University of Thi-Qar Journal of Science (UTJsci)
E-ISSN: 2709-0256, P-ISSN: 1991-8690, Vol. 10, No. 2, Dec. 2023

Analysis and evaluation of sediment pollutants of Euphrates River at Al-Nasiriyah city, south of Iraq

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Received: 2023-08-24, Revised: 2023-09-17, Accepted: 2023-09-22, Published: 2023-12-25

***Abstract*—In this work, total phosphorus (TP), total nitrogen (TN) and organic matter (OM) were detected in the sediment of Euphrates River in different period's time. Then we did the analysis and the characterization of these pollutants for this river. In addition, determine relationship between the sediment of the water period and the pore-water was explained in detail. The findings of this study showed that the sediment levels of total phosphorus in Euphrates river were 2.05 ~ 6.50 mg/g, 1.65 ~ 3.17 mg/g and 0.71 ~ 0.93 mg/g the sediment levels of total nitrogen were 5.06 ~ 8.98 mg/g, 6.07 ~ 8.56 mg/g and 5.02 ~ 7.99 mg/g. Also, organic matter levels in sediment were 40.54 ~ 70.1 mg/g, 58.70 ~ 85.63 mg/g and 11.32 ~ 30.17 mg/g in dry season, water period and wet season respectively. Clearly, from that analysis and comparison of pollutants level, the sediment of Euphrates River is the main source of contamination. This may be able to result from increasing the human activities and the increment of industrial actions in this region.**

***Keywords*— Euphrates River; Sediment pollutants; Water period.**

I. INTRODUCTION

Water covers 71% from the earth's surface. Ocean covers 98% of this area and 2% of it is freshwater [1]. Water pollution means the contamination freshwater sources like lakes, rivers, and groundwater, and marine environments, oceans and seas, by various harmful substances. Contaminants can come from many sources, such as sewage, industrial waste, agricultural fertilization, oil spills, and improper disposal of chemicals. Pollution of water has detrimental effects on aquatic ecosystems, human health, and the environment as whole. The key issue is the waste in water sources such as lakes, rivers or reservoirs [2].

The Euphrates River is one of the main sources of water for human utilize, in which causes the water pollution the water . Common sedimental pollutants are:

1. Heavy Metals include lead, mercury, cadmium, and arsenic, which can originate from industrial activities, mining, and atmospheric deposition. These metals can have toxic effects on aquatic organisms and humans.

2. Organic Contaminants include pesticides, herbicides, industrial chemicals, and petroleum hydrocarbons. They can come from agricultural runoff, industrial discharges, and urban storm water runoff. Organic contaminants can have toxic and bio accumulative effects on aquatic life.

3. Nutrients: Excessive amounts of nutrients such as nitrogen and phosphorus in sediments can lead to eutrophication, causing excessive algae growth and depletion of oxygen in the water, negatively affecting aquatic ecosystems.

4. Pathogens: Sediment can act as a reservoir for microorganisms, such as bacteria, viruses, and protozoa, which can pose health risks if released into the water.

5. Micro plastics like small plastic particles 34haccumulate in sediment from various contaminated sources from single use plastics, microbeads, and degraded plastic items. Micro plastics can be ingested by organisms and potentially have harmful effects [1].

The world health organization announced that the contaminants of water are caused about 250 million injuries per year and 10 million deaths [3]. The ability of water to purify itself from impurities and environmental factors if the impurities are within the source of water able to tolerate and treat them [4]. The pollution of water with different types of contaminants becomes essential because of the risks to water sources and also the life of animals in the aquatic environment [5]. Many studies agree with the fact that the most groups of polluting to water are elements of cleaning, phosphorus compounds, manufactured organic compounds, vehicles membership, detergents and radioactive materials [6].

Nitrogen considers a nutrient that limits the growth of phytoplankton in the water [7]. Phosphorus is a significant element in aquatic ecosystems. Phosphorus in water exists in two forms: dissolved and particulate phosphate compounds [8].

https://doi.org/10.32792/utq/utjsci/v10i2.1110

Because of the serious effect of these pollutants on human life, massive research was conducted in this field. Safana B. Sharhan *et. al.* were determined these pollutants in the sediments of Euphrates River at Al-Nasiriyah city [9]. Sarah Awad Turki et al estimated these pollutants in water of Euphrates River at Al-Nasiriyah city. Both of these studies found that an increment of pollutants in both cases whether sediments or water in this study region [10].

The aim of this study to reveal the concentrations level of total phosphorus (TP), total nitrogen (TN) and total organic matter (OM) and evaluate the pollution index (PI) of nitrogen, phosphorus and organic matter pollutants in the sediments from Euphrates River at Al-Nasiriyah city.

II. MATERIALS AND PROCEDURE

A. Study Area:

Based on previously investigation of hydrological limitation and basin population forindustry and distribution in Euphrates River, there are three areas for collecting samples , as following: -

Station 1: the main agricultural area (Al-Sdinawiyah)

Station 2: main residential area (Al- Fadhliyah)

Station 3: the main industrial area (Electrical power station)

Practically, there are three regions which are located by riverside were selected to collect the samples. The selected areas were chosen according to the verity of causes and effects of pollution that are result from people activity, agricultural actions and industrial impact. The three selected stations are located in Nasiriyah city, southern of Iraq. The first one is Al- Fadhliyah which mainly residential area. The second station is Al-Sdinawiyah, which represent an agricultural area, while the third region is near to or around the Nasiriyah power station.

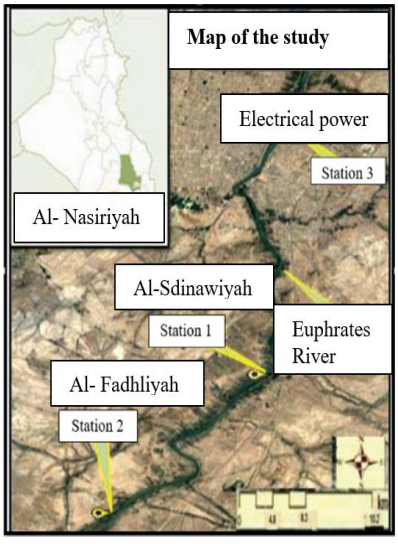

Fig (1): Map of the study area showed the study stations

B. Samples Collections :

The sediment Samples that were collected during the period time in July 2022 and December 2022 represents the samples of the dry season and wet season. The samples were collected from three stations: picked from surface 0 ~ 12 cm above the sediment by using sample stick. While the water period samples were collected from 0.5 m above the sediment. Then added acid to change a PH sampling is less than 2 and kept under 5°C, and measured in laboratory within 24h. Sediment of pore- water is prepared from sediment by centrifugating at 4000 r/min for 30 min. Sediment dried and crushed through (100 mesh) sieve and kept in plastic bags and stored at 4°C to be measured.

C. Sample Analysis and Testing

The examination procedure in this work involved measuring the contaminated level in the water period, total phosphorus (TP), total nitrogen (TN) and organic matter (OM) in sediment for the selected regions. TN is tested by potassium persulfate oxidation spectrophotometry [11], TP by ammonium molybdate spectrophotometric method [11]. OM with potassium dichromate oxidation using low temperature hot outside – colorimetric method [12].

III. RESULTS AND ANALYSIS

A. The Pollutants Distribution in The Sediment

Tables 1, 2 and 3 are for Euphrates River sediment contaminates that showed in figures (2, 3 , 4) . There is a gap of research in this situation related to sediment's pollution in this region. Therefore, in this study we will try to fill this gap by measuring the accumulation of pollutants in the sediment of Euphrates River. From the table, the sediment levels of total phosphorus in the study region of Euphrates river were 2.05 ~ 6.50 mg/g , 1.65 ~ 3.17 mg/g and 0.71 ~ 0.93 mg/g . The increase in the total phosphate values may be due to human waste and phosphate rich detergents [13]. The total nitrogen levels in sediment were 5.06 ~ 8.98 mg/g , 6.07 ~ 8.56 mg/g and 5.02 ~ 7.99 mg/g . This high concentration of nitrogen is caused by the release of fertilizers and other human wastes into water and then sediments [14]. In addition, the organic matter levels in sediment were 40.54 ~ 70.1 mg/g , 58.70 ~ 85.63 mg/g and 11.32 ~ 30.17 mg/g in dry season , water period and wet season respectively . Comparing these results with previous study that was done in the same area in 2019 [9], the values of TP and TN were (0.209 ~0.81 and 0.011 ~ 0.029) mg/g respectively. Large difference between the values in these two studies shows the massive pollution that occurred recently in this area of study. This could result from increasing the human activities and the increment of industrial actions in this region. Standard of TN, TP and OM in sediment reference to the Canada Ontario Environment and Energy (1992) [15].

Table 1: Various TP levels of water contaminant in sediments (with mg\g)

Sampling station	TP		
	Dry season	Water period	Wet season
1	2.05	1.65	0.71
2	4.62	1.95	0.73
3	6.50	3.17	0.93
Evaluation reference value	0.60		

Table 2: Various TN levels of water contaminant in sediments (with mg\g)

Sampling station	TN		
	Dry season	Water period	Wet season
1	5.06	6.07	5.02
2	7.13	6.62	7.99
3	8.98	8.56	7.51
Evaluation reference value	0.55		

Table 3: Various OM levels of water contaminant in sediments (with mg\g)

Sampling station	OM		
	Dry season	Water period	Wet season
1	70.1	69.53	11.32
2	43.19	58.70	28.22
3	40.54	85.63	30.17
Evaluation reference value	34.00		

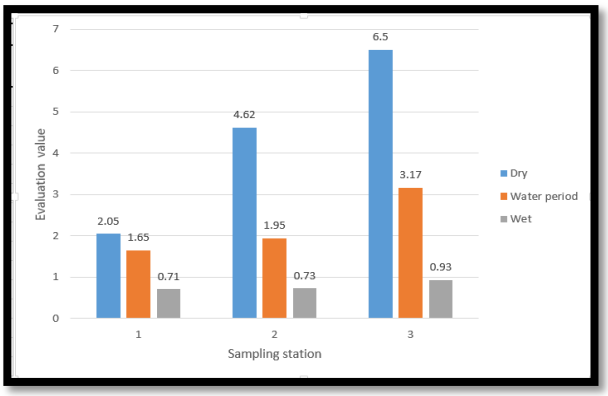

Fig 2: Evaluation values of TP in wet and dry seasons and water period for sampling stations

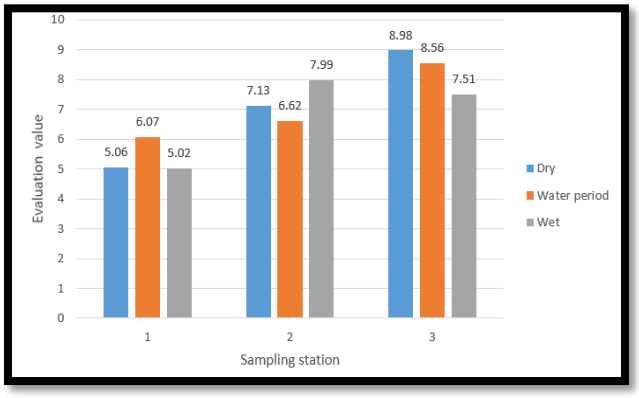

Fig 3: Evaluation values of TN in wet and dry seasons and water period for sampling stations

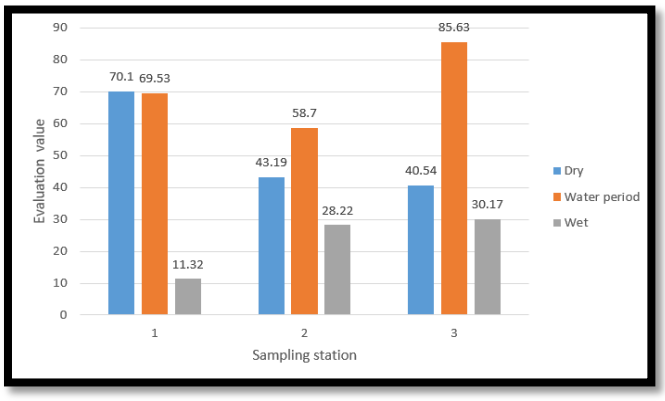

Fig 4: Evaluation values of OM in dry and wet seasons and water period for sampling stations

The tables 1, 2 and 3 shows concentrations of pollutants in wet season were the less because wet sediment erosion led to the release of the pollutants in sediment, while in water period diluted by rainwater [1-6].

The OM and TN in sediment relatively decreased comparing with OM and TN of water period content in dry season. TP in dry season sediment compared with water period has increased.

This may result from the input of exogenous in dry season increase the TP content of sediment absorbs TP and water period [16].

From these results, the highest level of pollutants in the sediment was in station 3, however, station 1 was the lowest in both dry and wet seasons approximately.

B. Assessment of Sediment in Water Pollution

The pollution index considers an essential factor that used to evaluate the status of water quality. It shows the conditions of water quality comparing with assured quality standards [17]. Single – factor PI calculated by the mean-based pollution index, Nemerow index evaluation of sediment, single factor pollution index i show in equations: [18]

$Pi = C_i / C_s$ ……. 1

Average pollution index, show below:

$PI_{1(i)} = \frac{1}{m} \sum_{i=1}^{m} Pi$ ……..2

Nemerow index shown in equation below :

$PI_{2(i)} = \sqrt{[(Pi)^2 max + (Pi)^2 avg]/2}$

Where :

C_i : is the measured value of evaluation factor i

C_s : is the evaluation of the value of factor .

$(Pi)_{max}$: is the maximum value of Pi

$(Pi)_{avg}$: is the Pi mean

Pi : is a single factor pollution index

$PI_{1(i)}$: index for the evaluation of the average individual.

$PI_{2(i)}$: is the Nemerow index.

Table 4: Pollution Index (PI) values :

Pollution Indicator	PI-values		
	Wet season	Water period	Dry season
P-OM	0.683	2.361	1.508
P-TN	12.436	12.878	12.830
P-TP	1.316	3.761	7.316
P-Mean	4.811	6.333	7.218
P-Nemerow	9.428	10.147	10.409

Where:

Table 5: Classification of pollution status [19]

Value of PI	Description
$0 \leq PIj \leq 1,0$	Good conditions
$1,0 < PIj \leq 5,0$	Mildly polluted
$5,0 < PIj \leq 10$	Medium polluted
$PIj > 10$	Heavily polluted

Table 6 : Pollution index quality

Pollution Indicator	PI-values		
	Wet season	Water period	Dry season
P-OM	Good conditions	Mildly polluted	Mildly polluted
P-TN	Heavily polluted	Heavily polluted	Heavily polluted
P-TP	Mildly polluted	Mildly polluted	Medium polluted
P-Mean	Mildly polluted	Medium polluted	Medium polluted
P-Nemerow	Medium polluted	Heavily polluted	Heavily polluted

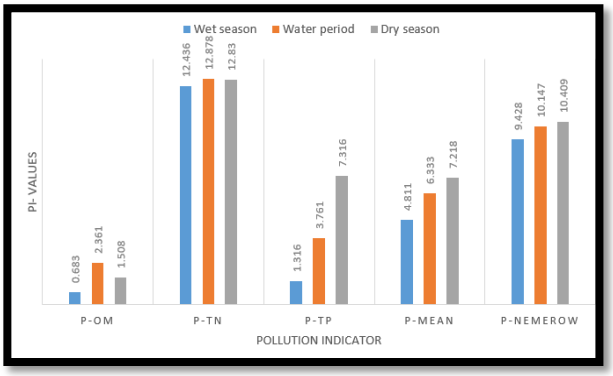

Fig 5 : pollution index values chart

Figure 5 indicates that the pollution index value of OM in wet season is less than 1 but another pollutants of Euphrates river values of sediment are higher than 1 . These pollution values are an urgent values. In different water, Nemerow index factor values in Euphrates river sediments were 8.826 ~ 10.428 far more than the standard value of PI which it is 3.0 [18] , therefore it is very severe contamination types.

IV. CONCLUSION

I. The highest level of pollutants in the sediment was in station 3, however, station 1 was the lowest in both dry and wet seasons approximately.

II. By comparing the concentrations of contaminants of sediment, water period and the wet sediment of TP, it was found clearly that, TP concentrations were higher for water period than the wet. However, in dry season the TP values were highest, but the OM and TN contents in sediment and water period were decreased in dry season.

III. The resulted values of the pollution index during both dry, wet seasons, and water period for all pollution indicators (P-OM, P- TN, P-TP, P- Mean and P- Nemerow) reveals there was remarkable medium to heavily contaminations in these area of study.

CONFLICT OF INTEREST

Authors declare that they have no conflict of interest.

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