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Evaluation of Qual2kw Model in Qualitative Simulation of Khorramabad River

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1-Introduction

Rivers are the most important sources of drinking, agricultural, and industrial water supply. In recent decades, however, these resources have become the main receivers of sewer pipelines due to rapid population growth. To evaluate the effects of pollutant discharge on the self-purification of rivers, it is necessary to use numerical simulations of water quality. Today, various softwares have been designed for this purpose. One of the most important of these softwares used in this research is the one-dimensional QUAL2Kw model that simulates water quality variables in a steady and non-uniform flow mode. In the present study, the water quality of the Khorramabad River was simulated with the help of this model over a distance of 35 km from the river.

2-Methodology

The range studied in this research is about 35 km along the Khorramabad River from the source of Khorramrud upstream of Robat Namaki village to Chamjangir hydrometric station, which in the geographical coordinates of 33°36'54" to 33°26'37" north latitude; it is located at 48°17'39" to 48°14'38" longitude. Khorramabad River pollution sources are divided into three main parts: urban, industrial, and agricultural. Due to the location of pollutant sources in the river, 5 points along the river were considered as sampling sites, two stations including the beginning and end of the study area, one station in the center of Khorramabad, and the other two stations were selected before the river entered the city and after leaving the city, respectively.

In this research, the QUAL2Kw model version 5.1 was used. The required data of the model is divided into three parts: geometric-hydraulic data, qualitative data, and meteorological data. The river was divided into 11 sections and simulated using the hydraulic Manning equation. In this study, important water quality parameters such as DO, $CBOD_f$, COD, NO_3, EC, and pH and temperature parameters in July and September

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of 2019 for calibration and validation, respectively, the model was used. Finally, RMSE, NRMSE, and MAE indices were used to evaluate the model in the simulation.

3-Results and Discussion

The results showed that the number of parameters including COD, $CBOD_{f,}$ and NO_3 increased after the Karganeh tributary joined the river and also the inflow of pollutant sources such as slaughterhouses, municipal treatment plant, milk factory, and alcohol production unit into the river. However, the pH (in both months) and EC (in July) parameters did not change much along the river; in other words, the river can self-purifying these parameters. In the research of Hashemi et al. (2019), for the simulation of the Talar River, the same result was obtained for these two parameters. Babakhani et al. (2019) in a study conducted on the Diwandara River reported a strong correlation between the measured and simulated values of the pH parameter because in surface water the pH value along the path with carbonate and bicarbonate in the path there reaches the equilibrium concentration. According to the results of the research and the fact that the Khorramabad River is used for agricultural and industrial purposes and is not a source of drinking water, at present, there is no limiting factor to achieve this purpose in the study route. Then, the calculation of statistical indices showed that the value of the NRMSE index in the calibration and validation stage of the model is the lowest for pH and equal to 8.83 and 9.22 percent and for EC is 11.05 and 13.86 percent, respectively. The simulation of DO parameter also had fluctuations along the river, while the statistical indices of NRMSE, RMSE, and MAE for this parameter in both calibration and validation stages were obtained at an acceptable level; thus, the above indices in the calibration stage of the model 12.49, 0.917 and 0.72, respectively, and in the validation stage of the model were calculated 24.65, 1.78, 1.55, respectively. In addition, the model was able to simulate the temperature parameter with high accuracy in July (RMSE = 1.92 and MAE = 1.57) and September (RMSE = 2.77 and MAE = 2.5709). Finally, the results of this study indicate the considerable accuracy of the QUAL2Kw model in simulating the above parameters in the Khorramabad River.

4-Conclusions

The results showed that the amount of chemical oxygen demand, biochemical oxygen demand, and nitrate parameters increased due to the entry of effluents from industrial pollutants. Besides, the evaluation index indicates that the QUAL2Kw model has shown good performance in estimating the acidity parameter compared to other parameters. It is suggested that in addition to the low water season, modeling be done in high water seasons and use two-dimensional quality models to simulate rivers.

Keywords: Qualitative Parameters, Simulation, QUAL2Kw Model, Khorramabad River, Lorestan Province

5-References

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