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WATER QUALITY OF SHATT AL-ARAB RIVER IN BASRAH IRAQ: HEAVY AND TRACE METAL CONCENTRATION

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ABSTRACT

Assessing water quality is an important factor in preserving environmental ecosystems. There are many physical and chemical properties of water which can be taken into consideration in order to assess water quality. In order to classify the quality of water in the Shatt Al-Arab River eight locations were selected along it in Basra city of Iraq during 2016. Six heavy and trace metals:- Cadmium (Cd), Copper (Cu), Iron (Fe), Manganese (Mn), Lead (Pb), and Zinc (Zn) were analyzed using Atomic Absorption Spectroscopy. The result shows that the observed values of Cd, Cu, Fe, Mn, Pb and Zn was (0.011-0.025), (0.102-0.285), (0.271-0.603) (0.231-0.354) (0.137-0.217) (0.197-0.314) mg/L respectively. Cd and Pb are well above the recommended value for all rivers maintaining systems and general waters from pollution, while Cd, Cu and Pb exhibit higher values than the guidelines values for protection of aquatic life. In addition to pollution from farms and factories, Metals increase in the water river may be due to runoff or Which comes down with rain to the ground from the air, which is instrumental in raising the concentration of lead in water. also the low water river discharge can be a mean reason that it could not cleanup itself.

KEY WORDS : Iraq, Shatt Al-Arab River, Water quality, Pollution, Heavy and trace metal, standard guidelines.

INTRODUCTION

Surface water has been and is still being used for many purposes, which include drinking, irrigation, animal farming, recreation and serves as habitat to many organisms. The aesthetic properties of most rivers and streams have made them sites for tourist attraction and activity. Freshwater sources like rivers and streams, need to be protected from contamination with benets not limited to humans alone, but also to avoid environmental deterioration and reduction in biodiversity.

Water quality is the chemical, physical and biological features of water, it is an evaluation of water condition relative to the requirements of human need (Diersing, 2009). It is used by reference to a set of standards against which compliance can be assessed. The common standards used to assess water quality relate to the health of ecosystems and safety of human uses. Heavy metals is an imprecise term generally taken to include the metallic elements with an atomic weight greater than 40, which have specific gravity greater than 5g/cm^3, but excluding the alkaline earth metals, alkali metals, lanthanides and actinides, they exposure causes serious health effects, including reduced growth and development, cancer, organ damage, nervous system damage, and in extreme cases, death. Some of them like Cd and Pb are toxic even at low concentrations, they can bio-accumulated through the food chain and are not degradable by decomposers organisms (Alani *et al.*, 2014, Al-Kazaeh, 2014). Heavy and trace metals can be presented naturally in the environment, they occur in water, sediments, plants and animals also can be enable to escape into the environment by many natural processing and anthropogenic sources (Abdulnabi1, 2019; Al-Asadi, 2017; AlAsadi *et al.*, 2019).

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The discharge of various metal pollutants in to the aquatic environment as pointed out by (Abowei and Sikoki 2005; Saeed and Shaker 2008; Hassan *et al.*, 2008). In Basra city the problem of environmental pollution has been worsen because of the large quantities of industrial wastes, waste water, fertilizers and pesticides, which find their way into the side branches and then to the Shatt Al-Arab then up to the different organisms (Hassan *et al.*, (2011). Assessment of heavy metals pollution index (HPI) and metal index (MI) for analyzed six metals (Fe, Zn, Cu, Pb, Cd and Ni) in Shatt Al-Arab river was suggested that not critically contaminated and was pure with respect to heavy metal pollution Also, the results of last researches pointed out that the origin of heavy and trace metals in this river mainly came from industrial activities, through municipal sewage, domestic wastes, traffic sources and atmospheric depositions, chemical weathering of minerals, and industrial discharges (Abdullah, 2013).

Shatt Al Arab River waters was found critically and seriously polluted with heavy metals according to the indices (Moyel *et al.*, 2015). In this study assess the water quality and water pollution status at Shatt Al-Arab river and evaluate the degree of pollution for each station by compared with the some standard guidelines values for Irrigation and drinking waters resources.

Study Area

Shatt Al-Arab consists of the meeting of Tigris and Euphrates rivers at Qurna, north of Basra. Extends in the south-east direction, for an approximately 200 kilometers to discharge into Arabian Gulf on south of Basra in Al-Fao city**.** Shatt Al-Arab passes through the city of Basra, which is one of the largest cities in Iraq. It includes industrial facilities and commercial ports. The area of the Shatt al - Arab basin is estimated at about one million square kilometers, including all land irrigated by river water. There are several sub - rivers on both sides of the Shatt Al - Arab, which were used as irrigation canals and these branches in the city, recently used as drainage channels for sewage and industrial facilities were established on them. The most important of these channels are Rabat, Al-Kandaq, Al-Ashar, Al-Khorra, Al-Sarraji and Salhia all drainage in Al-Ashar station. Both the natural and anthropogenic factors can be effect on the water quality in the Shatt Al-Arab basin (Al-Asa*di et al.*, 2019). The Shatt Al Arab River will be facing a freshwater deficit as a result of the decrease of water received from its tributaries (Al-Asadi, 2017).

MATERIALS AND METHODS

The samples were collected in 2016 from eight sites were selected along Shatt Al-Arab River within Basra city (Figure 1). These sites are Qurna (station 1), Saad Birdge (station 2), Al-Harth (station 3), Al-Sandbad (station 4), Al-Ashar (station 5), Abo Al-Kasseb (station 6), Al-Seba (station 7) and Al-Foa (station 8). Water samples collected from a depth of 10-30 cm below the surface and kept in acid washed polyethylene containers. The containers were rinsed thoroughly with distilled water after being washed in dilute nitric acid (HNO_3). Concentration HNO_3 (5 mL) used in the digestion 100 mL of water sample which transferred to beaker. Heat on a hot plate nearly to dry, after removed from hot plate dilute to 50 mL in volumetric flask with deionized water. Six heavy and trace metals were analyzed (Cd, Cu, Fe, Mn, Pb and Zn) using Atomic Absorption Spectrophotometry (AAS-6300, Shimadzu) according to (APHA, 1995).

The mean value from the eight sampling sites was recorded for each metal. A comparison of the mean and range values of heavy metals concentration (mg/L) in Shatt Al-Arab River with some standard guidelines values (Ayers and Westcot 1985) for Irrigation water resources, (WHO 2004; WHO, 2011), (EPA, 2012) Iraqi systems for rivers maintains in (Yaqub, 2011) and WHO guidelines for domestic water use. The data were statistical analysis to test the analysis and correlation among all the parameters using SPSS 20 statistical software.

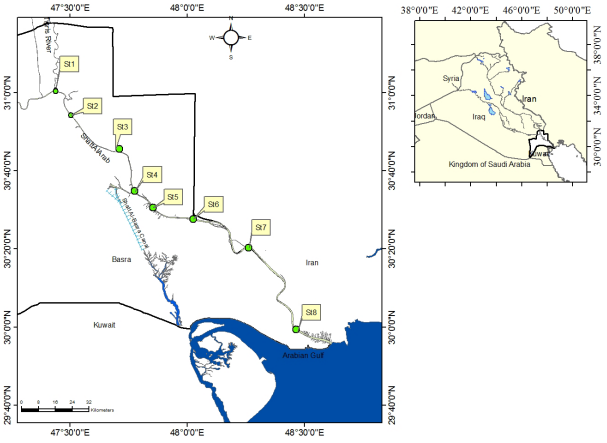

Fig. 1. Map of Shatt Al-Arab River showing the eight sampling stations

RESULTS AND DISCUSSION

Cadmium: Cd is a non-essential element and it is highly toxic to freshwater aquatic life. Human activity has significantly increased Cd concentration in the aquatic ecosystem. It can move for a long distances from the source of emission by atmospheric transport (WHO, 2011). The experimental data of Cd obtained in this study was between 0.011-0.025 mg/L (Table 1). The concentration of cadmium is increasing towards the downstream the highest value in Fao (St8) indicating that the river is not cleanable it self (Fig. 2).

The reason of increasing Cd concentration in these study sites may be related to the sewage, industrial and the agricultural activities (Manahan, 1993; Al-Kazaeh, 2014). There are another important

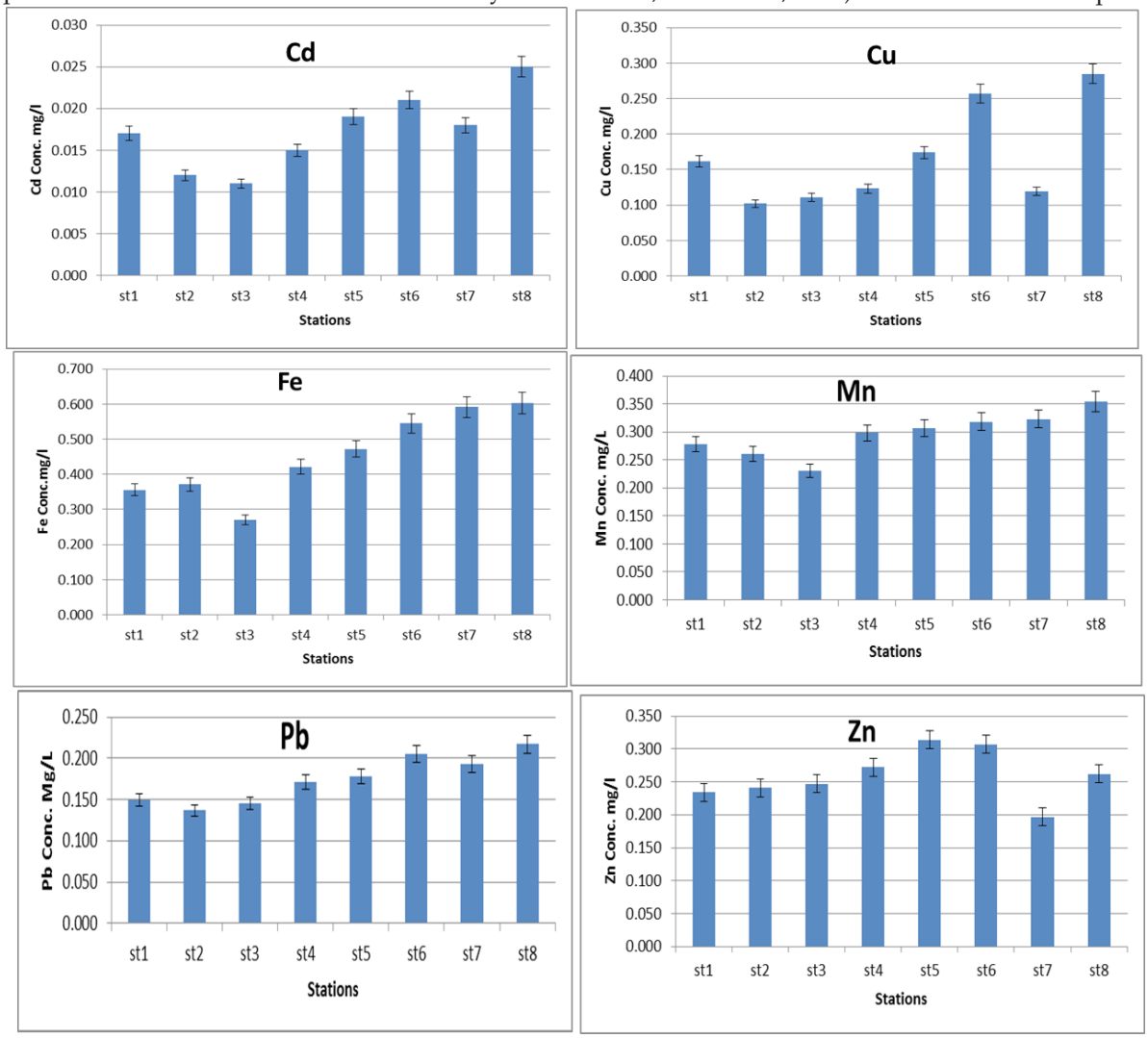

Fig. 2. The concentration of Cd, Cu, Fe, Mn, Pb and Zn (mg/L) in the stations of study aria

Table 1. Heavy and trace metal mean contamination, Standard Deviation (SD), Minimum, Maximum and Range Shatt Al-Arab of River (mg/L).

	Cd	Cu	Fe	Mn	Pb	Zn
Mean	0.02	0.17	0.45	0.30	0.17	0.26
SD	0.00	0.07	0.12	0.04	0.03	0.04
Minimum	0.01	0.10	0.27	0.23	0.14	0.20
Maximum	0.03	0.29	0.60	0.35	0.22	0.31
Range	0.01	0.18	0.33	0.12	0.08	0.12

sources of river pollution with toxic metals the atmospheric deposition of gaseous emissions from oil production and electric generators and the surface runoff from agricultural areas after rainfall (Al-Asadi *et al.*, 2019). These result agree with Hassan *et al.* (2017) how noted that the atmospheric dust in Basra city is polluted with heavy and trace elements.

Copper: The Cu concentration range from 0.102 to 0.285 mg/L. (Table 1 & Fig. 2). This result agreement with (Hassan *et al.*, 2008). Copper shown the same cadmium behavior as it rises down the river. Both ion decreases at St7 and then rises in Fao City. This declines in St7 is probably due to the dilution in Al-Seba water with freshwater from Karun river which discharge water in this station from Iran whilst Fao station effected by seawater.

Iron: The Fe concentration in water of Shatt Al-Arab river varies from 0.271 to 0.603 mg/L. Fe is an essential metal for most living organisms and humans. It is a constituent of proteins and many enzymes, including hemoglobin and myoglobin (Brody, 1999). It is usually more abundant in freshwater environment than other metals, due to its high occurrence on Earth (Hassan *et al.*, 2008). As noted by Albdran *et al.* (1996) sediment of Shatt Al Arab have high content of dark metals which rich with iron in its composition.

Manganese: The Mn concentration in the Shatt Al-Arab river water varies from 0.231to 0.354 mg/L (Table 1). The observed values of Mn in this study sites have been above of the recommended value for rivers maintaining system and general water from pollution for Irrigation water resources, Iraqi system for rivers maintains. Mn concentrations in the range of 0.24–0.35 mg/L can lead to memory lapses in children. Similar ndings have also reported decreased concentration and attentiveness in classes by children who drink water with a high Mn concentration(Wasserman *et al.*, 2006).

Lead: Pb value varied from 0.137-0.217 mg/L (Table 1). Pb have both a toxic and non-essential metal having no nutritional value to living organisms. The increase may be due to runoff or Which comes down with rain to the ground from the air, which is instrumental in raising the concentration of lead in water (Hassan *et al.*, 2017; Asadi *et al.*, 2019) .

Zinc: Zn having many physiological functions in living organism. It has an adverse effect on human and other organisms when deficient or present in an excessive amount and thus affects most metabolic processes (Al-Hejuje, 2015). The levels of Zn found 0.20 -0.31 mg/L (Table 1). Zinc is a common element in rocks and minerals, but its solubility is limited (Hassan *et al.*, 2008).

Water quality

The result in (Table 2) show the World and the Iraqi Permissible values for heavy and trace metals in water as compared with the present study and the other studies in same area. Cd in this study did not comply with all the world and the Iraqi Permissible values. The observed mean values of Cu within the recommended value for Irrigation water (Ayers and Westcot 1985). Also it is less than the permission of (WHO 2004; WHO, 2011) and (EPA, 2012). The observed values of Fe within the recommended values for rivers maintaining system and the Iraqi system for rivers maintains and (EPA, 2012), but it Above the acceptable guidelines values for (WHO 2004; WHO, 2011) for drinking and domestic purposes and much higher than the Iraqi standards for drinking water (EPA, 2012). Mn less than the acceptable guidelines values for WHO (2004, 2011) for drinking and domestic purposes. In domestic water, Mn can constitute a trouble if present in a

Table 2. The World and the Iraqi Permissible values for heavy and trace metals (mg/L) in water as compared with the present study and the other studies in same area.

	Cd	Cu	Fe	Mn	Pb	Zn
Mean Present study	0.02	0.17	0.45	0.3	0.17	0.26
WHO (2004 &2011)	0	2	0.05	0.4	0.01	3
Ayers and Westcot (1985)	0.01	0.2	5	0.2	5	2
Iraqi systems for rivers	0.01	0.05	0.3	0.1	0.05	0.5
maintains (Yaqub, 2011)	0.01	1	0.3	0.05	-	5
(EPA, 2012)						
Hassan *et al.* (2008)	0.011-0.015	0.117-0.433	0.348-0.571	0.152-0.31	0.109-0.200	0.175-0.257
AL-Saad *et al.* (2015)	0.012-0.034	0.014-0.046	0.72-0.98	0.035-0.72	0.060-0.083	0.050-0.07
(Moyel *et al.* (2015)	0.019-0.076	-	1.088-2.890	0.021-0.048	0.511-2.700	0.052-0.010

high concentration with a characteristic metallic taste and staining properties (Ljung and Vahter, 2007). The (EPA, 2012) didn't have permission the concentration of Lead. The high concentration of Pb in the river water can be related to the anthropogenic activities such as vehicular emissions. No amount of Pb is considered safe in drinking water. It is essentially harmful to children under the age of six and causes mental and physical retardation (WHO, 2004, 2011).

CONCLUSION

Water samples collected from eight In order to classify the water quality of Shatt Al-Arab River. Metals in this study increasing towards the downstream refers to the inability of the river to clean itself. According to world and the Iraqi Permissible values for heavy metals the water quality unsafe for human use. In addition to pollution from farms and factories, Metals increase in the water river may be due to runoff or Which comes down with rain to the ground from the air, which is instrumental in raising the concentration of lead in water. also the low water river discharge can be a mean reason that it could not cleanup itself.

REFERENCES

Diersing, N. 2009. Water Quality: Frequently Asked Questions. Florida Brooks National Marine Sanctuary. *Key West, FL*.

Alani, R., Alo, B. and Ukoakonam, F. 2014. Preliminary investigation of the state of pollution of Ogun River at Kara Abattori, near Berger, Lagos. *Inter. J. Envir. Sci. Toxicol.* 2(2) : 11-23.

Al-Kazaeh, D. K. K. 2014. Chemical and Physical properties of common water in area and evaluation degree for Irrigation in Basra/ Iraq. *Journal of Basra Research (Scientific)* 40(2b): 18 : 26-44.

Abdulnabi, Z. A., Altememi, M. K., Hassan, W. F., Kassaf Al-Khuzaie, D. K. and Saleh, S. M. 2019. Assessing of Some Toxic Heavy Metals Levels and Using Geo Accumulation Index in Sediment of Shatt Al-Arab and the Iraqi Marine Region. *Baghdad Science Journal*. 16 (2) : 323-331.

Al-Asadi, S. A. 2017. The future of freshwater in shatt al-arab river (southern iraq). *Journal of Geography and Geology*. 9(2) : 24-38.

Al-Asadi, S. A., Al Hawash, A. B., Alkhlifa, N. H. A. and Ghalib, H. B. 2019. Factors Affecting the Levels of Toxic Metals in the Shatt Al-Arab River, Southern Iraq. *Earth Systems and Environment*. 1-13.

Abowei, J. F. and Sikoki, F. D. 2005. Water Pollution Management and Control, Double trust. *Publication. Company, Port Harcourt*. pp : 236.

Saeed, S. M. and Shaker, I. M. 2008, October. Assessment of heavy metals pollution in water and sediments and their effect on Oreochromis niloticus in the northern delta lakes, Egypt. In 8th international symposium on Tilapia in Aquaculture (Vol. 475, p. 490). Central Laboratory for Aquaculture Research, Agricultural Research Center. Limnology Department.þ

Hassan, W. F., Albadran, B. N. and Faraj, M. A. 2008. The geochemical distribution of trace metals in Shatter Al-Arab River Sediments. *Marine Mesopotamica.* 23(2) : 419-436.

Hassan, W. F., Hassan, I. F. and Jasim, A. H. 2011. The effect of industrial effluents Polluting water near their discharging in Basrah Governorate/Iraq. *Marine Science Center University of Basrah*. 37 : 21-32.

Abdullah, E. J. 2013. Quality assessment for Shatt Al-Arab River using heavy metal pollution index and metal index. *Journal of Environment and Earth Science*. *3*(5) : 114-120.

Moyel, M. S., AYMTEGHY, A., Hassan, W. F., Mahdi, E. A. and Khalaf, H. H. 2015. Application and evaluation of water quality pollution indices for heavy metal contamination as a monitoring tool in Shatt Al Arab river. *J Int Academic Res Multidiscip*. 3(4): 67-75.

APHA (American Public Health Association). 2005. Standard method for the examination of water and wastewater - 21th edition, Washington, D. C., pp. 1193.

Ayers, R. S. and Westcot, D. W. P. R. 1985. Water Quality for Agriculture. *FAO Irrigation and Drainage* 1(29): 188.

WHO, W. H. O. 2004. Guidelines for Drinking-Water Quality. Geneva, Switzerland 1(3ed edition).pp 668

WHO, W. H. O. 2011. Guidelines for Drinking-Water Quality. Geneva 27, Switzerland 4thedition pp:564

EPA, U. S. E. P. A. 2012. Edition of the Drinking Water Standards and Health Advisories. EPA 822-S-12-001 Office of Water U.S. Environmental Protection Agency Washington. pp. 20.

Yaqub, Y. Y. 2011. Groups of laws, Decisions, and Instructions related to the works of Ministry of Water Resources. part 2, 521.

Manahan, S. E. 1993. Fundamentals of Environmental Chemistry. *Lewis Publishers. USA*. pp. 993

Hassan, W. F., Hassan, I. F., AlKhuzaie, D. K. K., Abdulnabi, Z. A., Khalaf, H. H., Kzaal, R. S. and Almansour, W. A. I. 2017. Monitoring of trace elements in dust fallout in Shaibah, Basrah city/ Iraq. Mesopo. Environ. j, 3(4), 1-5.

Brody, T. 1999. Nutritional biochemistry San Diego, CA, USA 2nd ed. *J. of the American College of Nutrition*. 19 (3) : 419-420.

Wasserman, G. A., Liu, X., Parvez, F., Ahsan, H., Levy, D., Factor-Litvak, P., Kline, J., van Geen, A., Slavkovich, V. and Lolacono, N.J. 2006. Water manganese exposure and children's intellectual function in Araihazar, Bangladesh. *Environ. Health Perspect.* 114 (1) : 124-129.

Al-Hejuje, M. 2015. Application of water quality and pollution indices to evaluate the water and sediments status in the middle part of Shatt Al-Arab River. Ph. D. Thesis. *University of Basrah, College of Science.* pp: 215.

Ljung, K. and Vahter, M. 2007. Time to re-evaluate the guideline value for manganese in drinking water. *Environmental Health Perspectives*. 115(11) : 1533-1538.