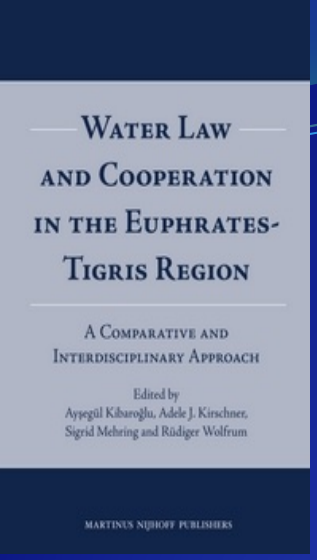

Sustainability in the Euprates-Tigris River Basin: Status and Challenges

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VW Sympoisum
"Sustainability of Engineered Rivers in Arid Lands (SERIDAS)"
Hannover
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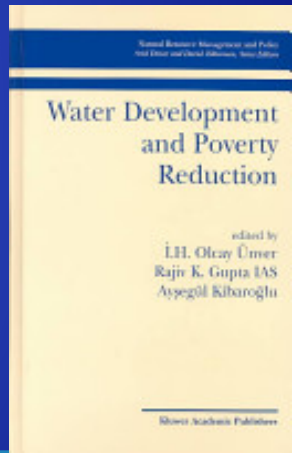

Outline

I. Status

- Location, size
- variability and natural hazards
- water availability vs demand
- main water related sectors

II. Sustainability: major challenges in the basin

III. Outlook: sustainability assessment

Figure 3:

Euphrates-Tigris river basin

Legend

- International boundary
- Administrative boundary
- Capital, town
- River basin
- Lake
- Intermittent lake
- Wetland
- Salt pan
- River, intermittent river
- Canal
- Dam (capacity > 1 km^3)
- Zone of irrigation development
- Southeastern Anatolia Project (GAP), ongoing
- Irrigation scheme

0 40 80 160 240 km

Albers Equal Area Projection, WGS 1984

FAO - AQUASTAT, 2009

Disclaimer

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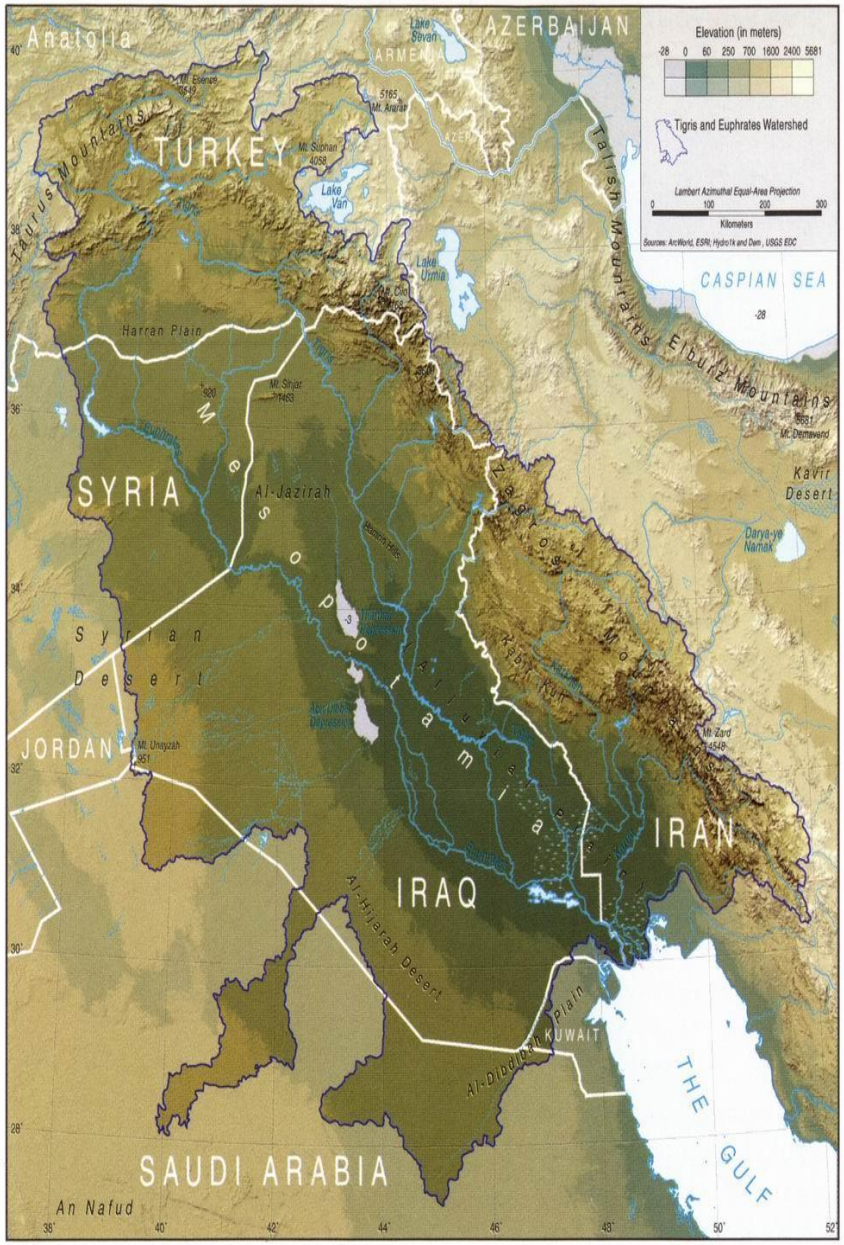


Figur No. 2: Relief variations within Iraqi territories (Sources: UNEP)

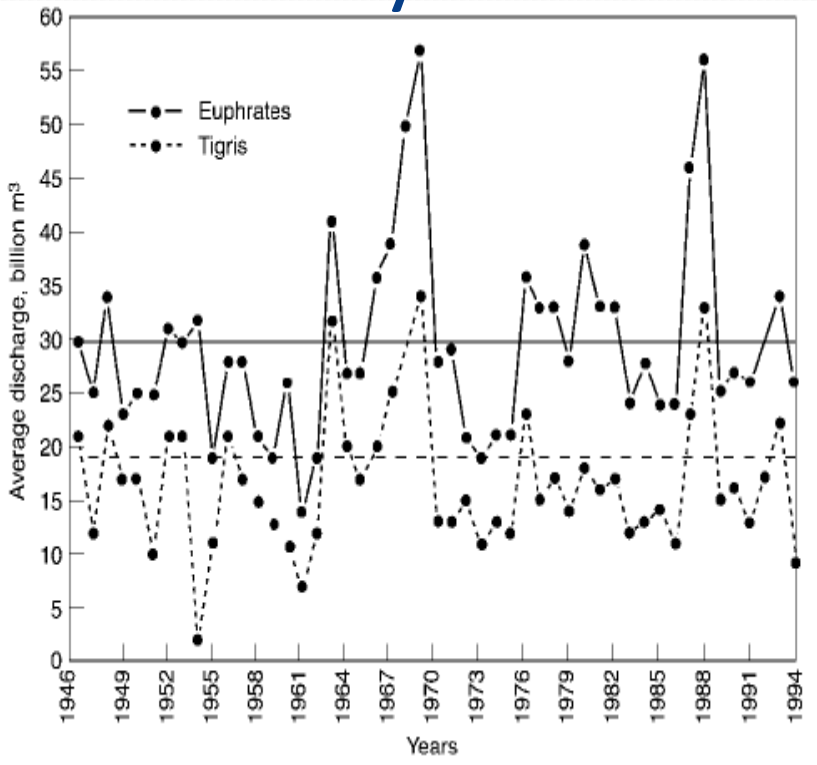
The two greatest rivers of the Eurasian landscape, namely the Euphrates and Tigris originate in a particular topographic zone and end up in quite a different one.

The basin is characterised by high mountains to the north and west and extensive lowlands in the south and the east.

Euphrates basin area: 444,000 km²; mean annual discharge 32 BCM		
Riparian Position	Basin area (percent of total) Contribution to annual discharge	Main water uses
TURKEY upstream	146,520 km² (33 percent) 28.922 BCM (90 percent)	irrigation, hydropower, flood control
SYRIA downstream	84,360 km² (19 percent) 3.213 BCM (10.0 percent)	irrigation, hydropower, flood control
IRAQ downstream	204,240 km² (46 percent) 0.0 BCM (-)	irrigation, hydropower, flood control inhabitants of marshes

Tigris basin area: 387,000 km²; mean annual discharge 52 BCM		
Riparian Position	Basin area (percent of total) Contribution to annual discharge	Main water uses
TURKEY upstream	46. 512 km² (12 percent) 20.840 BCM (40 percent)	irrigation, hydropower, flood control
SYRIA - border with /	776 km² (0.2 percent)	irrigation
IRAQ downstream	209.304 km² (54 percent) 26.571 BCM (51 percent)	irrigation, hydropower, flood control
IRAN -upstream on one tributary	131.784 km² (34 percent) 4.689 BCM (9 percent)	Irrigation, hydropower, flood control

Variability in flow



Source: UNEP (2001) *The Mesopotamian Marshlands: Demise of an Ecosystem*, Early Warning and Assessment Technical Report no. 3, UNEP/DEWA/TR.01–3 (Geneva: UNEP).

- The hydrologic records (1946–1994) of average annual flow for the Euphrates and Tigris rivers are shown in the Figure. At the Turkish–Syrian border, for the Euphrates, annual discharge values range from a minimum flow of 14 km3/y (1961) to a maximum of 57 km3/y (1969). The discharge values for the Tigris at the Turkish border dropped to 7 km3/y in 1961 and rose to 34 km3/y in 1969.

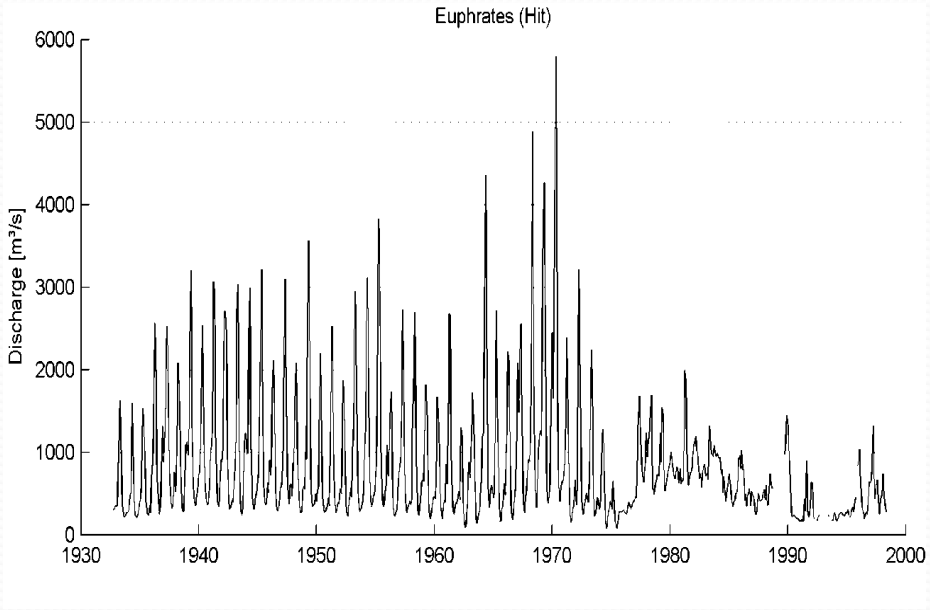


Figure: Monthly discharge of the Euphrates (Hit), 1932-1998.

- After the first big dams had been finished, hydrologic dynamics completely changed.
- From the late 1970s until the early 1990s, the flow regime of the Euphrates was clearly smoothed, peak floods were reduced and low flows were less drastic due to beneficial reservoir operation.

Hazards (natural?)

- Droughts
- Floods
- Desertification
- Dust storms

Water availability (supply) and demand

Table:
The Water Potential of the **Euphrates** Basin and the Consumption Projections of the Riparian States (in bcm/year)

	Turkey	Syria	Iraq	Total
Supply	28.922	3.213	0.000	32.135
Demand	18.500	11.500	23.000	53.000

Table:
The Water Potential of the **Tigris** Basin and the Consumption Projections of the Riparian States (in bcm/year)

	Turkey	Syria	Iraq	Iran	Total
Supply	20.840	0.000	22.571	10.000	52.100
Demand	6.500	3.000	41.800	?	51.300

These tables exhibit mismatches between supply (average discharge) and demand in the Euphrates-Tigris river basin. Also, the consumption targets for the year 2040 which are indicated in both tables are calculated by each riparian, thus they stand to be subjective and exaggerated.

Summary of water budgets at full development scenario in 2040 (km^3/y)

	Altinbilek (1997)	Kolars (1994)	Kliot (1994)	US Army Corps of Engineers (1991)	Belul (1996)
Euphrates					
Natural flow at Turkish– Syrian border	31.43	30.67	28.20	28.20	31.4
Net withdrawal by Turkey	—14.50	— 21.6	— 21.50	— 21.5	—12.3
Entering Syria	16.93	9.07	6.7	6.7	19.1
Inflows in Syria	2.05	9.484	10.7	4.5	3.1
Net withdrawals bySyria	— 5.5	—11.995	—13.4	— 4.3	—10.5
Entering Iraq	13.48	6.559	4.0	6.9	11.7
Net withdrawal by Iraq	—15.5	—13.0	—16.0	—17.6	—19.0
Flow into Shatt- al-Arab	— 2.02	— 6.441	—12.0	—10.7	— 7.3
Tigris					
Runoff in Turkey	18.87	18.5	18.5	18.500	19.3
Net withdrawal in Turkey and Syria	— 8.0	— 6.7	— 7.2	— 6.7	-10.2
Entering Iraq	10.87	11.8	11.3	11.8	9.1
Inflows in Iraq by tributaries	30.7	30.7	31.7	30.7	31.0
Net withdrawal in Iraq	— 31.9	— 33.4	— 40.0	— 32.8	— 33.5
Flow into Shatt- al-Arab	9.67	9.1	8.0	9.7	9.0

Source: D. Altinbilek, "Development and Management of the Euphrates-Tigris Basin," *Water Resources Development*, Vol. 20, No 1 2004.

Main water related sectors

Agriculture

- Agriculture is by far the dominant sector as far as water consumption is concerned in the ET basin. It accounts, in average, for more than 70 percent of water allocated and used in the riparian countries.
- However, agriculture's contribution to Gross National Product (GNP) has been declining in all riparian economies. Yet, a significant portion of the labor force is still employed in this sector.
- Moreover, food security is still a prevailing approach particularly in the midst of growing global food crisis.

Hydropower

- ***Iraq***: Hydroelectric power (HEP) generation is about 17 percent of current electrical energy production in Iraq. The dams and HEP plants on the Euphrates, the Tigris and its tributaries almost entirely account for HEP generation in the country.
- ***Syria***: The major development plan for the Euphrates in Syria consisted of the construction of three multipurpose dams: Tabqa Dam (1975), Al-Baath Dam (1988) and Tishrine Dam (1999). At the heart of national plans lies the Tabqa Dam, which has contributed up to 60 percent of Syria's energy production.
- ***Iran***, has built several HEP plants on the tributaries of the Tigris, i.e. Diyala, and in the Karkheh and the Karun sub-basins.

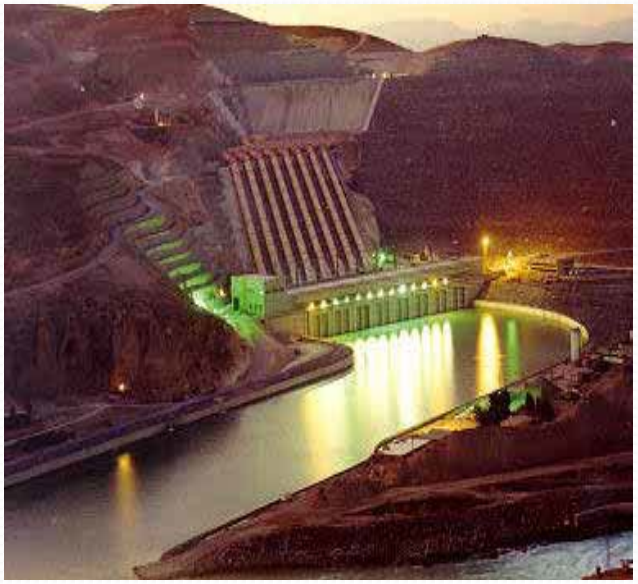
Southeastern Anatolia Project (GAP) consists of 22 dams and 19 hydroelectric power plants on the Euphrates and Tigris and their tributaries with a total capacity of 7500 MW.

GAP's hydroelectric production had reached approximately 80 percent of its capacity, contributing 1/3 of HEP production in Turkey.

Drinking (Domestic) Water

- The combination of rapid urbanization (4.5 percent) and population growth (2.4 percent) has steadily increased the demand for domestic water in **Syria**. Euphrates used to supply drinking water to the governorates of Deir ez Zor, Raqqah and Allepo as the major population centers.
- Access to safe drinking water is currently critical for millions of people in large parts of the ET basin which has led to a sharp increase in waterborne diseases.

- Urbanization growth rate is 6,9 percent in the GAP region, **Turkey**. Facing the increasing demand of domestic water in the GAP provinces, DSI, major water development agency, has finalized a series of projects for drinking water supply. Yet, only 53 percent of the domestic water supply projects could have been realized in the GAP region.



Atatürk Dam and HEPP

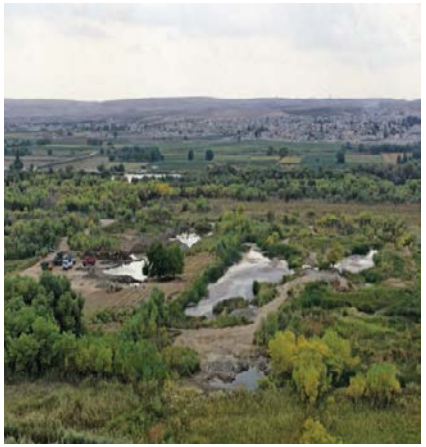
- Decades of war, combined with limited environmental awareness, have destroyed **Iraq's** water resources management system. Thus, Iraq faces difficulties to realize the target of 91% of households using safe drinking water supply by 2015. Currently, 16% of households report daily problems with supply and 20% use an unsafe drinking water source.

Industrial Water Use

Year	Country	Total Water Allocated For Industrial Use
2000	Iraq	14.5%
2003	Turkey	11 %
2003	Syria	3 %

Environment

- In the 1960s and 1970s dams were seen as a good investment due to the possibility to generate energy without emitting carbon. It was not until the 1990s that the adverse social and ecological impacts of large dams and HEPP became a point of concern in the basin.
- With the rising of environmental concern and with an aim to catch up with international concern for sustainable development, the three major riparians established the ministries of environment and adopted related legislation, i.e. environmental impact assessment at national level though the implementation of the environmental protection measures fell short of expectations.



Sustainability: major challenges in the basin

Overarching political problems

- The biggest challenge is to coordinate water resources management and establish transboundary water cooperation in the midst of current state of affairs in the region.
- Overarching political problems, namely the civil war in Syria and the deterioration of bilateral political relations between any pair of the riparians constitute disabling political background for sustainable water policy and management in the Euphrates-Tigris river basin.

Non-state actors!

- The ongoing spread of ISIS across region has ended up with "non-state actors" to seize control of water resources in Syria and Iraq.

Lack of coordination in transboundary water management

- Shortcomings and loopholes in existing transboundary water sharing treaties:
  - Tr-Syr Protocol (1987)
  - Iraq-Syria Protocol (1989)

Lack of coordination in transboundary water management

- Syria experiencing significant internal unrest and Iraq recovering from decades of sanctions and war, water resource management capacities in both countries are considerably diminished.
- On the other hand, Turkey's water policy has been evolving since the early 1990s which shaped up in a more complex legal and organizational framework, and demonstrating only a partial progress in water resources protection and public participation in water policy-making process.

Climate: natural variability and climate change

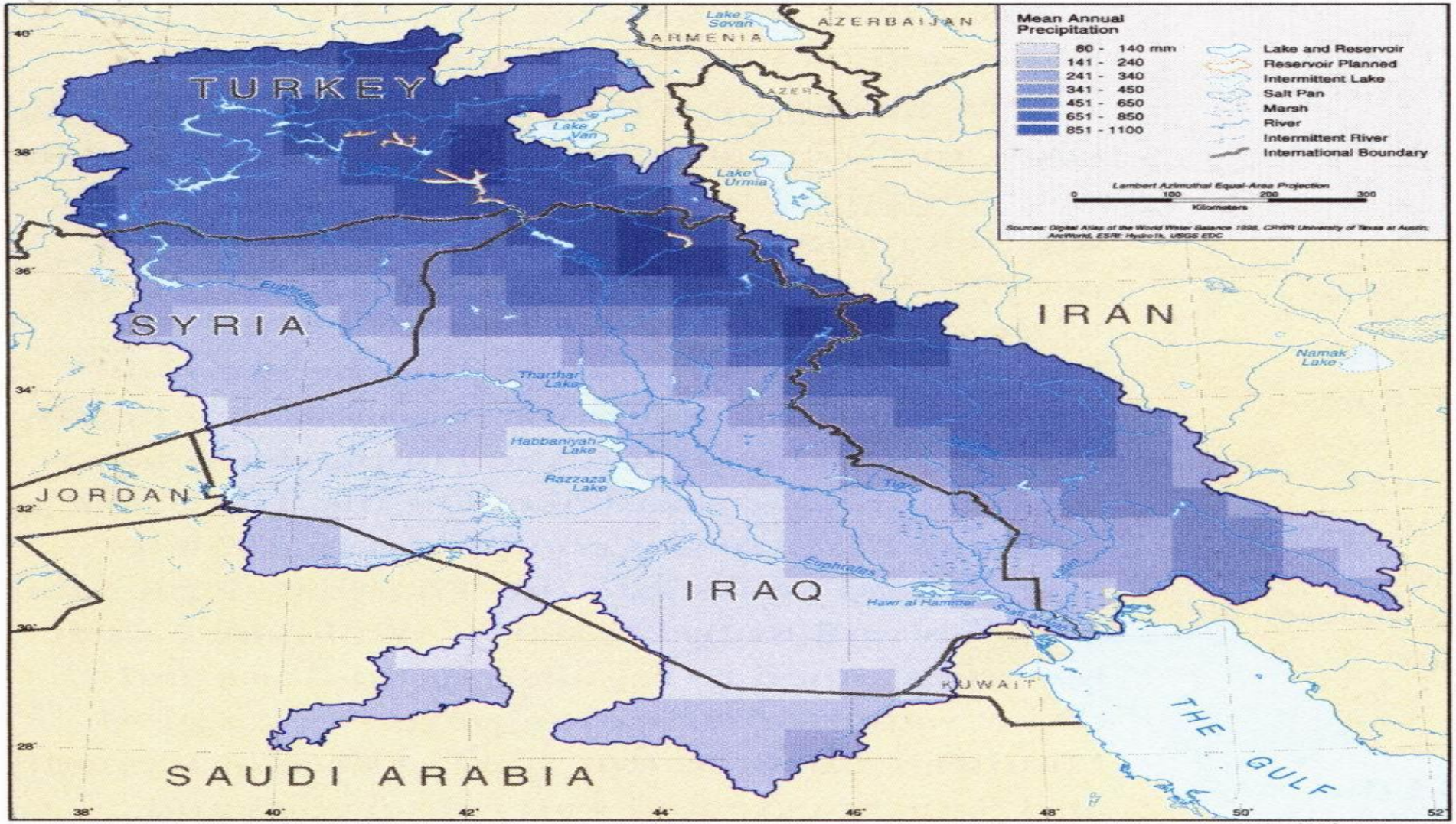


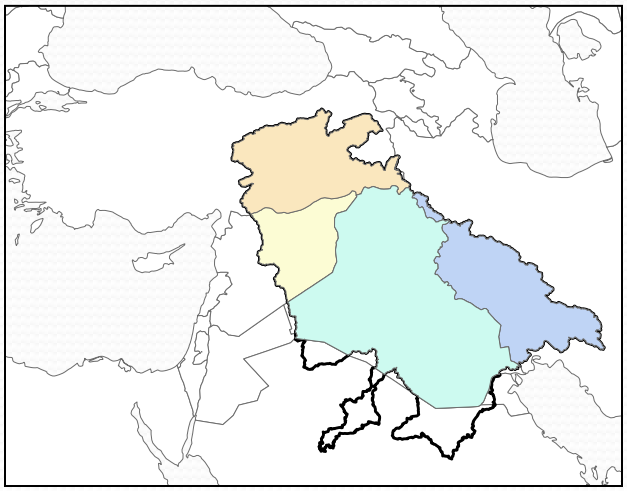
Figure No.3: Mean annual precipitation in the Tigris-Euphrates basin.
(Sources: UNEP)

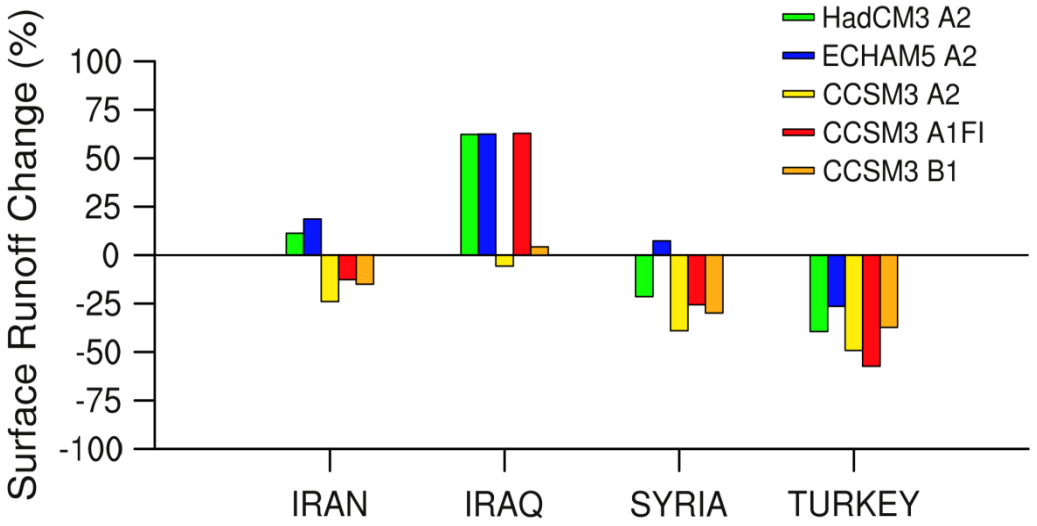
Current knowledge about impacts of climate change

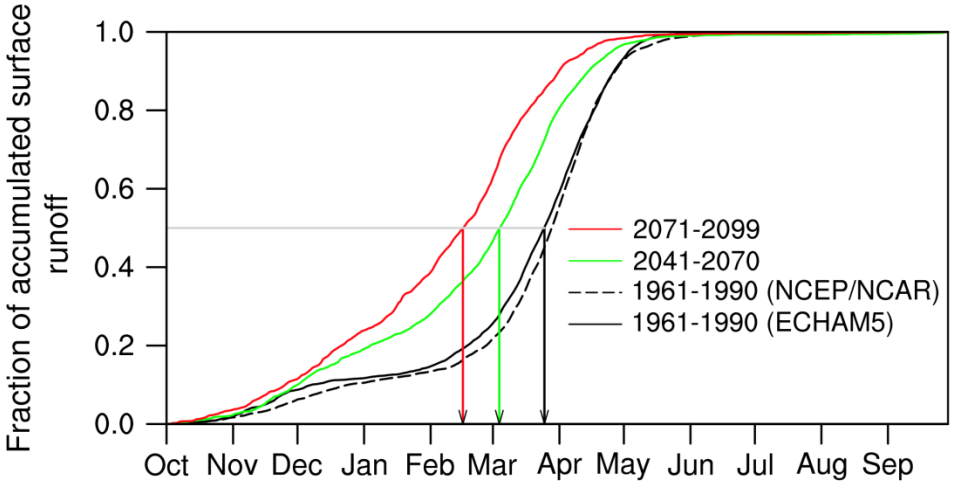
- All scenario simulations indicate surface temperature increases across the entire Euphrates–Tigris basin. The increase is comparatively greater in the highlands in winter.
- In terms of precipitation, there is a broad agreement among the simulations, which indicate a decrease in the highlands and northern parts of the basin and an increase in the southern parts.

IPCC. (2007). “Contribution of working group I to the fourth assessment report of the intergovernmental panel on climate change.” S. Solomon,et al., eds., Cambridge University, Cambridge, UK and New York.)

Changes in surface runoff in the ET basin







Based on different model and scenario simulations, the annual total surface runoff is found to decrease about 25–55% in the eastern Anatolian mountains (main headwaters of the basin) by the end of the 21st century.

Bozkurt, D. and O.L. Sen (2013). Climate change impacts in the Euphrates-Tigris Basin based on different model and scenario simulations. *Journal of Hydrology*, 480, 149-161.

Population change and projections

Population Projections

	2013	2025	2050
Turkey	74 933 000	83 713 000	94 606 000
Syria	21 898 000	27 865 000	36 706 000
Iraq	33.765.000	45 892 000	71 336 000
Iran	77 447 000	88 064 000	100 598 000

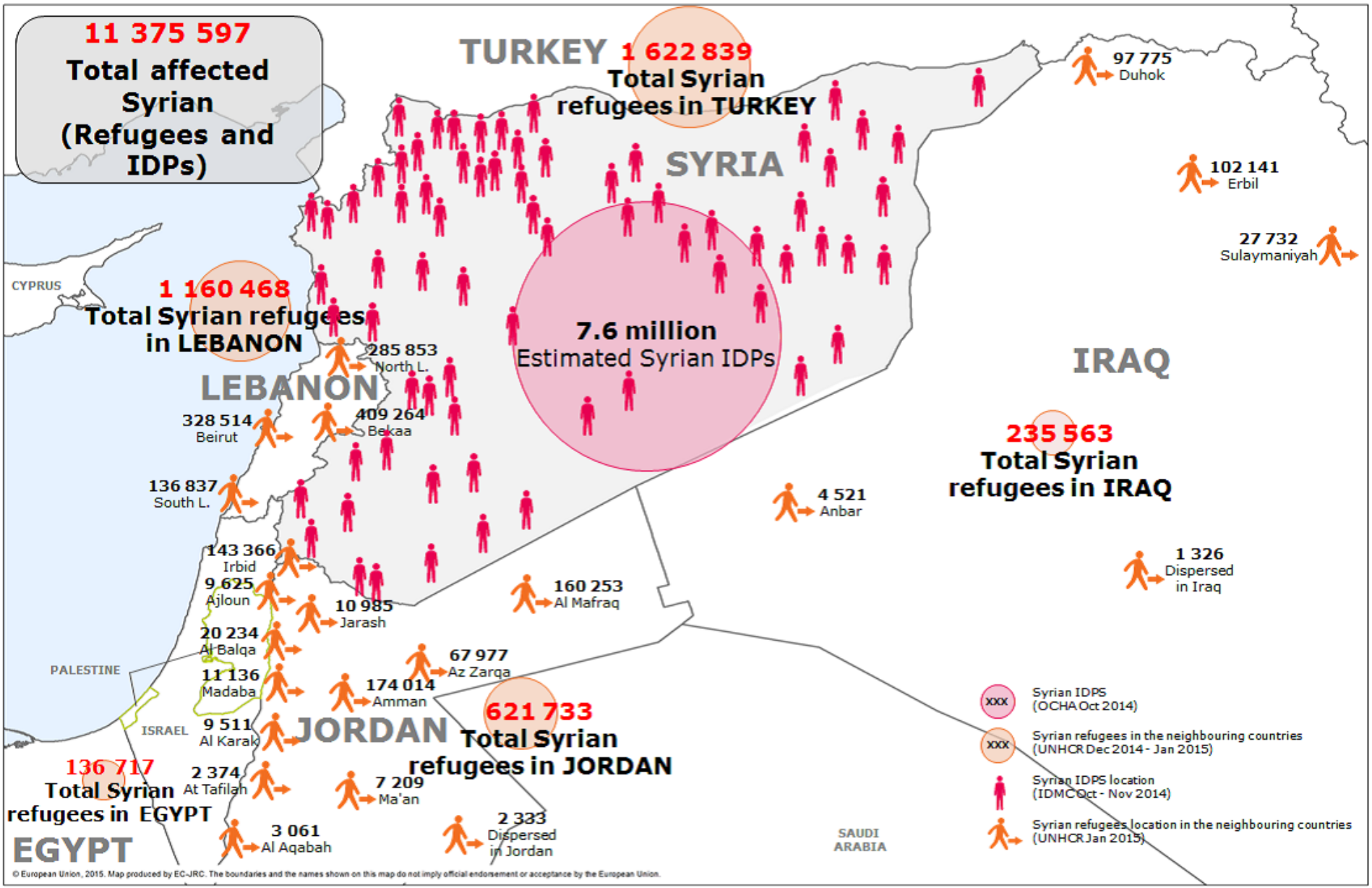
World Population Prospects: The 2012 Revision, Key Findings and Advance Tables,
United Nations Department of Economic and Social Affairs/Population Division

Population Growth Rates

	1985-2000	2000-2015	2015-2030	2030-2050
Turkey	1,70 %	1,30 %	0,80 %	0,40 %
Syria	2,75 %	2,18 %	1,52 %	0,85 %
Iraq	2,75 %	2,92 %	2,67 %	2, 06 %
Iran	2,55 %	1,26 %	0,90 %	0,55 %

http://esa.un.org/unpd/wpp/Demographic-Profiles/index.shtm
United Nations Department of Economic and Social Affairs/Population Division

Syrian IDPs and refugees in the neighbouring countries (as of 22.01.15)



Population displacements

- Before the civil war in Syria: extreme dryness, combined with other factors, including misguided agricultural and water-use policies of the Syrian government, caused crop failures that led to the migration of as many as 1.5 million people from rural to urban areas. This in turn added to social stresses that eventually resulted in the uprising against President Bashar al-Assad in March 2011.
- As of March 2015, around half the Syrian population has been forced to leave their homes, with 7.6 million internally displaced, 3.8 million refugees, and more than 1.5 million non-refugee migrants.

Reservoir Sedimentation

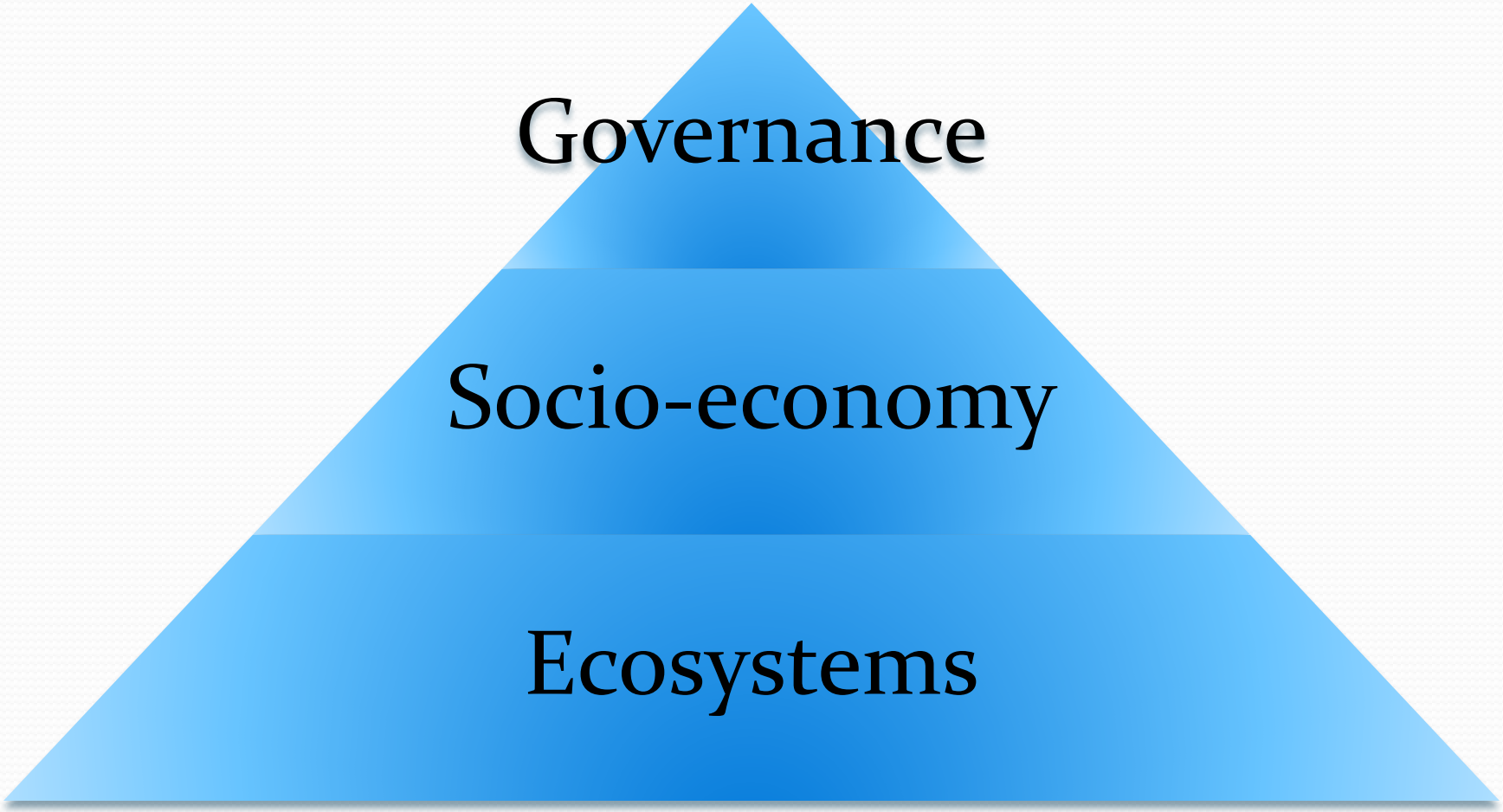
- Annual storage loss in Keban reservoir is estimated to be 0,147 %, and by 2006 the Keban dam lost its total storage capacity by 4,55 % due to sedimentation.
- The deforested Turkish watershed of the Euphrates has negative effects on sedimentation rates, and estimates assume that yearly sedimentation in the three Turkish reservoirs, i.e. Keban, Karakaya and Atatürk, can reach a volume of 1,050 cubic metres per square kilometre

Challenges in irrigation sector

- social and institutional issues
- inefficiency: open channels; surface (flood) irrigation
- salinization
- erosion
- ineffective pricing system

Outlook: sustainability assessment

Sustainability assessment framework: ET basin



Policy principles to operationalize the concept of sustainable development

- **Participatory policy-making**: informing, consulting and active involvement of the public
- **Equity**: Equity forms the strong normative foundation for the social dimension of sustainable water use and development
- **Integration**:
  - Vertical integration:
    - local
    - regional
    - national
    - transboundary
  - Horizontal policy integratio: identifying synergies and trade-offs across domains
    - water
    - energy
    - health
    - agriculture
    - Biodiversity

Governance and sustainability analysis

- First of all, it cannot be denied that the overarching and chronic problem of political and social instability and confrontational political relations in the region has long had a negative effect on the sustainable management and use of transboundary water resources in the ET basin.
- Bleak future demands concerted efforts of regional governments and international organizations to extend their humanitarian aid and economic support to the region in systematic and determined ways.

sustainability analysis (cont'd)

- I argue that adopting a sustainability approach in ET basin is important because there are various pressures on the rivers system due to population growth; agricultural, hydropower development and ecosystem mismanagement. Impacts of climate change add to the complexity of transboundary water management, as the basin is one of the most affected regions.

sustainability analysis (cont'd)

- I argue that transboundary institutions should apply new approaches, such as the sustainability (i.e. WEF nexus approach), which helps to identify key development drivers as well as to unpack and clarify the development challenges and necessary trade-offs in transboundary river basins.

Sustainability analysis: during and post conflict

- There is an immediate need to improve drinking water supply and to support agriculture in areas less affected by the fighting.
- From a post conflict perspective, rehabilitation of the domestic and agricultural water infrastructure will be a priority to ensure the sustainable return of displaced populations.
- Beyond emergency relief interventions, the prioritization and allocation of resources for reconstruction will be determinant factors in the reconciliation process.

Sustainable water use and management

- water shortages
- environmental problems and water quality deterioration
- inefficiencies, inequities in agricultural water use and irrigation management
- increasing needs of urban and industrial water, which are in competition with irrigation water
- climate variation, impacts of climate change in the form of periodic multi-year droughts on the one hand, and flash floods on the other