Hydroclimatology Analysis of Water Level Fluctuations in Urmia Lake

Dariush Yarahmadi*
Assistant Prof., Dep. of Geographical Sciences, Lorestan University

Received: 08/09/2013 Accepted: 16/03/2014

Extended Abstract

Introduction

Lake Urmia, at the northwestern tip of Iran, is one of the largest permanent hyper saline lakes in the world and the largest lake in the Middle East. The lake is located between Eastern Azerbaijan and Western Azerbaijan, west of the southern portion of the similarly shaped Caspian Sea. It extends as much as 140km from north to south and is as wide as 85km from east to west during high water level periods. Because of being located in a dry and semi-dry region, this region doesn't have suitable water resources comparing with global average water resources. Drought, climatic fluctuations, and shortage and disorder of rainfall cause many problems with regard to food and water for people who live in this region. Urmia lake is also one the most important and the largest aquatic ecosystems of Iran. The systemic and chain changes in the lake will lead to great effects on the climate and economic, social and hydrology conditions. Oscillations of the lake water levels and volume in recent years have attracted many opinions and created apprehensions.

Methodology

Groundwater data, meteorological precipitation and temperature data were obtained from Urmia station of Meteorology Organization for the period from 1981 to 2010. Then time series were formed for temperature and precipitation in the form of annual, seasonal, and monthly files. The time series of temperature, precipitation, rivers discharges, and water table levels and oscillations of the lake water level were collected and adjusted for the periods 1981-2010. To inform homogeneity and randomness of data and possibility of any trends in the time series, the nonparametric test was used. In this study, precipitation, river discharges and water tables and

*E-mail: d.yarahmadi@gmail.com Tel: +98 9161654281

temperatures were assessed as the independent variable and the water level as the dependent variable. After reviewing the different parametric and nonparametric tests on the data in this study, we eventually used a multivariable regression parametric test (Y=a+b1x1+b2x2) for temperature and precipitation and these tests ultimately showed the ability to cover the analysis of data and review of this study.

To determine the direction of the trend, type and time of changes based on a Man-Kendall graphical and statistical test, the following formulas were used:

1) $$Ui = \frac{(\sum ti - Ei)}{\sqrt{\mathrm{Vi}}}$$

2) $$U'i = \frac{-(\sum t'i - E'i)}{\sqrt{\mathrm{V'i}}}$$

Results and Discussion

In this study, the relationship between climatic factors and their effects on the hydrological conditions such as the river discharge, water level of Urmia Lake and wells water table were studied. For presence or absence of relationship between them, the Pearson correlation coefficient was used. The highest correlation between the water table and lake water level was 0.71 which is significant at the level of 0.05. Among the four effective independent variables, the lowest correlation was observed between climate change and the water level of the lake. The coefficient for the river discharge and the water table was, respectively, 0.72 and -0.71. The Pearson correlation test shows that linear gradient during the period is significant with time increasing. The results indicate that the relationship between the precipitation and water level is negative and temperature and the water table is positive. The regression gradient line at the scatter plot shows that the precipitation increase raises the water level. The highest annual decreasing rainfall is -2.56. Increasing temperatures and declining rainfall, snowfall reduction, increasing evapotranspiration and reducing the water as input decreased the water level of the lake. As a result, the lake water level trend was decreasing 0.18 mm in each year. The model and the regression analysis were calculated due to the delayed effects of climate and hydrological factors interference in each other. The coefficient determination indicates that other factors remain constant; approximately 0.30 of the dispersion of the observed changes in the lake water level is justified by temperature and precipitation variations. If we assume that hydrology parameters are constant, we can say that lake water level increases 0.005 meters per one mm rainfall and the lake water increases 1.672 meter per one cm river discharge.

Conclusion

By designing a hydrology model, it was determined that 42 percent of water level fluctuations is due to changes in the river discharge of the region and groundwater and water table. By examining regression models, we find that changes in hydrological parameters that are related to human factors rather than climatic parameters have the most influential effects on the lake water level fluctuations. The temperature increase affected the lake water level dropping more than the

rainfall decrease. By examining Man-Kendall graphics, we characterized that leaping in temperature started in 1993. Precipitation and discharge decreasedin1993-1994 and this caused the rise of the trend water table and reducing of water level in Urmia Lake, happened with a four-year delay which started from 1998.

Keywords: ***Discharge, Precipitation, Temperature, Urmia Lake, Water Table.***