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Assessment of Heavy Elements' Pollution in Surface Water of Tigris River Between Baghdad and Kut cities, Iraq

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Abstract

Along the Tigris River is the study area between Baghdad and Kut cities using ten water samples, the current study assesses the pollution caused by heavy metals in water (two samples from drainage water and Eight samples from surface water the water collected from the shore by skimming the surface) on the 4th of November 2023. The heavy element analysis of the study area's water samples revealed that the water had been polluted with high concentrations of these elements (Pb and Cd). The amounts of heavy metals increased as the river flowed southward. This is related to the reduction in the water level of the Tigris River and the frequent discharge of various pollutants, which have led to an increase in pollution. Organic, and the spread of various chemical pests, an increase in the concentrations of different types of pollutants, whether from hospital pollutants or direct sewage, hospital pollutants are deemed more dangerous due to the potentially pathogenic substances they carry, treatment plant failure to follow wastewater filtration standards, wellbeing, besides rapid population growth rates, The influence of heavy elements found in water on people when exposed to them in high concentrations or over an extended time. However, these metals have no harmful impacts because the concentrations of (Cr, Fe and Cu) in water samples are within both Iraqi and WHO acceptable levels.

Keywords: Tigris River, Water pollution, Baghdad, Kut, Surface water, heavy elements.

تقييم تلوث المياه السطحية بالعناصر الثقيلة في نهر دجلة ما بين بغداد والكوت، العراق

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الخلاصة

تقع منطقة الدراسة على طول نهر دجلة ما بين بغداد والكوت هذة الدراسة تتعامل مع تقييم تلوث المياه السطحية بالعناصر الثقيلة في منطقة الدراسة حيث تم جمع عشر عينات نموذج من المياه (اثنين من مياه المبازل وقنوات الري وثمانية من المياه السطحية) في الرابع من تشرين الثاني 2023. حيث اظهرت نتائج التحاليل الكيميائية للمياه انها ملوثة بتراكيز من ايونات العناصر الثقيلة (الحديد, الكادميوم, الرصاص) ان هنالك زيادة واضحة في تراكيز العناصر الثقيلة باتجاه جريان النهر نحو الجنوب ويعزى ذلك الى انخفاض منسوب مياه نهر دجلة وقد أدى كثرة التخلص من النفايات المختلفة إلى زيادة التلوث العضوي وزيادة في تركيزات الملوثات بأنواعها المختلفة، سواء من ملوثات المستشفيات أو مياه الصرف الصحي المباشرة؛ تعتبر ملوثات المستشفيات أكثر خطورة بسبب المواد المسببة للأمراض التي تحملها؛ وعدم التزام محطات المعالجة

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بمعايير تنقية مياه الصرف الصحي، إلى جانب معدلات النمو السكاني السريعة. تأثير العناصر الثقيلة الموجودة في الماء على الإنسان عند تعرضه لها بتركيزات عالية أو على مدى فترة طويلة من الزمن بينما تراكيز العناصر الثقيلة (النحاس, الكروم) هي ضمن الحدود المسموح بها.

1. Introduction

Only a small percentage of the planet's overall water content is found as freshwater found in its rivers and lakes. Most of the freshwater supply is used for agriculture, leaving only a tiny portion available for human consumption. Pesticides and fertilizers produced in agriculture are transported by drain water that empties into rivers and streams before flowing into the ocean. If concentrations of these chemicals are high enough, they can harm fish and other marine life.

Pollution in the study area can be said to be caused by the following: the growth of slums, a decline in water imports, and an increase in the concentrations of different types of pollutants, whether from hospital pollutants or direct sewage; hospital pollutants are deemed more dangerous due to the potentially pathogenic substances they carry and treatment plant failure to follow wastewater filtration standards wellbeing, besides rapid population growth rates[1]. The influence of heavy elements found in water on people when exposed to them in high concentrations or over an extended time. Chronic disorders like cancer and cardiovascular disease can be made more likely by these factors, which can also harm tissues, organs, and the nervous system. Heavy metals such as lead, mercury, cadmium, zinc, and copper can accumulate in a person's body following exposure to contaminated water. Certain heavy metals can cause symptoms like diarrhea, nausea, exhaustion, headaches, hepatitis, shortness of breath, and acute poisoning, which can vary according to the type of metal and the degree of exposure [2].

The growth of agricultural industries and technologies and the frequent disposal of various wastes have led to increased organic pollution and the spread of various chemical pests. Among the factors that cause pollution of aquatic media is water sewage. The term sewage refers to wastewater containing pollutants from mixing sewage with different sources [1,2]. Water consumption rises owing to population growth, economic progress, and environmental concerns [3]. Considering that most of these metals have an accumulative capacity, they accumulate in humans and come into proximity to aquatic creatures' bodies through ingestion, including fish, birds, and plants. Fish whose cells are made up of these mineral complexes and whose bodies are incapable of breaking down chemical disintegration There are differences in the sources of liquid waste, leaching, farm and garden waste, and ground and surface water. When it accumulates in the bodies of living things, it finds its way into drinking water and the food chain through plants, which absorb it through their roots and eventually reach human food crops and fruits, which are contaminated with heavy metals due to their internal bioaccumulation. The anatomy of humans is termed heavy metal poisoning because it is more rapidly absorbed than it can be eliminated through excretion or metabolism. Eating a lot of it can be dangerous or even toxic, with heavy metal toxicity [4]. This study aims to assess the level of pollution of the Tigris River by heavy metals and compare the results with previous studies.

2. Location of study area:

The study area lies between Baghdad and Kut cities on the Tigris River (Figure 1). It is situated in the Mesopotamian plain, a portion of the stable shelf [5]. Furthermore, it is covered by a variety of Quaternary sediment types, including sand sheets, marsh sediments, floodplain sediments, crevasse splay, shallow depression sediments, and anthropogenic sediments [6].

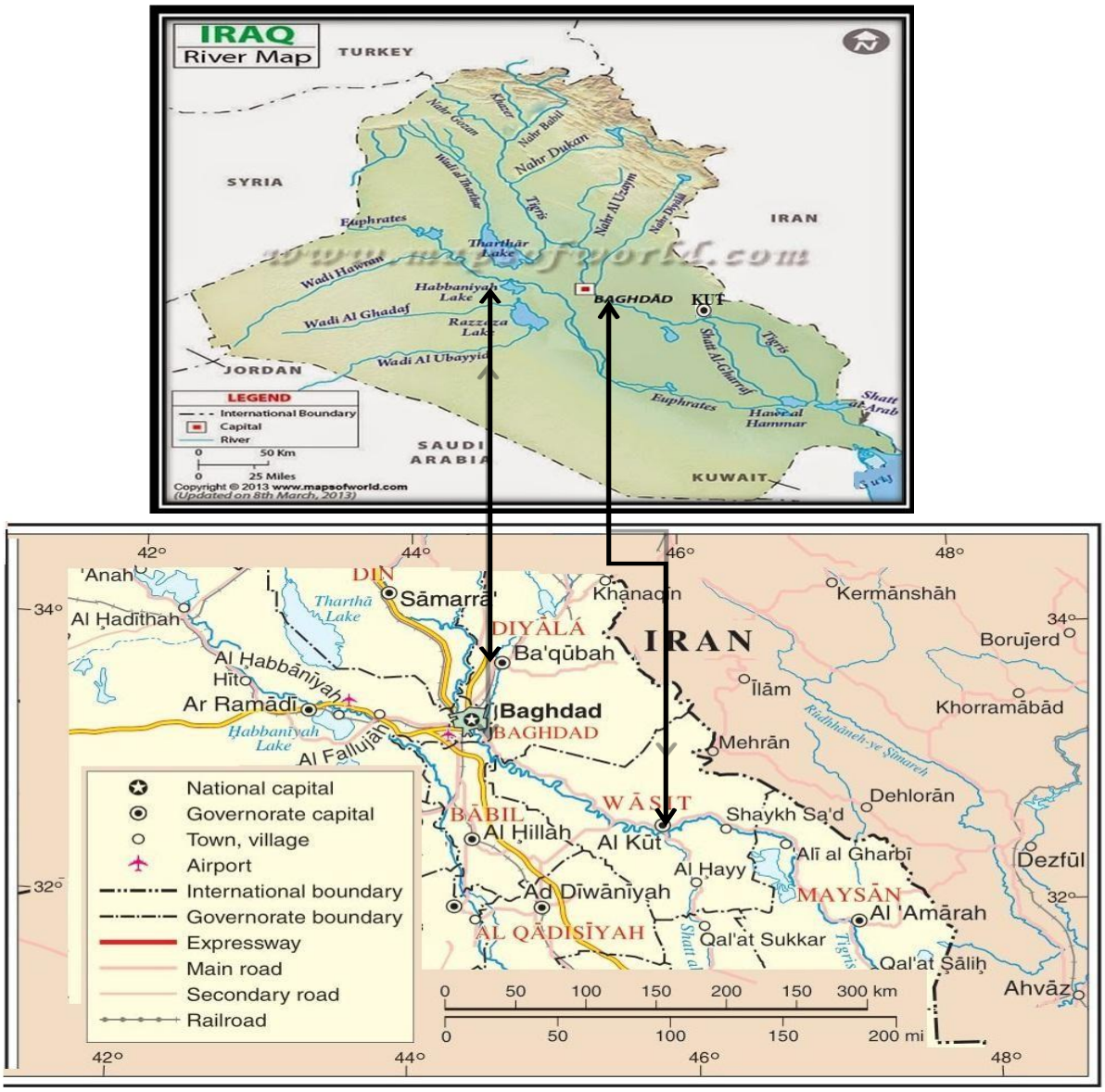

Figure 1: Location map of the study area.

3. Material and Method

Ten water samples were taken from various locations on November 4, 2023, to cover the study region as part of the field activity (Figure 2). The water samples were from surface water and drainage water from varied locations along the Tigris River between Baghdad and Kut (Table 1). I samples were collected directly by filling the container from the surface water body, The sites for collecting hydrological samples were chosen based on the distribution of cities, population density, and agricultural and industrial projects located on the banks of the river. Using an atomic absorption spectrometer, the heavy metals (Pb, Fe, Cu, Cd, and Cr) found in water samples were analyzed at the Central Laboratory for Analysis of Sediments, Water and Plant Analysis, Baghdad University, College of Agricultural Engineering Sciences.

Table1: Locations of water samples along Tigris River**.**

Station No.	District	Lat.	Lon.
S1	Baghdad Adhamyah Aaema bridge	33^0 22` 30" N	044^0 21` 20" E
S2	Diyala Bridge	33^0 11` 35" N	044^0 29` 17" E
S3	north Suwaira Drain	32^0 55` 13" N	044^0 47` 45" E
S4	south Suwaira Drain	32^0 53` 42" N	045^0 04` 20" E
S5	Al-Aziziya	32^0 45` 24" N	045^0 11` 33" E
S6	Zubaidyia	32^0 38` 58" N	045^0 19` 55" E
S7	Numaniya	32^0 33` 18" N	045^0 25` 21" E
S8	Hussainiya	32^0 31` 44" N	045^0 35` 36" E
S9	Before Kut Dam	32^0 30` 10" N	045^0 48` 38" E
S10	After Kut Dam	32^0 29` 10" N	045^0 50` 02" E

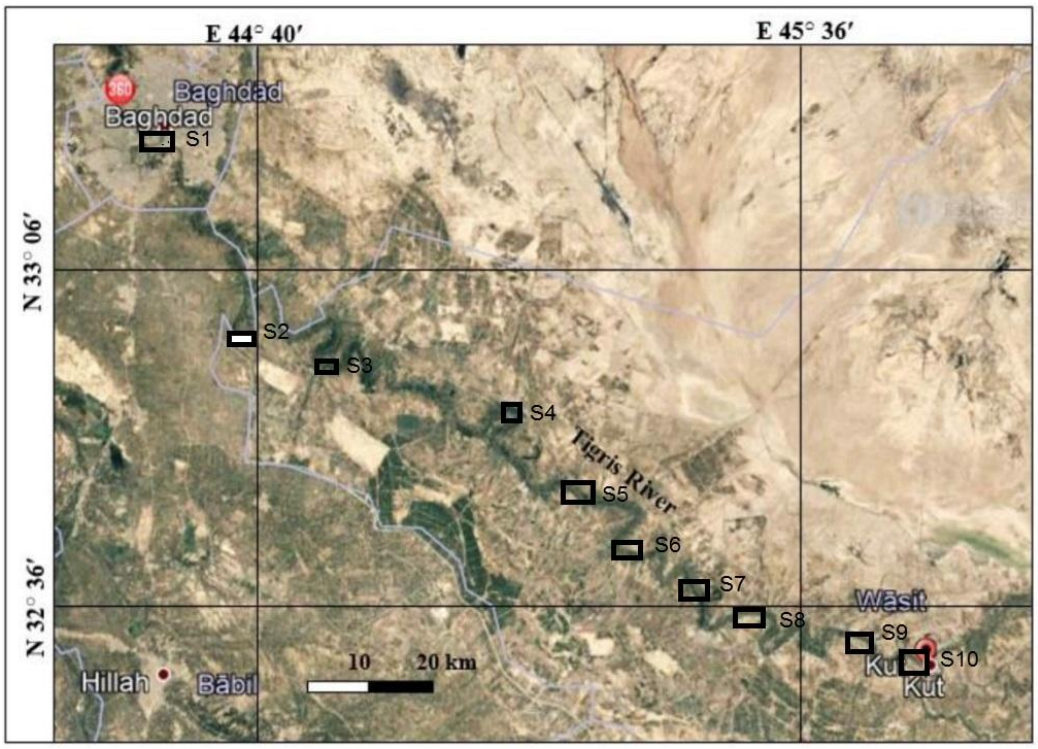

Figure 2: Locations of water samples of Tigris River between Baghdad and Kut site.

4. Results and Discussion

The concentrations of heavy metals vary depending on where you are along the Tigris River. The results of comparing these concentrations to the Iraqi standards [12] and World Health Organization [13] standards are given in (Table 2).

There is an increase in the concentration of (Pb and Cd) in water samples of the study area, particularly in S4 (south Suwaira drain) which has the highest concentration of Pb (Figure 3), because of water of Suwaira drain that empties into the Tigris River in that site The wastewater that is thrown into the river causes an increase in the salinity levels of its water, due to the salts it contains, and S5 (Al-Azizya) which has the highest concentration of Cd because of wastewater that present nearby this site, which exceeds the permissible limits of [12] and [13] , as shown in (Figures (4 and 5) respectively. The high concentration of (Cd and Pb) originated from numerous sources, the main one being industrial waste, and that is because the amounts

of heavy metals increased as the river flowed southward. Because of the high concentration of (Pb) element in water samples, the study of [7] discovered multiple diseases that impacted humans, including scabies, vitiligo, eczema, and conjunctivitis [7].

The current study was compared to [8], and the results show that there are increases in heavy metals along the Tigris River between Baghdad and Kut (Table 3), (Figure 6). The increases of concentrations of heavy metals, because the amounts of heavy metals increased as the river flowed southwards and related to the fall in the water level of the Tigris River and the frequent disposal of various wastes have led to an increase in organic pollution and the spread of various pests, chemicals, an increase in the concentrations of different types of pollutants, whether from hospital pollutants or direct sewage. Removing heavy metals from industrial waste and sewage water is recommended to prevent future deterioration of river quality. In addition, modern water treatment units were added to drinking water supply stations to remove unwanted substances such as heavy metals, cations, and anions [9]. Among the most prevalent pollutants in the environment are heavy metals, whose presence in biota and waterways suggests the existence of either natural or man-made sources. Soil leaching and chemical weathering of minerals are the primary natural sources of metals in waterways. The primary anthropogenic causes are related to water runoff, landfill leachate, urban storms, mining of coal and ore, industrial and residential effluents, and atmospheric sources and inputs. Outside of cities, among the most prevalent pollutants in the environment are heavy metals, whose presence in biota and waterways suggests the existence of either natural or man-made sources. Soil leaching and chemical weathering of minerals are the primary natural sources of metals in waterways. The primary human sources are related to mining, urban storm drains, water runoff, landfill leachate, and industrial and residential effluents of atmospheric sources and inputs in rural areas[10]. The high concentrations of heavy metals in surface water could be caused by human activities like farming and excessive fertiliser use, among other things like industrial [11].

This is related to the fall in the water level of the Tigris River and the frequent disposal of various wastes, which have led to an increase in pollution Organic, and the spread of various pests chemical, an increase in the concentrations of different types of pollutants, whether from hospital pollutants or direct sewage; hospital pollutants are deemed more dangerous due to the potentially pathogenic substances they carry and treatment plant failure to follow wastewater filtration standards wellbeing, besides rapid population growth rates, The influence of heavy elements found in water on people when exposed to them in high concentrations or over an extended period of time.

The growth of agricultural sectors and technology and the routine disposal of various wastes have all contributed to increased pollution. Infestations can be organic, chemical, or pest-related. Water sewage is a factor contributing to aquatic media pollution, along with minor factors such as agricultural waste and municipal sewage. Furthermore, because of the decline in water levels during this time period, the content of various heavy metals in the research region's water samples has increased, causing the study area to become polluted. The Cu, Fe and Cr concentrations are within the allowable limits defined by [12] and [13]; thus these metals pose no risk.

Table 2: The concentration of heavy elements in water samples of the study area in (ppm).

Sample No.	Pb	Cd	Cr	Cu	Fe
S1	0.1777	0.0401	0.0117	0.01353	0.2482
S2	0.115	0.0198	0.02	0.02541	0.1481
S3	0.1567	0.025	0.0791	0.0256	0.3676
S4	0.1788	0.0723	0.0301	0.0458	0.3877
S5	0.1264	0.0781	0.0296	0.02915	0.2993
S6	0.1739	0.031	0.012	0.01742	0.1824
S7	0.1633	0.0219	0.0289	0.01591	0.3663
S8	0.1652	0.0399	0.0982	0.09713	0.195
S9	0.1542	0.0251	0.0332	0.04582	0.2771
S10	0.1479	0.079	0.0778	0.02377	0.3301
Ave.	0.15591	0.04322	0.04206	0.033954	0.28018
MAX.	0.1788	0.079	0.0982	0.09713	0.3877
MIN.	0.115	0.0198	0.0117	0.01353	0.1481
[10]	0.01	0.003	0.05	2	< 0.3
[11]	0.01	0.003	0.05	1	0.3

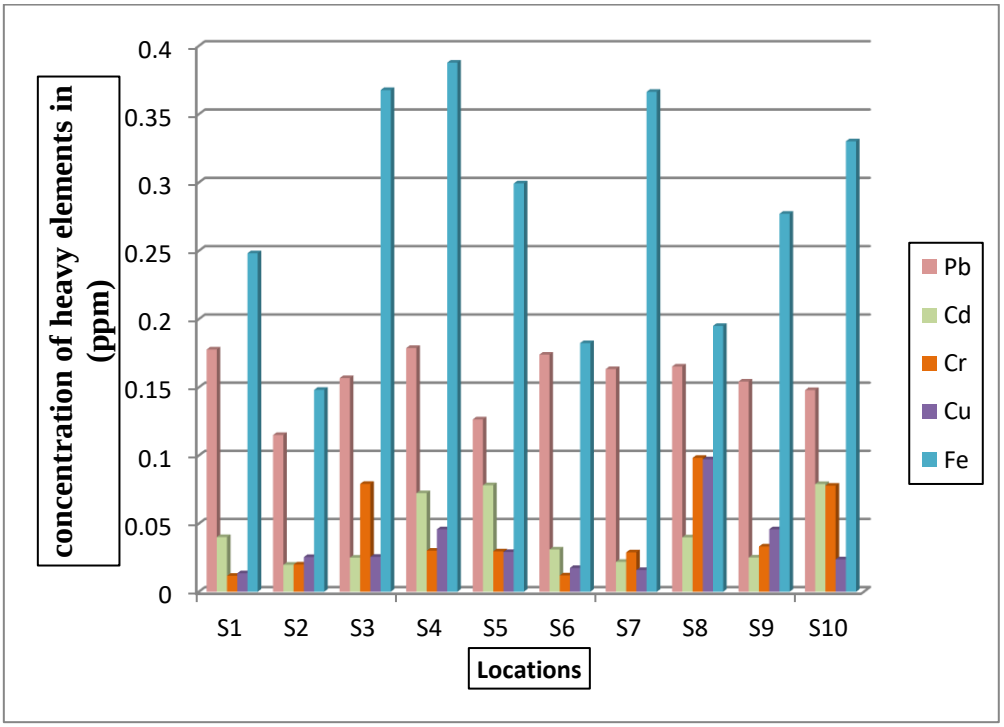

Figure 3: The distribution of heavy metals in water samples from the study site.

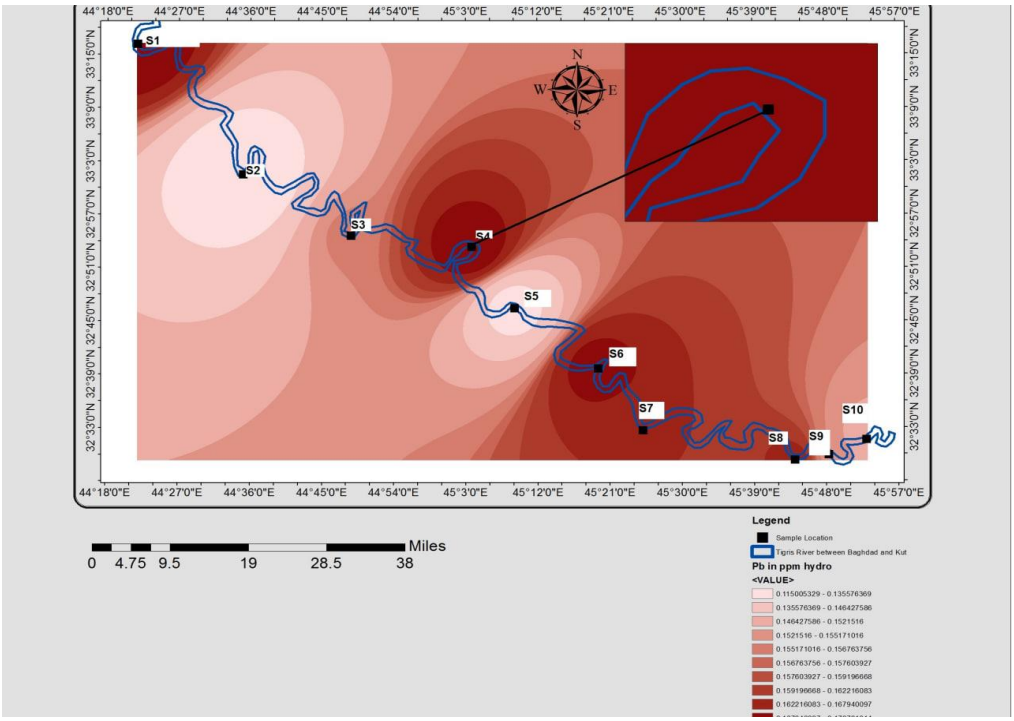

Figure 4: Map of location study showing the concentration of Pb in ppm along the Tigris River between Baghdad and Kut

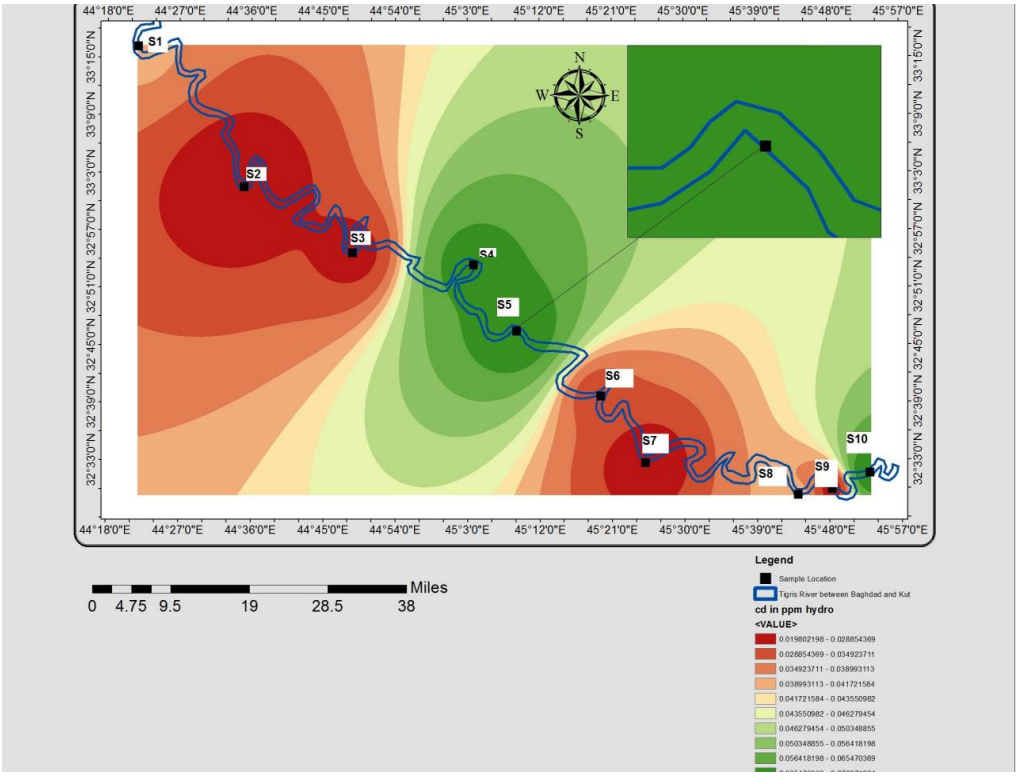

Figure 5: Map of location study show the concentration of Cd in ppm along Tigris River between Baghdad and Kut

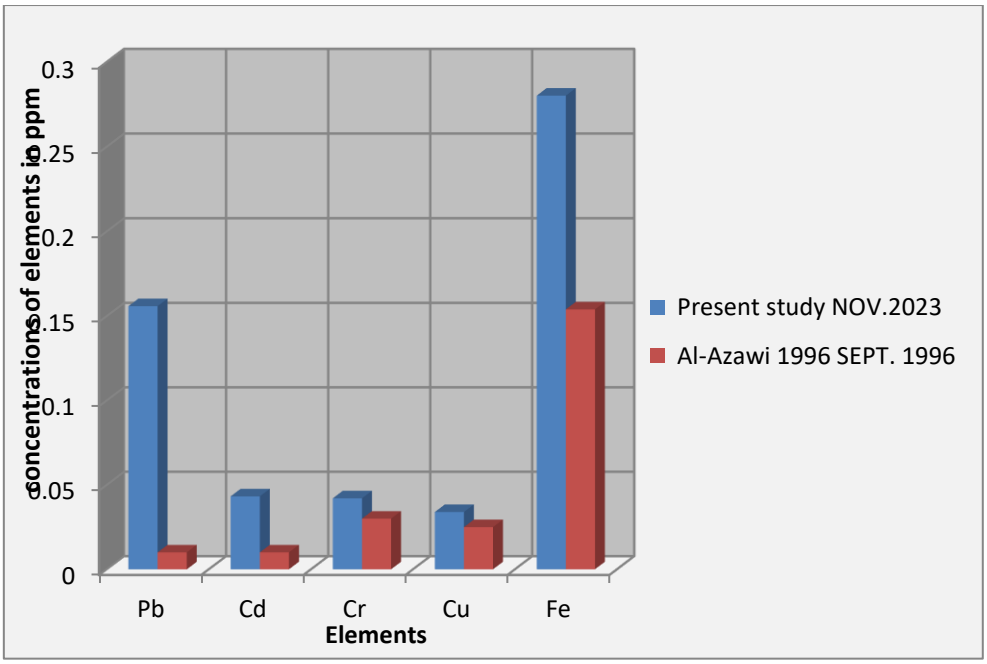

Figure 6: Comparison of heavy metals between the present study and [8].

Table 3: Comparing the heavy metals between present study 2023 and [8]

Elements	Present study NOV.2023 Tigris river between Bagh. And Kut	[8] Tigris River between Bagh. And Kut
Pb	0.15591	0.01
Cd	0.04322	0.01
Cr	0.04206	0.03
Cu	0.033954	0.025
Fe	0.28018	0.154
ALL concentrations in ppm		

5. Conclusion

The results demonstrate that the water samples from the study area are polluted with (Pb, and Cd) levels that exceed the permitted limits of [12] and [13], The concentrations of Cu, Fe and Cr in water samples from the research area are within the allowed limits of [12] and [13] and there are no hazard effects from these elements. The current study was compared to [8], and the results show notable increases in heavy metals along the Tigris River between Baghdad and Kut. The amounts of heavy metals increased as the river flowed southwards and related to the fall in the water level of the Tigris River and the frequent disposal of various wastes have led to an increase in organic pollution and the spread of various pests chemicals, an increase in the concentrations of different types of pollutants, whether from hospital pollutants or direct sewage**.**

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