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EXTENDED ABSTRACT

Assessment of Meteorological and Hydrological Drought and its Effect on Water Quality: (Case Study: Godarkhosh River)

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Introduction

Drought is a natural phenomenon that causes water resources shortage in various sectors such as drinking water, industry and agriculture. Drought is one of the climatic phenomena that can be observed not only in arid and semi-arid regions, but also alternately in wet areas. It should be noted that aridity and drought are different, aridity is a climatic trait specific to arid and semi-arid regions and is a permanent feature of the climate of the dry region (Eslamian et al, 2012). Liu et al (2011) with the study of meteorological and hydrological droughts in Oklahoma State discovered the two-day drought incidence of 2 months and the correlation coefficient between SPI and SDI profiles in an optimal state was 0.63. Eskandari-Damaneh (2015) investigated temporal and spatial relationships between meteorological and hydrological droughts in Tehran province. The results showed a correlation of 99% between meteorological and hydrological droughts and the increasing trend of drought in Tehran province. Mahmoudi et al. (2015) assessed the drought of meteorology in Sistan and Baluchestan Province using a standard score index and its impact on water quality in the province. Delpla et al (2009) examined the impact of climate change on the quality of surface waters in relation to drinking water production and concluded that climate change has reduced the quality of drinking water that has potential health impacts. Also, Mosley (2015) indicated that drought increased salinity, algae and soluble ions, which greatly reduced the quality of freshwater. According to drought studies, the main objective of this study is to study the drought of meteorology and hydrology, as well as to determine the probable delay between the occurrence of these two types of drought and their impact on river water quality, for water resources management in Godarkhosh basin which is one of the most important basins in Ilam province.

Methodology

The Godarkhosh catchment with an area of approximately 1216.58 km2 situated between the northern latitudes of 33°8′−34°00′ and eastern longitudes of 45°47′−46°34′. Godarkhosh river is located on the border between Iran and Iraq in Ilam province, Iran. The average annual rainfall in the study area is 570.6 mm and most of the precipitation is in winter. The catchment area of this river is located between the three basins of Konjanchem, Kangir and Talkhab. The rate of river discharge varies during different seasons. The difference between the height of the river and the surrounding land is 320 meters, the length of the river is 187 kilometers and its width varies. According to Domarton index, this region has had semi-arid climate. The present study has

carried out to assess meteorological and hydrological drought and its impact on water quality Godarkhosh river located in Ilam province during 1987 to 2013. For this purpose, 22-year-old statistics from the temperature and precipitation for six meteorological stations and the discharge and water quality data for a hydrometric station at the study area was used. Also, low flow index, Q90, and the meteorological and hydrological drought, Standardized Precipitation Index (SPI) and Standardized Discharge Index (SDI) were calculated for time periods of 3, 6, 12, 24, and 48 months. The water quality parameters used in this study are chloride anions (Cl^-), sulfate (SO_4^-), bicarbonate (HCO_3^-), and the most important cations include sodium (Na^+), magnesium (Mg^{2+}) and calcium (Ca^{2+}), which may cause changes in their concentration during every year. Then, water quality characteristics including anions and cations, Total Dissolved Solid (TDS), electrical conductivity (EC) and acidity (pH) were analyzed. In order to study the water quality, Schuler diagrams were plotted and analyzed.

Findings

The results showed an increase in severity and frequency of droughts, especially the hydrological drought in recent years and proved the existent a high correlation in the 12-month delay between the meteorological and hydrological drought. The comparison between SDI and SPI indicated that about 55% if the hydrologic drought happened in time of the meteorological drought which rainfall was not in normal conditions. Also, based on SPI and Q_{90} indices, the common terms of meteorological and hydrological drought was obtained to be 11 months. The obtained results of the effects of drought on the surface water quality indicated that the river discharge decreased by drought and the temperature increment has increased anions (SO_4, Cl and HCo_3) and cations (Na, Ca and Mg) amounts as 4.09 and 8.04% , respectively, in dry years than the 22-year-old average. Furthermore, the electrical conductivity (EC), dissolved salts and sodium absorption ratio (SAR) were increased as 0.24, 0.17 and 5.88 %, respectively, but according to Schuler diagram, water quality is almost within the acceptable range.

Conclusions

Studies have shown that there is a significant relationship between meteorological and hydrological droughts, so that the occurrence of meteorological droughts has reduced the volume of surface water discharge, which has continued to decrease in subsequent years. The results of meteorological and hydrological drought data indicate that the drought is intensified and continued, especially hydrological drought, in the next years of the meteorological period with a delay of 12 months. In the study area, although the meteorological and hydrological drought has affected water quality, but no significant changes were observed. Based on the Shuler charts, water quality in this catchment area was relatively acceptable.

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