Sawa Medical Journal

Reprint from

Vol.1 Issue.1 2025

Sawa Medical Journal

Study of Mineral Ratios in Drinking Water Sources in Muthanna Governorate and its Suitability for Human Use

L.M. Rasheed[1], Attallah Bani Hmood[2], Safaa Mustafa Hameed[3]

Department of Criminal Evidence Department, College of Science, Sawa University, Almuthana, Iraq[1].
Department of Medical Physics and Radiotherapy Engineering Technologies, College of Engineering Technology, Sawa University, Almuthana, Iraq[2].
**Department of Optics Technologies, College of Health & Medical Technology, Sawa University, Almuthana, Iraq[3]*

Abstract

The study was conducted to assess the suitability of Al-Rumaytha River water for human use and to evaluate the efficiency of drinking water from Al-Samawah Pump (1) and Al-Samawah Pump (2), located on the river, for providing drinking water. Samples were collected from January to June 2024. The study included measuring pH, electrical conductivity, total dissolved solids, total hardness, calcium, magnesium, chlorides, turbidity, sodium, and potassium. The results showed that the pH was generally alkaline across all months of the study. It was also found that the total hardness of drinking water was approaching the globally permissible maximum limit. The results also indicated that the levels of magnesium, sodium, potassium, and turbidity in drinking water were within the World Health Organization's specifications. As for the electrical conductivity and chlorides, they were high and exceeded the globally permissible limit.

Keywords: Turbidity, chlorides ,potassium ,drinking water

Introduction:

The great importance of water for life cannot be overlooked, as it covers more than 70% of the Earth's surface and constitutes more than 60% of the bodies of plants and animals; hence, it is said that water is the secret of life. Access to potable water in our country is considered a fundamental for health, social, and industrial development. Therefore, raw water sources must be far from waste sources; activities and operations near these sources must be identified; and sound methods for handling different water sources must be adopted. Knowing that a clean appearance and palatable taste are not sufficient indicators of drinking water quality, some physical and chemical tests are conducted to determine the extent of water contamination (1).

God Almighty has blessed us with the Tigris and Euphrates rivers, and, for various reasons that need not be mentioned, the need for and interest in water sources across the country have increased recently. The Al-Rumaitha River (a branch of the Euphrates River) is the primary source of water for the Al-Samawah Governorate, supplying water for various agricultural, industrial, and human uses. The Al-Rumaitha River is subject to pollution from the discharge of organic and inorganic substances from various sources.

These waste materials contain many chemicals and heavy metals, either dissolved or suspended. This affects the physical and chemical changes of this water. These waters also include various types of microorganisms, such as bacteria and parasites, that can cause many harmful diseases in humans. Therefore, it is necessary to identify the activities and operations near these sources and adopt rigorous methods to manage the various water sources. Knowing that a clean appearance and palatable taste are not sufficient indicators of drinking water potability, some physical and chemical tests are conducted to determine the extent of contamination (1).

Studies on industrial wastewater and urban waste discharged into rivers have shown that these discharges can alter water's chemical and physical properties and negatively impact the aquatic environment. (2,3) The Al-Rumaitha River is the primary source of raw water for the water treatment facilities that supply the city of Samawah. These facilities use chemical methods for filtration and disinfection, and pump water through a network of pipes to the city's residential areas. The current study aims to investigate the impact of waste on the physical and chemical changes in drinking water sources, determine the characteristics and specifications of drinking water, and assess the extent of pollution in the Al-Rumaitha River on the efficiency of the water treatment facilities located along it.

We relied on the average value of the analysis and measurement results, and the findings concluded that most cities are located near rivers, especially factories and hospitals. Therefore, it is expected that their various wastes, particularly chemical wastes, which are among the most dangerous forms of pollution affecting human health, are discharged into these rivers.

The physical and chemical properties of water:

A physical property is a characteristic that can be documented or measured without changing the internal composition of the material. Physical properties are used to observe and describe the material. Examples of these properties include solubility, specific heat, surface tension, and others.

As for chemical properties, they are properties that can be observed only when a chemical change alters a substance's internal composition. It is used to describe the behavior of the substance when exposed to certain materials such as air, water, acids, bases, and others [4]. Examples of chemical properties include acidity, hardness, electrical conductivity, and others.

Materials and Methods:

The study included field visits to the Al-Rumaitha River and the drinking water pumping stations covered in the study, as well as assessing the efficiency of these stations. The samples were collected in plastic polyethylene containers with a capacity of 2 liters. After cleaning them with acetone to remove impurities, rinsing them several times with distilled water, and drying them, the samples were sealed to prevent contamination. The samples representing the raw water for the filtration stations were taken at the intake point from the water withdrawal site at different depths ranging between (10-20-30) cm. The average depth was then calculated due to the unavailability of depth and temperature measurement devices. As for the samples representing drinking water, they were collected at the ends of the drinking water pumping stations. The samples were collected in two seasons: the first (January - February - March) and the second (June - July - August) of 2024, due to differences in waste levels between summer and winter.

The materials used in chemical and physical tests A mercury thermometer graduated from (100-0) degrees Celsius to measure temperature. Pocket-sized pH meter for measuring pH levels Flame photometer device for measuring sodium and potassium elements in mg/L units YSI 556 device for measuring dissolved solids in mg/L Turbidity meter 550 device for measuring turbidity levels in units (NTU) (Nephelometric Turbidity Unit) Portable conductivity meter for measuring electrical conductivity in microsiemens/cm units As for total hardness, calcium, and magnesium, they were estimated according to the method described by (4) by titrating 50 ml of the sample with a standard EDTA solution (0.01) and

using the Erich Rom black T indicator, expressed in mg/ml. While the fluorides were measured according to the method outlined by the American Public Health Association for measuring fluorides by titrating a 100 ml sample with a standard silver nitrate solution (0.141 molar) and using potassium chromate solution as an indicator, the results were expressed in mg/L (5). The globally permissible limit for chlorides is 200 mg/liter.

Results and Discussion

pH: The results of Table 1 and Figure 1 showed that the average pH values for all study sites were similar and within the slight alkaline trend for both seasons. This can be attributed to the presence of bicarbonate ions (6). Additionally, continuous mixing of water due to river flow may increase pH values towards alkalinity (7).

Table No. (1) Hydrogen ion concentration ratios at all study sites

Location	pH value in the first season	pH value in the second season
Water withdrawal	8.1	8.2
Pump number 1	7.87	7.8
Pump number 2	8.1	8.1
The average	8.16	8.03

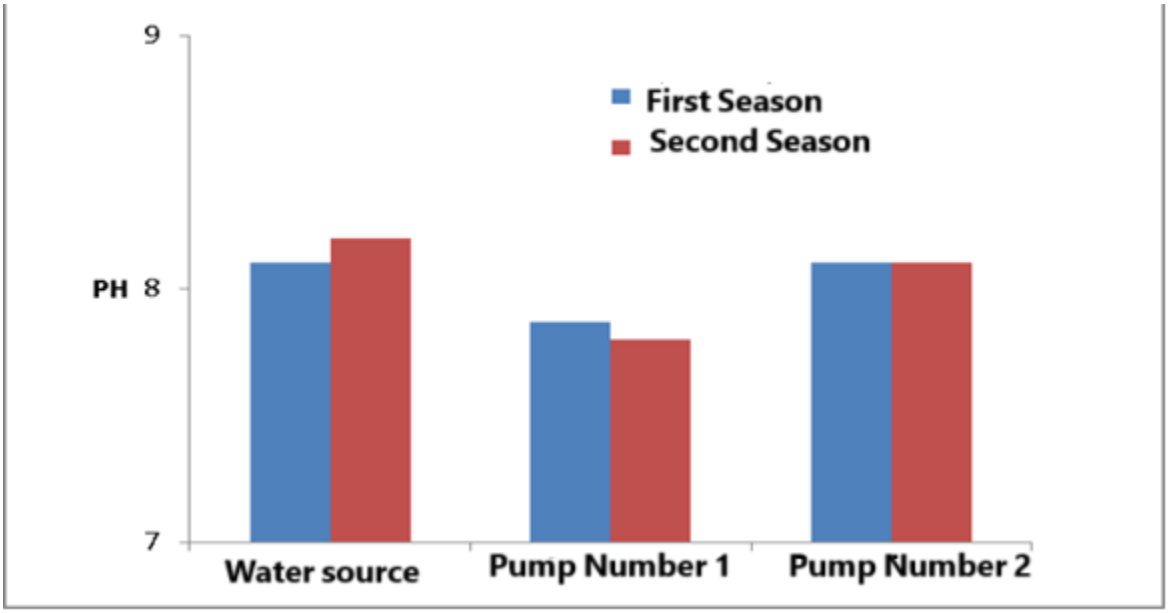

Figure 1: Hydrogen ion concentration at all study sites

Electrical Conductivity (E.C.):

Electrical conductivity is a numerical value that indicates a water's ability to carry an electric current. It depends on the concentration of dissolved ions present in the water and the water temperature. The salinity of the irrigation water, measured as electrical conductivity in deciSiemens per meter, showed significant variation between the two seasons. The average conductivity values in the first season were (4.1 dS/m), while in the second season, they were (3.4 dS/m), as shown in Table 2 and Figure 2. This variation in electrical conductivity values during the first season is attributed to rainfall, which can dissolve the salts present in the soil and wash them into the river water [8,9], With electrical conductivity values (in decisiemens per meter), this increase in electrical conductivity values can be attributed to rainfall, which can dissolve the salts present in the soil and wash them into the river water (4). The results indicated that filtration and purification processes do not reduce conductivity in drinking water samples by lowering ion concentration, consistent with the findings of Alia (13).

Table No. (2) Electrical Conductivity for All Study Sites

Location	The first season	The second season
Drawing water from the river	3.92	3.23
Pump number 1	4.1	3.34
Pump number 2	4.32	3.45
The average	4.1	3.4

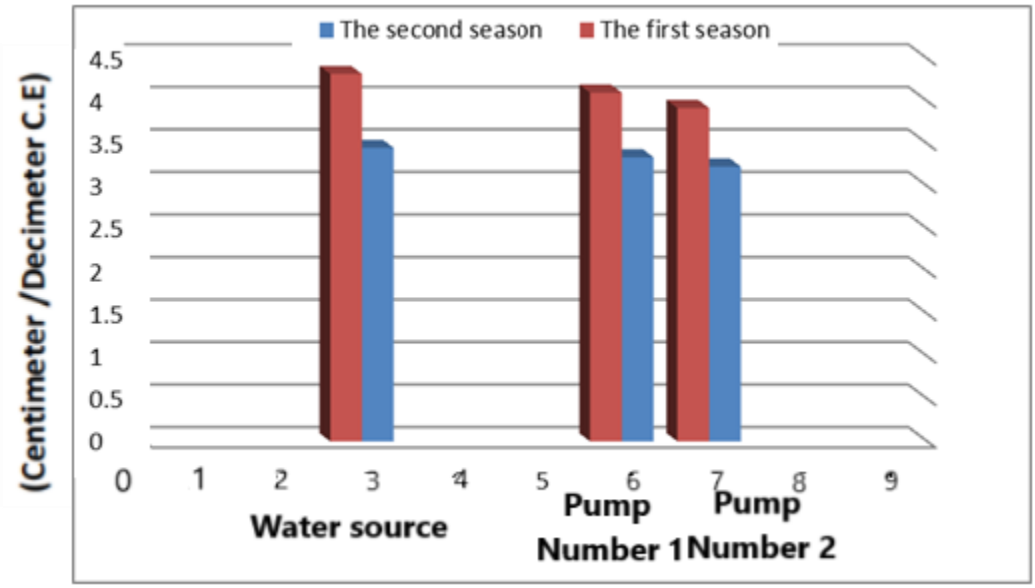

Figure 2: Electrical conductivity for all study sites

Turbidity: Table 3 and Figure 3 show that the average turbidity values during the first season were 6.23 NTU. (NUT) During the first season, it was (6.23 NUT), while during the second season, it was (4.42 NUT). The water withdrawal site on the river is characterized by high turbidity in both seasons, which can be attributed to increased upstream water movement, leading to greater mixing and, consequently, higher turbidity (9,10) in summer. In contrast, lower turbidity values were observed in drinking water, which can be attributed to the appropriate amount of alum added in relation to the turbidity levels, as well as the balance between the production capacity of the filtration stations and the water consumption by citizens, allowing sufficient time for water to settle in the sedimentation basins. It is worth noting that the globally permissible limit is (1-5 NTU).

Table (3) represents the turbidity for all study sites.

Location	The first season	The second season
Drawing water from the river	10.7	7.46
Pump number 1	4.4	3.6
Pump number 2	3.6	2.2
The average	6.23	4.42

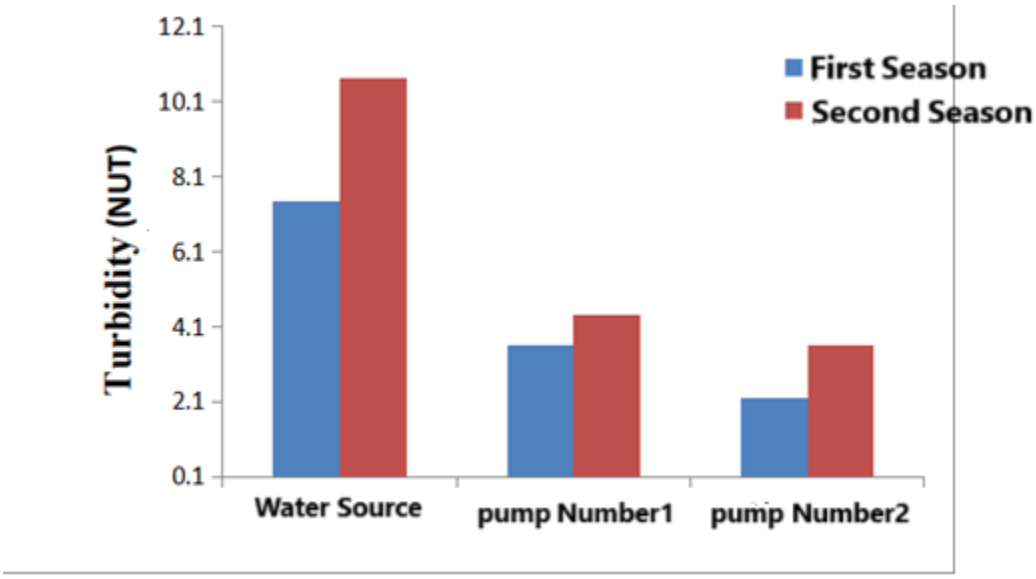

Figure (3) shows the turbidity for all study sites.

Turbidity: It is the scattering and absorption of light, not a measurement of the amount of suspended solids. And the highest permissible value ranges between (1-5) NUT.

As for total hardness, magnesium, sodium, potassium, and calcium, they were within the permissible limits according to the World Health Organization's drinking water standards (11). However, it was observed that the chloride values, which are caused by pollution due to the dissolution of organic and inorganic salts or through the discharge of irrigation water used for agricultural purposes and other industrial waste, exceeded the permissible limit of 200 mg/L. The average values in the two seasons were 267 mg/L, as shown in Tables (4 and 6) and Figures (4 and 6). It is noteworthy that high concentrations of chlorides are related to heart and kidney diseases and blood pressure.

The problem of toxicity:

When adopting the classification (12) [Ayers33}, the studied waters cause toxicity problems under surface irrigation conditions. The danger of toxicity from chloride ions lies in the fact that it is an ion that is not adsorbed by soil colloids because it is a negative ion that remains in the soil solution and is absorbed by plants. Consequently, it can accumulate in various parts of the plant. It has been found that some plants have the ability to tolerate high concentrations of chloride ions in irrigation water under surface irrigation conditions. We find that the water under study, except for tap water, causes a toxicity problem.

Table number (4) first season

Location	Total Hardness	Calcium	Magnesium	Sodium	Potassium
Drawing water from the river	189.6	125	21.4	168	5.4
Pump number 1	176.5	90.3	17.6	154.3	4.7
Pump number 2	146	90.3	17.6	150.3	4.7
The average	170.7	101.8	18.8	157.5	4.9

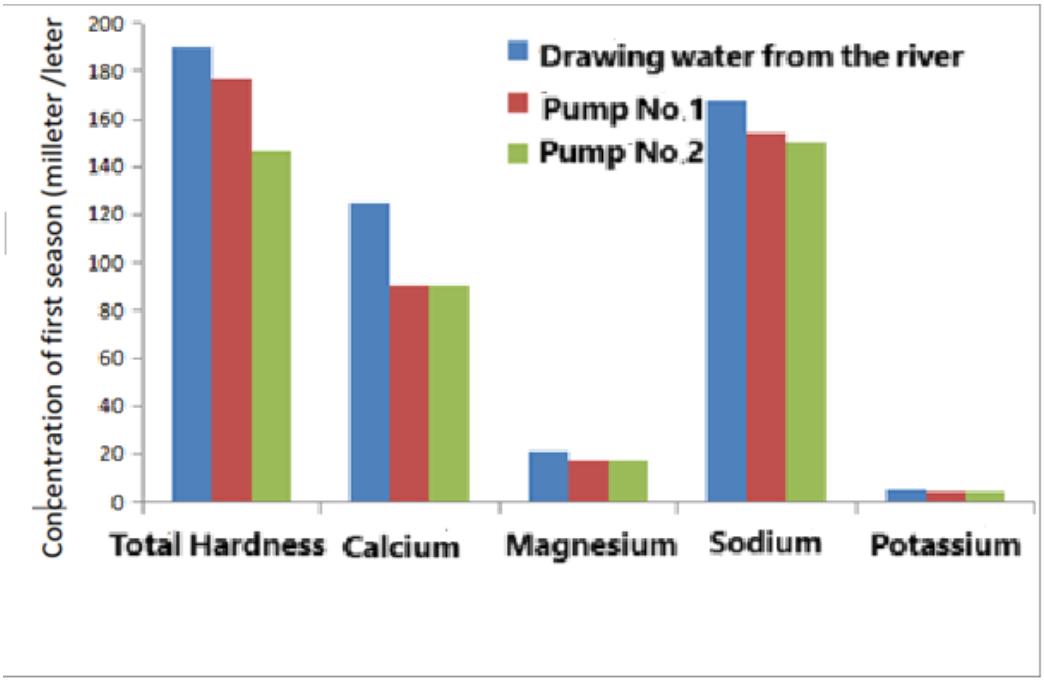

Figure 4: Concentrations of the First Season

Table (5) Focus of Season Two

Location	Total Hardness	Calcium	Magnesium	Sodium	Potassium
Drawing water from the river	368.6	123.3	24.3	253.3	6
Pump number 1	352	114.8	16.4	190.6	5
Pump number 2	325.6	114.8	16.4	192.3	5
The average	348.7	117.6	19	212	5.3

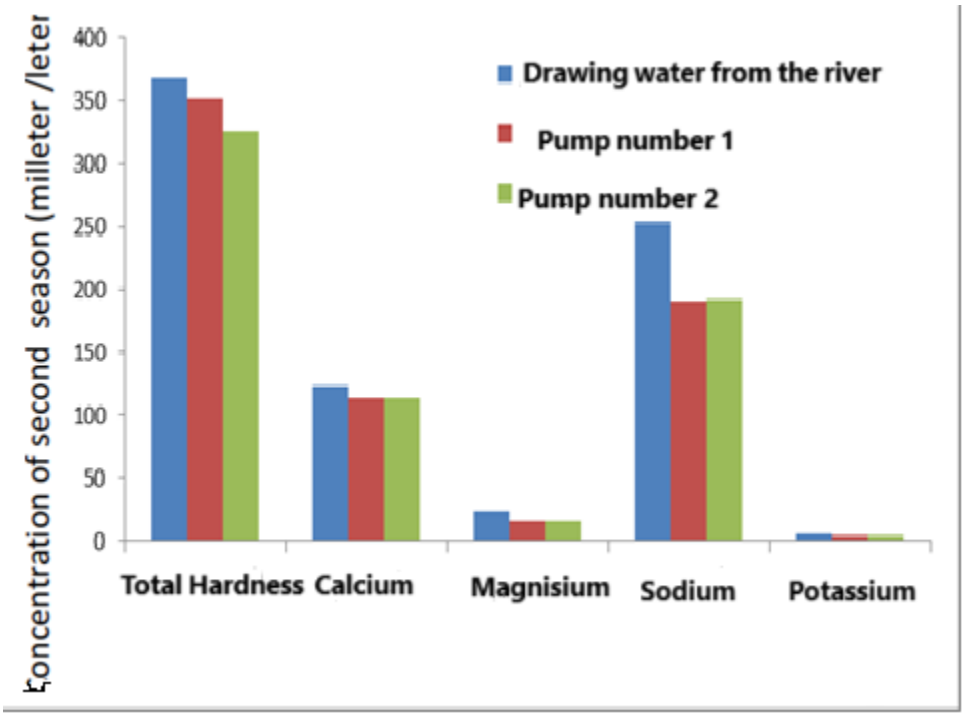

Figure 5: Concentrations of the second season

Table No. (6) Chloride Concentration

Location	The first season	The second season
Drawing water from the river	272	301
Pump number 1	236	260
Pump number 2	256	278
The average	254.6	279.6

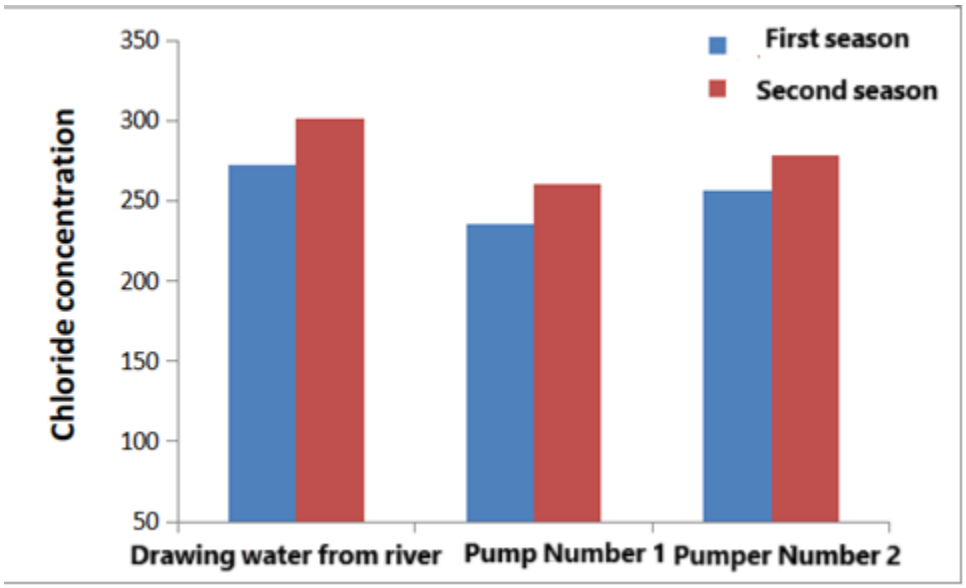

Figure 6 represents the chloride ratios for all the sites included in the study.

Conclusion :

The importance of studying physical and chemical changes helps us in understanding the factors affecting the water environment and in determining the suitability of water for different uses, as well as knowing the different mineral substances so that they are minor with other seasons, in addition to monitoring pollution and identifying its types within the permissible limit for drinking and irrigation. In this study, we found that most substances in the water are within the globally permitted limits, except for chloride levels, which can be practically treated within the recommendations outlined in the research.

Recommendations:

We first recommend raising community awareness of specific terms, such as turbidity, hardness, and certain chemical elements, as exceeding their permissible limits can cause health problems. Secondly, we advise maintaining the cleanliness of the sites from which water is taken periodically to prevent the accumulation of aquatic plants or foreign materials, and to ensure health monitoring of water sources. Thirdly, the chemicals used in disinfecting drinking water should comply with standard specifications.

References:

1- American Public Health Association(1995). Standard methods for the examination of water and waste water 16th ed-New York.
2- Al-Imarah,F.J.M.(1999).Evolution of the effect on industrial effluent from fertilizer factory upon Khor- Al-Zubair environment Iraq, Al-Qadisyia .J.Sci., 4(1):84-90 .
3- Rozov,I.(1993).New guidelines for drinking water quality . Appl . Environ.Microbial. 13(5) :270 .

-4 علكم، فؤاد منحر (2001). دراسة لمنولوجية لمياه نهر الديوانية.العراق،مجلة القادسية ،(2): 68

والكيمياوية -5 الطائي ,ابتهال عقيل عبد المنعم (2009) دراسة تأثير المبزل الشرقي الرئيس في بعض الخصائص الفيزيائية والهائمات النباتية في نهر الفرات عند مدينه السماوة – العراق – رسالة ماجستير , كلية العلوم – جامعة القادسية –

6- Lami,I A.; A, W. Sabri; T. I. Kassim and K, A. Rasheed.1996. " The ecological effect in Diyala River on Tigris Rever . 1. Limnologgy J. Coll. Edue. For Women Univ. Baghdad.7 (1);84-92

7- Iwakuma, T. O.; A. Hartotot; D. I. Imin; S. H. Torang; I. Jaya and N. Tanaka. 2000.preliminary study on liminological features of lakes and rivers in the peat swamp area of central Kalimantan. Rep. Suw. Hydrbiol. 12: 81 -88.

8- الحلو، عبد الزهرة عبد الرسول والعبيدي، عبد الحميد محمد جواد (1997). كيميائية مياه شط العرب من القرنة إلى الفاو. مجلة وادي الرافدين لعلوم البحار. 2 (1): 190 -201.

9- الموسوي، نداء محمد جاسم (1992). دراسة بيئية لمصب شط العرب عند مدينة البصرة. رسالة ماجستير– جامعة البصرة

–10- السويج , عرفات رجب أحمد(1999) . دراسة لمنولوجية مقارنة شط العرب وقناة الخورة. رسالة ماجستير – كلية الزراعة عـاتي، رائـد سامي (2004). .جامعة البصرة

فـي نهـر كرمة علي، Heckel uorax Aspius 1843 , 10- المظفر، رجـاء عبد علي محمد حسين (1999). حيـاتيـة تكـاثـر الشلق محافظة البصرة. رسالة ماجستير – كلية الزراعة – جامعة البصرة.

11- محمد، حمزة جاسم (1999). الصفات الفيزيائية والكيميائية لمياه الشرب في محافظة النجف. مجلة جامعة بابل، العلوم الصرفة والتطبيقية .4(3): 785- 789.

12- Ayers, R.S. and D. W. West cot (1985). Water for agriculture. Irrigation and drainage Paper (29 Rev. I) FAO, Rome Italy