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Study of the effect of agricultural and domestic pollutants on the water quality of the Diyala River in Iraq

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***Abstract*---**This study was conducted to assess the effects of agriculture and domestic pollutant on the quality of the Diyala River. Water samples and fish samples were taken bimonthly at three stations in Diyala River and18 parameters (air and water temperature, TDS, dissolved oxygen, BOD, pH, EC, No2, NO3, total PO4, heavy metals (Cd, Pb, Al) in water and heavy metals (Cd, Pb, Al) in fish sample) were analyzed. The river has a total length of 574 km and a drainage area of which 25% is in Iran and 75% is in Iraq, Results of the study indicated that the Diayla River is more polluted and this is confirmed by Physico-chemical properties, as well as the carp fish was one of the most local fish sensitive to water pollution, especially heavy metals (HMs). The model gave a good idea to assess the water quality of the Diyala River under the effect of dryness and large quantities of pollutants on it.

***Keywords*---**agriculture pollutant, Diyala river, domestic pollutant, physicochemical property, carp fish.

Introduction

Globally, river pollution is an issue that has increased in both developed and developing countries has an influence on the chemical quality, and destroys the community and delicate food chain, resulting in a produced unbalance in aquatic ecosystems. Water quality in many big rivers has degraded dramatically throughout the world as a result of anthropogenic activity over the previous 2-3 decades. By continuing to dispose of municipal wastewater, industrial

wastewater, solid trash, and agricultural field and road runoff water(Alazawii, 2019).

The structure of the geological materials through which the groundwater travels, as well as the quality of the groundwater recharge, influence the kinds and concentrations of natural pollutants. Groundwater are traveling through sedimentary rocks and soils and might be take up a variety of substances, including magnesium, arsenate, and chloride, fluoride, nitrate, calcium, and iron; hence, the influence of these natural contaminants is dependent on their kind and concentration (Sharma & Bhattacharya, 2017).

Surface flow and soil erosion in any agricultural region result in nutrient depletion from using extensive fertilizers as well as other chemicals to improve yields, as appropriate food stocks can be sustained through the use of fertilizers. When it rains, the exposed soil sediments are transferred to the river and other surface water bodies, causing water bodies to impair more quickly. Several studies have found that nutrient concentrations in river water are substantially linked to the percentage area of agricultural land (Stålnacke et al., 2003).

The wastes add pollutants such as sediments, nutrients, pesticides, herbicides, pathogens, organic enrichment, toxicants, oxygen demanding compounds, salts, heavy metals, and petroleum products, which pollute recipient water bodies to toxic levels (Tabor et al., 2011). Domestic waste water release into water bodies' causing degradation of water quality by increasing concentrations of BOD, suspended solids, EC, TDS, and nitrates, primarily at the site of sewage. also increase eutrophication and thereby disrupting the aquatic environment (BONARERI, 2013).

It is critical to note that the population and urbanized expansion, as well as the greater weight of city dwellers, are all on the rise. Rivers in metropolitan areas, on the other hand, play an important role in transporting industrial and municipal wastes, manure discharges, and runoff from agricultural fields and streets, all of which contribute to river pollution. (Al Obaidy *et al.*, 2014).

Heavy metal contamination of the environment is a worldwide issue due to these elements are non-biodegradable and most of them have negative impacts on people and other organisms when their levels exceed of these elements, the levels of accumulation of these heavy metals are usually exceeded, such as volcanoes, hurricanes, and weathering rocks, or via anthropogenic intervention, such as pesticide use. (Tabor et al., 2011). or trash disposal, industrial and agricultural activities, and other military activities, increased levels of dangerous pollutants (Jean-Philippe *et al.*, 2012).

Heavy metals are inorganic elements that are required for plant development in trace or extremely minute amounts. In larger doses, they are toxic and poisonous (Kar *et al.*, 2008). Nonetheless, mining and associated industries are the most significant human sources of heavy metals in metropolitan areas that have a harmful impact on the surrounding environment (Vaněk *et al.*, 2005).

The aim of study Determination of the effects of agricultural and household pollution in on Diyala River and Providing a platform for comparing agricultural and domestic pollution and explaining which is more impactful.

Materials and Methods

The study area's description: The Diyala River is one of Iraq's most important water resources, with major tributaries feeding the Tirgis River near Baghdad (Al-Ansari *et al.*, 2014)The Diyala River rises at Sanandaj in Iran's Zagros Mountains and flows for more than 30 kilometers along the Iran-Iraq border. The river has a total length of 574 km and a drainage area of which 25% is in Iran and 75% is in Iraq (ESCWA-BGR Cooperation, 2012). The current study aims to investigate the impact of agricultural and domestic pollutants on the water quality of Baghdad's Diyala River by selecting three stations. The stations that have been chosen are listed below.

The first station

A first station, situated before the Al-Rustamiya plants, drains sewage water into the Diyala River in the north latitude of 33.306609 and east longitude of 44.536375, and the stream in this location is known for its high plants grown over its banks, intermediate breadth, and extremely lower water level.

The second station

A second station is located in the north latitude of 33.269831 and east longitude of 44.536830 after the Al-Rustamiya very short distance flow, and the discharge point symbolizes the treated wastewater redirected by pipes at a flowing rate of 24 hours/day.

The third station

This is approximately 6.8 km after the second station in the north latitude of 33.236159 and east longitude of 44.522033. The river in this section is distinguished by its large breadth, lack of vegetation on its banks, and high population density on both sides.

Table 1: Testing methods for water samples

parameters	site	methods	Unite
Air and water temperature	In situ	Thermometer (APHA,1998)	C
TDS	In lab	HANNA H1 99300 portable conductivity\TDS meter with H1 76306 probe	Mg/l
pH	In lab	HANNA H1 99300 portable device	
EC	In lab	portable meter HANNA	µs/cm
Salinity	In lab	Measurements of salinity depended on EC value	ppt
DO	In lab	WTW\Germany according (APHA,1998)	Mg/l

BODS	In lab	azide modification at 20 c (5D) according (APHA,1998)	Mg/l
Cl	In lab	using silver nitrate titration, potassium chromate solution, the sample titrated against silver nitrate solution until convert the color from yellow to orange, according (APHA,1998)	Mg/l
NO2	In lab	combining diazotized sulphanilamide with ethylenediamine dihydrochloride and forming a reddish-purple azo dye. the color system obeys beer's, colorimeter	Mg/l
NO3	In lab	UV-spectrophotometer at wave length 220nm and 2ml HCl (1N) applied to the diluted sample	Mg/l
PO4	In la	spectrophotometric, molybdate- ascorbic acid method according (Clesceri *et al.*, 1999).	Mg/l
Heavy metals (Cd,Pb,Al) in water	In lab	flame atomic absorption spectrophotometer (FAAS), nitric acid was added, this solution was warmed on a hot plate to nearly dry at 85°C where formation white salt then dissolved in N hydrochloric acid. While Al by ERIOCHROME CYANINE R SPECTROPHOTOMETRIC (use at 535ηm)	Mg/l
Heavy metals (Cd,Pb,Al) in fish	In lab	the determination of heavy metals in muscle tissues of fish were done. 0.5 g dry weight of the fish tissues put into beaker with HCl and HNO3 . The beaker was then placed on a hot plate and heated to almost 80°C, then a combination of concentrated HF and HClO4 (1:1), adding deionized distilled water then the heavy metals were measured using flame atoms absorption spectrophotometer. According (Moopam, 1999)	Mg/kg

Results and Discussions

The physical–chemical characteristics at study stations during autumn 2020 to summer 2021. The essential statistics of all water quality variables, which were measured during the sampling period of one year at the three stations on the river, are summarized in Table (2). The nonsignificant ($p>0.05$) change was observed in water pH between stations and Pb of water between stations during the study period. One of the factors for this variation could be regional temperature. On the other hand, there was significant variation ($p<0.05$) among stations of temperature, total dissolved solid (TDS) and salinity, also there were significant variation among stations ($p<0.01$) of EC, DO, BODs, Cl, No2, No3, Po4, Cd, Pb, and Al of water.

Table 2: Statistical analysis of physical–chemical characteristics at study stations during 2020 -2021.

parameters	S1	S2	S3	LSD Value
Temperature (°C)	20.50	21.38	22.50	1.20*

TDS	1039	1033	1053	41*
pH	6.75	6.79	6.60	$0.25^{N.S}$
EC	2213	2109	2133	22**
Salinity	1.42	1.35	1.36	0.05*
DO	6.98	4.78	5.18	0.19**
BODs	2.48	4.60	4.53	0.18**
Cl	538	458	479	5.15**
No_2	2.16	3.26	4.63	0.21**
No_3	21.51	26.79	51.39	1.31**
Po_4	3.190	3.033	3.655	0.157**
Cd	0.104	0.078	0.159	0.018**
Pb	0.273	0,238	0.194	$0.087^{N.S}$
Al	6.35	7.35	8.38	0.65**

Data presented as Mean ± SD, N.S: Not significant, *,** Significant at (P <0.05) and at (p<0.01) respectively.

Concentration of Heavy Metals in fish: The mean concentrations of Cd at station 1 were 2.00, and the highest mean concentrations of Pb and Al at station 1 were 60.00 mg/kg and 45.00 mg/kg respectively, as shown in table (3). The mean of concentration of heavy metals (Cd, Pb, Al) at station 2 in winter 2021 was 0.8 mg/kg, 35 mg /kg and 8 mg /kg, respectively, while no sample of fish was founded in autumn 2020 and both spring and summer 2021, Due to the deterioration of water quality and pollution of the Diayla river, so did not find a fish sample because of the high pollution.

Table 3: Concertation of heavy metals (Cd, Pb, Al) in fish at station 1

Season	Cd of fish	Pb of fish	AL of fish
Autumn	2.00	60.00	12.00
Winter	2.00	60.00	12.00
Summer	2.00	20.00	45.00
LSD	$0.972^{N.S}$	6.36*	5.81*

Data presented as Mean ± SD, N.S: Not significant, *,** Significant at (P <0.05) and at (p<0.01) respectively.

In the present study, the water quality was evaluated from Diyala river. The variation in the water temperature depends on the external region and study area temperature. At station 2 and station 3 lot of organic matter, turbidity, TDS, and nutrients were discharged from Al- Rustamiya sewage treatment plant. Hence, there might be the bad water quality. This changes the physical and chemical characteristics of diayla river at station 2 and 3 drastically. Our results are accordance with previous studies from Iraq. This study reported poor to marginal for aquatic life in diayla river as a result of drainage of treated organic pollutants from domestic sewers, industrial and agriculture wastes to water sources.

The increase of the concentration of Cd during the autumn at station3 and due to increased discharge of domestic sewage, especially at station 3 that affected by Al-Rustumiya region. Also, using of fertilizer and pesticides that are added to agricultural lands causes an increase in the rate of cadmium in the soil and

therefore it transfers into the river water because of irrigations and the dusty storms (Lawson, 2011). The recorded concentrations of Pb at study area in all the stations as a result of the passage of the rivers through agricultural lands that used different chemicals that contains Pb, which are used in the production of agricultural crops, these compounds contained which accumulate in the agricultural soils and find their way to the streams during the raining seasons or as a result of the erosion of soils, as well as the lead concentration increased due to the cars exhausts because the car's fuel contains Tetraethyl lead and Tetramethyl lead as enhancers of fuel, then the rains work on washing them to the rivers (Akoto *et al.*, 2008)

This study reports poor to marginal for aquatic life in station 2 and station three as a result of drainage of treated organic pollutants from domestic sewers, industrial and agriculture wastes to water sources. Due to the deterioration of water quality and pollution of the Diayla river, so did not find a fish sample because of the high pollution.

Conclusion

It was concluded from the present study Station 2 and station 3 in Diyala River is the most polluted site it is being subjected to the influences of Rustamiya sewage treatment plant (RTP) which is discharged directly into the Diyala River. The majority of all the physico-chemical parameters exceeded their standard limits concerning of aquatic life protection especially at station 2 and station. 3. The trend of studied heavy metals concentrations in water can be represented as Al > Cd > Pb and heavy metals concentrations were always higher than objectives except. Poor water quality in the Diyala River indicates deterioration in the quality of this water and its inability to support aquatic life, which means a negative impact on biodiversity in the study region

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References

Al-Ansari, N., Ali, A., & Knutsson, S. (2014). Present conditions and future challenges of water resources problems in Iraq. *Journal of Water Resource and Protection*, *6*(12), 1066–1098.

Al Obaidy, A., Al Mashhady, A. A. M., Awad, E. S., & Kadhem, A. J. (2014). Heavy metals pollution in surface water of Mahrut River, Diyala, Iraq. *International Journal of Advanced Research*, *2*(10), 1039–1044.

Alazawii, L. H. (2019). Assessment of the Effect of Diyala River upon the Quality of Tigris River in Baghdad Province by National Sanitation Water-Quality Index (NFS-WQI). *EXECUTIVE EDITOR*, *10*(1), 526.

Akoto, O., Bruce, T. N., & Darko, D. (2008). Heavy metals pollution profiles in streams serving the Owabi reservoir. *African Journal of Environmental Science and Technology*, *2*(11), 354–359.Apha, A. (1998). WEF (American Public Health Association. *American Water Works*.

BONARERI, S. P. (2013). *Effects of human activities on water quality of Rupingazi River, Embu County, Kenya*. Kenyatta University.

Clesceri, L. S., Greenberg, A. E., & Eaton, A. D. (1999). American Public Health Association (APHA); American Water Works Association (AWW**A);** Water Environment Federation (WEF). *Standard Methods for the Examination of Water and Wastewater,*.

ESCWA-BGR Cooperation. (2012). Inventory of Shared Water Resources in Western Asia (Online Version). Chapter 4: Shared Tributaries of the Tigris River. Beirut.

Jean-Philippe, S. R., Labbé, N., Franklin, J. A., & Johnson, A. (2012). Detection of mercury and other metals in mercury contaminated soils using mid-infrared spectroscopy. *Proceedings of the International Academy of Ecology and Environmental Sciences*, *2*(3), 139.

Kar, D., Sur, P., Mandai, S. K., Saha, T., & Kole, R. K. (2008). Assessment of heavy metal pollution in surface water. *International Journal of Environmental Science & Technology*, *5*(1), 119–124. Moopam, R. (1999). Manual of oceanographic observations and pollutant analysis methods. *ROPME. Kuwait*, *1*(20), 122–133.

Lawson, E. O. (2011). Physico-chemical parameters and heavy metal contents of water from the Mangrove Swamps of Lagos Lagoon, Lagos, Nigeria. *Advances in Biological Research*, *5*(1), 8–21.

Sharma, S., & Bhattacharya, A. (2017). Drinking water contamination and treatment techniques. *Applied Water Science*, *7*(3), 1043–1067.

Stålnacke, P., Grimvall, A., Libiseller, C., Laznik, M., & Kokorite, I. (2003). Trends in nutrient concentrations in Latvian rivers and the response to the dramatic change in agriculture. *Journal of Hydrology*, *283*(1–4), 184–205.

Tabor, M., Kibret, M., & Abera, B. (2011). Bacteriological and physicochemical quality of drinking water and hygiene-sanitation practices of the consumers in Bahir Dar city, Ethiopia. *Ethiopian Journal of Health Sciences*, *21*(1), 19–26.

Vaněk, A., Borůvka, L., Drábek, O., Mihaljevič, M., & Komárek, M. (2005). Mobility of lead, zinc and cadmium in alluvial soils heavily polluted by smelting industry. *Plant Soil Environ*, *51*(7), 316–321.