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Evaluating the water pollution in the rivers of Iraq

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1. Abstract

The study was conducted during July for the years (2007, 2008) for the purpose of evaluating the percentages of some heavy metals and boron and their role in water pollution in central and southern Iraq of the Tigris, Euphrates, and Gharraf rivers for irrigation and drinking purposes.Where eight sites were selected on the site map where water models were taken from the middle of the river to determine the concentrations of the elements (As, B, Fe, Hg, Cu, Ni, Se, Cd, Zn, Cr, Mn, Co, Ag, Pb). The results of laboratory analyzes showed that there were no concentrations of the elements Pb, Mn, Fe, Cu, and Zn, while there were less than the permissible limits in the Euphrates River. It showed presence in varying proportions in all study areas, but it is under the permissible limits. As for the boron element, it showed high percentages more than the permissible limits, especially in the sites of Nasiriyah and Qurna, and these percentages were associated with the percentages of high concentrations of salts. In general, all percentages are below the permissible limits according to the system of the Iraqi Ministry of Health, Center for Environmental Protection and Improvement. WHO, FAO Maintaining rivers from pollution.

2. Introduction

With its geological source (heavy & trace element), the percentages of heavy trace elements are affected, and there are several ways to calculate their ROCK–forming element and rock quality .The ratios of these

elements are also affected by Kwong, 1993 (USGS2006 - and their contents). Especially boron by human activity and land uses, and its proportions increase in soil, water, and air due to its waste. Industrial laboratories, textile laboratories, oils, and automobile exhaust, generate cases of environmental pollution and deteriorate water quality, especially drinking water (Radiological Guideline drinking water).

Boron B is one of the pollutants of the quality of irrigation water if its concentration increases to 1.0 ppm (Bauder et al. 2005), which affects the growth of plants sensitive to boron. The idea of this research came from the water quality study program in Iraq for the Tigris and Euphrates rivers at the Environmental Studies Center / Ministry of Water Resources to determine and diagnose the ratios of all standards affecting water quality, including boron and trace elements and their potential impact on water quality and pollution, where heavy elements are found in aquatic environments in The fine parts of the sediments (1993) chakra pain and Subramanian.

The content of heavy and trace elements in water is important for humans and plants, but in limited proportions that cannot be exceeded according to international standards, as very slight increases are toxic, so knowing and diagnosing these elements is very necessary, although their small amounts are necessary for vital processes such as enzyme production, chlorophyll formation and cell division Representing protein and regulating unwanted transpiration processes, such as cadmium and lead, even in trace amounts. Therefore, international organizations related to water quality, such as (NAWQA), the National Water Quality Assessment, the World Health Organization (W.H.O.) and the Health Canada to study each element separately to know its impact and its role in public health and setting the upper permissible limits in the use of water (Table 1) and according to Standard Specifications No. 417 and the River Conservation System from Pollution No. 20 of 1967 and the FAO Bulletin (Table 2).

Table 1 - Permissible limits for uses the water

Ministry of Health (1998) Environmental Legislation, Environmental Protection and Improvement Center

Element		Drinking water (mg/L) WHO Standard Specification No. 417	River water (mg / liter) The system of maintaining rivers from pollution 25 in 1967
arsenic	AS	0,01	0,05
Boron	B	0,5	1,0
Iron	Fe	0,3	1,0 – 0,5
Mercury	Hg	0,001	0,005
copper	Cu	0,01	0،05
nickel	Ni	0,01	0,1
selenium	Se	0,001	0,005
Cadmium	Cd	0,001	0,005
zinc	Zn	0,05	1,0 – 0,5
chrome	Cr	0,05	0,1
manganese	Mn	0,01	0,5 – 0,1
cobalt	Co	0,05	0,5 – 0,1
Silver	Ag	0,01	0,05
Lead	Pb	0,01	0,03

Table - 2 Maximum permissible limits

Ministry of Planning, Central Agency for Standardization and Quality Control, Quality Standard Specification No. 3241 for 1992

Element		permissible limit mg/L
arsenic	As	0,1
Boron	B	1
Iron	Fe	5
Mercury	Hg	0,001
copper	Cu	0,2
nickel	Ni	0,2
selenium	Se	0,02
Cadmium	Cd	0,1
zinc	Zn	2

chrome	Cr	0,1
manganese	Mn	0,2
cobalt	Co	0,2
Silver	Ag	0,05
Lead	Pb	0,1

3. Materials and working methods

Water models were taken from the waters of the Tigris, Euphrates and Al-Gharraf in eight locations (locational map - Figure 1): Baghdad - Hilla - Samawah - Al-Amarah - Kut - Al-Hayy - Nasiriyah - Qurna - for two consecutive years 2007-2008 during the month of July for each year, with an average of four models for one site and calculating the rate from the middle of the river at a depth of 20-40 cm by a device for collecting water samples and placing them in glass containers and then sent to laboratories for the purposes of measuring the concentrations of elements (Fe, Mn, As, Zn, Cu, Co, Cd, pb, Cr, Ni, Hg, Se, Ag) In addition to boron. The ratios and concentrations of these elements were measured using atomic absorption spectrometry AAS,And by color methods according to the capabilities of the available laboratories, which are the Soil and Water Research Center, Al-Dora laboratories, the laboratories of the Ministry of Municipalities, the Canal chest, the environment laboratories, and the Environmental Studies Center / Ministry of Water Resources.The values and ratios of the concentrations of trace elements were compared with the permissible limits according to the international standards mentioned in the introduction to the research, especially NAWQA , FAO , WHO In addition to the use of standard specifications No. 417 and the draft standard specification No. 3241 of the Ministry of Planning.

4. Results and discussion

Concentration analyzes of trace heavy elements and boron were carried out as in Table (3), where the results of analyzes showed the different

levels of ion concentrations according to their locations and water sources with the increase of concentrations towards southern Iraq.

Table (3) - The concentrations of ions of the elements in the selected sites of the Tigris, Euphrates and Gharraf rivers for the years 2007-2008 for the month of July

Site and year/ concentration (mg/L)	Fe	Mn	Zn	A	Cu	Co	Cd	Pb	Cr	Ni	Hg	Se	Ag	B
Baghdad 2007-2008	0,001	0,11	Nil	Nil	*	Nil		0,05	Nil	Nil	Nil	Nil	Nil	0,1
		0,12	Nil	Nil	*	Nil		0,06	Nil	Nil	Nil	Nil	Nil	0,03
Al-Hilla 2007-2008	0,002	0,13	Nil	Nil	Nil	*		0,04	Nil	Nil	Nil	Nil	Nil	0,02
		0,12	Nil	Nil	Nil	*		0,05	Nil	Nil	Nil	Nil	Nil	0,04
Muthanna 2007-2008	0,001	0,06	0,02	Nil	0,06	*	*	0,04	Nil	Nil	Nil	Nil	Nil	0,7
	0,002	0,07	0,01	Nil	0,075	*	*	0,03	Nil	Nil	Nil	Nil	Nil	0,8
KUT 207-2008	0,002	0,125	*	Nil	0,001	*	*	0,03	Nil	Nil	Nil	Nil	Nil	0,11
	0,001	0,13	*	Nil		Nil	Nil	0,02	Nil	Nil	Nil	Nil	Nil	0,07
Al-hayy 2007-2008	0,002	0,14	0,01	Nil	Nil	0,001		0,03	Nil	Nil	Nil	Nil	Nil	0,12
	0,001	0,13	0,007	Nil	*	Nil		0,03	Nil	Nil	Nil	Nil	Nil	0,126
Nasiriyah 2007-2008	0,002	0,08	0,018	Nil	0,08	*		0,04	Nil	Nil	Nil	Nil	Nil	1,15
	0,002	0,07	0,19	Nil	0,09	*		0,06	Nil	Nil	Nil	Nil	Nil	1,09
Amarah 2007-2008	*	0,09	0,001	Nil	0,001	0,001		0,04	Nil	Nil	Nil	Nil	Nil	0,08
	0,001	0,12	0,001	Nil	0,002	*		0,05	Nil	Nil	Nil	Nil	Nil	0,09
Qurna - Shatt Al Arab 2007-2008	0,001	0,08	0,007	Nil	0,06	0,001		0.05	Nil	Nil	Nil	Nil	Nil	0,9
	0,001	0,1	0,009	Nil	0,05	0,001		0.06	Nil	Nil	Nil	Nil	Nil	1,03

It is noted in table .3 that the values of iron ion (Fe) concentrations are less than 0.002 mg/liter in the Tigris and Euphrates rivers, and these concentrations are low compared to the international standards allowed in drinking and irrigation water.As for Mn, the concentrations ranged between 0.12 mg/liter in the waters of the Tigris and Al-Gharraf to less than 0.07 mg/liter in the waters of the Euphrates. Therefore, the concentrations of Mn are high in the Tigris compared to the Euphrates River, but it remains under the permissible limits. While the results of the

chemical analysis of the water models of the zinc ion in Muthanna and Nasiriyah of the Euphrates River showed values ranging between 0.07 - 0.065 mg/liter, and no concentrations of this ion appeared in the waters of the Tigris and Gharraf at sites 2.1, while the results of the analyzes showed the ions of the elements arsenic, As and selenium Se, silver (Ag), mercury (Hg), nickel (Ni), chromium (Cr) and cadmium (Cd). There are no concentrations of these ions in the waters of the Tigris, Euphrates, and Gharraf. As for the cobalt Co, it showed very low concentrations less than 0.001 mg/liter in the neighborhood, Al-Amarah, and Al-Qurna sites, which do not affect the water suitability for drinking and irrigation and are below the permissible limits according to international standards.

As for the copper element (Cu), it showed the presence of concentrations that ranged between (0.09-0.075) mg/liter in the waters of the Euphrates, and there were no percentages of it in the sites of Baghdad, Hilla, and Al-Hayy, except for the presence of a low concentration of less than 0.001 mg/liter in the city of Kut.

Also, Zn did not appear in the sites of Baghdad, Hilla, and Kut, while the sites showed low concentrations, as well as the sites of Nasiriyah, Al-Amarah, and Al-Qurnah, where the percentages ranged between 0.001-0.019 mg/liter, which do not affect the suitability of water for irrigation.

As for manganese, Mn was present in concentrations that ranged between (0.6 - 0.13) mg/liter, and the Tigris River showed high percentages compared to the Euphrates River.

As for the iron Fe concentrations, they ranged between 0.001-0.002 mg/L and it decreased or appeared and decreased in the sites of Al-Hilla for the year 2008 and Al-Amarah for the year 2007, but the percentages of lead concentrations showed values in all the sites of the Tigris, Euphrates, Gharraf and Shatt Al-Arab rivers and during the years 2007 and 2008 for the month of July, where they ranged Concentrations between 0.03 - 0.06 mg/liter.As for the boron ion B, it showed a clear presence in all waters and the ion concentrations varied according to the water source (Tigris and Euphrates) and according to the years of study and the nature of land use and water salinity, where high levels of boron ion concentrations were observed with the electrical conductivity values, Ec in the water and the table (4) shows the relationship of Ec Boron concentrations in the study area.

Table (4) show relationship of salinity to boron ion concentrations

Seq.	Location	Electrical conductivity	Ion concentration mg/L	year

1	Baghdad	600	0,01	2007
		800	0,05	2008
2	Al Hilla	680	0,02	2007
		750	0,04	2008
3	Al -muthanna	2500	0,7	2007
		2800	0,8	2008
4	Al-KUT	950	0,11	2007
		800	0,07	2008
5	AL-Hayy	930	0,12	2007
		940	0,125	2008
6	Nasiryah	4000	1,15	2007
		3500	1,09	2008
7	AL-omarah	950	0,08	2007
		980	0,09	2008
8	qurna	3000	0,9	2007
		3500	1,3	2008

It is noted in Table (4) that boron concentrations are increasing towards southern Iraq, especially in the Euphrates River. The proportions of boron concentrations have been affected by the quantities of dissolved salts in the water. It is noted that the quantity decreased in Shatt al-Arab compared to Nasiriyah because of mixing the Tigris and Euphrates waters in the Qurna region.

5. Conclusions

1- The water quality is acceptable according to international standards, with exceptions, especially for boron, salinity, lead and manganese, Mn and Pb.
2- The quality of the water of the Tigris is better than that of the water of the Euphrates in terms of concentrations of trace elements.
3- There are no problems determinants of the water quality of the Tigris and Euphrates in terms of concentrations of heavy and trace elements because they are less than the permissible limits according to international standards.

4- There are no environmental problems that threaten the life of fish and aquatic life due to the absence of high concentrations of heavy and toxic elements Cr, Cd, Ag, As

5- The presence of small percentages of the elements Zn, Cu, Ca, and Pb, especially in the waters of the Euphrates River due to the different water sources associated with the geological and structural conditions.

6- Boron rates are high in the Euphrates River, due to the high concentrations of salts, especially in Dhi Qar, Muthanna and Shatt al-Arab. While the percentages of boron are few in the Tigris River compared to the Euphrates. In general, the percentages of boron are relatively high and have exceeded the international standards allowed in the areas of Nasiriyah, Muthanna and Qurna.

The differences in Table (3) show the concentrations of heavy and trace elements ions, it may be due to the following reasons:

A - The differences in the geological formations and the quality of the rocks that generate heavy and trace elements.

B - The impact of the human factor, land use, leather, and chemical industries.

C- Disposal of waste and untreated water, sewage, and sewage.

Dr . Effect of sediments, storage, and evaporation processes on water quality.

E- Effect of saline water discharged from troughs and residues of materials used in industry and pesticides, which are discharged into the Euphrates and Tigris waters.

F- And the Impact of wars, military materials, waste of petroleum products, and radioactive activities.

G- Part of the elements such as iron, manganese, and boron are related to the nature of their natural geochemical presence.

H- The presence of boron and lead is related to human uses of land, energy, and automobile exhaust.

7- Although boron is in high concentrations ppm > 1 in water and its effect is toxic, especially in dry and semi-arid areas and its use for irrigation purposes accumulates in the soil, causing problems of difficulty in the reclamation of soil containing boron and the

readiness of boron decreases with the increase of soil interaction (pH).

8- There are no problems with using water for the rare elements, especially copper, lead, nickel, chromium, mercury, Arsenice, and selenium, and then studying vanadium (V) and fluorine (F) for technical reasons.

9- Although the results are few about the pollution of river water with micro and heavy elements.. and because previous studies confirmed the effect of washing and reclamation processes in raising the levels of these elements, especially iron, manganese, copper, and zinc, and they increased in water more than doubled.

10- The proportions of elements, boron, and salinity increase as we head towards the south, which increases the degree of pollution and the unfitness of water for drinking and irrigation.

11- The impact of storage operations on the properties of water and its suitability, as the amount of lead, zinc, copper, and iron decreases. As for cadmium, cobalt, and chromium, they remained unaffected by storage (Augustine 1986).

6. Recommendations

1. Conducting periodic analyzes of elements of a radiological and toxic nature that are related to the health aspect.
2. Support studies related to water quality and suitability, especially heavy and trace elements in surface and ground water and their relationship to pollution.
3. We recommend studying the sediments of the Tigris and Euphrates in relation to the concentrations of these ions and the degree of geochemical affinity for these elements.
4. Adoption of the specifications contained in international organizations and the standards adopted in the world to determine the suitability of water for drinking and for irrigation purposes.

5. We do not recommend using the Euphrates River at Nasiriyah and Samawah for drinking purposes because it exceeds the permissible limits for drinking purposes (0.9 mg / liter.(
6. The possibility of using Tigris water for irrigation purposes without limitations, except for the Euphrates water at Nasiriyah and beyond, which needs effective water management due to the high concentrations of dissolved salts and boron, which affect public health and soil productivity.
7. We recommend setting up desalination and water treatment plants and improving their specifications so that they become suitable for drinking purposes.
8. We recommend finding standards and criteria for Iraqi waters for the purpose of classifying them, studying their powers and identifying their problems.
9. We advise, after using drip water to irrigate crops, to increase the concentrations of heavy elements in the soil, especially when the irrigation periods are long and for years.
10. Raising the level of water and environmental awareness in protecting water resources from pollution.

7. References

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