WATER QUALITY OF AL-HAMMAR MARSH SOUTH IRAQ

Tariq J.Kadhem Al-Mosewi
Department of Environmental Engineering/College of Engineering/Baghdad University-Iraq

ABSTRACT

Water quality plays an important role in the restoration of marshes south Iraq, hence, in this paper water samples were taken from different sites in Hammar marsh in south of Iraq to know the variation of some water parameters with the distance along Hammar marsh. The water samples will submit to chemical and physical analyses.

Ten water samples were analysis to discuss the results of these parameters and give reasons for changing these parameters with the location along the Hammar marsh. It was found that the concentrations of Biochemical Oxygen Demand (BOD) and Dissolved Oxygen (DO) with the acceptable range for drinking and agriculture uses, DO concentrations did not decreased less than 6 mg/l.

The analyses showed that high concentrations of The Total Dissolved Solids (TDS) and Electrical Conductivity (EC) at the beginning and end of the marsh, the analyses showed a decrease in these parameters at the middle of the marsh.

The analyses showed low concentrations of Total Suspended Solids (TSS) along the Al-Hammar marsh, the concentration of TSS strongly depends on the velocity of water in marsh which is considered low at the study region. As well as the analyses showed that the Mg concentration increased above 125 mg/l level, this level may cause diarrhea.

It was also found that the concentrations of sulphates exceed allowable limits of WHO standards for drinking water (400 mg/l), these concentrations of SO_4 came from severally burned of organic matter in soils after drainage period.

الخلاصة

تعد نوعية المياه في الاهوار ذات اهمية كبيرة في عمليات انعاش الاهوار التي تجرى في الوقت الحاضر، في هذا البحث تم اخذ عدة عينات لمياه هور الحمّار في جنوب العراق لمعرفة تغيرات بعض خصائص المياه في الهور حيث تم تحليل هذه العينات كيمياوياً وفيزياوياً .

تم اخذ عشرة عينات لمناقشتها واعطاء تفسير لتغير مواصفات المياه حسب مواقع العينات داخل الهور. وجد ان قيم تراكيز المتطلب الكيمياحيوي والاوكسجين المذاب ضمن الحدود المقبولة لاستخدام المياه لاغراض الشرب او للاغراض الزراعية حيث ان قيم الاوكسجين المذاب لم تقل عن 6 ملغم/لتر.

بينت النتائج ارتفاع قيم تراكيز المواد الكلية الذائبة والتوصيلية الكهربائية خاصة في العينات الماخوذة من بداية ونهاية الهور مع انخفاض ملحوض لهذه التراكيز في العينات المأخذوة من منتصف الهور.

بينت النتائج انخفاض قيم تراكيز المواد العالقة الكلية على طول هور الحمّار حيث ان تراكيز المواد العالقة الكلية في المياه السطحية تعتمد بشكل كبير على سرعة المياه في الهور والتي تعد بطيئة نسبياً. كذلك بينت نتائج الفحوصات ارتفاع قيم تراكيز المغنيسيوم حيث وصلت اكثر من 125 ملغم/لتر حيث ان مثل هذه التراكيز في المياه السطحية قد تسبب الاسهال، بينما وصلت تراكيز الكبريتات اكثر من 400 ملغم/لتر، هذه التراكيز للكبريتات تاتي بصورة رئيسية من المواد العضوية الوفيرة في ترب الاهوار المجففة.

INTRODUCTION

Marshes in Iraq are important for economic, social and biodiversity Values characterized by frequency of water flows and quality, accumulation of nutrients and organic matter and the production of commercially important vegetation and fish, They were the permanent habitat for millions of birds and a flyway for millions more migrating between Siberia and Africa (Maltby, 1994).

Although the uncontrolled reflooding is welcome news, it presents potential problems and challenges regarding the quality of water:

1) The release of toxins from reflooded soils that are contaminated with chemicals, mines and military ordnance.
2) Flooding of local villages and farms now developed on the edges of formerly drained marshes.
3) A false sense of security regarding the volume of water that will be available to restore the marshes in future years.

Many studied were achieved from many Iraq Ministries, Organizations and Associations that related to the restoration of marshes. United Nation Environment Program (UNEP) was made many studies before and after 2003 some of them:

- **Water Quality of Marshlands,** south of Iraq(2004) in this study the team of UNEP took many water samples and analyses their to know the water quality of Abu-Zaraq marsh (40 km) east of Al-Nasria city, the results of chemical analyses compared with the upper limits of concentrations in irrigation water, the comparison shows moderate saline water and no significant effect of Na,Cl,No_3.
- **Environment in Iraq** (UNEP progress, October 2003), this study concerned on the environment status in Iraq, background materials used in the reports preparation relied on UNEP's earlier work in the region, including three studied it had carried out about the environmental impacts of the 1991 gulf war, and the 2001 report on the demise of the Mesopotamian marshlands, this study was represented the reflooded marshlands in summer 2003, in addition discussion the status of marsh Arabs. The study also was showed all the constrains that forced the restoration of marshes.

Partow (2001) Studied the hydrology of marshes of Iraq and mentioned that less than 10 % of the area of marshes in Iraq remained as functioning marshland by the year 2000; the only remaining marsh was the northern portion of Al-Hawizeh. The researcher was concluded that the idea that only 15 % to 20 % of dried wetland could be restored because of excessive salinity, environmental pollution, lack of availability high-quality water.

Curtis (2006) studied the ecology of the Iraq marshes focusing on the returned different species of animals and plants. Samples of water and soils at selected locations in marshes were analyses for Conductivity, Dissolved oxygen, dissolved solids, total nitrogen, total phosphorus and salinity. The researchers were showed that uncontrolled release of water in many areas was resulted to return of native plants and animals, including rare and endangered species of birds, mammals and plants. In addition the researchers were concluded that the poor water quality presence high saline soil and toxic materials would prevent the complete ecological restoration of marshes.

The marshes in Iraq were considered once famous for their biodiversity and cultural richness. Hammar marsh is the largest marsh on the right side of Euphrates River before it joins Tigris River at Al-Qurna to form Shut Al-Arab. After 1991 Hammar Marsh subjected to many drying processes and the reason of this drying is to increase the agriculture areas in the country (Al-Samaria 1999).

Water enters Hammar marsh from many feeders, the most important of them are Kurmishia, Um-Nakhla and Jassim rivers, all them take their water from Euphrates River. During the flood season, Hammar marsh becomes a connected lake and becomes disconnected shallow small lakes depth (0.2–0.5m) during the dry season. (Al-Samaria 1999). **Fig.1** shows satellite image of Hammar marsh area after 2003 [Google Earth].

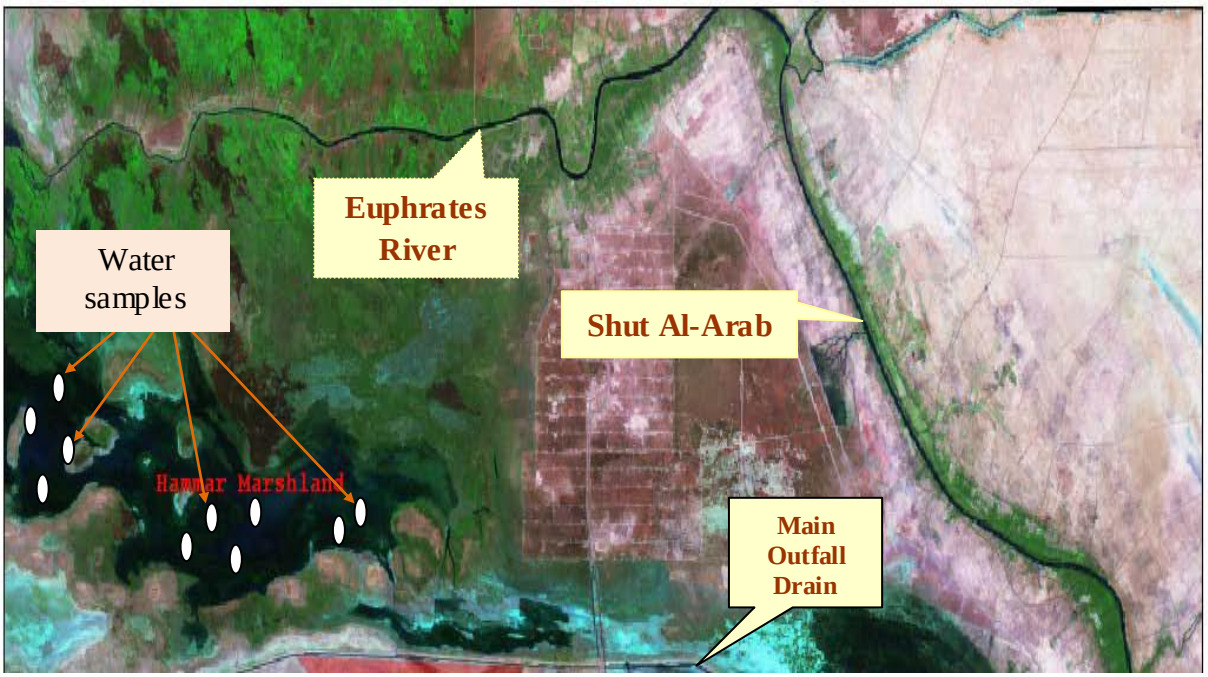


Fig.1 Satellite Image of Hammar Marsh.

Many studies showed increase in salinity in both soil and water of marshes in Iraq, the cause for increase of salinity is unknown, but it probably relates to a rise in salinity in the Euphrates River and to increase flux into the water column of ion concentrated in the soil after 10 years of drainage and evaporation. In addition the continued use of ancient methods of flooding vast agriculture field from open ditches coupled with extremely high evapotranspiration rates and result in massive losses to the atmosphere and increased soil salinity problems. Accordingly it was expected that the salinity of Hammar marsh is high.

The following table shows the physical and chemical analysis of samples taken from different locations in Al-Hammar marsh soil in Al-Basra city (Al-Hasseny,2005)

Table 1 Physical and chemical analysis of four samples from Al-Hammar marsh soils.

	Clay %	Sand %	Silt %	Organic matter %	pH	EC (Ds/m)
Al-Az	42	18	40	5.5	7.7	10.9
Al-Naser	49	19	32	7	7.7	11.2
Al-Shafi	44	20	36	10	7.7	11.5
Al-Mudel	44	16	40	7.7	7.7	11.2

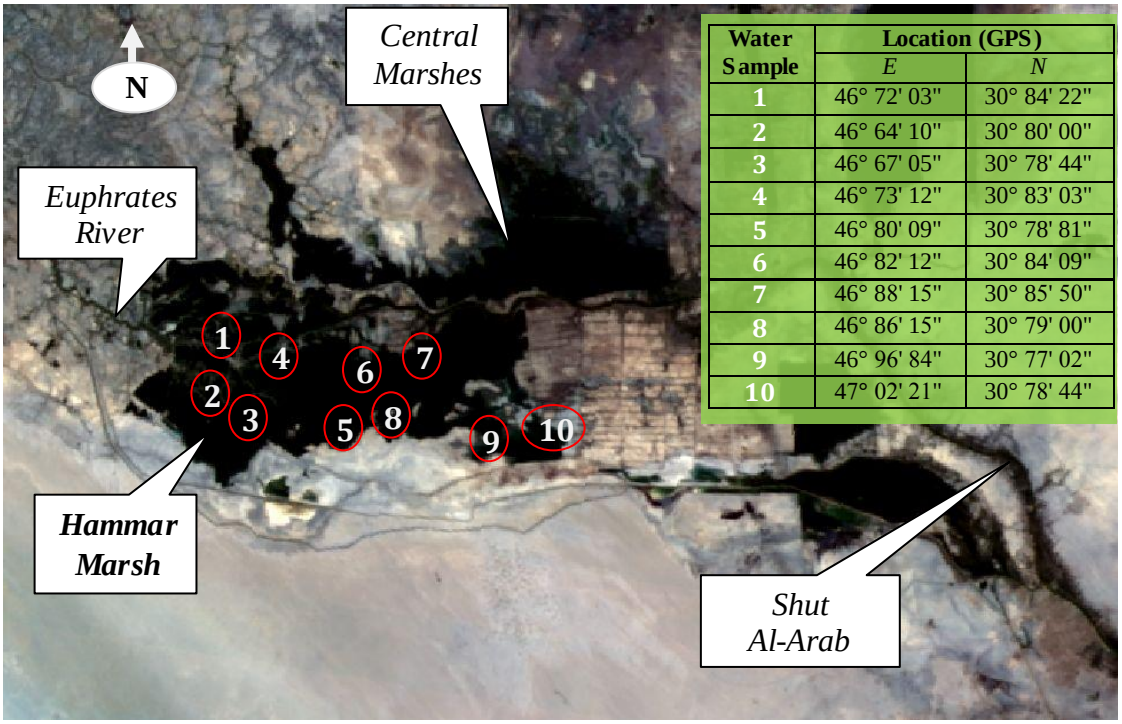
RESULTS AND DISCUSSIONS

Saline irrigation water compounded with urban and industrial effluent would therefore have a major negative influence on any rehabilitation plans of marshes (Partow, 2001). Therefore, studying of water quality of marshes leads to give imagination of pollution in these marshes.

Ten water samples were taken at different locations of Al-Hammar marsh on February, 2007 to know the water quality, four of the water samples taken from at locations near the feeders of

Al-Hammar marsh and four at different locations in the middle of the marsh, the remains two taken from locations near the end of marsh.

All water samples submitted to tests that identify the tests of "Standard Methods" the details of procedures can be found in authoritative references of testing procedures in water pollution control such as (APHA, 1975). The following figure shows the locations of ten samples.



Water Sample	Location (GPS)	
	E	*N*
1	46° 72' 03"	30° 84' 22"
2	46° 64' 10"	30° 80' 00"
3	46° 67' 05"	30° 78' 44"
4	46° 73' 12"	30° 83' 03"
5	46° 80' 09"	30° 78' 81"
6	46° 82' 12"	30° 84' 09"
7	46° 88' 15"	30° 85' 50"
8	46° 86' 15"	30° 79' 00"
9	46° 96' 84"	30° 77' 02"
10	47° 02' 21"	30° 78' 44"

Fig.2 Locations of Ten Samples were Taken at Different Locations of Al-Hammar Marsh.

Iraqi legislations did not put water quality standards to the marshes as well as lacking information of water quality of Iraqi marshes before drying operations; all that prevent evaluation of water quality samples that taken from marshes, so that comparisons of water quality values with the requirements of different uses of water of marshes becomes important in Environmental impact assessment. The most important uses of water in marshlands are agriculture and drinking.

Fig.3 shows the results of dissolved oxygen (DO) and biochemical Oxygen Demand (BOD) analysis of the ten samples which were taken from different locations in the Al-Hammar marsh. From this figure it can be seen that the highest value of DO obtained at location 1 and then began to decrease at location 3 and reached its minimum value at location 8 before it increased at location 9, the D.O in water is related to atmospheric aeration and photosynthetic activity of aquatic plants. Many factors are effect on the concentrations of dissolved oxygen in water body among them Temperature, light penetration, water movement, available of nutrients, salinity (UNEP,WHO,UNESCO and WMO 1992). Optimal concentrations of DO required for aquatic life are over 5 mg/l, all analysis samples showed the D.O concentrations above 6 mg/l in Al-Hammar Marsh, but it should emphases that high oxygen concentrations in the first samples are slightly decreasing in other samples, the reason of that is the first samples were taken from locations near the feeders of Al-Hammar marsh, these feeders may contain high concentrations of dissolved oxygen.

Also for BOD analysis it can be noticed that there is a fluctuation for its value from one location to another, so it was clear that the highest value happened at location 4 while the lowest value at location 8. However the value of BOD is low and this due to two points, first there are no

industrial activities that throw pollutants directly to the marsh, as well as the human pollution is low because of little villages in Hammar Marsh, second the spreading of plants and slow water velocity contribute to decrease BOD concentration.

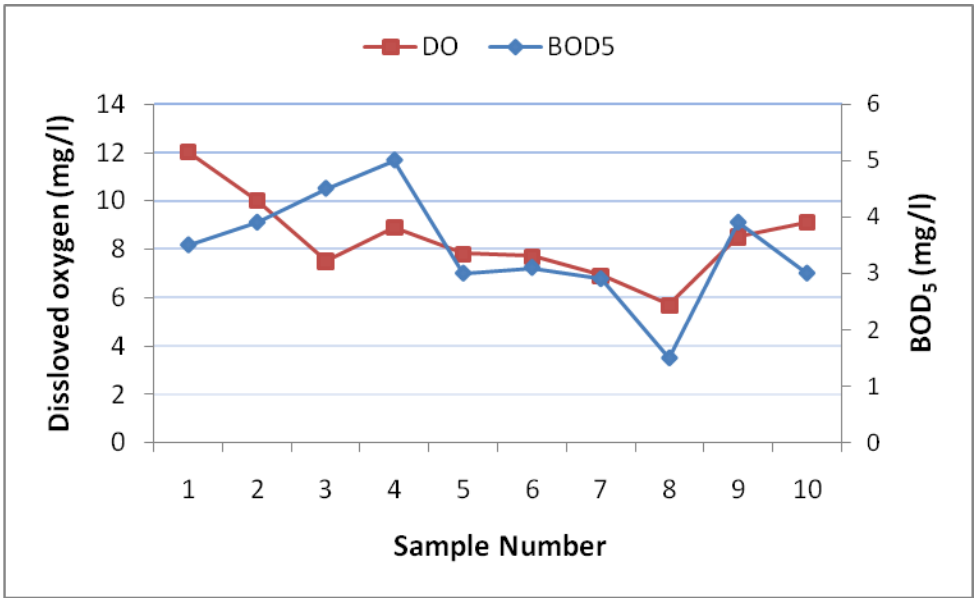


Fig. 3 Results of Dissolved Oxygen and BOD Analysis.

The changes of pH and water turbidity along Al-Hammar marsh are plotted into **Fig.4**. The pH of an aqueous solution is controlled by interrelated chemical reactions that produce or consume hydrogen ions (Hem, 1989). Dissolved gases, such as carbon dioxide, hydrogen sulfide, and ammonia have an appreciable effect on pH. The samples analysis shows that the range of pH was from 6.5-9; this range is acceptable for different uses such as drinking and agriculture. Also from the same figure it can be seen that a sharply increased in the turbidity value (samples 7 and 8) because in this area it was noticed movement of fishermen boat as well as those fishermen were using toxic materials for fishing that may cause high turbidity level. This sharply change effects on the photosynthesis in this area and leads to decrease dissolved oxygen concentration.

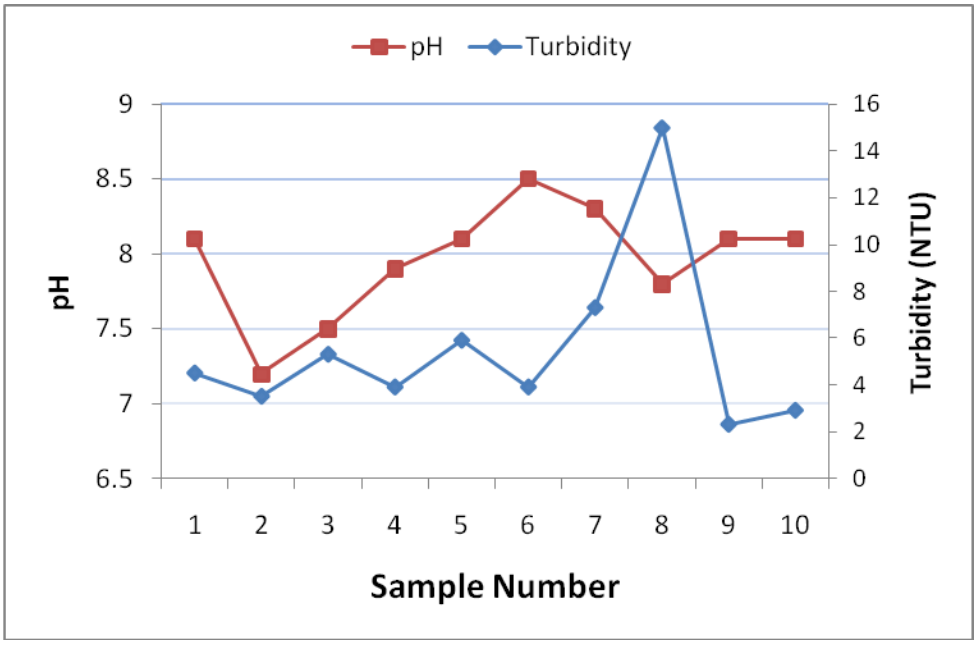


Fig. 4 Results of pH and Turbidity Analysis.

Electrical conductivity is a measure of the capacity of water to conduct an electrical current and is a function of the types and quantity of dissolved substances in water and temperature. Specific conductance of the water increases. Specific conductance measurements are good indicators of total dissolved solids and total ions concentrations, but there is no universal linear relation between total dissolved solids and specific conductance.

Fig. 5 shows the variation of electrical conductivity and total dissolved in the ten samples, it is clear that the first samples gave high concentrations of EC and TDS while the sample taken from the middle of Al-Hammar marsh gave concentrations in less degree, but in the end of the marsh the EC concentration return to high levels because of the following reasons:

- The first locations contain high concentration of total dissolved solids convey from feeders that take water from Euphrates River.
- The final samples show high concentrations of EC and TDS because of tide waves that come from shut Al-Basra which is connected with Hammar marsh by Al-Msheb and Al-Salal marshes.
- The middle samples show decreasing the EC and TDS concentration from first and end samples and that may justify that marsh plants and phytoplanktons have the ability to adsorb dissolved solids.

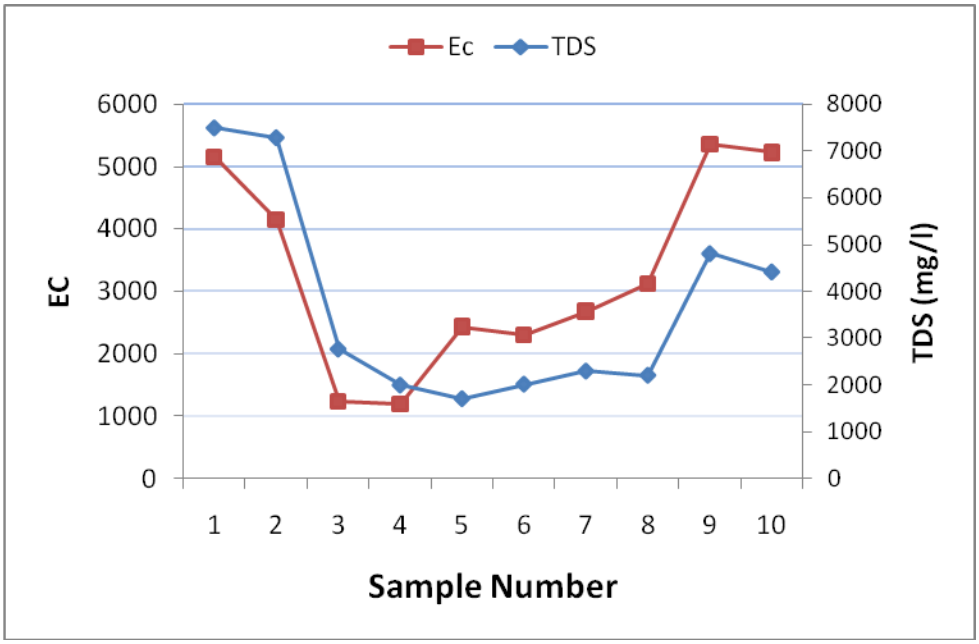


Fig.5 variation of EC and TDS.

Fig.6 shows the variation of temperature and the total dissolved solids at different locations, temperature depends on the weather and the time of taking samples, as the temperature increases, the solubility of water to carry suspended materials decreases. Stoke's law describes the velocity of settling particles in a non turbulent medium by the following equation:

$$V_S=d^2g(\rho_s-\rho_w)/18\mu \qquad (1)$$

Where: Vs= settling velocity (m/s),d= diameter of particles(m), g=gravitational acceleration = 9.81, m/s^2,ρ_s= density of settling particles(Kg/m^3), ρ_w= density of water, (Kg/m^3), μ=viscosity of water.($N.S/m^2$).

Many Studies reoffered to that the TSS concentration in marshes considered low because of the stagnant of water, hence the samples results did not refer to increase TSS more than 35 mg/l, this value is consider low in surface water.

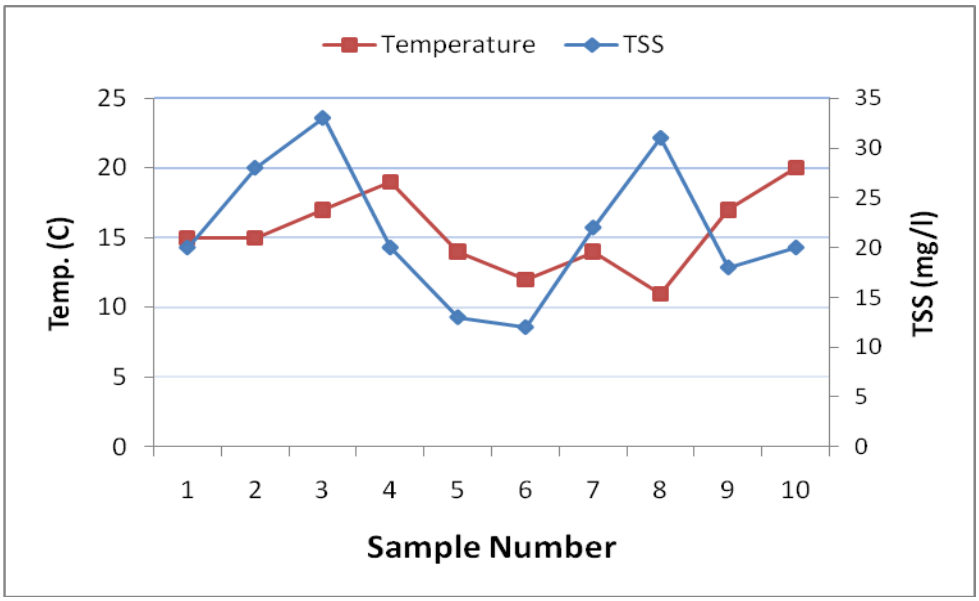


Fig.6 Variation of Temperature with the TDS.

Fig.7 shows the variation of Ca and Mg along Al-Hammar marsh. Many water rivers that flow in limestone soil may be contain (30-100) mg/l, while the rivers flow in Gypsum soils may contain hundreds concentrations. Ca concentrations contribute to raise the hardness of water.

Mg is a wide spread agent in surface water. The effects of Mg are same of Ca effects as well as Mg concentration more than 125 mg/l may be cause diarrhea (UNEP,WHO,UNESCO and WMO 1992).

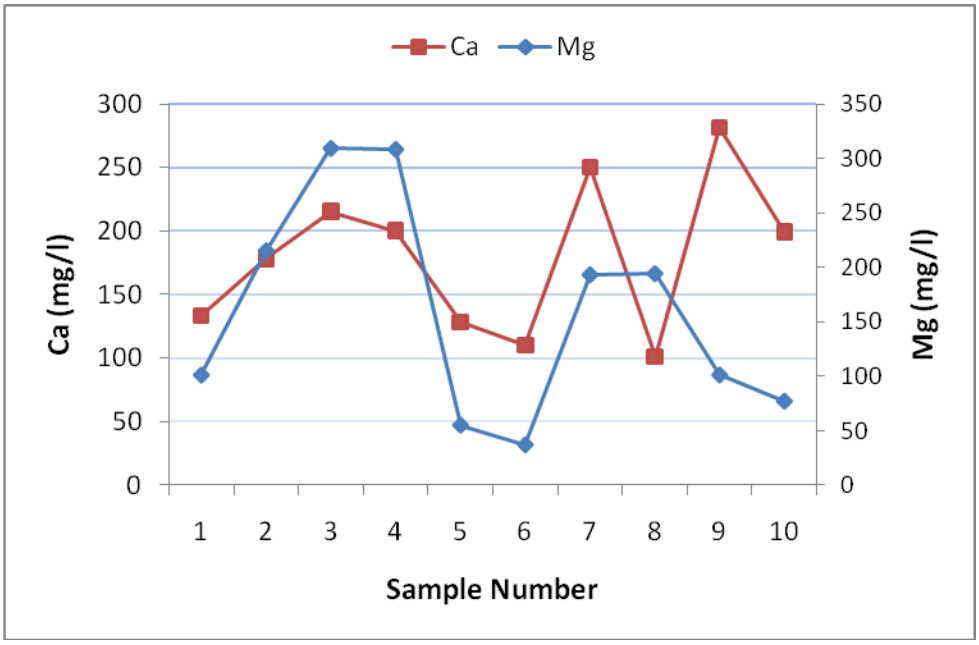


Fig.7 variation of Ca and Mg along Hammar marsh.

Fig.8 shows the concentration of total hardness and the hardness of carbonates, this hardness is strongly related to the nature of soils of Hammar marsh. From this figure it can be conclude that the total hardness is high at samples taken from the beginning of Al-Hammar marsh and may reach more than 1800 mg/l, while the other samples show decrease of hardness and don't exceed more than1000 mg/l.

The variations of concentrations of chloride and sulphates along the marsh shown in **Fig.9**. Chloride effect on agriculture and make salty taste to the water. Sulphate may be found in surface water at concentrations from little milligrams to more than thousands milligrams, the So_4 effects on the taste of water, WHO limited 400 mg/l as a maximum allowable level in drinking water.

Many areas of the marshes were severally burned after drainage. The intensity of the burns in some areas, with high surface organic matter covering sulfidic pyrite soils beneath resulted in soils being greatly altered chemically and then exposed to oxygen for decades for draining, resulting in the formation of sulphuric acid (Fitzpatrick, 2004).

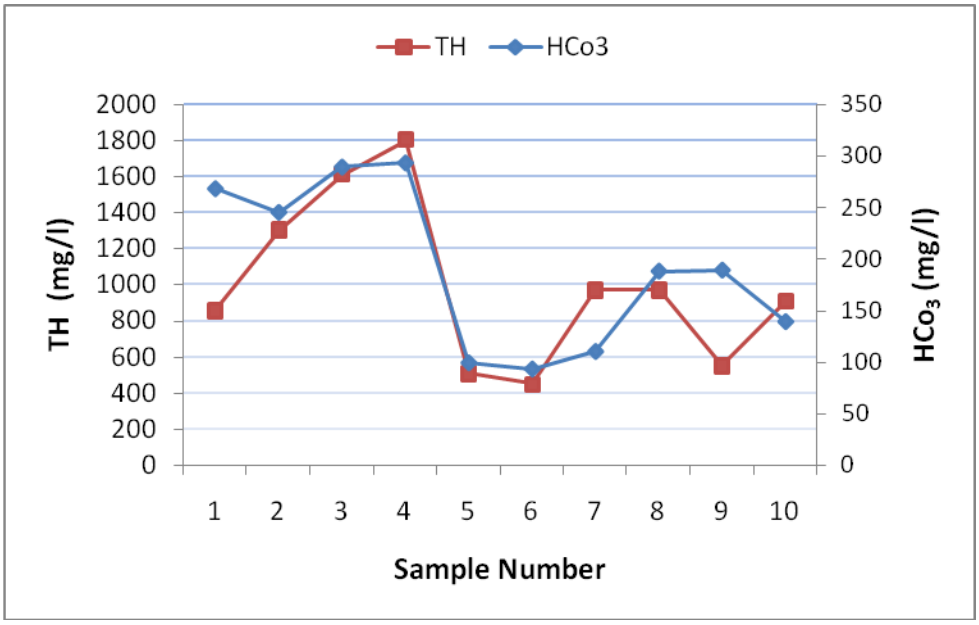


Fig.8 Concentration of Total Hardness and the Hardness of Carbonates.

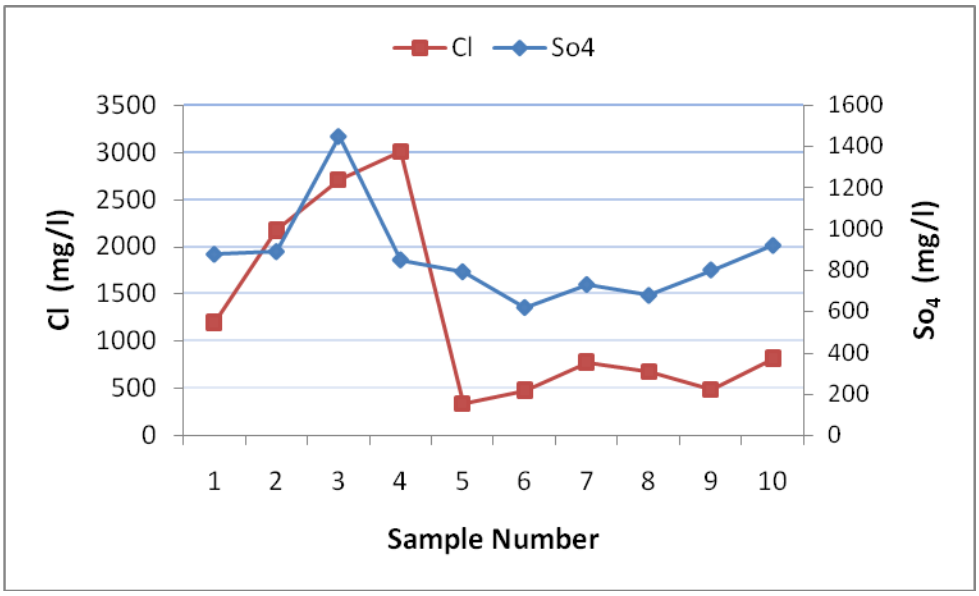


Fig.9 Variations of Concentrations of Chloride and Sulphates.

CONCLUSIONS

- Water analyses were showed that Al-Hammar marsh contains high quantity of salts; the concentration of salts sometimes exceeds the acceptable level of water for agriculture use (EC above 800 µS/cm).
- Samples of Al-Hammar marsh water were showed perceptible concentrations of Sulphate and Magnesium and calcium.
- Concentrations of TSS, BOD and pH don't exceed at significant degree along the study region.

REFERENCES

- Al-Hasseiny, Ayad Kadhim Ali, (March/ 2005), "Study the Properties of Some Dried Hore Al-Hammar Soils Southern in Iraq", M.Sc.Thesis, College of Agriculture, University of Baghdad.
- APHA,American Public Health Association,(1975)"Standard Methods for the Examination of water and wastewater". Washington,D.C.
- Curtis J.Richardson and Najah A.Husssain ,(June/ 2006) "Restoration the Garden of Eden: An Ecological Assessment of the Marshes of Iraq", Research, Bioscience Journal, Vol. 56, No.6. WWW.biosciencemag.org.
- Fitzpatrick.R.W,(2004)"Change in Soil and Water Characterisitics of some Natural, drained and Reflooded Soils in the Mesopotamian Marshlands" CSIRO land and water client report . N.P, Internet.
- Hem,J.D.,(1989)"Study and Interpretation of the Chemical Characteristics of Natural Water", US Geological Survey, Water Supply Paper, p 264.
- Maltby E,ed.(1994) "An Environmental and Ecological Study of the Marshlands of Mesopotamia" Wetland Ecosystem, Research Group, University of Exeter. London.
- Partow H.(2001) "The Mesopotamian marshlands, Demise of Ecosystem " Narobi (Kenya), UNEP publication, TR.01-3.
- UNEP,2005, " Water Quality of Marshlands, South of Iraq", UNEP publication, Internet.
- UNEP, October/ 2003," Environment of Iraq" UNEP publication, Internet.
- UNEP,WHO,UNESCO and WMO " Global Environment Monitoring System (GEMS)" Water Operational Guide/Water Research Institute, Canada, 1992.

- السامرائي، محمد جعفر جواد (شباط/1999)" مشاريع الري والبزل الحديثة في محافظات ميسان وذي قار والبصرة ، دراسة في جغرافية الموارد المائية " اطروحة دكتوراه، كلية الاداب/ جامعة بغداد.
- وزارة البيئة / دائرة الاعلام والتوعية البيئية ،"التشريعات البيئية العراقية النافذة لعام 1990/ نظام رقم 25 لسنة 1967 – صيانة الانهار والمياه العمومية من التلوث".