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Seasonal variation of macronutrients concentration in Shatt Al-Arab and Al-Ashar Canal

Adian A. Kahami[1], Asia Fadhile Almansoory[1] Imad J.M. Al-shawi[2]

[1]Department of Ecology, College of Science, University of Basrah,
[2] Department of Applied Marine Science, College of Marine science, University of Basrah, Iraq
E-mail: asia.abdullah@uobasrah.edu.iq

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Abstract:

Seasonal variation of macronutrients (P, K, Ca, Mg, and S) was studied in waters at two locations, the Shatt Al-Arab and Al-Ashar Chanel, using a device called Inductively Coupled Plasma – MASS SPECTROMETRY (ICPMS). The measured concentrations in two stations for different macronutrients this is ranged as follows: P (4,000-0.090) ppm, K (90.040-8.300) ppm, Ca (286.600-135.550) ppm, Mg (331.330-72.170) ppm, S (458.300-218.720) ppm. arrange of macronutrients from higher to lower mean content of this study: S> Mg> Ca> K> P

Keyword: Shatt Al-Arab, macronutrients, Al-Ashar canal, ICPMS

Introduction:

Water is the most important and essential component on Earth for living organisms and vital activities (Sawad,2021), Over the centuries, river has been very important to the human society, River has also provided water for irrigation, industrial and domestic uses, additionally river plays an important role in assimilating municipal and industrial effluents as well as runoffs from agricultural land and the surrounding area in a watershed (Hanafiah *etal*.,2018) Shatt al-Arab River, one of the most important major rivers, consists of the confluence of the Tigris and Euphrates rivers in the city of Qurna, north of Basra, Iraq, then extends for about 200 kilometers until it empties in the northwest of the country in the Arabian Gulf south of the city of Fao (Aldoghachi,2022).

All living organisms are composed of organic and inorganic compounds, which are equally important for their growth and development. Mineral nutrients are generally classified into two major groups according to their concentrations in the organism: trace minerals (less than 50 mg/kg of body weight) and macro minerals (above 50 mg/kg of body weight ((Terech-Majewska et al.,2016).

The term macronutrient refers to elements required in comparatively large quantities, including nitrogen (N), potassium (K), sulfur (S), phosphorus (P), magnesium (Mg), and calcium (Ca) (Amtmann and Blatt 2009). Among these,

Phosphorus is considered one of the main nutrients in aquatic environments, and its concentrations are low in freshwater. Phosphorus originates from natural and human sources, such as rocks, soil, industrial waste, and commercial cleaning products (Sepllman, 2014). Potassium is an important element, and it is one of the elements with low concentrations, despite its strong ability to dissolve in water (Al-Badiri, 2018; APHA,2003), Calcium is an essential element in the aquatic environment and is one of the most abundant cationic metals in the Earth's crust (Al-Ghurabi,2016), Its sources in water are the melting of sedimentary rocks and minerals exposed to chemical weathering processes in the riverbed, which leads to the liberation of calcium metal to the water environment (Maarouf, 2008). Magnesium is considered one of the most important positive elements that enter aquatic environments. The increase in magnesium concentration and its association with sulfate lead to water pollution. Sulfur is one of the most common elements in the environment, as it is present in the atmosphere, water, and living organisms (Jasińska et al.,2012).

The importance of macronutrients

phosphorus (P) is essential macronutrients for the growth of bacteria and phytoplankton in general, Sulphur is known as a major constituent of amino acids, proteins, enzymes, sulfolipids, and a number of other biochemical compounds, the major cations K, Mg and Ca are important as cofactors for many plant enzymes, in addition to Mg being involved in the transport of phosphates, it is also an important component of the chlorophyll molecule (Erga *et al*.,2017).

The aim of the present study was to compare the concentrations of macronutrients between Shatt Al-Arab and Al-Ashar Canal.

Materials and methods:

Site description

There are several sub-canals 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, and Al-Sarraji (Al-Asadi *et al.*, 2019).

Al-Ashar Canal is one of the most important branches of the Shatt Al-Arab, and it is the longest among them. It is characterized by its rectangular shape, with a length of 8 km, width of 37 m, and maximum width of 50 m near the intersection with the river. Its depth ranges from (5-10) m. The canal is located in a densely populated area of Basra. Most of the waste is dumped into it, and the canal suffers from sewage pollution (ALsarker *et al*., 1980). The water of the Shatt al-Arab enters the al-Ashar Canal during the tidal period and returns at low tide, mixed with sewage water and loaded with agricultural waste (Al-Sowaig, 1999).

Three stations were selected for the current study. The first station is located north of the Al-Ashar Canal near the Shatt Al-Arab water purification plant. The second station is located at the meeting point of the Al-Ashar Canal with the Shatt Al-Arab near the city of Al-Ashar Games (Happy Land). The third station is located inside the Al-Ashar Canal, opposite the Old Basra Governorate Council.

Table 1: Latitude and longitude of selected stations in the studied are

Sample ID	Latitude	Longitude
Station 1	N: 30°31.9654’	E: 47°50.2465’
Station 2	N: 30°31.3571’	E: 47°50.4615’
Station 3	N: 30°30.6359’	E: 47°49.7822’

Sample collection and analysis:

Water sampling was conducted in November (autumn) in 2021 and February (winter), April (spring), and July (summer) in 2022. Water samples were collected from three selected stations during the day. EPA method (1994) No. 200.8 was followed in measuring heavy metals were measured using the Agilent 5110 ICP-MS (manufactured in the ICPMS Type ICPMS Type Agilent).

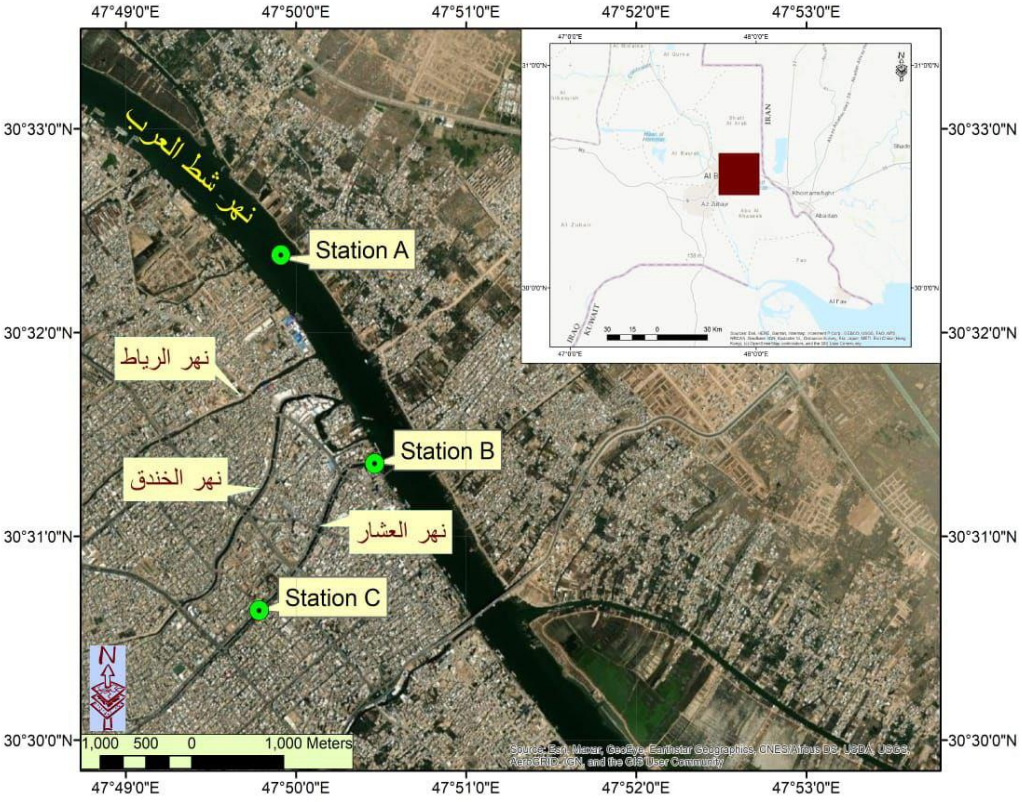

Figure. 1: A map showing the three study stations

Results and discussion

In this study, five Macronutrient (P, K, Ca, Mg, S) were detected in the waters of the Al-Ashar Canal and Shatt Al-Arab in three selected stations during four seasons using device inductively coupled plasma - mass spectrometry (ICPMS)

The highest concentration of phosphorus was (4.000) ppm in the third station during the spring season, while the lowest

concentration was (0.090) ppm in the first station during the winter season (Figure 2). The results of the statistical analysis showed that there were significant differences in phosphorus between the seasons (F = 20.849, P = 0.000), and there were also significant differences between stations (F = 54.018, P = 0.000). The high concentration of phosphorus in the third station may be due to the disposal of household sewage and agricultural fertilizer residues. Its high concentration may also be due to its low consumption by phytoplankton (Rasran, 2001).

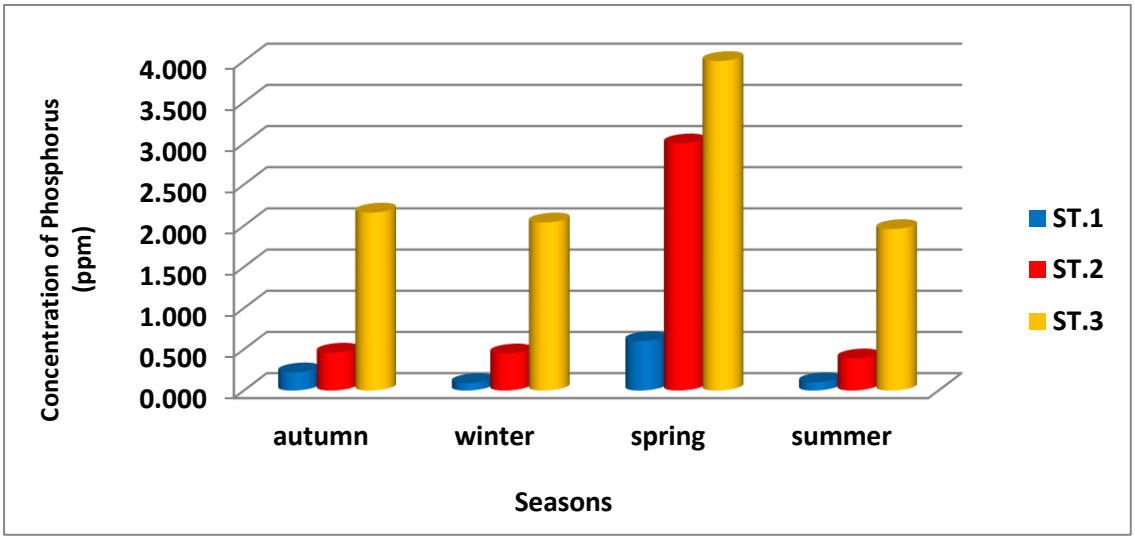

Figure. 2: Seasonal variation in the values of phosphorus in the study stations

The highest value for potassium were (90.040) ppm at the first station during the summer season (Figure 3), and the lowest value were (8.300) ppm at the first station during the spring season. The results of the statistical analysis showed that there are significant differences for the element potassium between the seasons (F = 19.597, P = 0.000), and there are also significant differences between the stations (F = 6.109, P = 0.009), Potassium concentrations were very high during the summer, It may be due to the excretion of sewage water containing a percentage of chemical fertilizers, which increases the concentrations of potassium ions in the water (Al-Aumary, 2015).

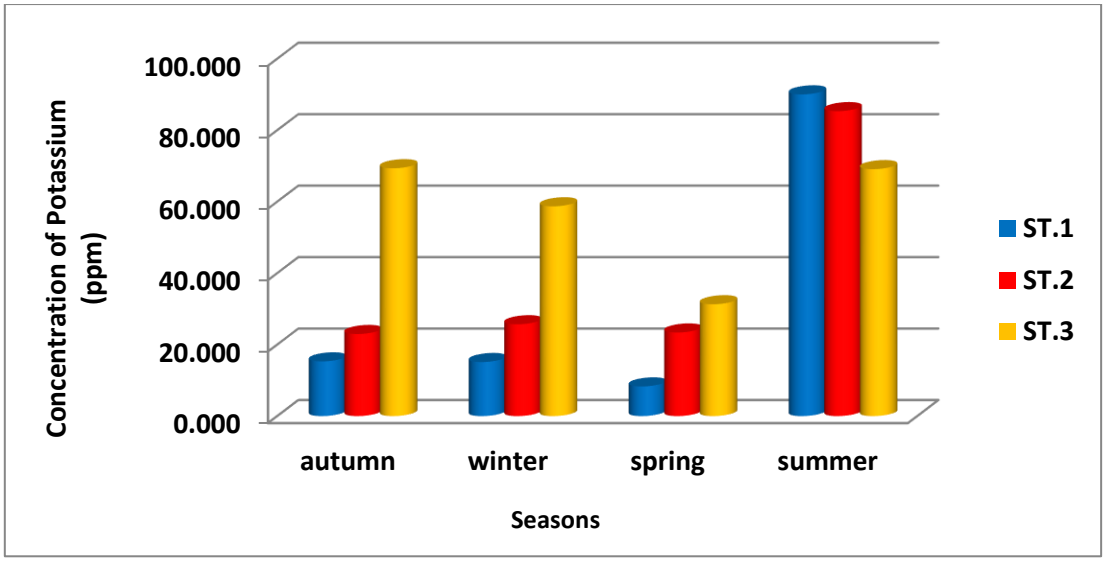

Figure. 3: Seasonal variation in the values of Potassium in the study stations

The highest value of calcium (286.600 ppm) was recorded during the spring season for the third station (Figure 4), while the lowest value (135.550 ppm) was recorded during the winter season for the first station. The results of the statistical analysis showed that there were significant differences in calcium between the seasons (F = 16.150, P = 0.000), and there were also significant differences between stations (F = 46.119, P = 0.000). The high concentration of calcium during the summer season may be due to the high temperatures, which leads to an increase in the dissolution of calcium carbonate as a result of its decomposition by microorganisms, and it may also be the reason for its rise to wastewater laden with calcium-containing fertilizers (Al-Aumary, 2015).

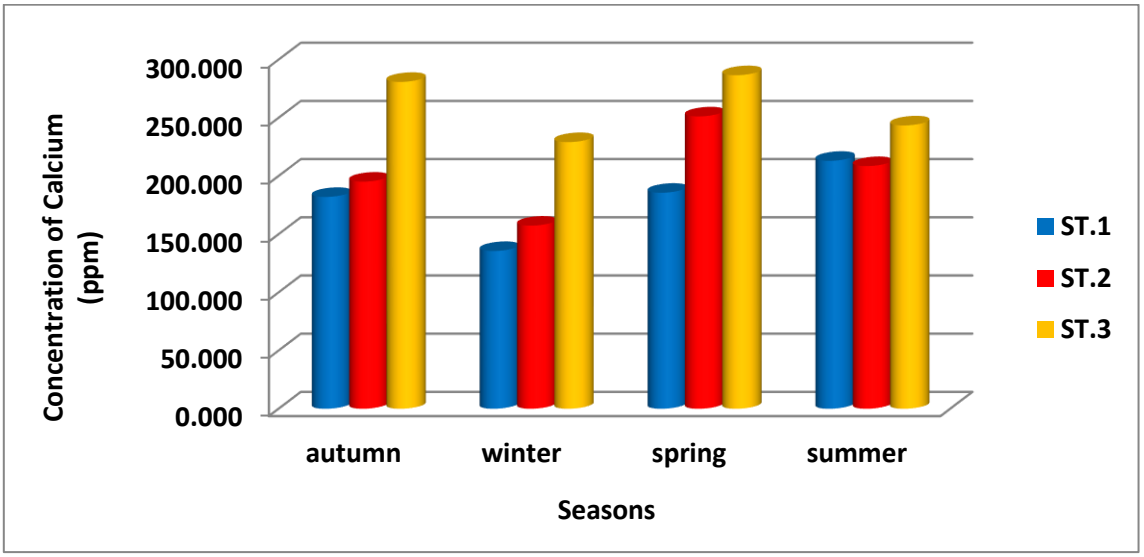

Figure. 4: Seasonal variation in the values of Calcium in the study stations

The magnesium concentrations in the study stations ranged from a lowest value (72.170) ppm during autumn at the first station, while the highest value was (331.330) ppm in the first station during summer (Figure 5). The results of the

statistical analysis showed that there are significant differences in magnesium between the seasons (F = 29.368, P = 0.000). The increase in magnesium during the summer may be due to the high temperatures that lead to an increase in the concentration of dissolved salts in the water (Hassan *et al*., 2014), or attributed to the decomposition of chlorophyll in algae and aquatic plants, which leads to the addition of magnesium to the water (Alkam et al., 2013).

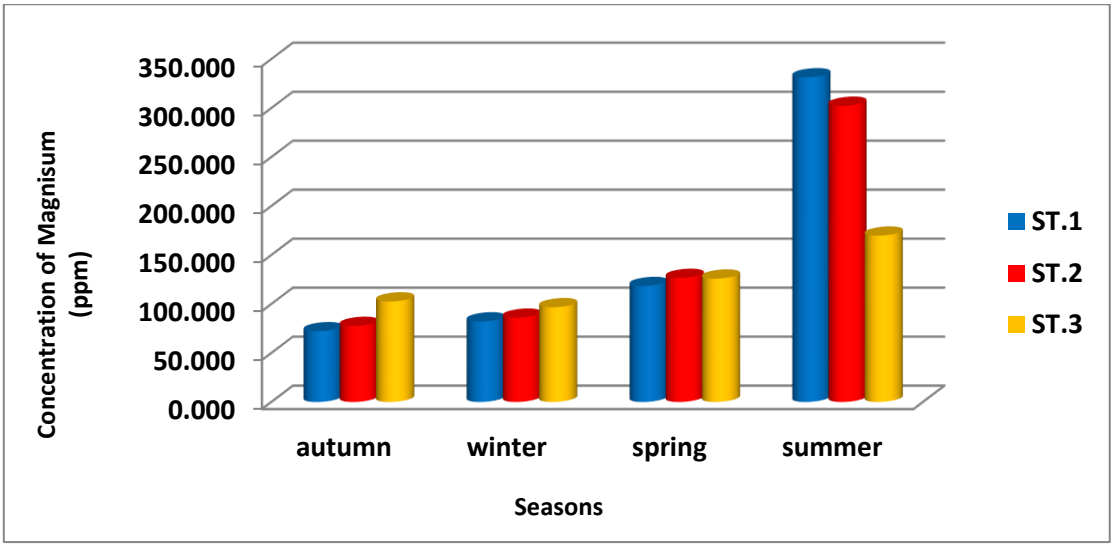

Figure. 5: Seasonal variation in the values of Magnesium in the study stations

The highest value of sulfur (458. 300) ppm was recorded during spring for the third and lowest value (218.720) ppm was recorded during spring and winter at the third and first stations, respectively (Table 6). The results of the statistical analysis showed that there were significant differences in the sulphur element between the seasons (F = 8.013, P = 0.001) and between the stations (F = 7.239, P = 0.005). Perhaps the reason for the high sulphur content is due to the high salinity or due to the oxidation of sulphur dioxide resulting from the combustion of coal to sulfuric acid, which is the main source of sulphur emission into the atmosphere and thus reaches the water (Al-Jumaili and Ahmed, 2018; Wetzel, 2001).

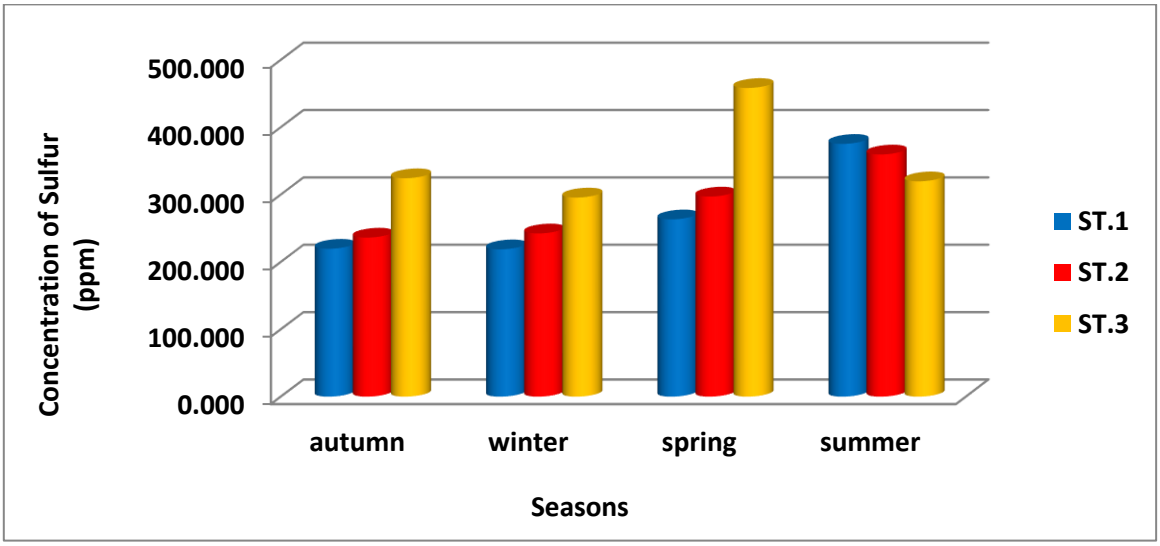

Figure. 6: Seasonal variation in the values of Sulphur in the study stations

The macronutrients in the present study were compared with the WHO guidelines 2007, USEPA 1986, and Iraq guidelines 2009, and the results are shown in Table (2).

Table.2: Comparison of macronutrient values in water in the present study with Iraqi and international determinants.

Macronutrients	**WHO guideline 2007, and USEPA 1986*,2009****	**Iraq guideline 2009**	**The present study**
Phosphorus (P)	0.1*	—	4.000
Potassium (K)	12	12	90.040
Calcium (Ca)	75	150	286.600
Magnesium (Mg)	125	100	331.330
Sulphur (S)	250**	—	458.300

Conclusion:

Five macronutrients were studied in the waters of the Shatt Al-Arab and Al-Ashar Canal, including (P, K, Ca, Mg, and S). These macronutrients were arranged from the highest to the lowest average content in this study as follows: S> Mg> Ca> K> P. These nutrients recorded an increase in the Al-Ashar Canal compared to the Shatt Al-Arab, except for (K and Mg) which increased in the Shatt Al-Arab. This may be due to the influence of the Shatt al-Arab on the salt front coming from the Arabian Gulf, which results in a significant increase in the concentration of salts (Moyel,2010). The concentrations of these macronutrients were compared with the Iraqi and international determinants, and it was found that their values exceeded the permissible limits for Iraqi and international waters.

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التباين الموسمي لتركيز المغذيات في شط العرب وقناة العشار

أديان علي. كحامي ، آسيا فاضل المنصوري 1 عماد جاسم الشاوي 2

قسم البيئة ، كلية العلوم ، جامعة البصرة ، 1

ـ قسم العلوم البحرية التطبيقية ، كلية علوم البحار ، جامعة البصرة ، العراق2

الملخص:

تمت دراسة التباين الموسمي للمغذيات الكبيرة P) ، K، Ca، Mg، (Sفي المياه في موقعين أولاً في شط العرب و-Al 10 Chanel، باستخدام جهاز البلازما المقترنة بالحث .MASS SPECTROMETRY (ICPMS) - تراوحت التركيزات المقاسة في محطتين للمغذيات الكبيرة المختلفة على النحو التالي (4000-0.090) P :جزء في المليون ، K (90.040-8.300)جزء في المليون ، (286.600-135.550) Caجزء في المليون ، (331.330-72.170) Mgجزء في المليون ، (458.300) -218.720) Sجزء في المليون. ترتيب المغذيات الكبيرة من محتوى متوسط أعلى إلى منخفض لهذه الدراسةP <K> Ca> Mg> S :