Urmia Lake

Assessing the portions of each parameter on decline of the Lake's water level in different years

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Urmia Lake


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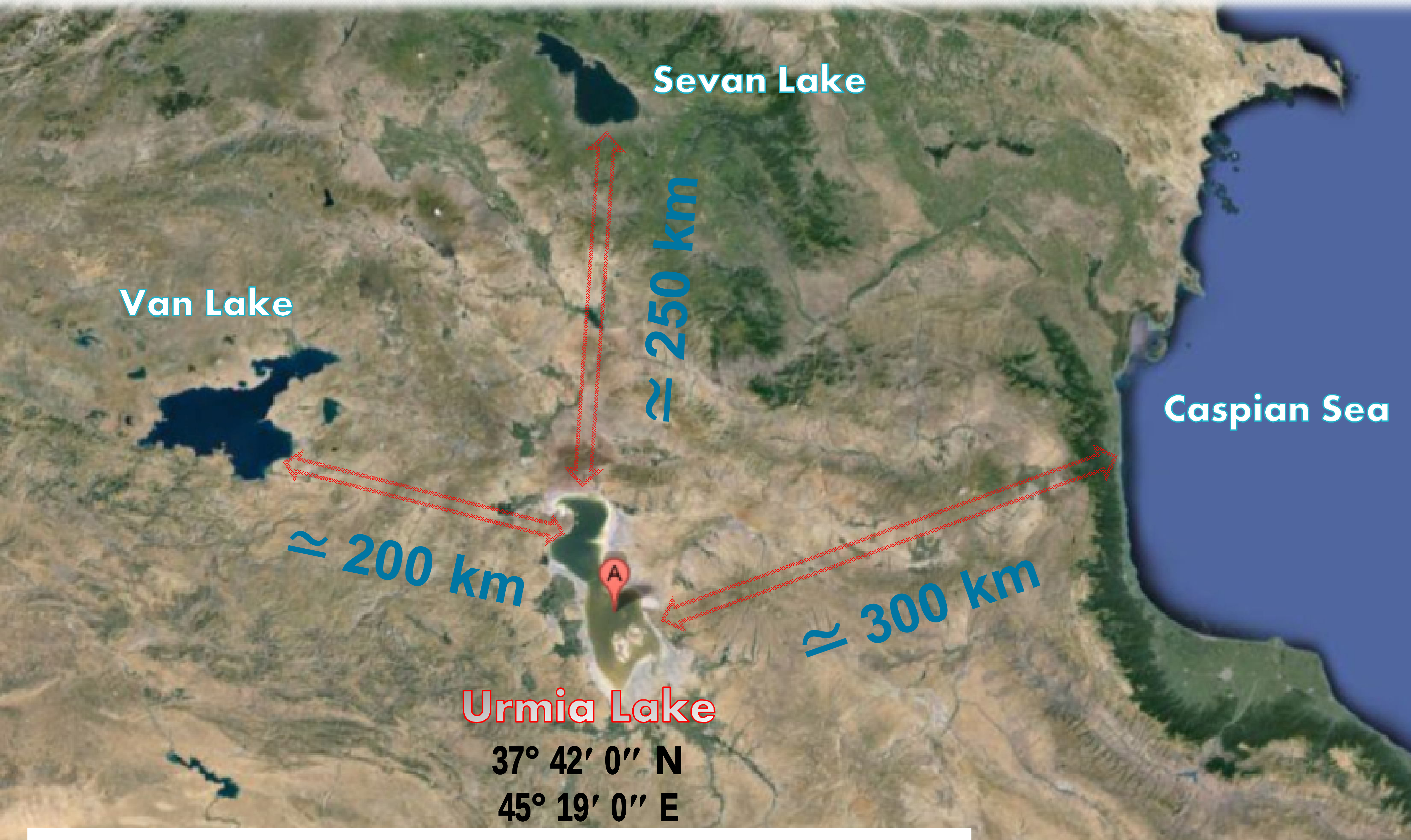
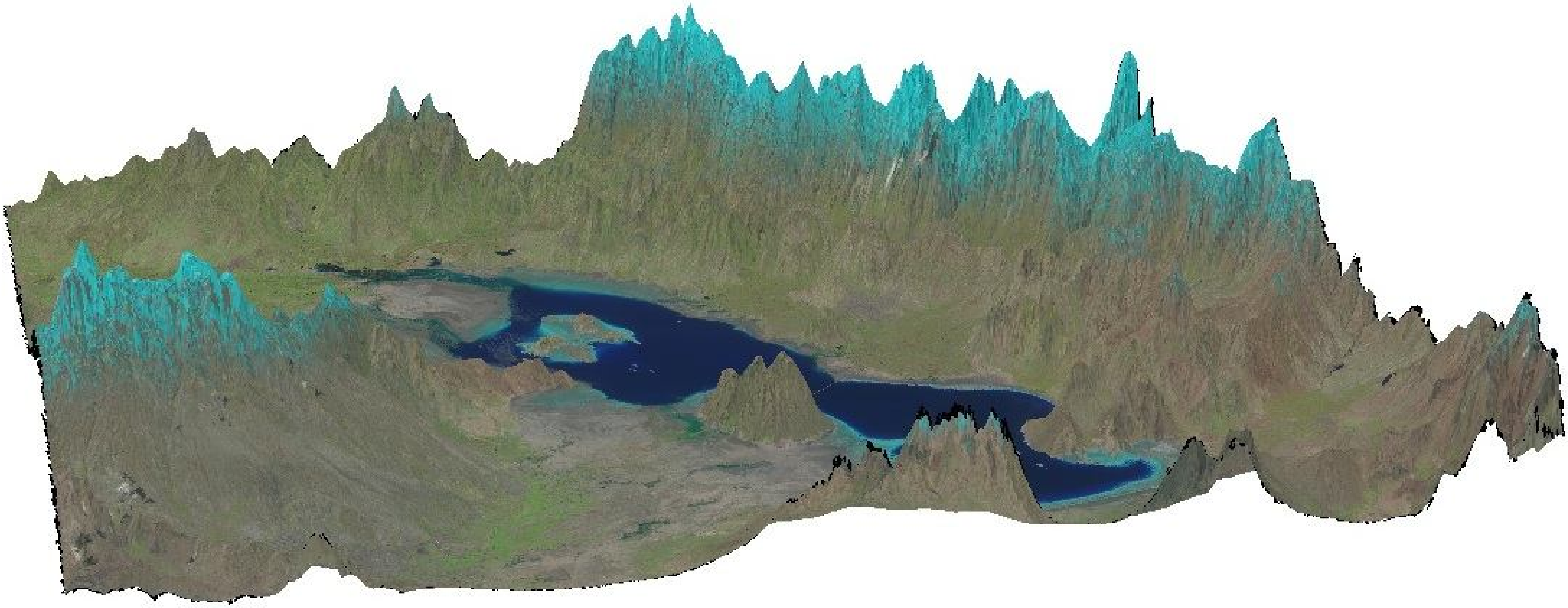
Turk.
Azr.
Ar.
Azerbaijan
Astara
Caspian Sea
Kizyl-Arvat
Turkmenistan
Chardzhou
Ashkhabad
Mary
Orumiyeh
Tabriz
Lake Urmia
Rasht
Mahabad
Irbil
Zanjan
Qazvin
Emamshahr
Mashhad
Kirkuk
Sanandaj
Tehran
Kushka
Hamadan
Qom
Dasht-e Kavir (salt desert)
Kavir-e Namak
Herat
Bakhtaran
Arak
Baghdad
Zagros Mountains
Afghanistan
Esfahan
Farah
Yazd
Dasht-e Lut
Iran
Kerman
Shiraz
Zahedan
Bandar-e 'Abbas
Bandar-e Lengeh
Qeshm
Pak.
Chah Bahar
Dubayy
Jask
U.A.E.
Abu Dhabi
Gulf of Oman
0 200 km
0 150 mi
36°
30°
24°
54°
60°

Geographical Position in Region

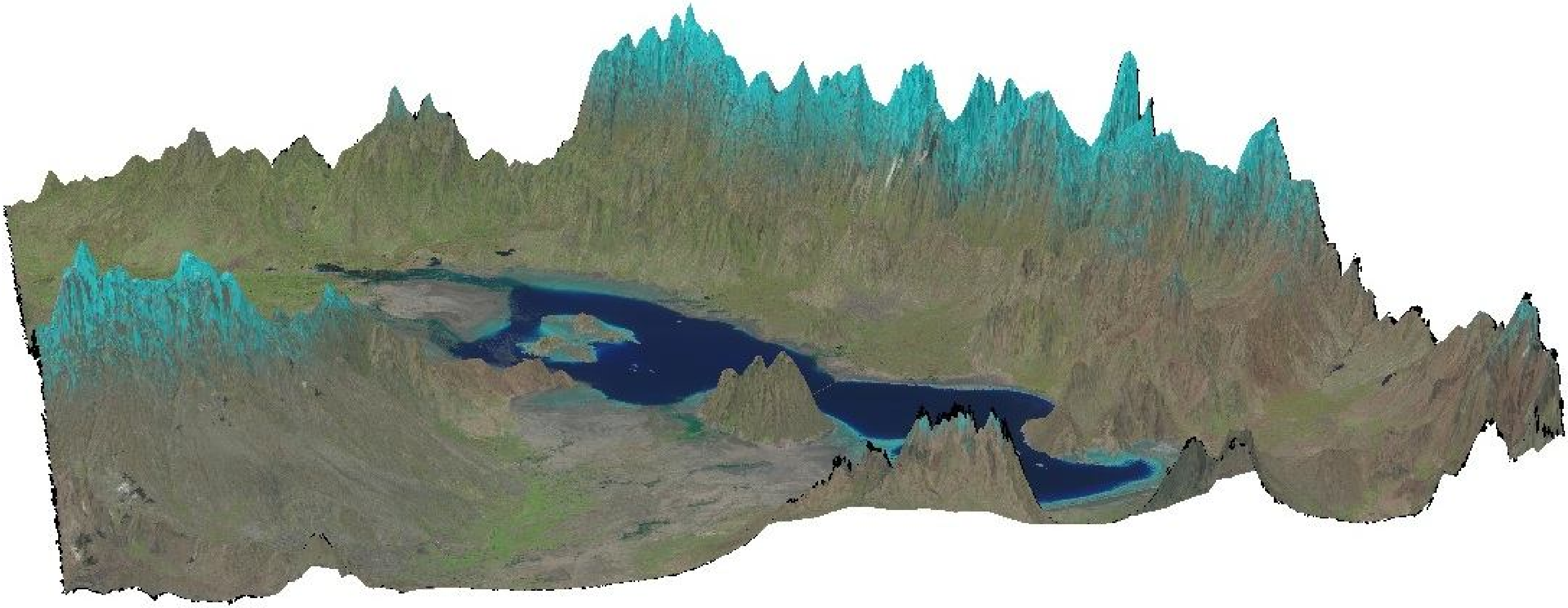


GIS Topographic Map

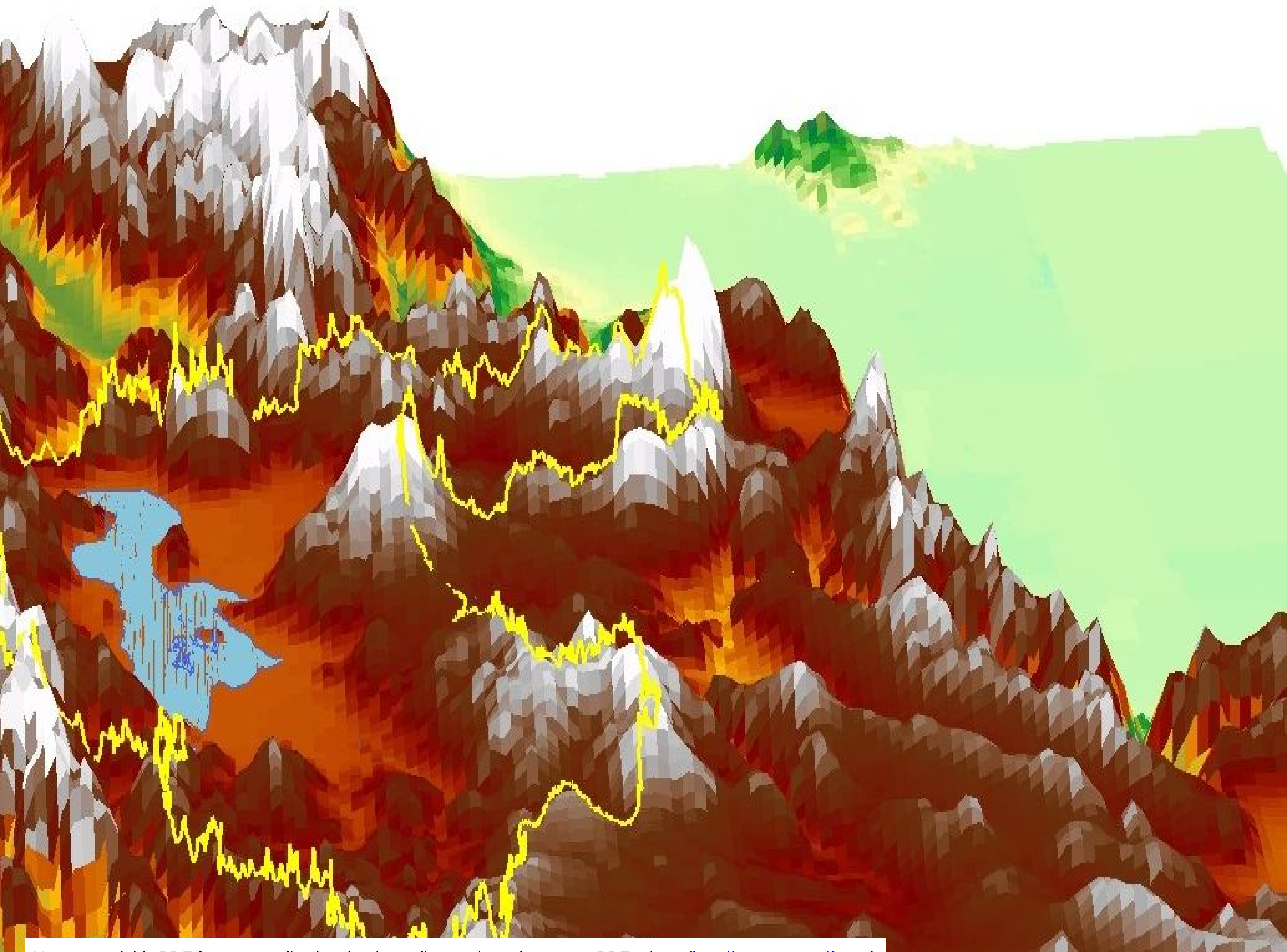


North-East View

GIS Topographic Map



North-East View



➢Introduction

A shallow water & high level lake without any outlet.

➢**Urmia lake basin area: about 52000 Km²**

➢**Lake Volume: 32000MCM**

➢**Lake Area: about 5300 km²**

➢**Lake Depth: about 4.5 m**

➢**Normal TDS: about 240 gram/lit**

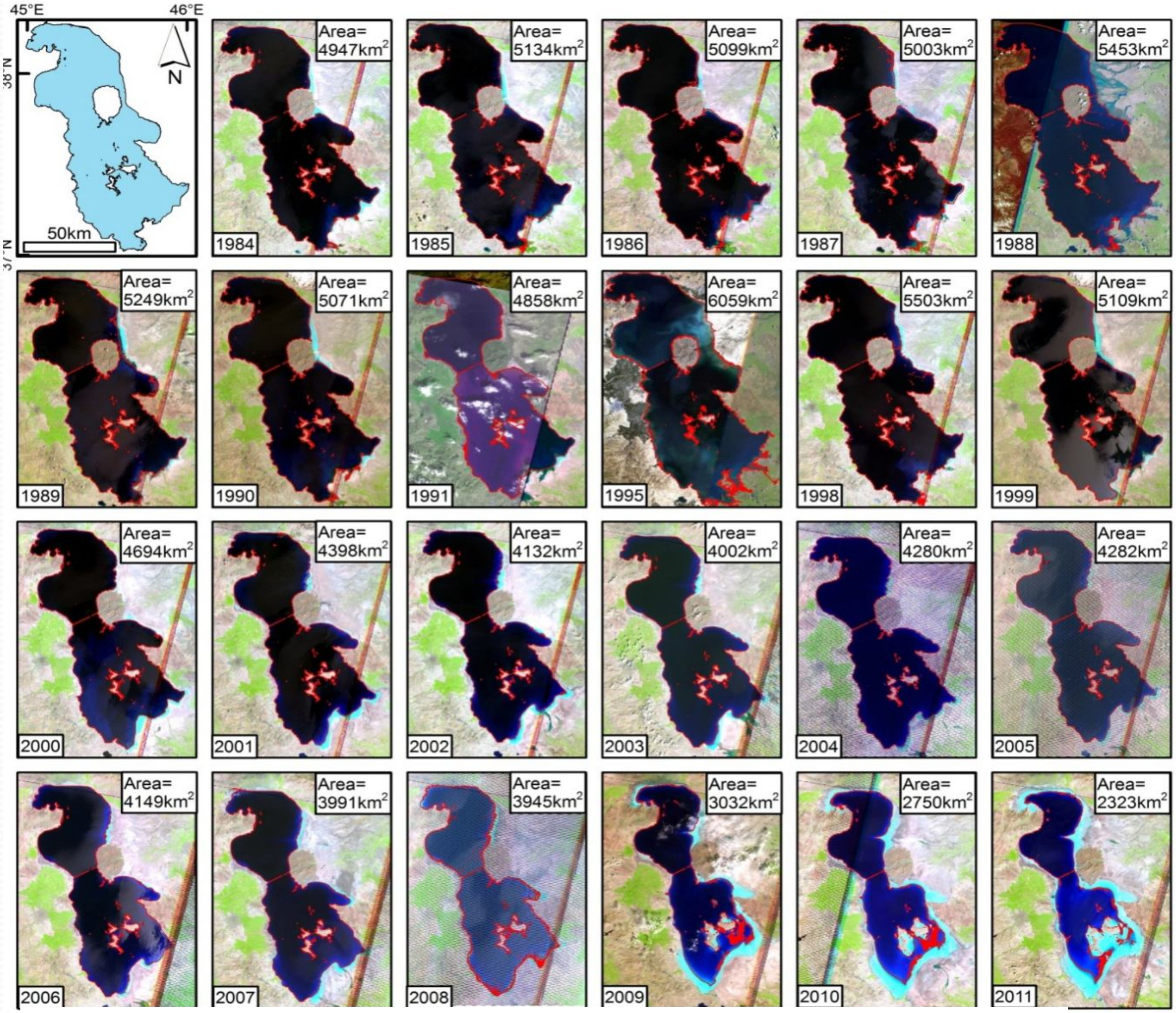
➢**Present TDS: More than 400 gram/lit**

✓ *National Park (since 1971)*

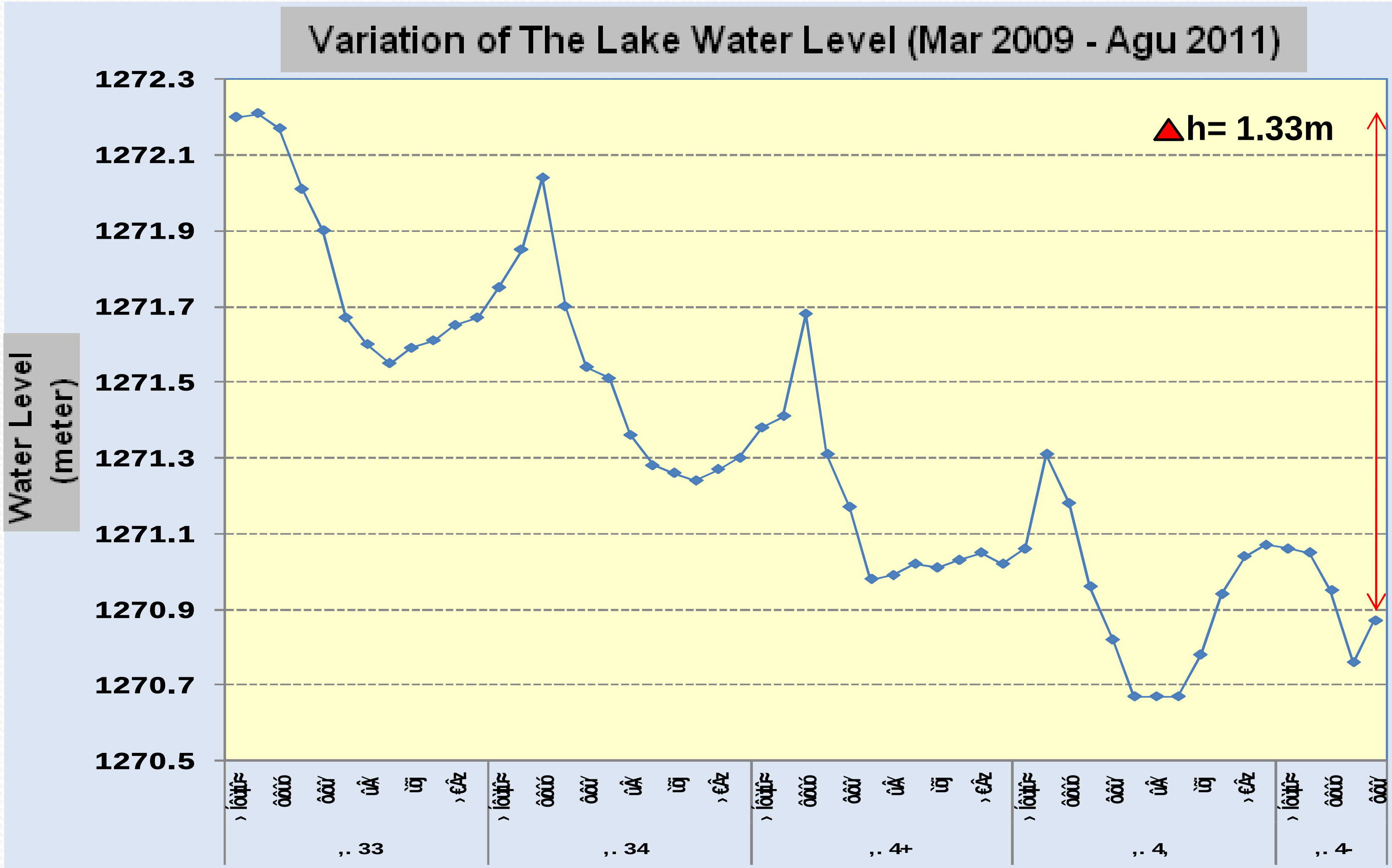
✓ *Ramsar Site (since 1975)*

✓ *UNESCO Biosphere Reserve (since 1976)*

Variation of the Surface of Urmia Lake (1984-2011)

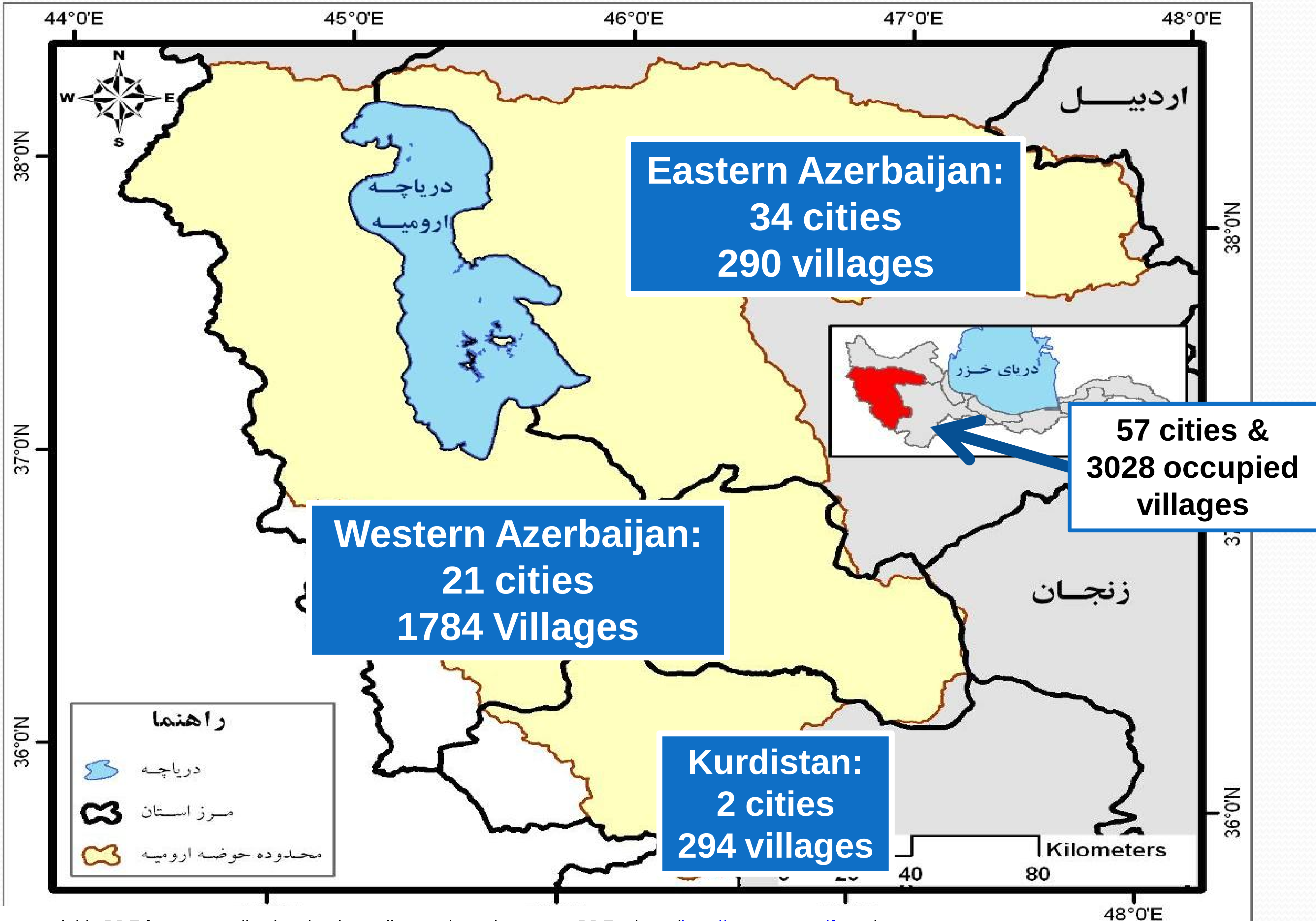


Year	Surface Of the Lake (Km^2)
1984	4947
1985	5134
1986	5099
1987	5003
1988	5453
1989	5249
1990	5071
1991	4858
1995	6059
1998	5503
1999	5109
2000	4694
2001	4398
2002	4132
2003	4002
2004	4280
2005	4282
2006	4149
2007	3991
2008	3945
2009	3032
2010	2750
2011	2323

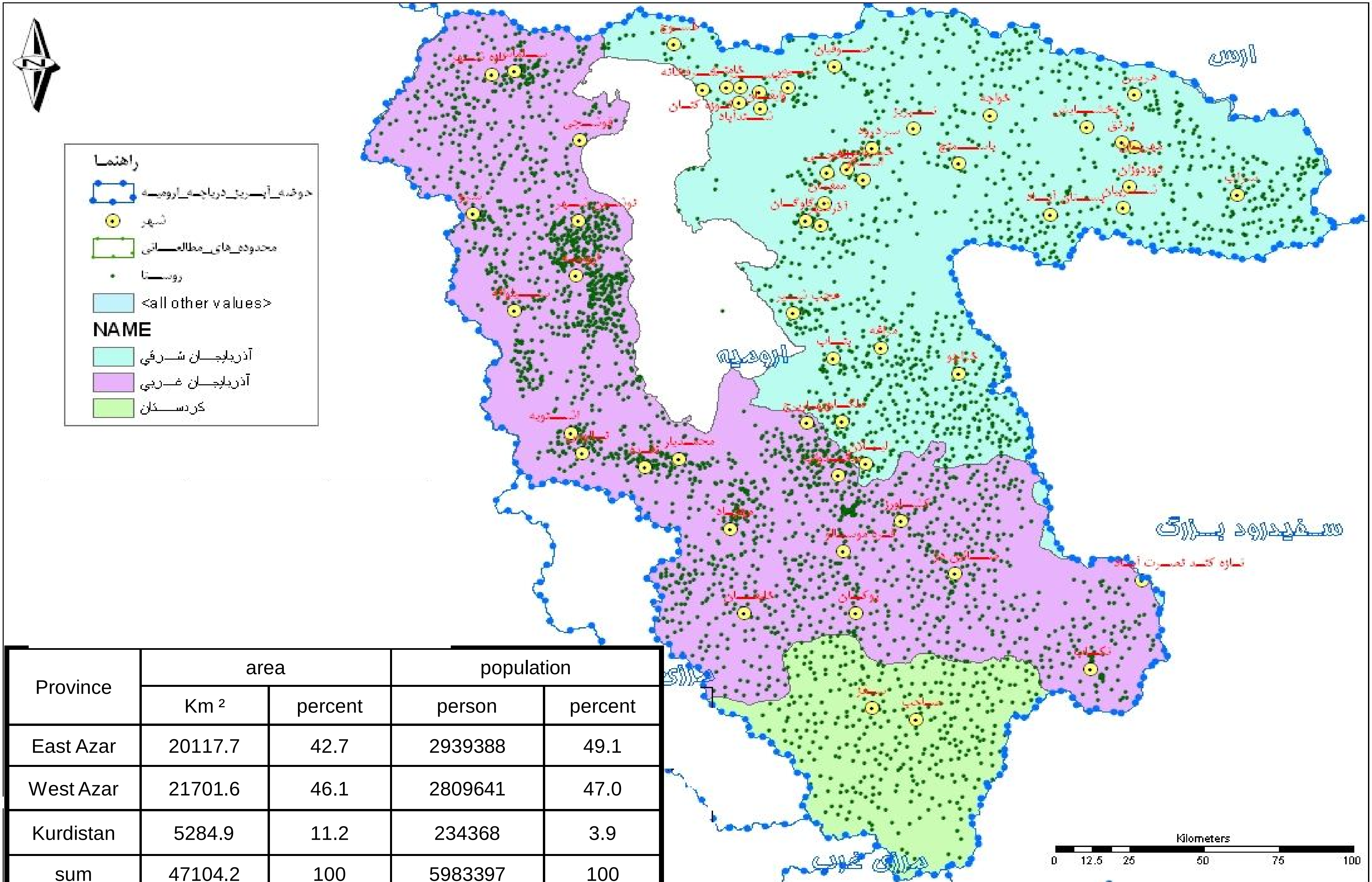


Parameters	Water year			Variation According to the (%)	
	2012-13	2011-12	Average of the Long Period	Last Water Year	Average of the Long Period
Water Level (m)	1270.87	1270.63	1275.3	0.24	-4.43
Lake Surface (Km^2)	3476.94	3386.95	5131.97	89.99	-1655.03
Volume of the Water (MCM)	12.6	11.83	31.09	0.77	-18.49

Social Life Around The Lake



Population and its distribution in Urmia lake basin

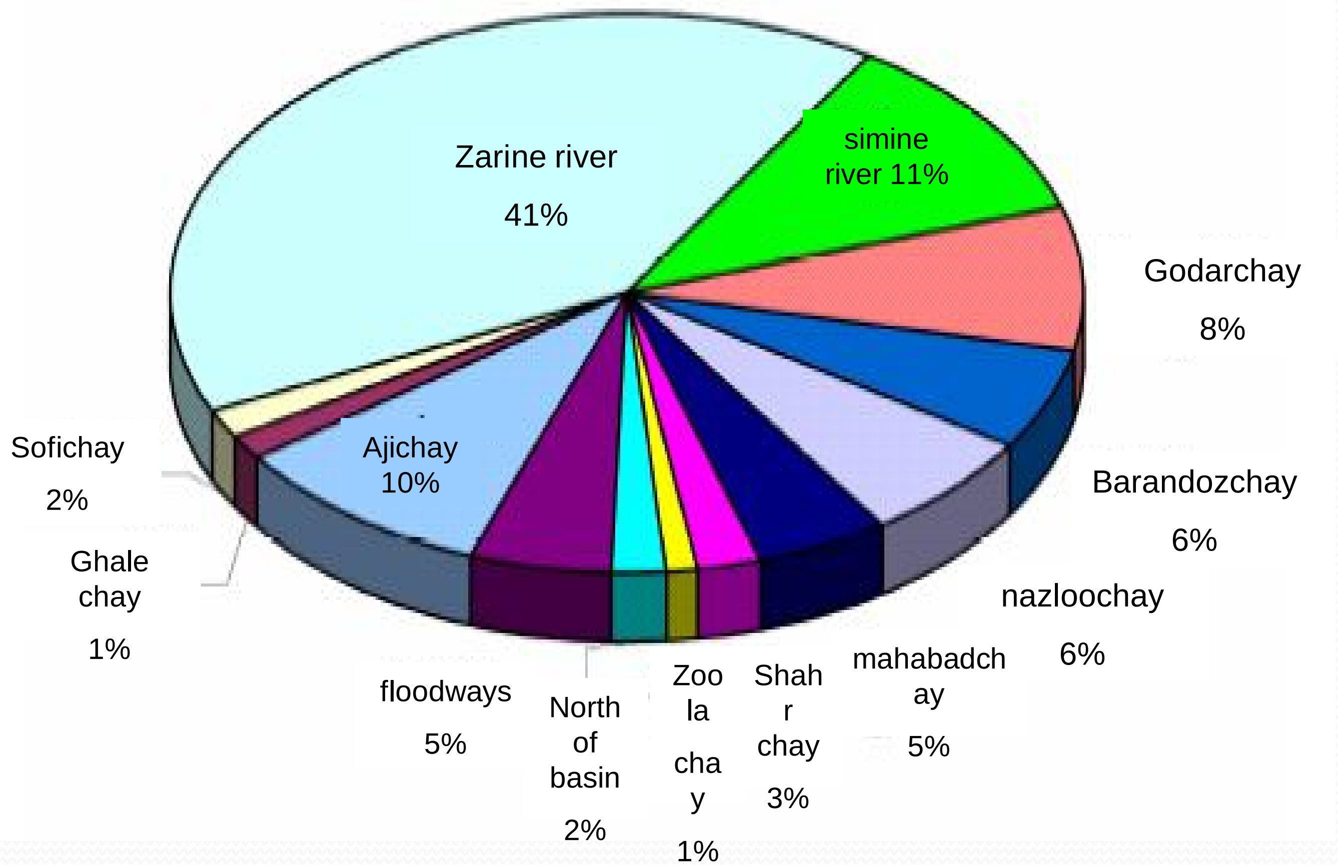


Province	area		population	
	Km ²	percent	person	percent
East Azar	20117.7	42.7	2939388	49.1
West Azar	21701.6	46.1	2809641	47.0
Kurdistan	5284.9	11.2	234368	3.9
sum	47104.2	100	5983397	100

Portion of rivers, seasonal rivers and floodways end to the lake

No of last hygrometry stations in main rivers ending to the lake: 18 with

37752 km² area (82% of basin area without lake)



- The volume of water discharged into the lake by these rivers varies considerably during the year: during the spring, Talkheh River and Simineh River may each discharge about 57 (cms), while the rate drops to only 3.7 or 1.7 (cms) in the dry summer.

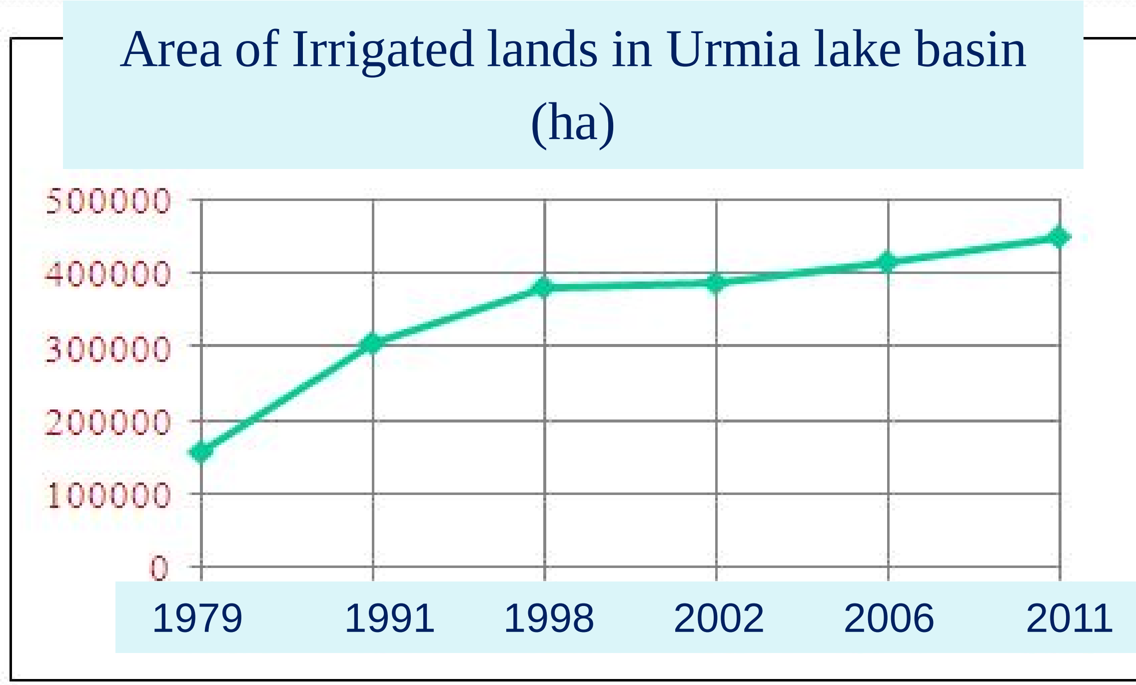
Domestic, Industrial & Agricultural Water Consumption (MCM)

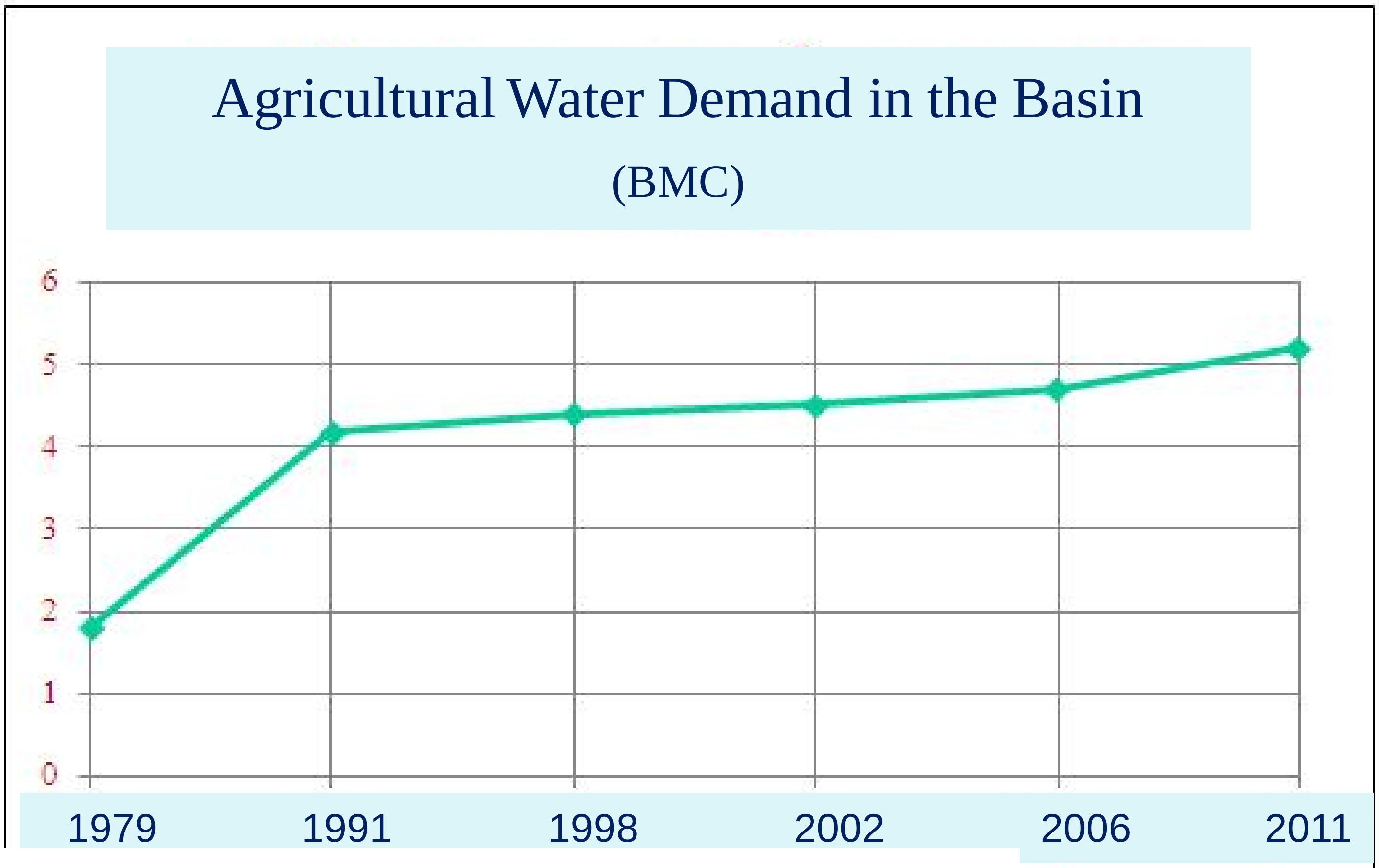
Water Resources/Use	Domestic	Industry	Agriculture	Sum
Surface Water	190	149	2626	**2965**
Ground Water	292	40	2029	**2361**
Sum	**482**	**189**	**4655**	**5326**

- **56% from Surface Water & 44% From the Aquifer**

- **More than 87% of Water Consumption is in Agricultural Sector**

year	Area of Irrigated lands (ha)
1979	158523
1991	306131
1998	381751
2002	387705
2006	415602
2011	450000





Main problems and hazards threatening the sustainability of Urmia Lake :

- ✓ Significant drawdown on the lake’s water level
- ✓ Increase in the lake water salinity
- ✓ Appearance of salty released lands and dispersion of salts by wind
- ✓ Considerable reduction in ecological sustainability of the lake
- ✓ Impacts on the local (micro) climate

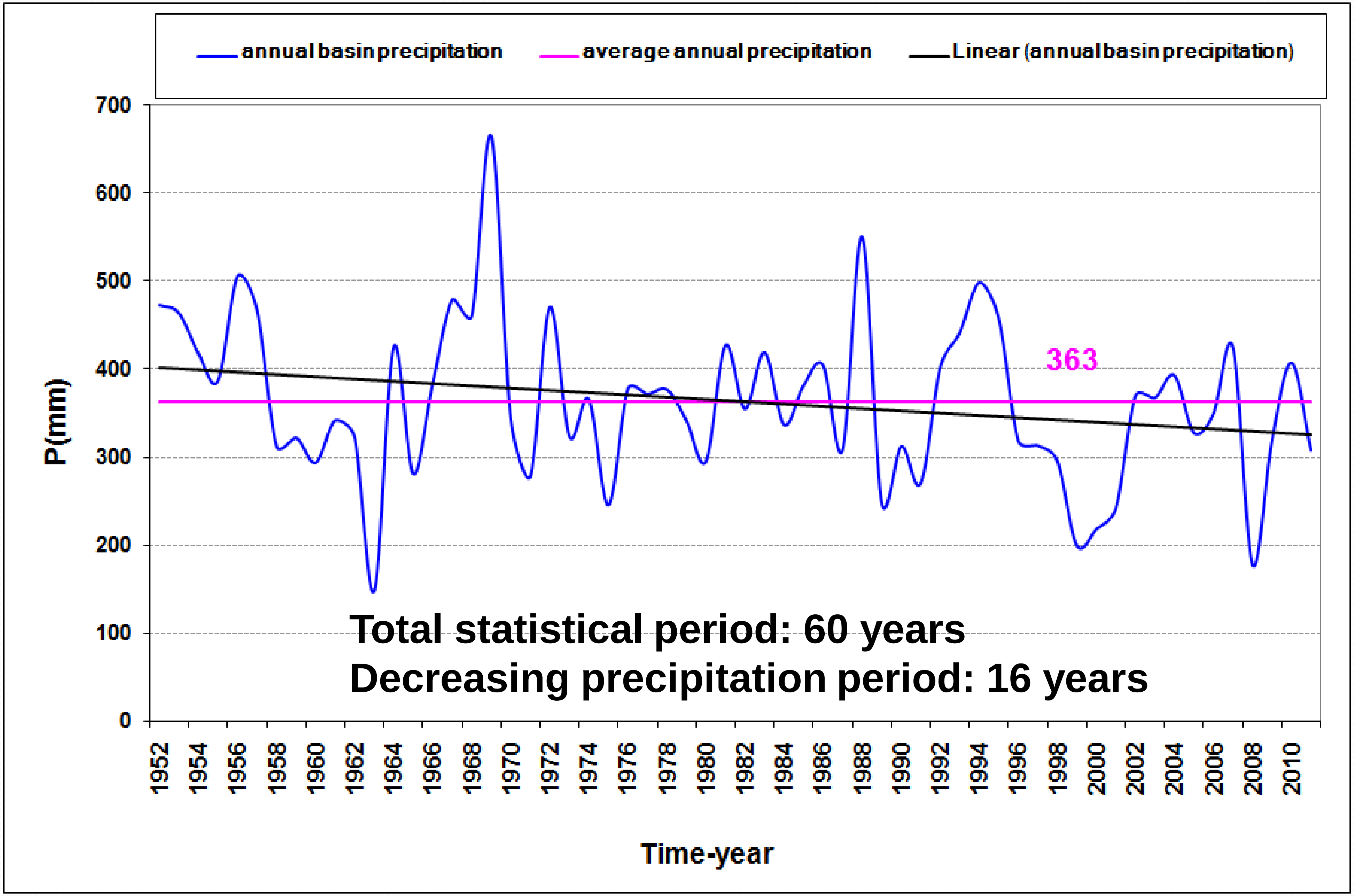
Methodologies

- We are formulating and developing an integrated water resources model in order to analyze the impacts of different parameters (climate change and water resources development projects) on Lake Urmia.
- The main steps we undertook to investigate the solutions for our statement as below:

- Rainfall analysis according to data from 34 stations
- Completing and analyzing runoff from 14 stations
- Calculating and analyzing the lake water inflow
- Evaluating impacts of upstream developments on downstream water supply
- Evaluating impacts of drought on the rate of discharge of the rivers

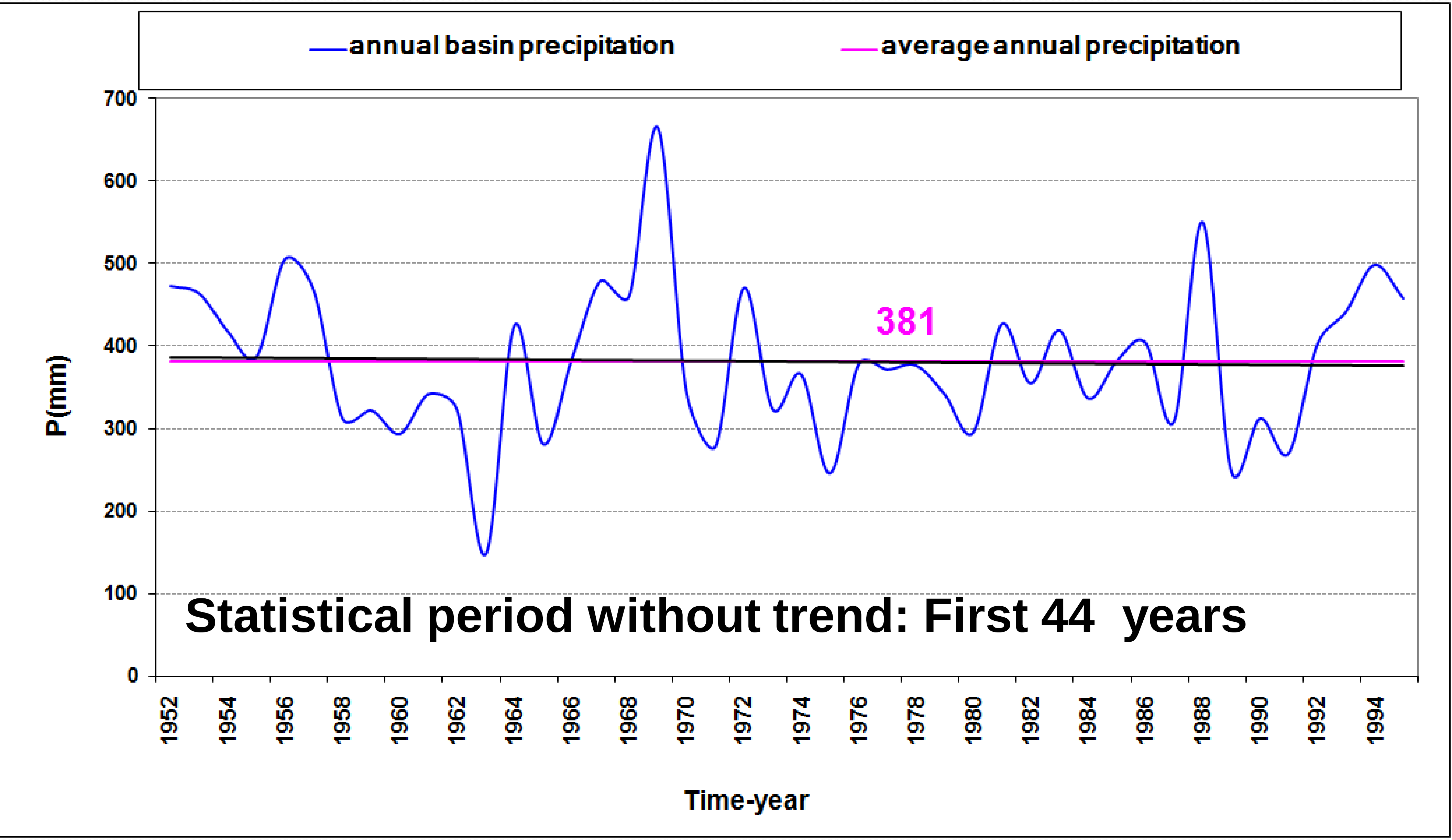
Variation of Precipitation in a 60-Year Period

(mm)



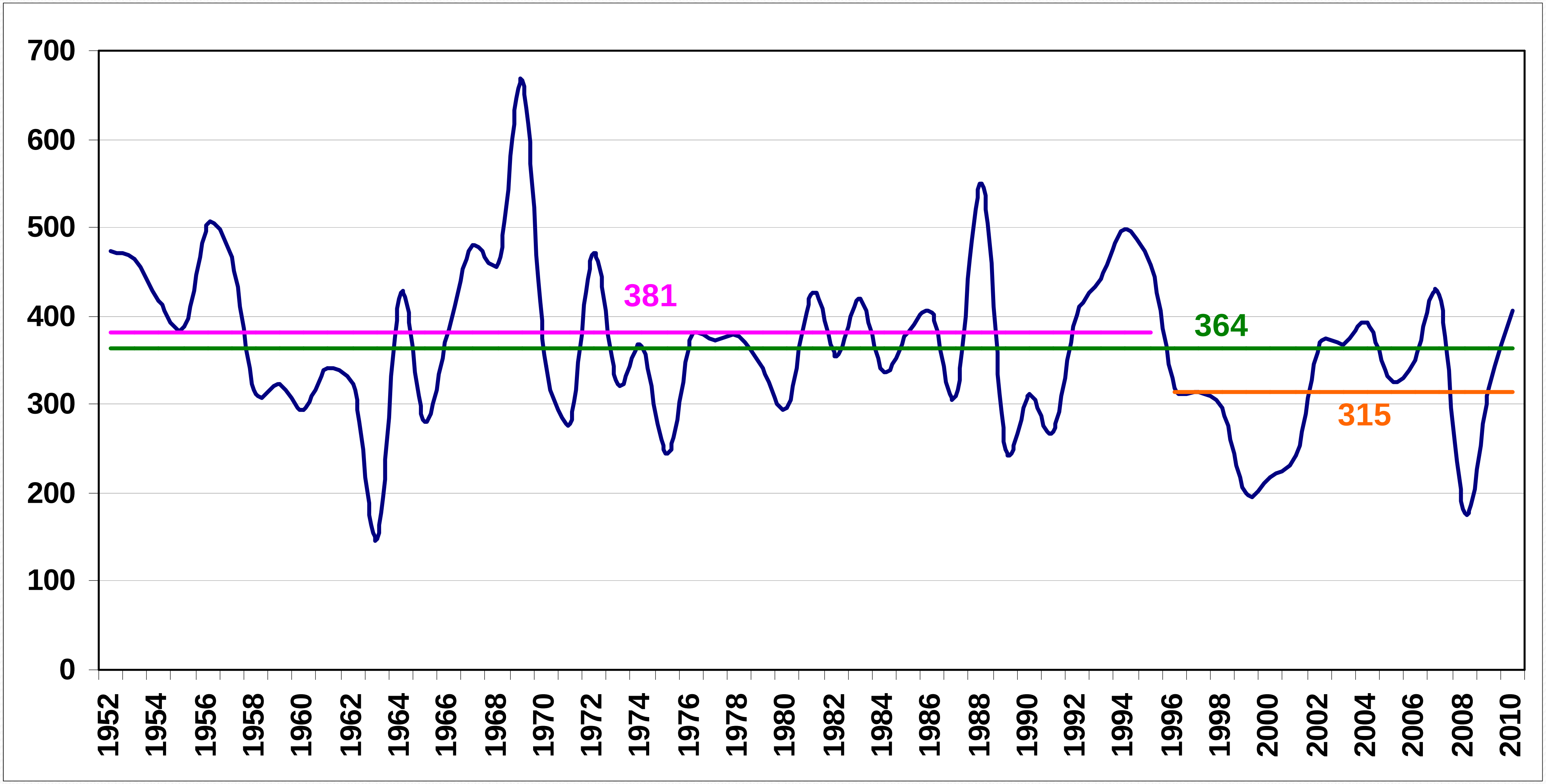
Average of Precipitation in a 60-Year Period

(mm)



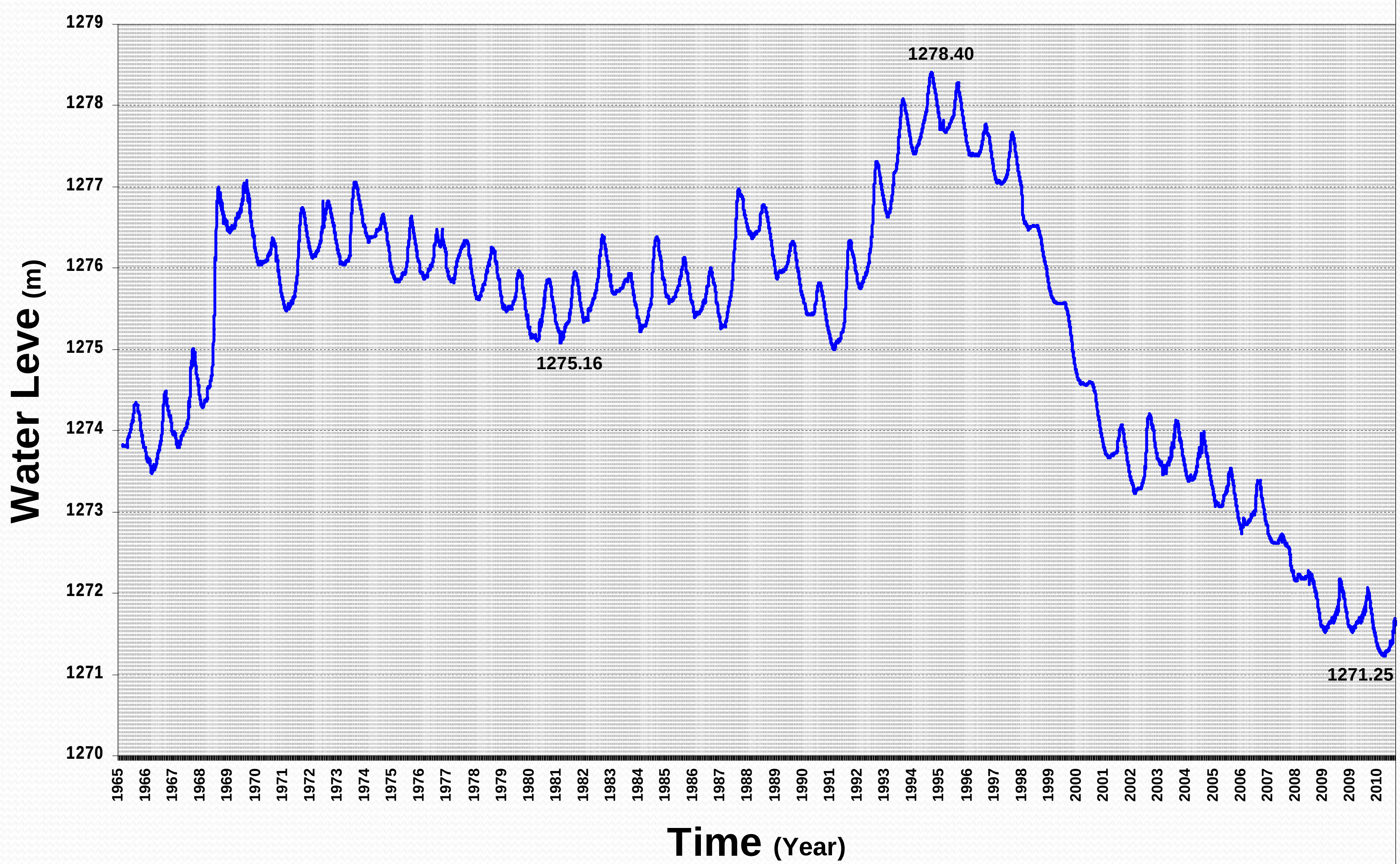
Variation of Precipitation

(Average: In a 59-Year Period, A period without trend, Drought period) (mm)



- Precipitation during resting period: 381 mm
- Precipitation during last 16 years: 315 mm
- Average of decreased precipitation: 66 mm

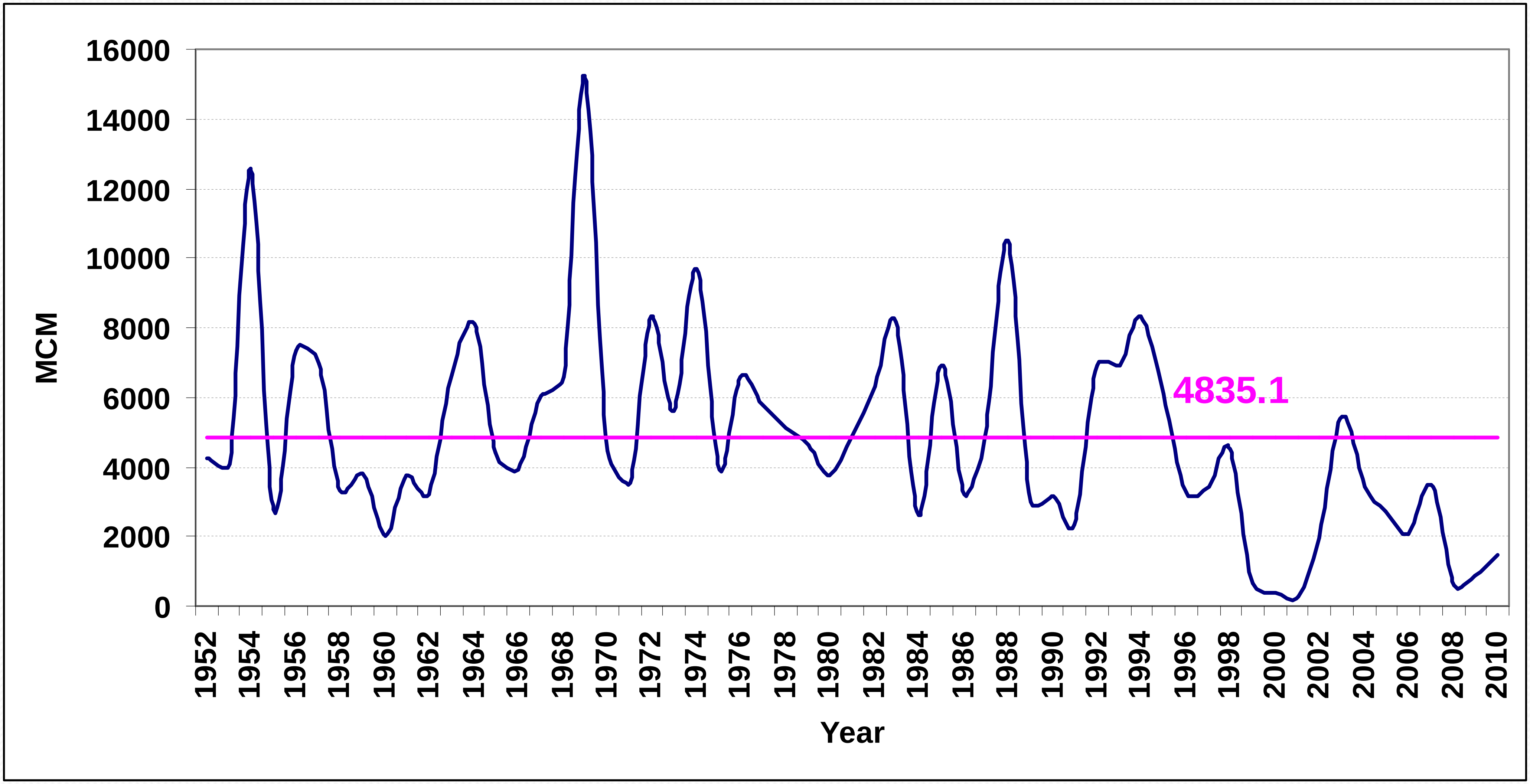
Variation of Urmia Lake Water Level in a 47-Year Period



Inflow to the Lake

- In order to estimate the volume of water inflow to the lake, the recorded information of 14 hydrometric stations is used.
- Since none of these stations are closed to the lake, the discharge values to the lake have been calculated according hydrological methods.
- Then removing the trend and adding the values of new consumption at the upstream, the volume of water entering the lake in the absence of additional upstream consumption was calculated.
- In another scenario with the assumption that none of the four major dam has been constructed, discharge values in the stations affected by the dams, for the years after dam construction was estimated using hydrological methods.
- According to calculations, the average volume of water entering the lake during the static period in natural circumstances that there is no dam and no overdraft at the upstream is estimated about 6565.8 (MCM) and the mean of inflow over the static period assumption that there is no dam is 5946.4 (MCM) and over the total period (59-year), the average of natural inflow (without any dam and excessive consumption at the upstream) is 6244.7 and the average of inflow to the lake while there is no dam is 5404.9 (MCM).
- Volumes of water entering the lake during the statistical basis period, in each of the above scenarios are shown in the next figure.

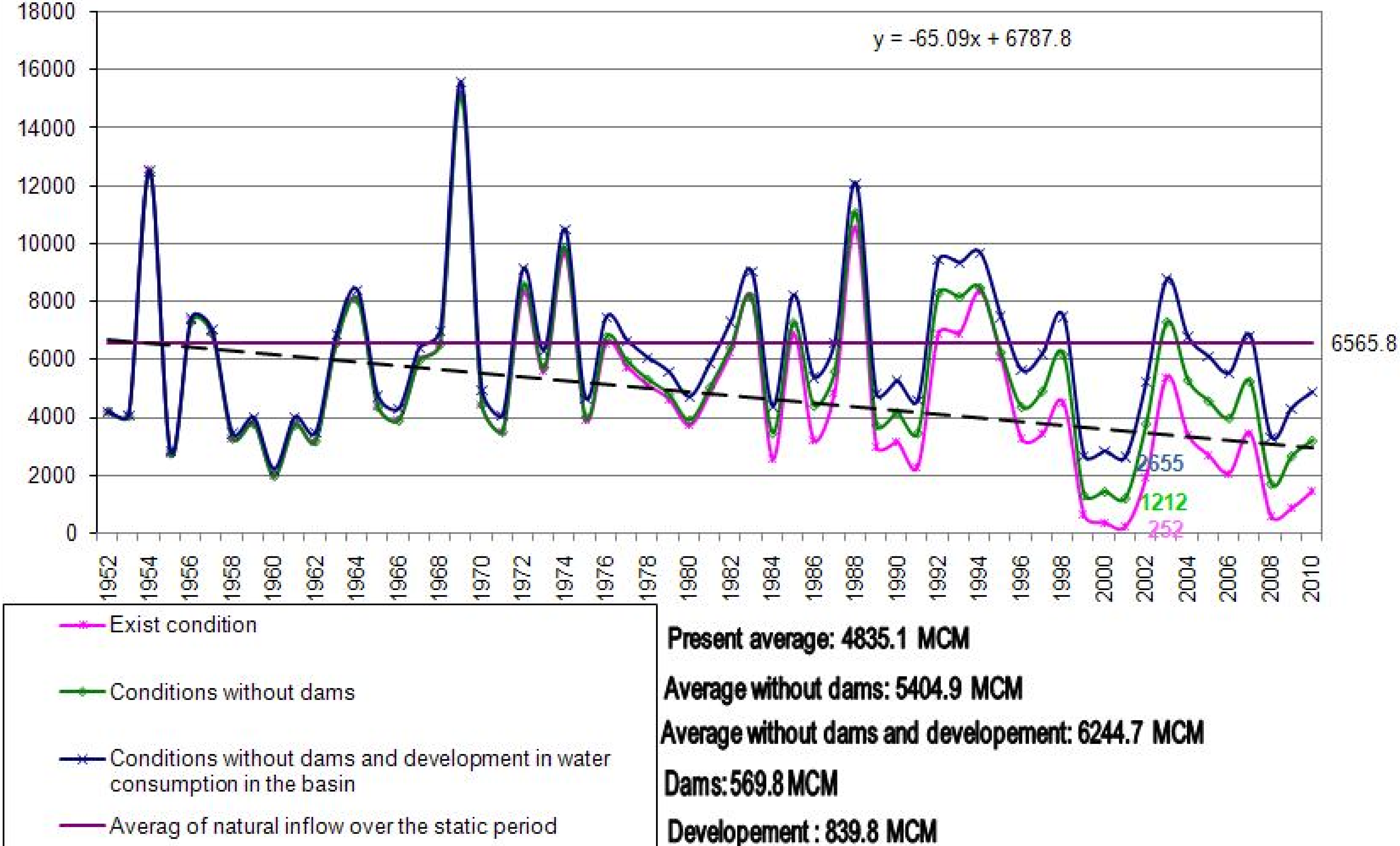
Variation of Inflow to Urmia Lake in a 59-Year Period



Summary of hydrological calculations (MCM)

Average	Observed	Whitout any operational dam	Natural (Whitout any operational dam and development)
Over the period without trend	5697.0	5946.4	6565.8
Total period (59-year)	4835.1	5404.9	6244.7

Assessing the portions of each parameter on decline of water level of the lake



Present average: 4835.1 MCM

Average without dams: 5404.9 MCM

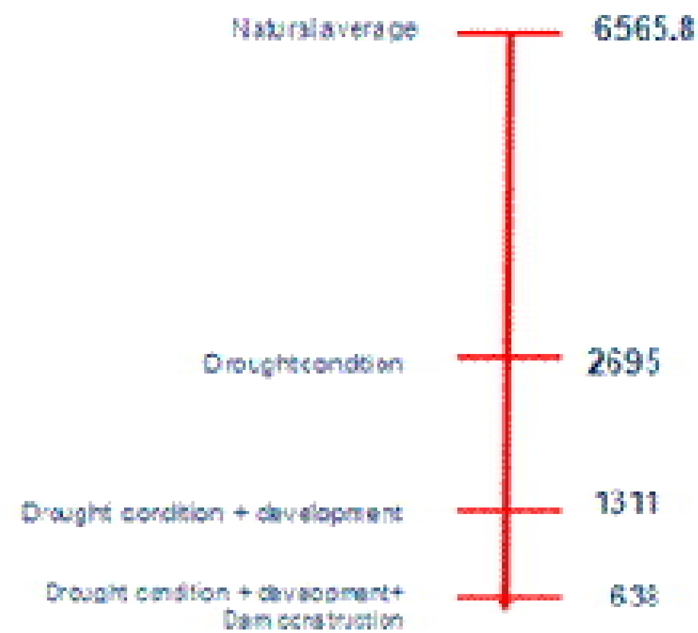
Average without dams and developement: 6244.7 MCM

Dams: 569.8 MCM

Developement : 839.8 MCM

Assessing the portions of each parameter on decline of water level in different years

1999				
Condition	Percent of variation	Cummulative variation	Flow variation compared to average	flow
Natural.	0	0	0	6565.8
Drought	65.30	65.30	3870.6	2695.3
Development	23.35	88.65	5254.8	1311.0
Dam construction	11.35	100	5927.5	638.3



Assessing the portions of each parameter on decline of water level in different years

2000				
Condition	flow (MCM)	Flow variation compared to average (MCM)	Cummulative variation (%)	Percent of variation (%)
Natural.	6565.8	0	0	0
Drought	2848.2	3717.7	60.10	60.10
Development *	1435.6	5130.2	82.93	22.83
Dam construction	379.7	6186.1	100	17.07

2001				
Condition	flow (MCM)	Flow variation compared to average (MCM)	Cummulative variation (%)	Percent of variation (%)
Natural.	6565.8	0	0	0
Drought	2655.0	3910.9	61.94	61.94
Development *	1212.2	5353.7	84.79	22.85
Dam construction	251.9	6314.0	100	15.21

2002				
Condition	flow (MCM)	Flow variation compared to average (MCM)	Cummulative variation (%)	Percent of variation (%)
Natural.	6565.8	0	0	0
Drought	5247.9	1318.0	28.69	28.69
Development *	3790.3	2775.5	60.42	31.73
Dam construction	1972.2	4593.6	100	39.58

Assessing the portions of each parameter on decline of water level in different years

2008				
Condition	flow (MCM)	Flow variation compared to average (MCM)	Cummulative variation (%)	Percent of variation (%)
Natural.	6565.8	0	0	0
Drought	3349.7	3216.2	53.91	53.91
Development *	1706.7	4859.2	81.45	27.54
Dam construction	600.0	5965.8	100	18.55

2009				
Condition	flow (MCM)	Flow variation compared to average (MCM)	Cummulative variation (%)	Percent of variation (%)
Natural.	6565.8	0	0	0
Drought	4337.0	2228.8	39.24	39.24
Development *	2670.3	3895.5	68.59	29.35
Dam construction	886.4	5679.4	100	31.41

2010				
Condition	flow (MCM)	Flow variation compared to average (MCM)	Cummulative variation (%)	Percent of variation (%)
Natural.	6565.8	0	0	0
Drought	4897.2	1668.7	32.79	32.79
Development *	3204.4	3361.4	66.05	33.26
Dam construction	1476.3	5089.5	100	33.95

Development*: Development of Irrigated lands and water consumption in the basin

Assessing the portions of each parameter on decline of water level in different years

As is shown in a bow tables, the effect of drought is more than the other parameters.

Average of effect of each parameter on decline of water level of the lake between the years 1999-2010

Condition	Percent of variation (%)
Drought	48.85
Development	27.27
Dam construction	23.87

Conclusion

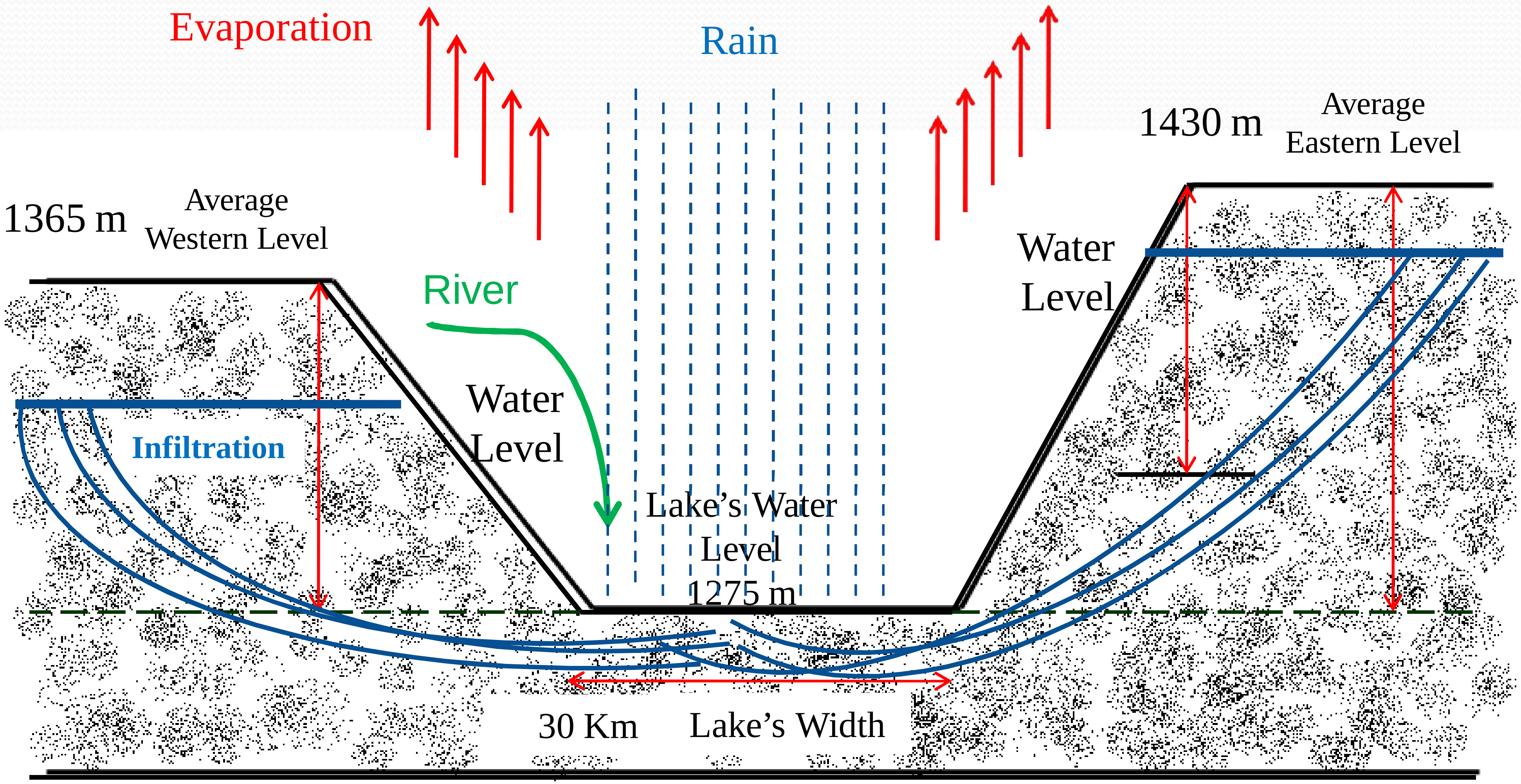
Main Affective Factors on Drying Up the Lake Urmia:

- **Decrease in precipitation:** Also the times of precipitation less than 10 mm, has increased.

- **Increase in temperature:** an increased of about 2C will lead to an increase in evaporation of about 11.2% from the lake surface and about 4.8% from the whole surface area of the basin; thus, resulting in an increase in water consumption for agriculture.

- **Increase in overdraft** from the aquifers and the increase in number of illegal wells .

Water Exchange Diagram



Main Affective Factors on Drying Up the Lake Urmia:

- **Poor level of efficiency** in water consumption for irrigation and industrial use.
- **Changing in crop pattern:** From crops requiring low- to high-water consumption.
- **Change in land use:** Pastures to orchards ,...
- **Expansion in areas of irrigated lands.**
- **Construction of hydraulic structures**(dams,..)
- **Increase in population:** Leading to an increase in water consumption, Specially in Agricultural Sector.

Conclusion:

- **The growth in population** leads to an increase in water consumption in different sectors, thereby necessity the development of the water resources

- **Uneven distribution of precipitation** in the country in terms of time and location results in the inability to respond to water needs in different sectors; so, it is necessary to construct water reservoirs to ensure water supply during times of low precipitation or lack of.

- **Dams may damage the environment**, but when there is a lack of a proper hardware and software management of dams within an integrated water resources management that has the participation of all stakeholders, the damage would be exponential.

Conclusion:

- **Dams are useful** not unless they are constructed not for a purpose but as a result of pressures from different sectors in the country.

- The most damage to the lake is a result of the **cumulative effect of droughts** in the past recent years.

- Water consumption in the basin is more than **90% of the total potential of water resources** and if mismanaged, the lake would still dry up even in normal conditions.

Conclusion:

- With the consideration of demand on one side and the consequential damage to the natural and social environment on the other with the drying up of the lake, it is critical that **stakeholders and all pertinent parties** agree on the necessary measures to undertake so that the lake be preserved and the needs of the stakeholders are met.

- ***So what we need to save the lake is an Integrated Watershed Management (IWM).***


Thanks for your
kind attention