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WATER QUALITY ASSESSMENT FOR AL-HAMMAR MARSHES, SOUTH IRAQ USING GIS AND REMOTE SENSING TECHNIQUES

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ABSTRACT

Water quality surveys were prepared and performed during 2017 for ten locations in Al-Hammar marshes, south of Iraq. The selected sampling locations covered the pollutants in the marshes. The physical and chemical characteristics of water such as temperature, pH, Turbidity (TB), total dissolved solid (TDS) and Electrical conductivity (EC) were studied, also the seasonal variation of all the parameters was covered during this paper, and the obtained had result some fluctuation in some of them during different seasons for different locations of the marshes. We used an interpolation technique of IDW (Inverse distance weighting) for generating thematic map of each parameter on Al-Hammar marshland area using Geographic Information System.

KEYWORD: Iraqi marches**,** water quality, remote sensing, IDW interpolation.

INTRODUCTION

One of the basic natural resources for human life is water, and is an important resource in developing the economy and society in terms of agriculture, industry and other sectors[1]. Water is one of the most indispensable resources hence life is not possible on this planet without water. Water quality indices are considered to determine conditions of water quality and, that require knowledge about principles and basic concepts of water and related issues[2]. For example, water quality in an aquatic ecosystem depends on many physical, chemical and biological factors[3]. Generally, the Iraqi freshwater environment is the southern marshy habitats there are various types of pollution that related to pesticides, hydrocarbons or heavy metal toxicants. A higher chemical pollution in the marshes and rivers was previously reported. It is noted an increase in the pollution levels in recent years [4]. Due to a rapid industrialization consequent contamination of surface water and groundwater so that, studies of contamination and its control, is actually an important due to its impact on human health. Water take the form of lakes, groundwater, glaciers, rain water, rivers, *etc*. Which are consumed such as drinking, industrial activities, livestock production agriculture, hydro-power generation, fisheries, and other effective activities. To begin studies the significant parts of the Mesopotamian Plain[5], one can focuses on an area about 15000-20000 km^2 [6]. The marshes influences, and also are influenced by many natural forces and human activities. They are important as incubators for fish and invertebrates, and have a vital role as habitat for majority of waterfowl. In addition, they are an impact factor in the life for Shatt-Al-Arab Estuary, the Gulf, and the surrounding land ecosystems. On this reason, It is, very important to remain marshes and protect and that lead to enhance their health wherever possible[7].

DATA AND METHODS

Study area

The Al Hammar Marshes are located almost entirely south of the Euphrates, stanties from near Al Nasiriyah in the west to the outskirts of Al Basrah on the Shatt-al- Arab in the east. To the south, along their broad mud shoreline, the Al Hammar Marshes are limited by a sand dune belt of the Southern Desert. The marsh area is ranged from 2,800 km^2 of contiguous permanent marsh and lake, extending to a total area of over 4,500 km^2 during periods of seasonal and temporary inundation. Al Hammar Lake covers approximately 120 km long and 25 km at its widest point. Slightly salty due to its proximity to the Gulf, the lake is eutrophic and shallow. At low water levels, maximum depth is 1.8m and about three meters at high water mark. During the summer, large parts of the littoral zone dry out, and banks and islands emerge in many places. Fed primarily by the Euphrates River, which shapes the northern bondary of these marshes, these waters conduct Qarmat Ali into the Shatt-al-Arab. A big amount of water from the Tigris River, excesses from the Central Marshes, also feed the Al Hammar Marshes. Groundwater recharge is another likely source of replenishment. The Al Hammar marsh complex prides one of the most important waterfowl areas in the Middle East, both in terms of bird numbers and species variety. The Lange and dense rush beds provide ideal home for breeding populations, while the ecotonal mudflats support shorebirds. Globally significant concentrations of migratory waterfowl have been registered during winter, and although not properly surveyed, the area is likely to host similarly high numbers during the spring and autumn seasons [8]. The figure below shows the studied area.

TABLE 1: Shows the location of selected points AL_Hammar Marshes

X_coordinate	Y_coordinate
650349	3417505
691726	3420844
678659	3420338
659794	3411700
665800	3413954
640774	3427433
637228	3411997
656581	3420686
653435	3409801
653035	3409755

(Unite: meter in WGS_1984_UTM_Zone_38N)

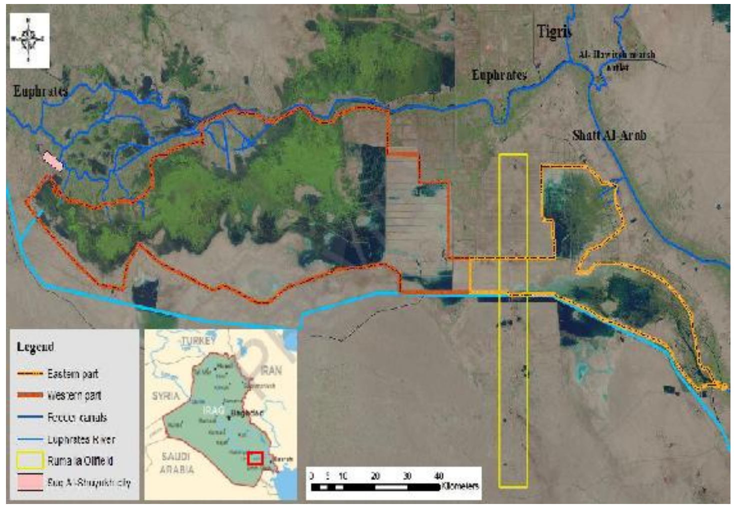


FIGURE 1: Map of southern Iraq, AL-Hammar marshes [9]

Definition of data

- pH: Is the negative common logarithm of the hydrogen ion activity:

pH = -log (H+)

In dilute solutions, the hydrogen ion activity represents by the hydrogen ion concentration. The pH of water is given by measuring the acid–base equilibrium and, in most natural waters, is dominance by the carbon dioxide–bicarbonate–carbonate equilibrium system. The increasing of carbon dioxide concentration will therefore lower pH, while a decreasing will cause it to rise. Temperature will also influence the equilibrium and the pH. In pure water, a decrease in pH of about 0.45 happens as the temperature is increased by 25°C. In water with a buffering capacity brought by bicarbonate, carbonate, and hydroxyl ions, this temperature effect is changed. The pH of most raw water is ranged by 6.5–8.5 [10].

- TB: Turbidity is a scale of the scattering of light by suspended particles in water. Turbidity is considered a way to measure water clarity. It is represented in terms of nephelometric units (NTU's), Turbidity is important as an index of suspended sediment and its effects on sedimentation over time and distance. The effect of elevated turbidity on the river ecosystem takes a number of ways, including higher water temperatures, reducing available oxygen. Suspended materials can close fish gills and supply a place for harmful microorganisms to breed and carry attached pollutants. Particle settling can affect in a bad way on the amount and type of habitat available for aquatic macro invertebrates[11].
- TDS: Total Dissolved Solid is a scale of inorganic salts, organic matter and other dissolved materials in water, Total dissolved solids cause poisoning through increases in salinity, changes in the ionic composition of the water and toxicity of individual ions. Increases in salinity make cause shifts in biotic communities, limit biodiversity, exclude less-tolerant species and make acute or chronic impact at specific life stages is generally measured in (mg/L) [12].
- EC: Electrical conductivity represent the ability of current conduction and in water case it is an estimator of the total dissolved salts or ions amount in water, water conductivity may be fixed by different factors like watershed geology, the watershed's size in relation to lake size, wastewater from point sources, runoff from non-point sources, atmospheric inputs, evaporation rates, some types of bacterial metabolism etc. Is generally measured in (μs/cm) [13].

Inverse Distance Weighted (IDW):

Inverse Distance Weighted represents as an exact local deterministic interpolation technique. IDW proposes that the value at an unsampled location equals a distance-weighted average of values at sampled points within a selected neighborhood surrounding the unsampled point [14]. In other words, IDW suggests that nearest points to the portended sites will have more impact on the portended value than points sited farther away: [15]. IDW utilizes

$$z(s_\circ) = \sum_{i=1}^{N} \lambda_i \, . \, z(s_i) \; - - - - - - - - 1$$

Where :($_o$) represents the portended value at the unsampled site s_0.

N represents the measured sample point's number within the neighborhood determined for s_0.

λ_i represent the combianted distance-dependent weights with each sample point.

(s_i) represents the observed value at site s_i.

The obtained results by weights are using:

$$\lambda_i = \frac{d_{io}^{-p}}{\sum_{i=1}^{N} d_{io}^{-p}} \; - - - - - - - - - - 2$$

$$\sum_{i=1}^{N} \lambda_i = 1 \; - - - - - - - - - - 3$$

Where:

di_0 represents the portended site s_0 and the measured site location s_i distance.

P represents the power parameter that measures the rate of weights reduction as distance increases.

IDW is controlled to be an accurate interpolator to avoid the division by zero that happens when $di_0 = 0$ at the sampled points [14, 15].

RESULTS & DISCUSSION

The Landsat 8 satellite images [16] were utilized for AL_Hammar Marshes and 10 sites were specified using GIS (Geographic Information System). AL_Hammar marshes in the governorate of Dhi Qar have been specified ten areas for studies, including nutrients, and rivers within the marshes.

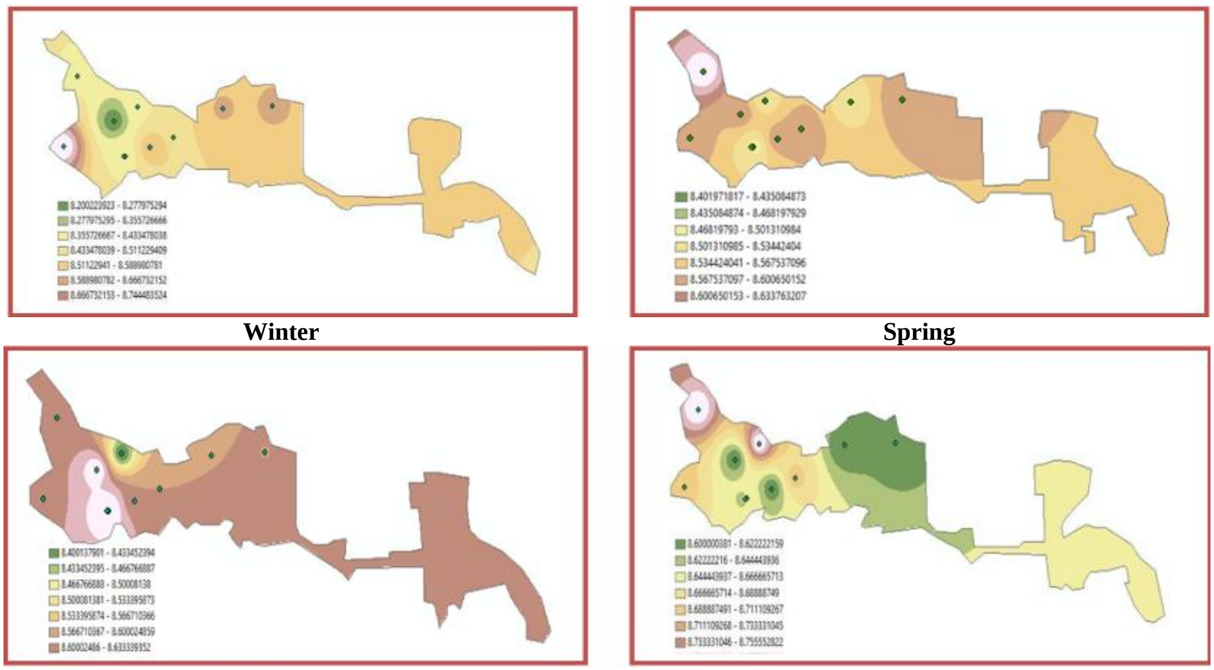
The spatial pattern of various water quality parameters are shown below ;

P^H

From results, it is noted that the pH values of the water samples ranged from 8.2 to 8.9 in the winter and ingested the highest values at a point 7, but its lowest values at a point 1. PH values in spring and summer ranged from 8.4 to 8.7, in the autumn season ranged from 8.6 to 8.8.This increasing Due to the increased concentration of carbonates in the marshes water.

Figure-2 illustrates the spatial distribution of pH in AL_Hammar Marshes. The statistical summary of water pH clarifies the data are fairly symmetrical presented in Tables (2, 3, 4 and 5) & Figure (6, 7).

IDW interpolation of parameter pH in the four seasons :



Winter **Spring**

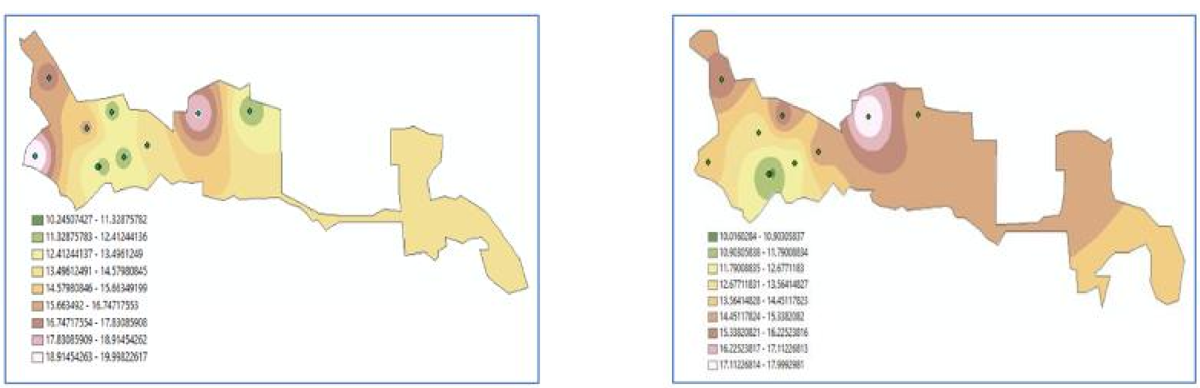
Summer **Autumn**

FIGURE 2: The spatial distribution of pH in seasons (winter, spring, summer and autumn) for Al_Hammar marshes

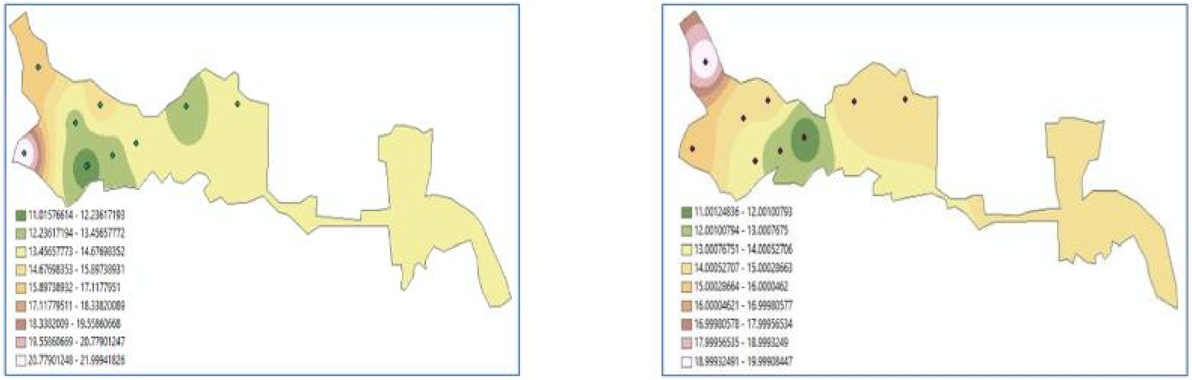
Turbidity

The obtained results of turbidity in marsh water ranged from 10 to 22 during the seasons (winter, spring and summer). Spatial distribution of turbidity values in AL_Hammar Marshes is shown in Figure 3. Maps shows that turbidity values are more in summer and they decrease in spring. Results of water turbidity in marshes are clarified in Tables (2, 3, 4 and 5) and figure (6, 7).

IDW interpolation of parameter TB in the three seasons :



Winter **Spring**



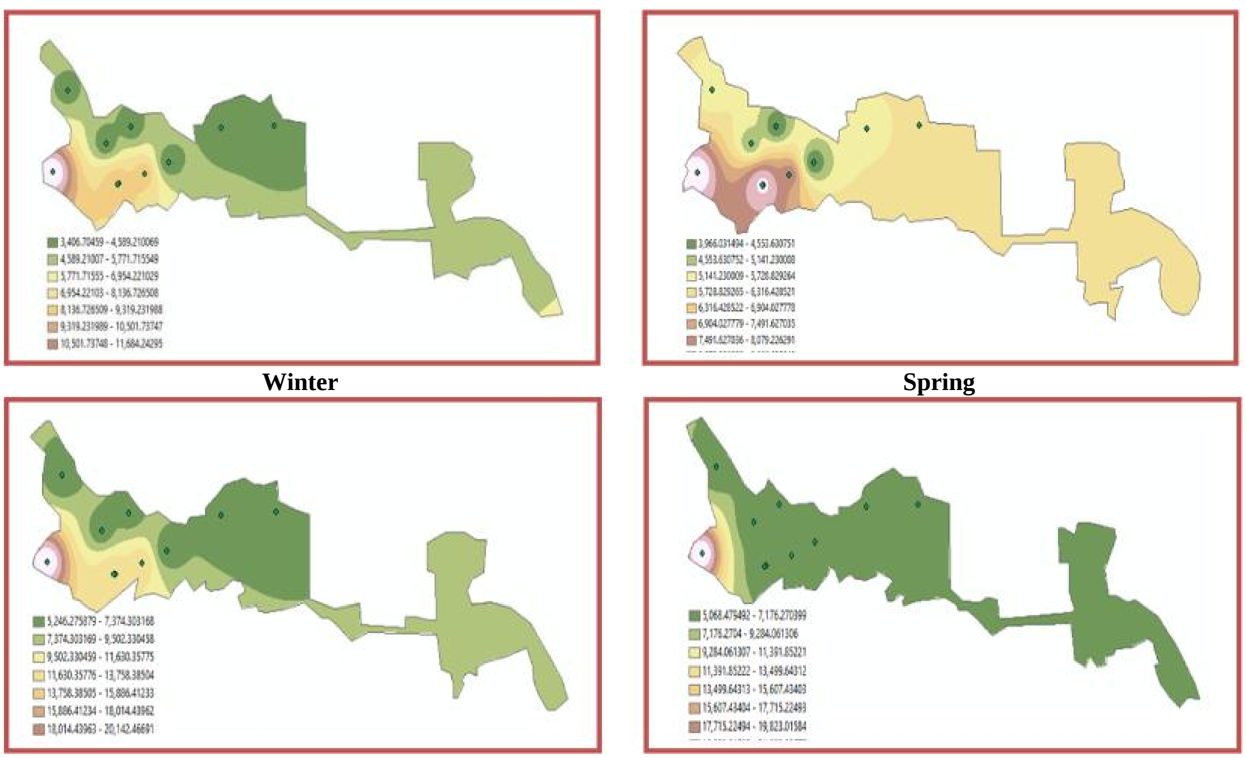
Summer Autumn

FIGURE 3: The spatial distribution of TB in seasons (winter, spring , summer and autumn) for Al_Hammar marshes

Total Dissolved Solid

In our study of the water soluble salts stunted from 3965 to 24400, very salty water and recorded the highest recorded values were during summer and autumn and the decreased gradually in winter after then in spring. Figure 4 shows the spatial distribution of TDS in marshes. This increasing in the saltant due to the nature of soil quality that directly affect the quality of the water where the water salts melt and finally leading to raise total salts concentration values and that was reflected on the electrical conductivity values for the same location and same season. Data of TDS water in AL_Hammar Marshes is given in Tables (2, 3, 4 and 5) & Figure (6, 7).

IDW interpolation of parameter TDs in the four seasons :



Winter Spring

Summer Autumn

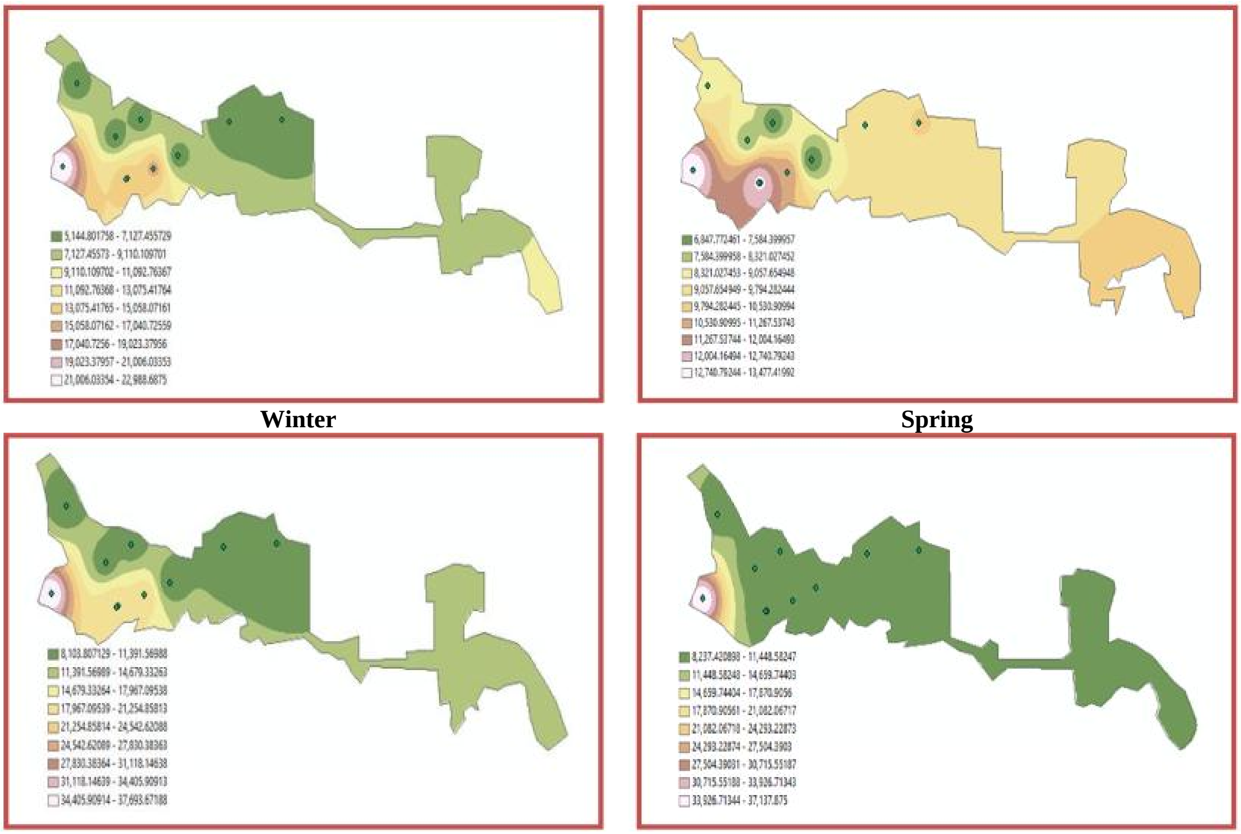
FIGURE 4: The spatial distribution of TDs in seasons (winter, spring, summer and autumn) for Al_Hammar marshes

Eelectrical Conductivity

From our results the electrical conductivity ranged between 5140 and 37700 during the 2017. The values showed that the highest value is in summer and autumn and the value decreases gradually in winter after then in spring. Statistical results of EC water in AL_Hammar Marshes are seen in Tables (2, 3, 4 and 5) and figure (6, 7). Figure5 illustrates the spatial distribution of EC in marshes.

The figure below shows the measurement of parameters for four seasons of the Marshes.

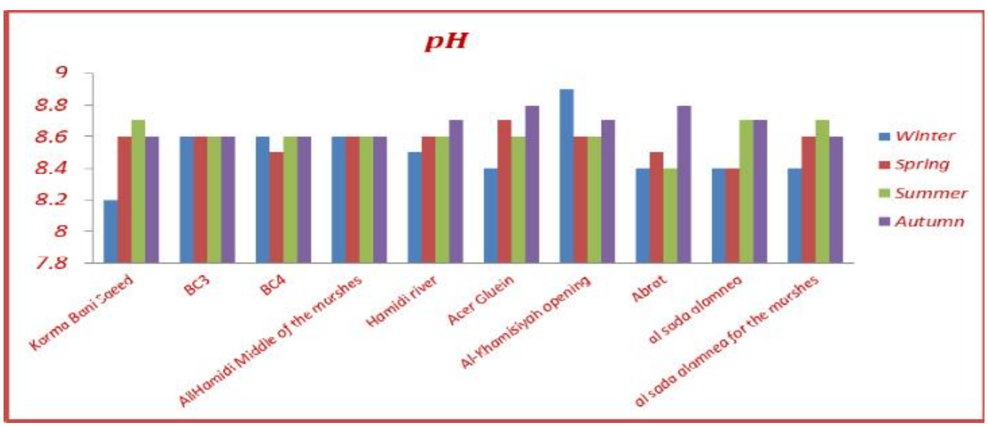
IDW interpolation of parameter EC in the four seasons :

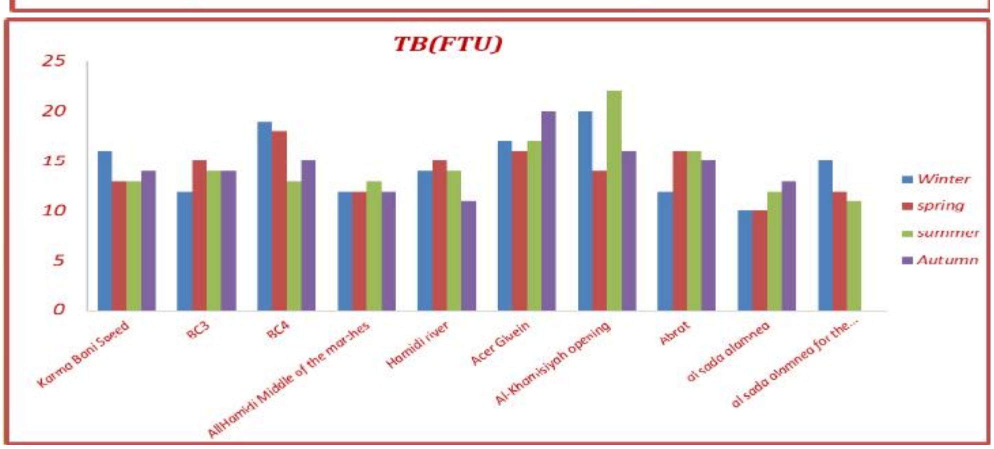


Winter **Spring**

Summer **Autumn**

FIGURE 5: The spatial distribution of EC in seasons (winter, spring, summer and autumn) for Al_Hammar marshes





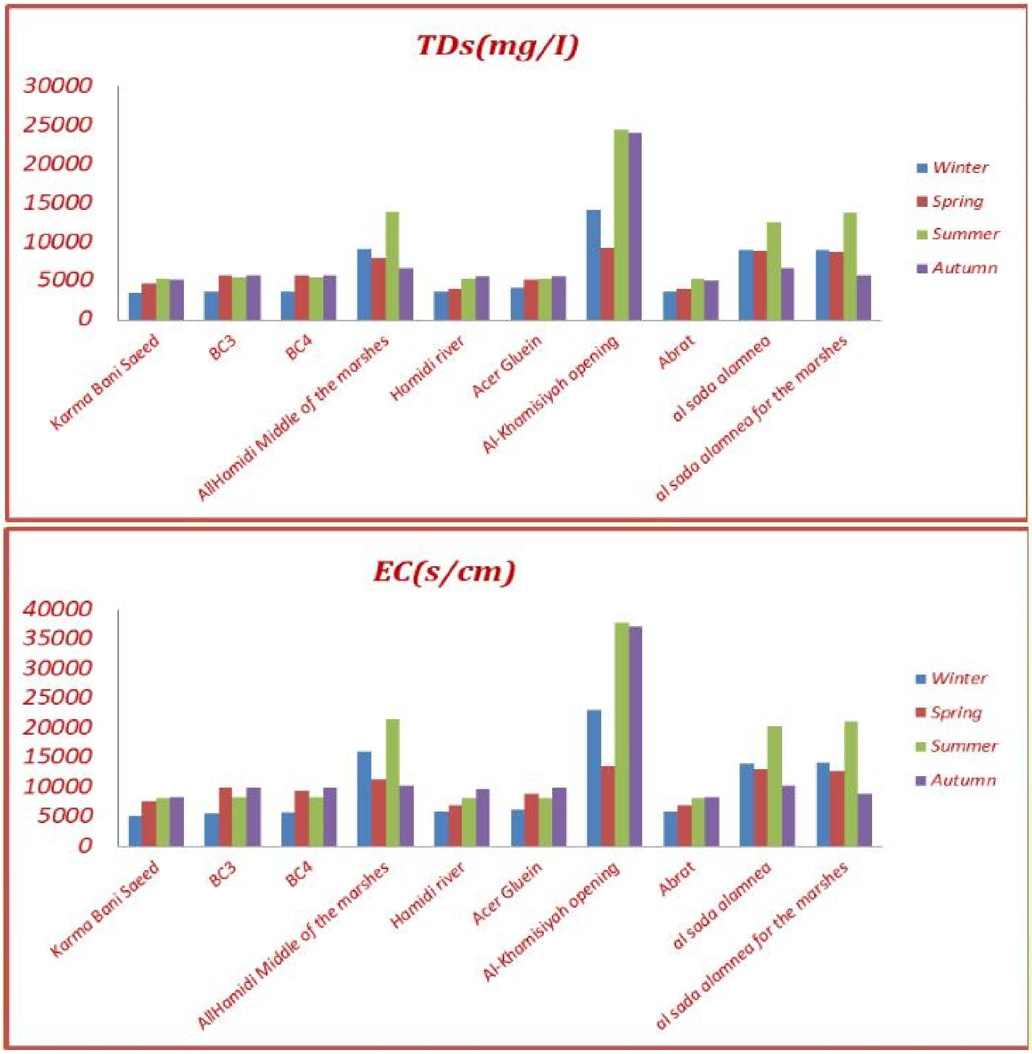


FIGURE 6: Results of water parameters (TDs and EC) in the all season

Tables below show the minimum, maximum, scale and means with the standard deviation of the parameters during the seasons (spring, winter, summer and autumn) in 2017 for the AL_Hammar marshes.

TABLE 2: The minimum, maximum, scale and means with the standard deviation of parameters (pH, TB, TDs and EC) for ALHammar marshes during winter

Parameters	Minimum	Maximum	Range	Means	Std. Deviation
pH	8.2	8.9	0.7	8.5	0.0596
TB(FTU)	10	20	10	14.7	3.3015
TDs(mg/l)	3405	14050	10645	6283	3724.298
EC(s/cm)	5140	22989	17849	10101	6223.801

TABLE 3: The minimum, maximum, scale and means with the standard deviation of parameters (pH, TB, TDs and EC) for ALHammar marshes during spring

Parameters	Minimum	Maximum	Range	Means	Std. Deviation
pH	8.4	8.7	0.3	8.57	0.0823
TB(FTU)	10	18	8	14.1	2.3781
TDs(mg/l)	3965	9255	5290	6385.6	2096.784
EC(s/cm)	6845	13478	6633	9981	2543.648

TABLE 4: The minimum, maximum, scale and means with the standard deviation of parameters (pH, TB, TDs and EC) for ALHammar marshes during summer

Parameters	Minimum	Maximum	Range	Means	Std. Deviation
pH	8.4	8.7	0.3	8.61	0.0876
TB(FTU)	11	22	11	14.5	3.171
TDs(mg/l)	5245	24400	19155	6933.8	6431.766
EC(s/cm)	8099	37700	29601	14943.2	10013.755

TABLE 5: The minimum, maximum, scale and means with the standard deviation of parameters (pH, TB, TDs and EC) for ALHammar marshes during autumn

Parameters	Minimum	Maximum	Range	Means	Std. Deviation
pH	8.6	8.8	0.2	8.67	0.0823
TB(FTU)	11	20	9	14.44	2.603
TDs(mg/l)	5068	24040	18972	7549.4	5818.667
EC(s/cm)	8237	37140	28903	12209.5	8790.891

CONCLUSION

The results showed that:

1. PH is essential parameter in this study, so during this study the pH values for all selected sites were higher in winter than in the rest season in 2017. The existence of huge plants leads to consumption of CO_2 gas during winter which in turn leads to increase the PH.
2. Turbidity refers to water clarity. The greater amount of suspended solids in the water, leads to the murkier appearance, consequently the turbidity values will be higher. Turbidity values ranged from a minimum of 10 to a maximum of 22 with a higher value in summer than in the rest season as shown in tables (2, 3, 4 and 5) and figure 3.
3. TDS in water is another important parameter in this paper. The salinity of the water in this area is affected by two main factors, first, the quantity of water interring the area in which salinity records were lower during spring 2017, while higher values were recorded during low water level time, summer and autumn. Second, high temperature during summer and autumn lead to high evaporation in addition to the semi arid nature of the area with very low rain, salinity will increase during season in this year. Also the high values may be due to high current in these stations causing the release of chemical elements and clay particular into the water.
4. The value of Electrical Conductivity (EC) ranged from 5140 and 37700 in Hor Al-Hammar, higher EC were observed during summer and autumn than in winter and spring (Tables 2-5). Low values of conductivity could be attributed to the dilution of salts due to rainfalls. It could be concluded that the value of conductivity is within the productive range and the marshes of southern Iraq could be considered as a productive water body.

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