Scientific Journal for Damietta Faculty of Science **13**(2) 2022, 1-9
Special Issue
The 6th International Environmental Conference
Climatic Changes and Sustainable Development
ISSN Print 2314-8594
ISSN Online 2314-8616

https://sjdfs.journals.ekb.eg/

Assessment of Surface Water Quality of the Nile River at Damietta Branch, Egypt

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Received: 14 November 2022 /Accepted: 07 May 2023

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Abstract

Nile River is subjected to many sources of pollution from municipal wastewater, agriculture, and industry, but little information is available on the quality of the river's water. This study aimed to assess the water quality of the Nile River at the Damietta Branch. Water samples were collected from the Damietta branch, the physico-chemical parameters and some heavy metals were analyzed which includes; temperature, pH, Turbidity, EC, TDS, alkalinity, total hardness, Ca^{+2} and Mg^{+2} hardness, chlorides, sulfates, and aluminum, ammonia, nitrite, nitrate, iron, manganese, and silica. The results indicated that, the turbidity value was 7.81 NTU, while temperature, pH, EC, and TDS were 23ºC, 8.03, 403.75 µmohs/cm, and 266.25 mg/l, respectively. The concentrations of alkalinity, total hardness, Ca^{+2} and Mg^{+2} hardness were 142, 131.5, 82.5, and 49 mg/l, respectively. While chlorides, sulfates, and aluminum concentrations were 27, 34.25, and 0.063 mg/l, respectively; ammonia, nitrite, and nitrate concentrations were 0.13, 0.083, and 0.59 mg/l, respectively. Iron, manganese, and silica concentrations were 0.058, 0.05, and 1.3 mg/l, respectively. Results from Water Quality Index (WQI) reveal that Nile River waters were generally categorized as poor quality or unfit for drinking purposes leading to presence of high pollution in the river. Water sample with Pollution Index observed that heavy metals concentrations had moderately affected except Cu^{+2}, Co^{+2}, and Zn^{+2} were not detected in raw Nile River water. Perhaps, new recent trends of treatment have to be designed so as to decrease the pollution load of the rivers.

Keywords: Drinking water, physicochemical parameters, heavy metals, Egyptian standards.

Introduction

Water pollution is one of major environmental problems in the world, which results from increasing population growth, urbanization, and industrialization **(Dwivedi, 2017).** In many countries, rivers have served as primary depository for both industrial and domestic waste. On the banks of the rivers there are many informal settlements which have no satisfactory sanitation and sewerage systems and thus release their untreated sewage into the rivers. Majority of companies find it economical to pour their industrial effluents directly to the rivers **(Kithiia, 2011).**

Nile River has been considered as the heart of Egypt because of its role in agricultural, drinking, fishing, navigation, industry, generation of hydropower, the waste disposal and the desert soil recharging **(Vörösmarty *et al.*, 2000).** Consequently, the Nile River water quality has been steadily deteriorating over the last few decades' due to discharge of these industrial effluents and various other untreated wastewater and anthropogenic inputs **(Rashid and Romshoo, 2013; Morsy *et al.*, 2020).** Damietta Branch of Nile River lengthens for 220 km from the Delta Barrage to the Mediterranean Sea **(Badr *et al.*, 2006)**. It is the main source of water supply to several governorates such as Damietta, El-Dakahlyia, El-Gharbyia and El-Qalubia **(El-Amier *et al.*, 2015)**.

Heavy metals discharge in water surface is a major pollution problem affecting the water quality causing a direct hazard to human health. The heavy metal compounds solubility in surface waters is controlled by the water pH, the type and amount of ligands on which the metal could adsorb the redox environment of the system and the oxidation state of the mineral constituents **(Akpor and Muchie, 2010).**

Monitoring the quantity and quality of water, as well as controlling pollution of water resources, is one of the national goals to reach sustainable development in Egypt **(Badr *et al.*, 2006; Hasballah, 2008; Yousry *et al.*, 2009; El Bouraie *et al.*, 2011; Ali *et al.*, 2014; Toufeek and Korium, 2015; Rawway *et al.*, 2016; El-Salam *et al.*, 2017; El-Rayes *et al.*, 2018; El-Bady, 2019; Elhdad, 2019; Elsayed *et al.*, 2020; Ibrahim and Elhaddad, 2020; Rizk *et al.*, 2020; Smysem *et al.*, 2020; El-Hadad, 2021 and Gad *et al.*, 2022).**

Damietta Branch suffers from the pollutants that are discharged from fertilizers factories and other agricultural, domestic, municipal and industrial activities that are disposed along the branch. Moreover, 10 out of 67 different drains discharging these pollutants and contaminants into the Nile Delta do not comply with the Egyptian standards **(Morsy *et al.*, 2020).** Water quality assessment is a very important tool to provide reliable information about water quality **(Rizk *et al.*, 2020)**. This study aims to analysis the physicochemical parameters and trace heavy metals to assess water quality which gives a good impression of pollution status of the Nile River water.

Materials and Methods

2.1. Samples and Sampling Site and Protocol

Water samples were collected near conventional Water Treatment Plant (WTP) located at Shribeen City, Daqahliya governorate (Fig. 1). Daqahliya governorate is located at the tail of water streams, i.e., the endpoint of the Damietta branch and other freshwater streams. Thirty-six grab samples of raw water (Nile River) were collected during the year 2021, which collected in high density polyethylene (HDPE) containers that were routinely acid treated and well rinsed with de-ionized water prior to use, dried, and stored with the caps on to prevent contamination. All samples were subjected directly to the laboratory analysis.

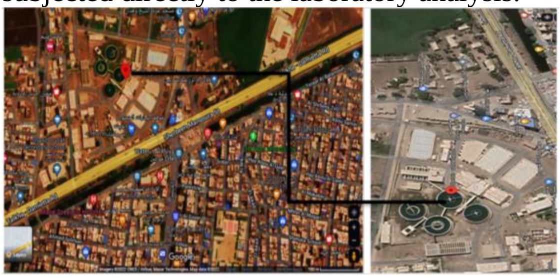

Figure (1): A map of Shribeen city in Daqahliya governorate illustrating the investigated Water Treatment Plant (WTPs)

2.2. Physico-Chemical Characteristics

All the water samples were characterized for some physicochemical parameters such as Turbidity, Temperature, pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Alkalinity, Total Hardness, Ca^{+2} Hardness, Mg^{+2} Hardness, Chlorides (Cl^{-}), Sulfates (SO_4^{-2}), Aluminum (Al^{+3}), Ammonia (NH_3^{-}), Nitrite (NO_2^{-}), Nitrate (NO_3^{-}), Silica (Si) and Heavy metals as Copper (Cu^{+2}), Cobalt (Co^{+2}), Cadmium (Cd^{+2}), Nickel (Ni^{+2}), Zinc (Zn^{+2}), and Lead (Pb^{+2}), Iron (Fe^{+2}), Manganese (Mn^{+2}) according to Standard Method **(APHA, 2017).** The pH of the samples was measured directly by pH Meter (model, 211 HANNA, USA). Electrical conductivity (EC) and Total Dissolved Solids (TDS) of the samples were determined by Digital Portable TDS/ Conductivity meter (Model 8033 HANNA, USA). Turbidity of samples was measured by Turbidimeter (Al1000 aqualytic Germany with measuring 0-200 NTU).

Determination of Heavy Metal

Heavy metals concentration in raw water were determined according to **(APHA, 2017).** A blank is subjected to the same procedures as the sample correct for impurities present in acids and reagent water. The values of Cu^{2+}, Co^{2+}, Cd^{2+}, Ni^{2+}, Zn^{2+}, Pb^{2+}, Fe^{2+} and Mn^{2+} were measured using flame atomic absorption spectrophotometer (PinAAcle -500: Perkin Elmer Optima 500, USA). The instruments were pre-calibrated and measured according to the manufacturer's guides. All the determinations were triplicated and the average values were obtained and used for further calculations.

Estimation of Water quality index

WQI is a mathematical way of summarizing multiple properties into a single value. WQI is useful for comparing differences in water quality across a region, or for monitoring changes in water quality over time. In the present study, WQI was calculated using the equation developed by **Tiwari and Manzoor (1988).** The quality rating (q_i) for the water quality parameter can be obtained by the following relation:

$$q_i = 100V_i/S_i \qquad (1)$$

Where V_i is the observed value of the parameter at a given sampling site, and Si is the stream water quality standard. Equation (1) ensures that qi = 100 if the observed value is just equal to its standard value. Thus, the larger value of qi revealed polluted water. To calculate WQI, the quality rating qi corresponding to the parameter can be determined using equation (2). The overall WQI was:

$$WQI = \sum q_i \qquad (2)$$

Where i=1

The average water quality index (AWQI) for n parameters was calculated using the following the equation (3):

$$AWQI = \sum \frac{q_i}{n} \qquad (3)$$

Table (1): Water quality classification based on WQI value

Water Quality Index Level	Water Quality Status
<50	Excellent
50-100	Good
100-200	Poor
200-300	Very poor
>300	Unsuitable

Metal Pollution index (MI)

The pollution index (PI) was used in this study to evaluate the degree of heavy metal contamination in water samples **(Emoyan *et al.*, 2005 and Odukoya and Abimbola, 2010).** The tolerable level is the element concentration in the water considered safe for human consumption **(Lee *et al.*, 1998).** Pollution index (PI) is based on individual metal calculations and categorized into five classes according to the following equation **(Caerio *et al.*, 2005).**

$$PI = \sum_{i=1}^{n} \frac{C_i}{S_i} / Nm$$

Where Ci = Heavy metal concentration in water; Si= permissible Level and Nm = Number of Heavy metals. Water sample with Pollution Index (PI) <1 is regarded as being no effect; (PI) = 1-2 (Slightly affected); (PI) = 2-3 (Moderately affected); (PI) = 3-5 (Strongly affected); (PI) = 4-5 (Seriously affected).

Results and Discussions

Physico-Chemical Characteristic

The physicochemical analysis of the Nile River raw water samples was shown in **Table 1** and Figure 2. The present study observed that the physicochemical analysis of the raw water of Nile River in the study area (Table 2) was in permissible limits of the Egyptian standards for drinking **(EWQS, 2007).**

The average value of turbidity for raw water samples was 7.81±0.23 NTU while Temperature, pH, EC and TDS were 23.28±3.39 ºC, 8.03±0.11, 403.75± 57.29 µmohs/cm, and 266.25±37.74 mg/l, respectively. The concentration of alkalinity, total hardness, Ca^{++} hardness and Mg^{++} hardness were 142±3.65, 131.5±9.85, 82.5±8.54, and 49±6 mg/l. While chlorides, sulfates and aluminum concentration were 27±3.83, 34.25±0.96, and 0.063±0.009 mg/l; ammonia, nitrite, nitrate were 0.13±0.04, 0.083±0.023, and 0.59±0.2 mg/l; iron, manganese and silica were 0.058±0.013, 0.05±0.034, and 1.3±0.2 mg/l, respectively.

Table (2): Descriptive analysis, WQI and AWQI of physicochemical characterization of raw Nile River water.

Parameter	Unit	Mean ±SD Vi	MIN	MAX	WQI qi=100[Vi/ Si]	Max. allowed in drinking water (EWQS, 2007). Si
Electrical Conductivity (EC)	µmohs/cm	403.75±57.29	349	467	40.4	1000
Temperature	℃	23.28±3.39	18.9	26.2	194	8-12
Total Dissolved Solids (TDS)	mg/l	266.25±37.74	230	308	53.25	500
pH	-	8.03±0.11	7.94	8.19	114.7	6.5-8.5
Turbidity	NTU	7.81± 0.23	7.6	8.1	781	1
Total Hardness	mg/l	131.5±9.85	122	140	26.3	500
Ca^{+2}. Hardness	mg/l	82.5±8.54	70	88	23.6	350
Mg^{+2}. Hardness	mg/l	49±6	40	52	32.6	150
Chlorides (Cl^-)	mg/l	27±3.83	24	32	10.8	250
Alkalinity	mg/l	142±3.65	138	146	71	200
Sulfates (SO_4^{-2})	mg/l	34.25±0.96	33	35	13.7	250
Aluminum (Al^{+3})	mg/l	0.063±0.009	0.05	0.07	31.5	0.2
Ammonia (NH_3^-)	mg/l	0.13±0.04	0.08	0.17	26	0.5
Nitrite (NO_2^-)	mg/l	0.083±0.023	0.05	0.1	41.5	0.2
Nitrate (NO_3^-)	mg/l	0.59±0.2	0.3	0.75	1.31	45
Silica	mg/l	1.3±0.2	1.2	1.6	1300	0.1
WQI = Σqi i=1					2729	
AWQI = Σqi/n					170.5	

WQI: Water quality index, AWQI: Average water quality index

Turbidity is the cloudiness of water caused by a variety of particles and is another key parameter in drinking water analysis. It is also related to the content of diseases causing organisms in water, which may come from soil runoff **(WHO, 2006).**

The turbidity result for raw water sample (7.81± 0.23NTU) is higher than that recorded (5.53 NTU) by **Hasballah, (2008)**, and **Smysem *et al.*, (2020)** which was 6.35 NTU, and the results lower than that reported (8.37 NTU) by **El-Salam *et al.*, (2017)** and **Ljiljana *et al.*, (2019)** was 19.7 NTU.

The average value of temperature ranged between 15 to 30 ˚C through the study duration this may be attributing to solar radiation and elevated resulting from discharges of heated water may have significant ecological impact **(Hasballah, 2008; Ali *et al.*, 2014; Toufeek and Korium, 2015; APHA, 2017; Ljiljana *et al.*, 2019 and Smysem *et al.*, 2020).**

Electrical conductivity and total dissolved solids are considered as reflected parameters to each other's that influenced by total concentrations of ions, their abundance and medium temperature, the electric conductivity of water is directly proportional with the availability of ions **(Gaber *et al.*, 2013).** Raw water had the lowest values EC (403.75±57.29 µmohs/cm) than that recorded (410.7 µmohs/cm) by **Hasballah, (2008)**, **Smysem *et al.*, (2020)** that was 419.80 µmohs/cm, and with study of **Ali *et al.*, (2014)** as it was 794 µmohs/cm. Value of EC recorded at the present study was higher than recorded by **Toufeek and Korium, (2015)** which was reported as 235.99 µmohs/cm and by **El-Salam *et al.*, (2017)** that it was 330 µmohs/cm and **Ljiljana *et al.*, (2019)** who recorded 254 µmohs/cm. The higher EC could be attributed to reduce of water level and decrease of water volume **(Kolo and Oladimeji, 2004).**

TDS include primarily chlorides, phosphates, sulfates, bicarbonates, and possibly nitrates of magnesium, potassium, sodium, calcium, in addition to traces of manganese, iron **(Akan *et al.*, 2012).** The value of TDS was 266.25±37.74mg/l that higher than that recorded (248.25 mg/l) by **Hasballah, (2008)**, **Toufeek and Korium, (2015)** as it was 156 mg/l, **El-Salam *et al.*, (2017)** who recorded 218 mg/l, **Ljiljana *et al.*, (2019)** which was 167.44 mg/l, and **Smysem *et al.*, (2020)** as it was 223.52 mg/l, while lowering than that recorded by **Ali *et al.*, (2014)** 524.00 mg/l, The high value of total dissolved solids may be due to the high amount of agriculture drainage and sewage water **(APRP, 2002).**

The alkalinity value was 142±3.65 mg/l which agreed with that recorded (141.47 mg/l) by **Hasballah (2008)**, (136.5 mg/l) by **El-Salam *et al.* (2017)**, (145.81 mg/l) by **Smysem *et al.* (2020)**, and higher than that recorded (22.4 mg/l) by **Ljiljana *et al.* (2019)**. Nile River near Mansoura City tends to have alkaline pH as the presence of carbonates and bicarbonates **(Ali *et al.*, 2014)**.

Variations in pH and alkalinity were found to be controlled by the level of CO_2 liberated through the nitrification process undertaken within the system followed nutrients and phytoplankton peaks **(Ali *et al.*, 2014).** The obtained pH result (8.03±0.11) is similar that recorded (7.44) by **Hasballah, (2008)**, (7.68) by **El-Salam *et al.*, (2017)**, (7.45) by **Ljiljana *et al.*, (2019)**, and is also similar that reported by **Smysem *et al.*, (2020)**, while lower than that recorded by **Toufeek and Korium, (2015)**. The pH values in the raw water are higher due to the occurrence of normally expected carbonates or bicarbonates **(Friendl *et al.*, 2004)**. The increase in pH in the rivers may be attributed to photosynthesis and growth of aquatic plants **(Yousry *et al.*, 2009).**

The value total hardness was 131.5±9.85 mg/l higher than that recorded by **El-Salam *et al.* (2017)** 88 mg/l, and **Ljiljana *et al.*, (2019)** that was 7.75 mg/l, and lower than that recorded (178.25 mg/l) by **Smysem *et al.*, (2020)**. The lowest total hardness value mention to the loss of calcium by precipitation as $CaCO_3$, that accompanied by a low dissolved oxygen value **(Ali *et al.*, 1992).** While calcium and magnesium hardness value were 82.5±8.54 and 49±6 mg/l, respectively, higher than calcium ions recorded by **Ljiljana *et al.*, (2019)** 33.90 mg/l due to soluble calcium and magnesium salts**,** and lower than that recorded by **Smysem *et al.*, (2020)** as they were 98.44, 79.86 mg/l for calcium and magnesium hardness, respectively**.**

Chloride value of raw water (27±3.83 mg/l) was lower than that recorded by **El-Salam *et al.*, (2017);** 43.05 mg/l and **Smysem *et al.*, (2020);** 37.20 mg/l. The increase of concentration of chloride in water may be due to the presence of high sodium chloride concentration **(APHA, 1998).** Also, sulfate value was 34.25±0.96 mg/l that agrees with **El-Salam *et al.*, (2017);** 34.33 mg/l, and lower than that recorded by **Ali *et al.*, (2014);** 62.57 mg/l. Sulfates, chlorides and other conductible salts highly impacted the Nile water conductivity (EC) **(Ali *et al.*, 2014).**

While ammonia result was 0.13±0.04 mg/l that nearest that obtained by **Smysem *et al.*, (2020);** 0.14 mg/l, and lower than recorded by **Hasballah, (2008);** 1.61 mg/l and **Ali *et al.*, (2014);** 2.83 mg/l. The high concentration of ammonia in water is due to high amount of drainage water, while the low ammonia concentration is due to increase of plankton population where the ions in preference to other inorganic nitrogen **(Hasballah, 2008).**

Nitrite is an intermediated step in the process of converting organic matter into a stable form. The decrease of nitrite content may be principally due to the increase of its oxidation to nitrate as it is the more stable form of nitrogen compounds and may also be uptaken by plankton **(Hasballah, 2008).** The value nitrite was 0.083±0.023 mg/l lower than that recorded by **Ali *et al.*, (2014);** 0.472 mg/l and higher than that recorded by **Hasballah, (2008);** 0.029 mg/l and **Smysem *et al.*, (2020);** 0.05 mg/l. The presence of nitrate in Nile River water may be attributed to the agriculture activity and intensive use of ammonium containing fertilizers **(Hasballah, 2008).** The value of nitrate concentration was 0.59±0.2 mg/l, which is similar to that obtained by **Ali *et al.*, (2014);** 0.63 mg/l, **Smysem *et al.*, (2020);** 1.74 mg/l, and higher than that recorded by **Hasballah, (2008);** 0.02 mg/l, this may be attributed to high amount of organic matter due to the discharge of sewage and agriculture drainage water contains nitrate.

Aluminum value was 0.063±0.009 mg/l. Aluminum is a metal widely spread in nature and may be found in water from both natural sources and human activities (Health Canada, 2019).

Silica value in raw water was 1.3±0.2 mg/l that nearest to that obtained by **Smysem *et al.*, (2020);** 1.02 mg/l, and lower than that recorded by **Ali *et al.*, (2014);** 3.50 mg/l and may be attributed to combination with metals as aluminum, calcium, magnesium, iron, potassium, sodium and others as salts to participate.

One initial step of result evaluation is to compare the physicochemical analysis of the raw water of Nile River samples for the current study with the Egyptian Drinking Water Quality

Standards **(EWQS, 2007) (Table 1).** The present study revealed that the overall water quality of the Nile River in the study area was ranged from marginal to good according to Egyptian laws of the Nile River protection agency **(Rawway *et al.*, 2016).**

Determination of Heavy Metal

The heavy metals analysis of the Nile River raw water samples was shown in **Table 2** and **Fig. 3.** The results showed that the concentrations of Copper, Cobalt, and Zinc not detected in raw water samples, While Cadmium was 0.021±0.0008 mg/l, Nickel was 0.047±0.0002 mg/l, and Lead was 0.067±0.0005mg/l. The heavy metals analysis of raw water was in permissible limits according to **(WHO, 2011)** standards for drinking water, except for Cadmium, Nickel, and Lead.

Table (3): Mean values ±SD (mg/l) and PI for Heavy Metal analysis of raw Nile River water.

Parameter	Mean ±SD	(Ci/Si)/ Nm	Max. allowed in drinking water (WHO, 2011)
Copper (Cu^{+2})	N.D	-	2
Cobalt (Co^{+2})	N.D	-	0.05
Cadmium (Cd^{+2})	0.021 ±0.0008	0.88	0.003
Nickel (Ni^{+2})	0.047 ±0.0002	0.29	0.02
Zinc (Zn^{+2})	N.D	-	3
Lead (Pb^{+2})	0.067 ±0.0005	0.84	0.01
Iron (Fe^{+2})	0.058±0.013	0.024	0.3
Manganese (Mn^{+2})	0.05±0.034	0.016	0.4
PI=∑(Ci/Si)/Nm		2.05	

N.D: not detected

The results in **Table 2** showed that the concentration of copper was not detected in raw water, in contrast that recorded by **El-Bady (2019);** 0.012 mg/l**, El-Emam (2020);** 0.223 mg/l, and by **Gad *et al.*, (2022);** 0.0046 mg/l. Moreover, cobalt not detected in raw water, in contrast that recorded by **El-Emam (2020);** 0.442 mg/l. The cadmium value in raw water was 0.021 mg/l that agreement with **Smysem *et al.*, (2020);** 0.02 mg/l and lower than that recorded by **El-Emam (2020);** 0.149 mg/l, while higher than that reported by **El-Bady (2019);** 0. 002 mg/l.

Nickel value in raw water was 0.047 mg/l that was similar to obtained by **Smysem *et al.*, (2020);** 0.04 mg/l and higher than that recorded by **El-Bady (2019);** 0.011 mg/l and by **Gad *et al.*, (2022);** 0.0183 mg/l, while lower than that recorded by **El-Emam (2020);** 0.12 mg/l and may result from anthropogenic activities such as use of chemical fertilizers, industrial and domestic sewage and pesticides in agriculture land **(EL-Bady and Metwally, 2016).**

Also, the concentration of zinc not detected in raw water that disagrees with that recorded by **El-Bady (2019);** 0.191 mg/l, **El-Emam (2020);** 0.466 mg/l, and **Gad *et al.*, (2022);** 0.0161 mg/l. The discharge of irrigation water directly into the river results in metals accumulation in water bodies **(El-Rayes *et al.*, 2018).**

Lead value in raw water was 0.067 mg/l lower than that recorded by **El-Emam (2020);** 0.401 mg/l and higher than that obtained by **Smysem *et al.*, (2020);** 0.03 mg/l and by **El-Bady (2019);** 0. 020 mg/l. The occurrence of lead may be as a result of fossil fuels burning, waste incineration, traffic, smelting, pesticides, and agricultural application of sewage **(Rahman and Singh 2019).**

While iron and manganese values were 0.058±0.013 and 0.05±0.034 mg/l, respectively, that agreed with **Smysem *et al.*, (2020);** 0.06 mg/l for iron. Iron is common element found in the earth's crust. The presence of dissolved iron and/ or manganese in lakes and reservoirs may be due to stratification, causing anaerobic conditions in the bottom water zone **(Khadse *et al.*, 2015).**

Estimation of Water quality index

Assessment of water quality for treatment plants under study according to drinking and aquatic life purposes was carried out using weighted arithmetic method of water quality index (WQI). Physico-chemical parameters of Nile River water treatment plant located at Damietta branch were analyzed before water treatment and the obtained values were used for calculation of Water Quality Index (WQI) as shown in **(Table 2).** The values of WQI showed that the water is poor quality for drinking and aquatic life as reported by **(El-Bady, 2019)** and **(Elhdad, 2019).**

Metal Pollution index (MI)

The study was extended also to include assess of water pollution by heavy metals (Cu^{+2}, Co^{+2}, Cd^{+2}, Ni^{+2}, Zn^{+2}, Pb^{+2}, Fe^{+2} and Mn^{+2}) via calculation of metal index (MI) and pollution index (PI). The results in **Table 3** indicated that there is moderately effect of metals in the case of water use for agricultural purposes that agreement with **El-Bady (2019)** and **Elhdad (2019),** whereas for drinking and aquatic life, all measured metals except Cu^{+2}, Co^{+2}, and Zn^{+2} were not detected in raw Nile River water. The wastes should be treated before dumped to protect the water quality and maintain environmental health.

Conclusion

Physico-chemical characteristics of water and some heavy metals were analyzed in water samples collected from the Nile River (Damietta Branch) to assess its quality. The obtained results indicate relatively better water quality of the Nile up stream at Daqahliya Governorate. The present study demonstrated that the overall water quality of the Nile River in the study area was ranged from marginal to good according to the Egyptian Drinking Water Quality Standards. The heavy metals concentrations of raw water were permissible limits of WHO standards for drinking water, except for cadmium, nickel, and lead that above the allowable level WHO standards for drinking water. Routine monitoring of water quality in water bodies should be continued to assure safety and quality of these vital resources.

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الملخص العربي

عنوان البحث: تقييم جودة المياه السطحية لنهر النيل بفرع دمياط ، مصر

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تتعلق مشكلة جودة مياه نهر النيل بصحة الجميع في مصر. حيث يخضع للعديد من مصادر التلوث منها البلديات والزراعة والصناعة، ولكن المعلومات المتاحة حول جودة مياه النهر غير كافية. وبالتالي، تركزت الدراسة إلى تقييم جودة مياه نهر النيل بفرع دمياط. وتم جمع عينات المياه من فرع دمياط ، بالاعتماد على التحاليل للخصائص الفيزيائية والكيميائية وبعض المعادن الثقيلة والتي تشمل: درجة الحرارة و الاس الهيدروجيني والعكارة و التوصيلية الكهربائية والمواد الصلبة الذائبة الكلية والقلوية والعسر الكلي و عسر الكالسيوم وعسر الماغنسيوم و الكلوريدات والكبريتات والألومنيوم والأمونيا والنتريت والنترات والحديد والمنجنيز والسيليكا. أوضحت النتائج إلى أن تركيز العكارة كان NTU 7.81 ، بينما درجة الحرارة و الاس الهيدروجيني و التوصيلية الكهربائية والمواد الصلبة الذائبة الكلية كانت ٢٣ درجة مئوية و٨,٠٣ و ٤٠٣,٧٥ ميكروموهس/ سم و ٢٦٦,٢٥ مجم / لتر على التوالي. وكانت تركيز القلوية والعسر الكلي و عسر الكالسيوم وعسر الماغنسيوم ١٤٢ و ١٣١,٥ و ٨٢,٥ و ٤٩ مجم / لتر على التوالي. بينما كانت تركيزات الكلوريدات والكبريتات والألومنيوم ٢٧ و ٣٤,٢٥ و ٠,٠٦٣ مجم / لتر على التوالي. وكانت الأمونيا

والنتريت والنترات ٠,١٣ و ٠,٠٨٣ و ٠,٥٩ مجم / لتر على التوالي. وكذلك الحديد والمنجنيز والسيليكا ٠,٠٥٨ و ٠,٠٥ و ١,٣ مجم / لتر على التوالي. وصنفت نتائج جودة المياه أن مياه نهر النيل ذات نوعية رديئة وغير صالحة للشرب نتيجة لارتفاع الملوثات في نهر النيل. كما أن مؤشر التلوث أظهر أن تركيزات المعادن الثقيلة قد تأثر بشكل معتدل علي المياه باستثناء النحاس والكوبلت والزنك حيث لم يتم الكشف عنها في مياه نهر النيل الخام. ربما، يجب البحث عن طرق مستحدثة لتقليل من تلوث للأنهار.