Water Quality Assessment of Al-Gharraf River, South of Iraq Using Multivariate Statistical Techniques

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Abstract

The multivariate statistical methods (principal component analysis "PCA" and hierarchical cluster analysis "CA"), were used to evaluate the water quality of Al-Gharraf River, the largest branch of Tigris River, south of Iraq. Water quality parameters were calculated monthly at each of the ten stations along the river during the year 2014-2015, to investigate the potential pollution sources and samples were analyzed for 18 physicochemical and biological parameters. The PCA supported in extracting and recognizing the factors that are responsible for river water quality variance over the year. Four factors identified that are responsible for 70% of the total variance in water quality of the river. The first factor is a multi-source factor that explains 31.6% of the total variation. The second factor is organic source factor that explains 14.6% of the total variance. The third factor is soil erosion source factor that explains 12.8% of the total variance. The fourth factor is caused by sulfates and calcium and explains 11% of the total variance. The hierarchical CA classified the 10 monitoring sites into three differentiated groups showed similar water quality features. The natural hydro-geochemical and anthropogenic activities such as domestic wastewater influents were the significant factors affect the water quality. The results of this work can be used to decrease the number of samples analyzed in both space and time to help the decision makers in recognizing priorities to improve water quality. [DOI: 10.22401/JUNS.20.2.16]

Keywords**:** Al-Gharraf River, water quality, multivariate statistical methods.

Introduction

Water is an essential natural resource for human life, developing economics and society regarding agriculture, industry and various facilities. Rivers are not supplying water for human consumption only, but also to receive wastes discharged from human activities [1]. Constant polluting sources are formed by municipal and industrial wastewater ejection, whereas surface overflow is a seasonal phenomenon, largely affected by climate within the surface water basin [2].

The Seasonal variation of precipitation, surface runoff, groundwater flow, and anthropogenic transfers have an intensive effect on the river discharge and, subsequently, on the amount and concentration of pollutants in water. Due to these complexities, water quality specialists and decision-makers often are confronted with significant challenges in their efforts to control water pollution [3, 4]. Through identifying spatial and temporal patterns in the river water quality, an improved understanding of the environmental conditions may help the stakeholder and decision-maker to establish priorities for sustainable of water management [5, 6, 7].

Previous studies have demonstrated that Iraq currently faces serious water problems; not only over-exploitation and uneven in the spatial distribution of water resources, but also severe water pollution in Iraqis main rivers, which give contribution for the scarcity of water of adequate quantity and quality [8,9,10]. Growing municipal wastewater discharges due to urbanization, agriculture, and industrial practices, along with the limitation of wastewater treatment facility and capacity, considered the principal drivers of water pollution. In Iraq, all wastewater discharged into rivers, and most of that is untreated [11, 12, 13].

Application of the multivariate statistical methods, like principal component analysis (PCA) and cluster analysis (CA), helps in the elucidation of complex data to improve the understanding of the water quality. Such tools facilitate the identification of possible factors