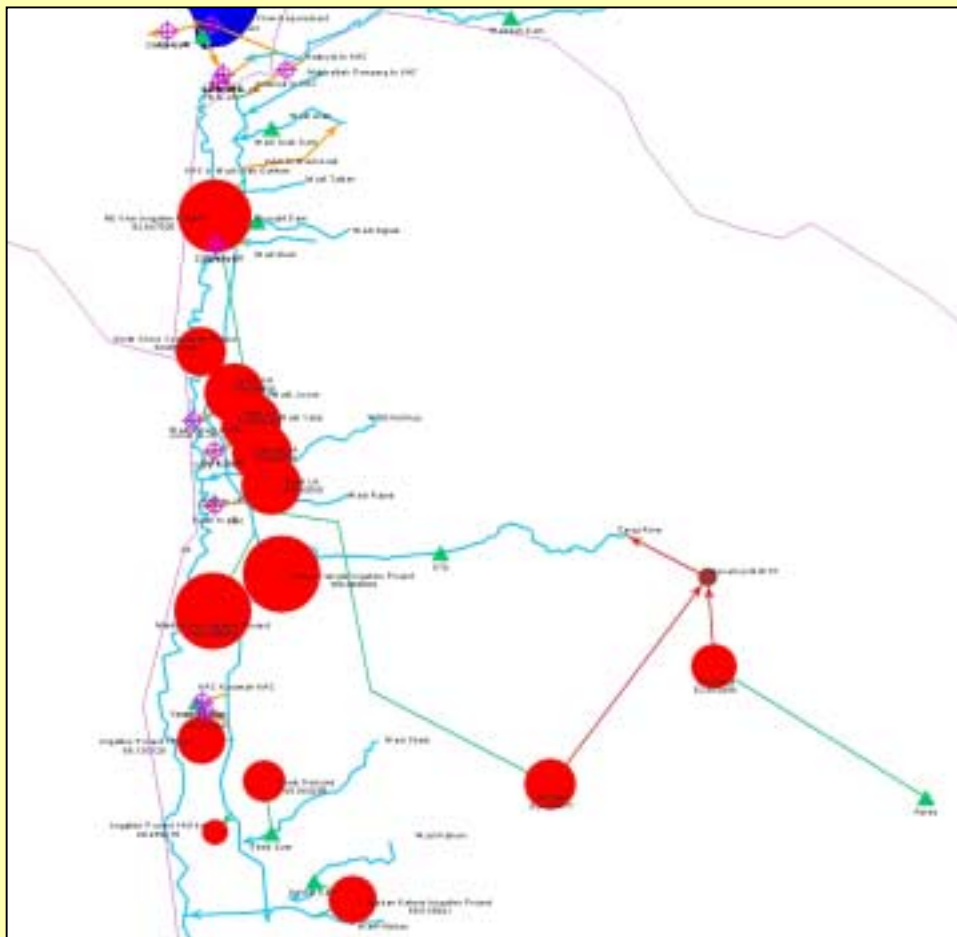
- 1) West Bank (Palestine)
- 2) Jordan Valley (Jordan)
- 3) Upper Jordan River (Israel)
- 4) Regional Transboundary



WEAP Jordan Valley

data synthesis

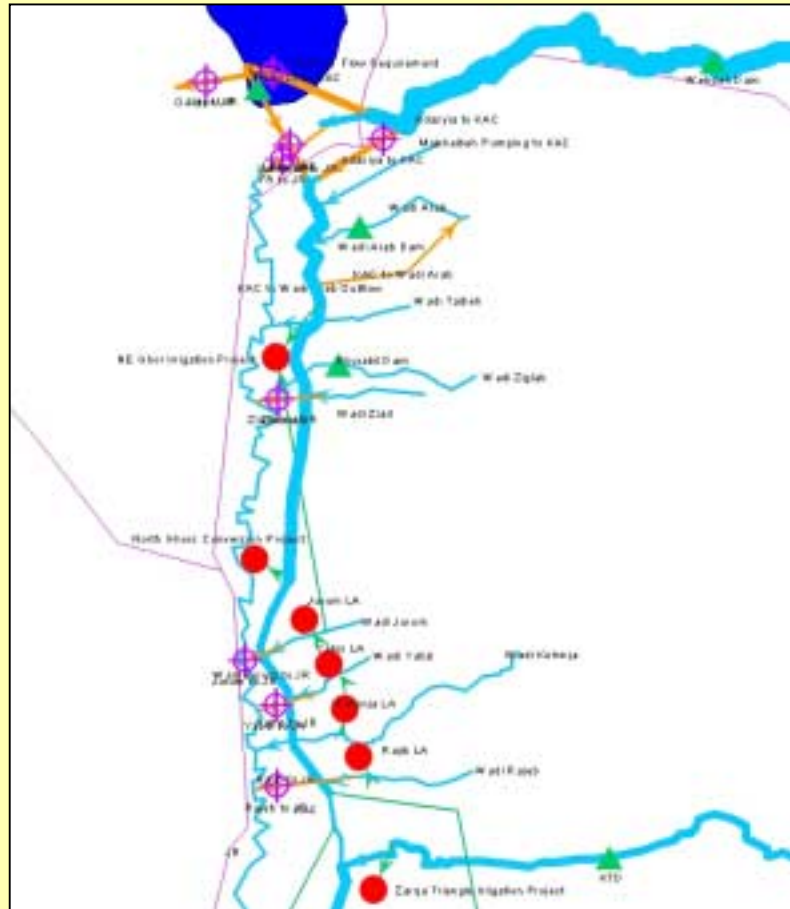
	2004
AZ Zarqa	12.8
Amman	33.9
Hisban Kafrein Irrigation Project	5.9
Irrigation Project 14.5 km	5.2
Irrigation Project 18 km	27.2
Jurum LA	0.1
Kufrinja LA	0.2
NE Ghor Irrigation Project	4.0
North Ghors Conversion Project	22.2
Rajib LA	0.0
Sheib Demand	3.7
Yabis LA	0.0
All Others	0.0
Sum	115.2



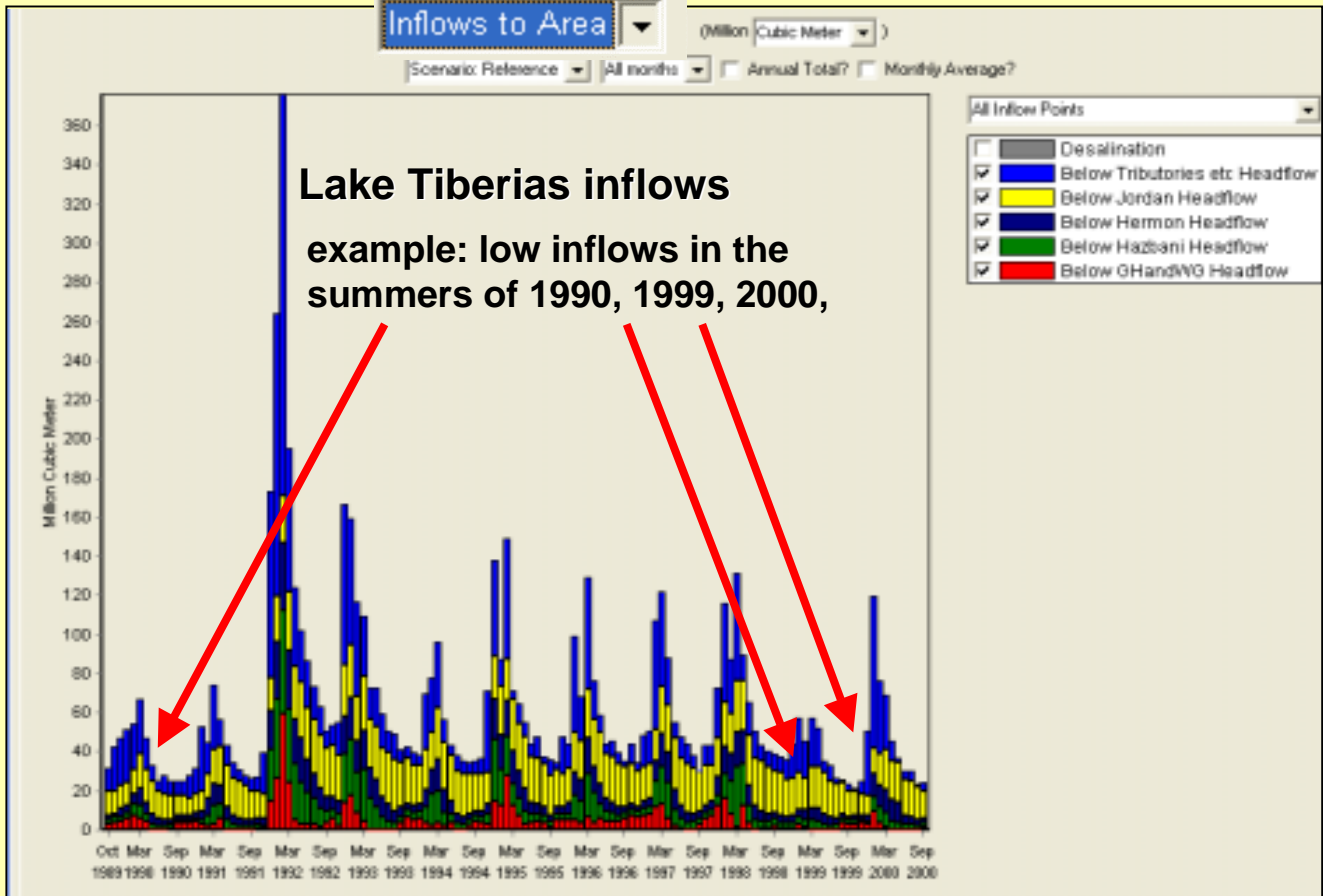
WEAP Jordan Valley

streamflows =
headflows + tributaries
- demands

	2004
Adasyia to KAC 0. Headflow	68.0
Adasyia to KAC 1. Adasiya to KAC	68.0
Adasyia to KAC 2. Reach	68.0
JR 0. Headflow	0.0
JR 1. Yarmouk to JR Inflow	3.9
JR 2. Reach	3.9
JR 3. Wadi Taibeh to JR Inflow	4.3
JR 4. Reach	4.3
JR 5. Ziad to JR Inflow	4.5
JR 6. Reach	4.5



WEAP – Upper Jordan River





WEAP – Upper Jordan River

Water Demand (not including loss, reuse and DSM)

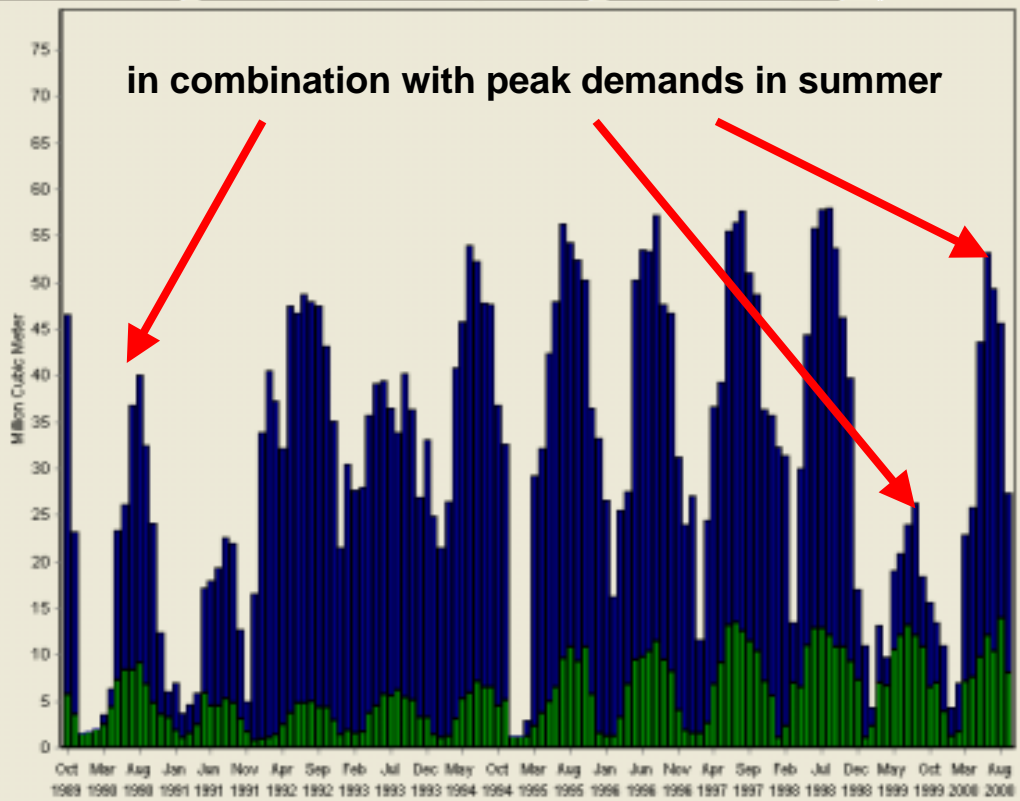
Cubic Meter

Total? Monthly Average?

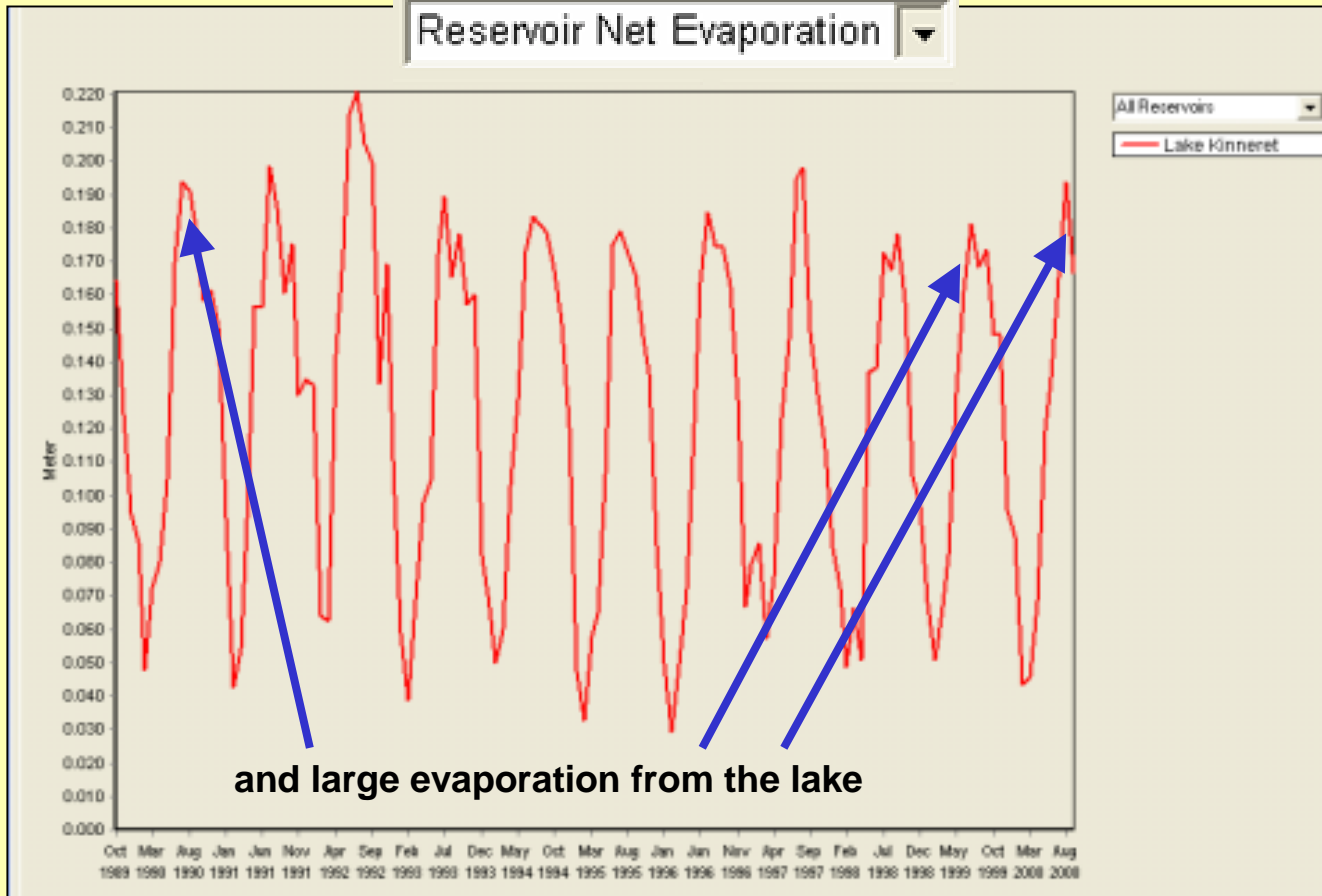
All Branches

- NWC
- Local Pumps
- Hula

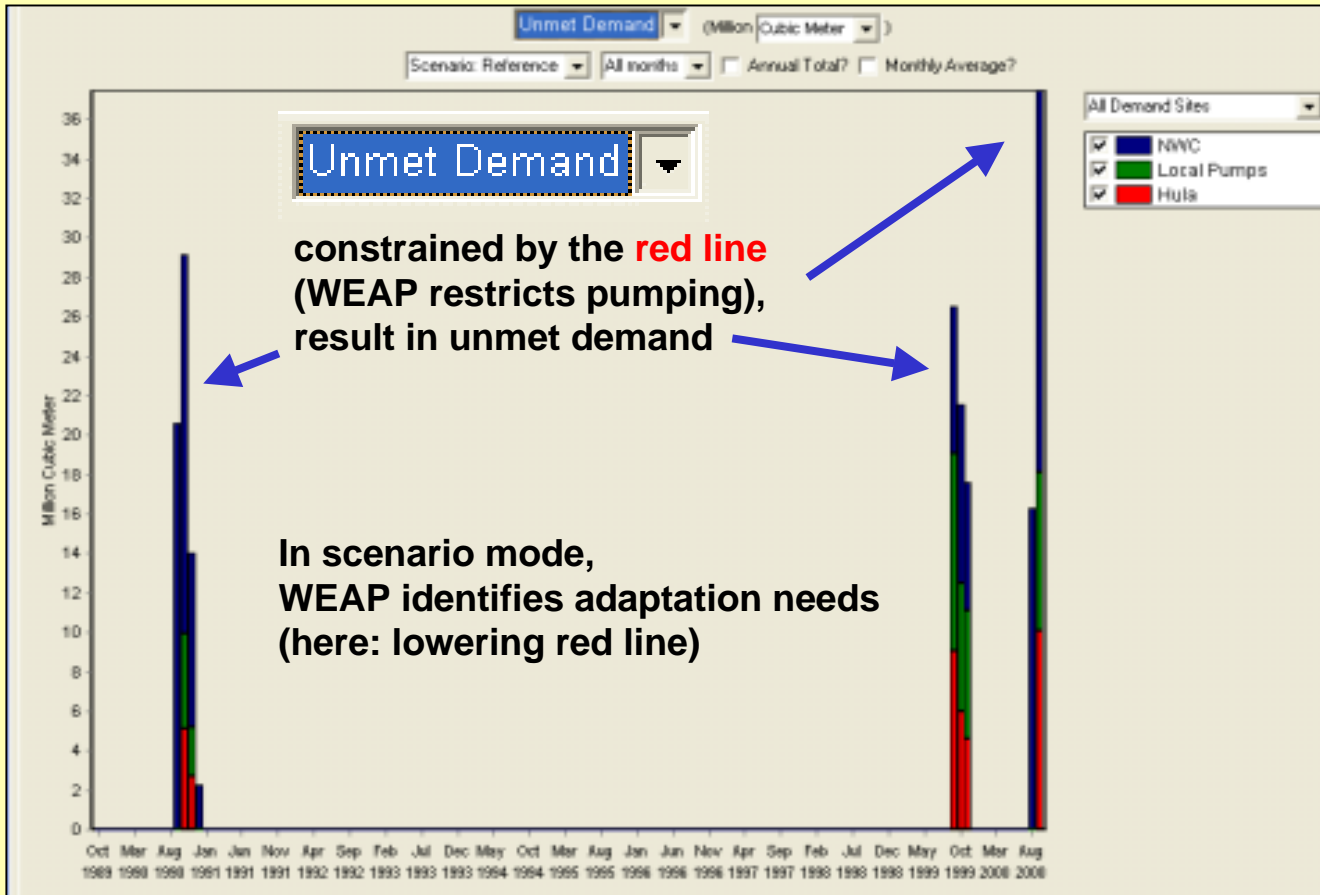
in combination with peak demands in summer



WEAP – Upper Jordan River



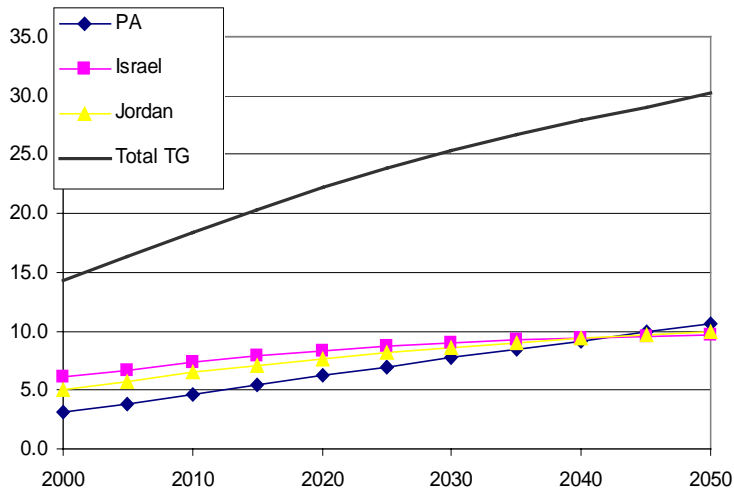
WEAP – Upper Jordan River



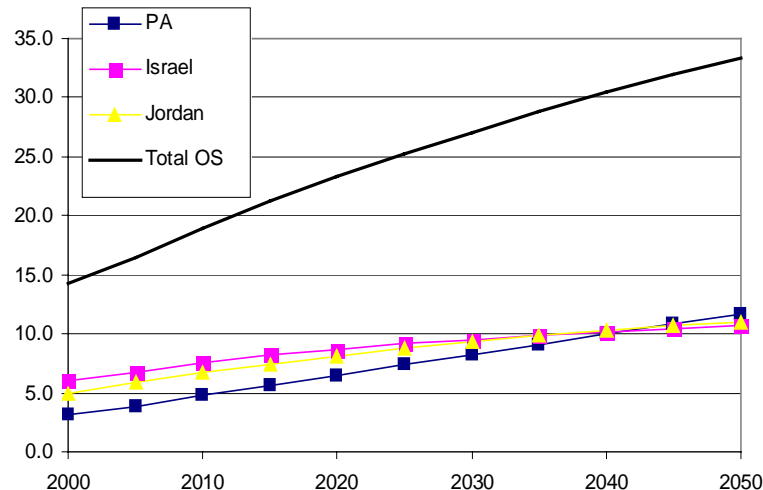
WEAP for scenarios analysis

population scenarios

Population: Economic growth / multi-lateral

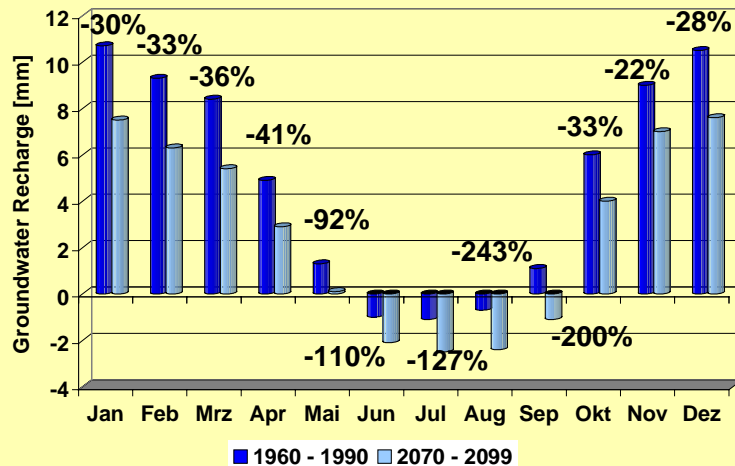


Population: Recession / uni-lateral

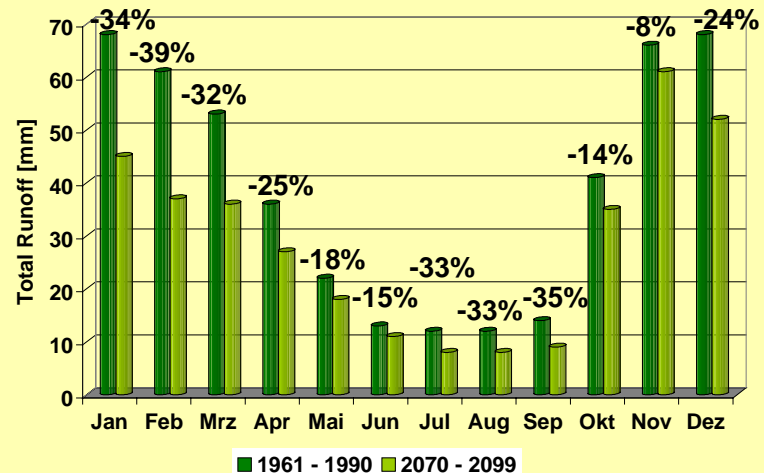


WEAP for scenario analysis

hydro-climatic scenarios



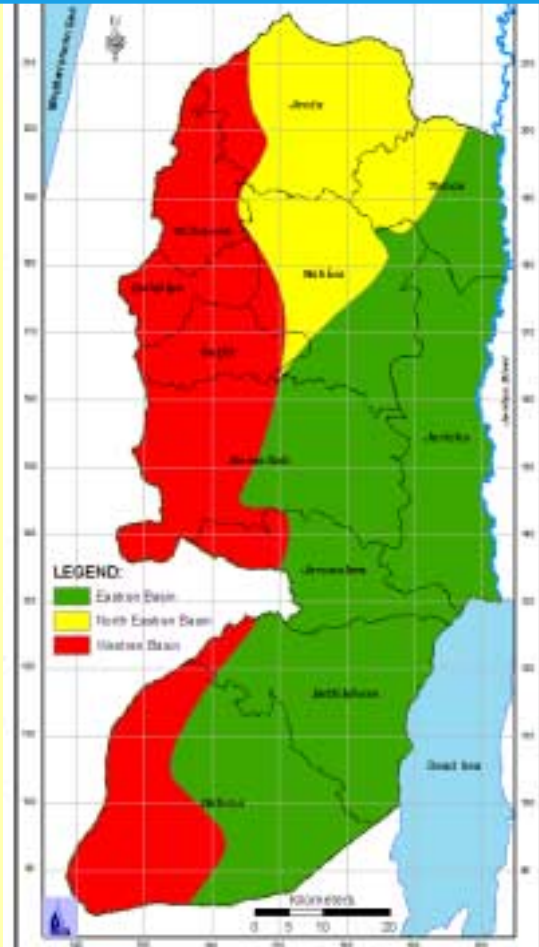
recharge



runoff

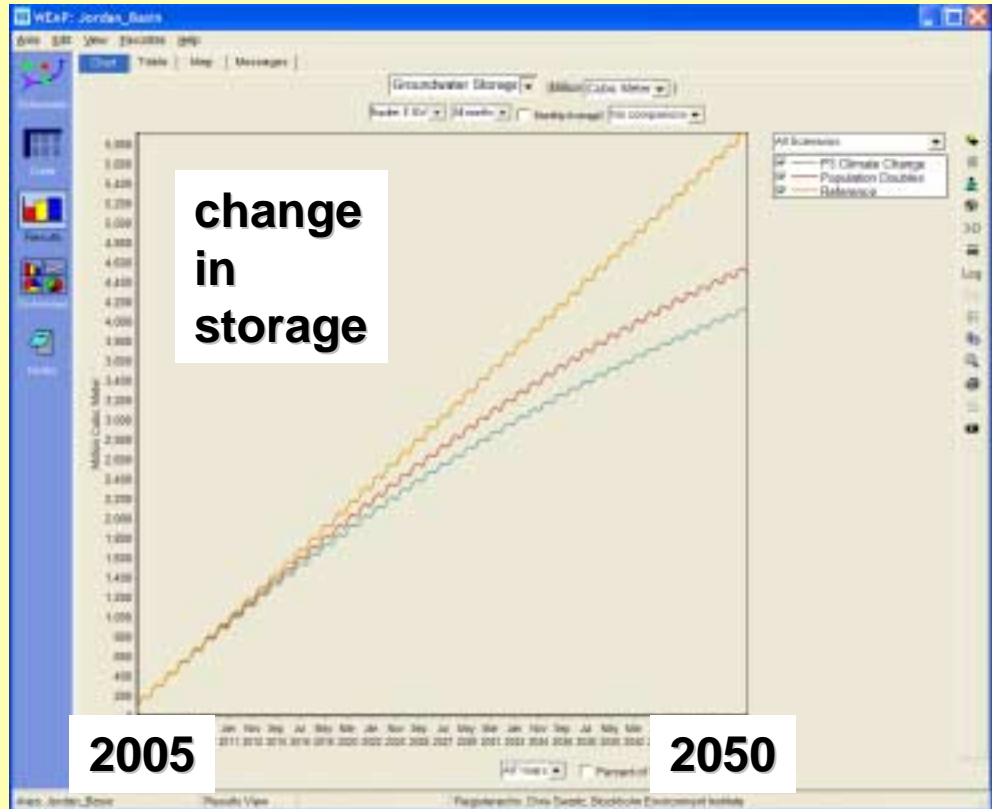
WEAP for scenario analysis

WEAP – Eastern Aquifer



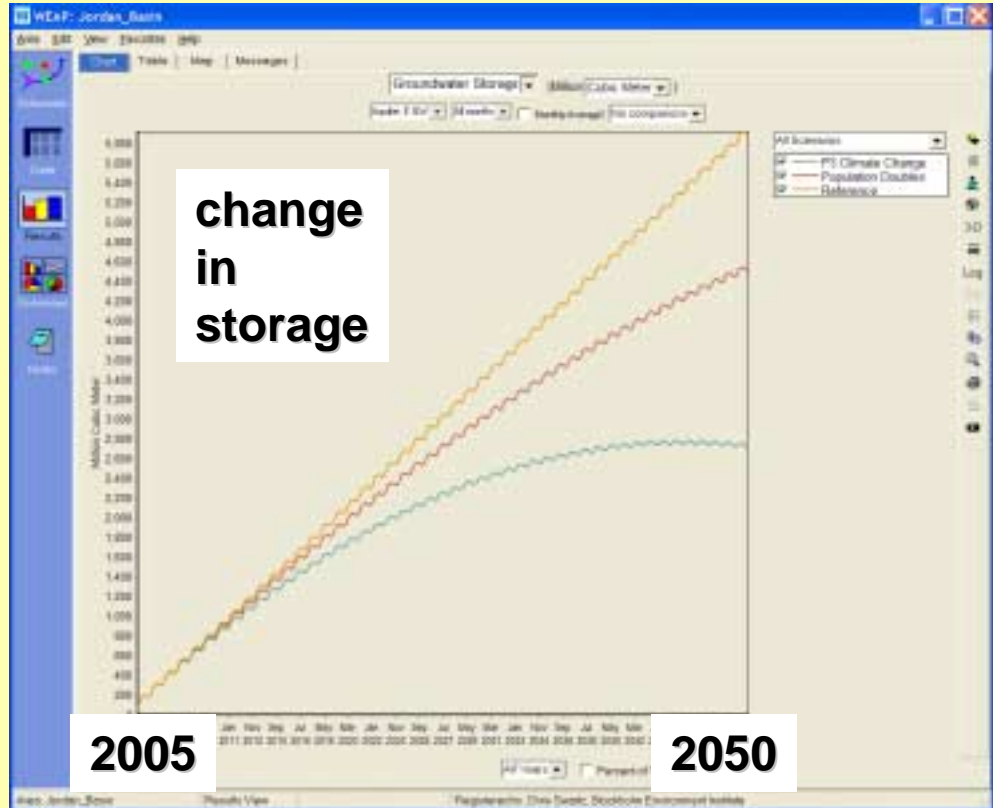
WEAP – Eastern Aquifer

population growth
or
climate change



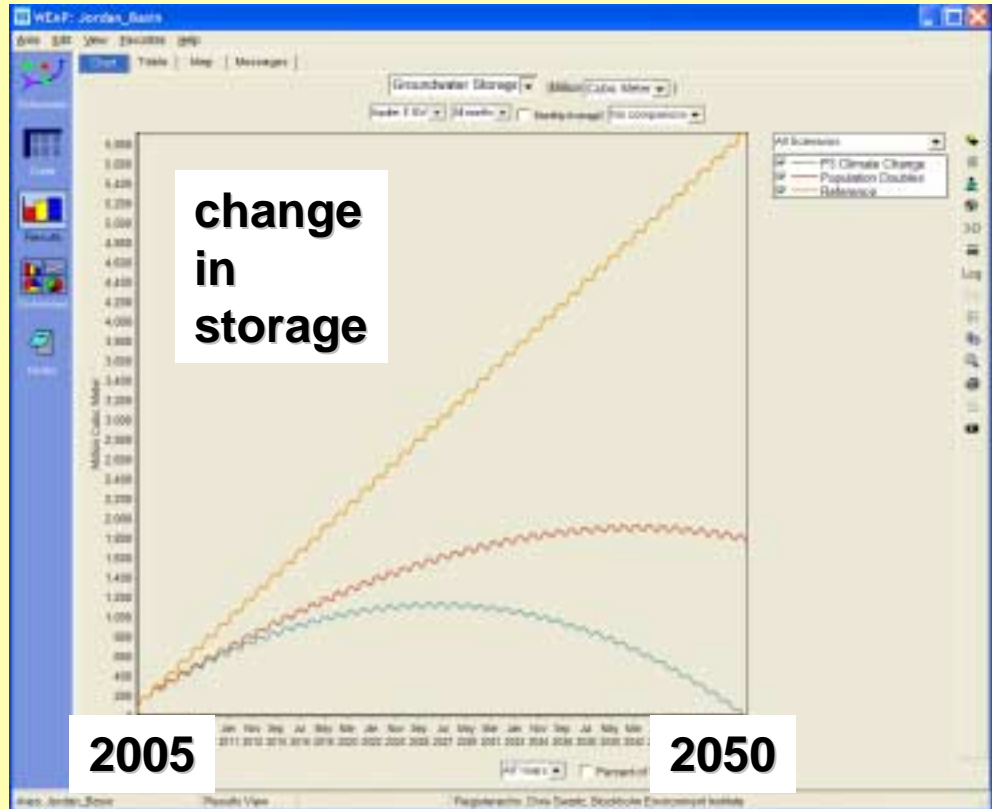
WEAP – Eastern Aquifer

population growth
and
climate change



WEAP – Eastern Aquifer

population growth
and
 climate change
and
 unrestricted
 pumping



Regional WEAP: key issues

1) Aggregating & reducing complexity

2) Integrating changes in:

- water demands
- water productivity
- allocation rules

3) Scenario development

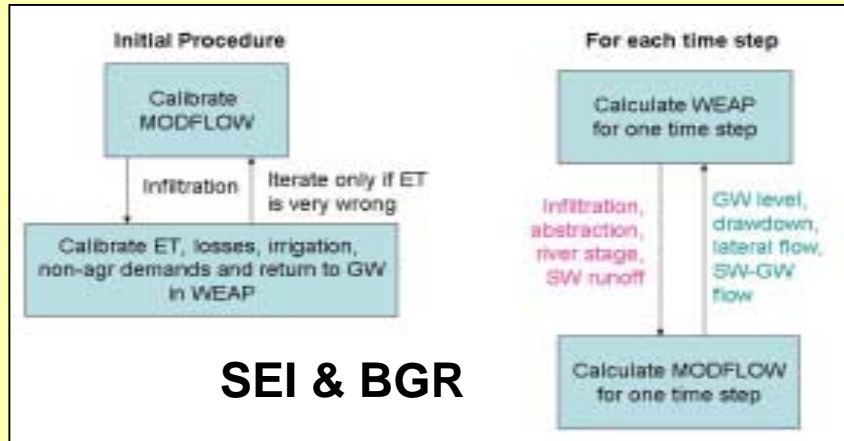
- climate change
- land use change
- multilateral water sharing vs. unilateral management

4) **Exploring adaptation options**



WEAP network

- dynamically linking WEAP to groundwater flow model (? SMART)



Establishing WEAP as strategic planning tool in the MENA region

Thank you !

