

The Salts diffusion between East Hammar marsh area and Shatt Al-Arab River Northern Basra City

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Abstract

Recent years, the problem of high salt concentrations in the Shatt al-Arab river repeated affecting directly on the human water uses, ecology, and agricultural activity of these regions. The study area was located at the lower part of the Mesopotamian Basin. Five stations were selected for measuring the salinity and water level. These stations were Hareer on Al-Sallal waterway, Al-Mas`hab on the Al-Mas`hab waterway, Garmah Bridge near on Garmah waterway, Haritha, and Maqal stations on Shatt Al-Arab River. The measurements were taken for salinity and water level over 30-day period for two season (winter, summer). It was measured synchronizing with the days of spring and neap tide during February and July months. Landsat 8 imagery, Operational Land Imager (OLI) sensor are acquired from USGS for the study area, in order to monitor and map salt features. The spatial distribution of salinity was drawn using geostatistical interpolation technique (kriging approach) in ArcGIS 10.1. The study revealed that water of Mas`hab and Al-Sallal entering Garmah waterways then Shatt Al-Arab river during ebb-tide period were negatively affected on water quality of Shatt Al-Arab, because of increasing of salinity concentrations. This study suggested a way to avoid the effects of Mas`hab and Al-Sallal waterways on the water quality of Shatt Al-Arab river.

KEY WORDS: Water Quality, Salinity, Spring-Neap tide, Salt Marsh, Remote Sensing, GIS

1- Introduction

The water quality subject considered a new scientific trends in the hydrological studies. So, the governments and international institutions began to interest this subject, especially in the early of 21th century as a result of the growing crisis of water scarcity and diversity of the water uses under climate change has affected the world in general and our region in particular. These trends discovered new dimensions adopting new analysis, such as in situ field measurements by collecting data from environmental sensors (Nigel, *et al.*,

2010). Another trend uses data and statistical methods . As well as, use new techniques of remote sensing and GIS . In recent years, the problem of high salt concentrations in the Shatt al-Arab repeated affecting directly on the human water uses, ecology, and agricultural activity of those regions. Especially the rise in concentrations of salts frequently repeats in irregular periods and continues for non-fixed periods, causing great loss for farmers, and owners of fish ponds. Therefore, it is important to detailed study the region and identify the causes and possible treatments for this problem that

affects the ecosystem of Basra governorate. From the hydrological view, the marshes area influenced by the hydrology of the Tigris, Euphrates, and Shatt Al-Arab rivers that effected by tide regime. It is mixed type ranging from (diurnal to semi-diurnal) but the semi-diurnal is the dominant type. The ebb-tide period is greater than flood-tide period, as well as the rates of currents velocities, when the velocities are increasing from (0.15-0.25 m/Sec) in Hartha Station to (0.51-0.6 m/Sec) in Fao Station (Al-Asadi, 2012; 2013). The discharge of Shatt Al-Arab differs from the ebb to flood-tide status, where the annual rates of ebb-tide discharge reached 825.5 m³/Sec in Hartha Station, while it decreased to 391.2 m³/Sec during the water year (2006-2007). Some of marshes areas affect on water quality of the Garmat Ali waterway, (Al-Saad, et al., 2010). The discharge of Shatt Al-Arab rivers differed from what it was in last of past century due to establishing and completing of many of a massive irrigation projects and Dams by the countries participating in the basin of Tigris and Euphrates basin and its tributaries (Turkey, Iran, Syria), which led to decreasing of water quality and quantity that entering the Shatt Al-Arab river and Marshes areas.

2- Study Area

The study area is located in the lower part of the basin of Mesopotamia. Tectonically, the area is a part of unstable shelf that characterized with very thick

sedimentary cover and anticlinal subsurface structures separated synclinal subsurface structures. These structures are one of the most important reservoirs, and oil fields in Central and Southern Iraq. It is worth mentioning that these structures have no reflection on the surface, but their effect reflects on river channel characteristics (cross-section, sinuosity). The geology of the area characterized by thick Quaternary sediments which are represented by floodplain sediments of lower Mesopotamian basin that belong to Pleistocene Period. The Holocene period represented by the marsh (active, dried) and the fluvial sediments for flood plains of the Tigris, Euphrates, and Shatt Al-Arab rivers, (Yacoub, 1992). These sediments are grey colored and fine contain organic material and particles of Mollusca and Ostracoda mixed with carbonate, clay, silt, and sand. Hammar formation underlays these sediments is marine and lacustrine sediments, belongs to early Holocene (Yacoub, 1992; 2011). Geographically, the study area locates in the southeastern part of Hammar Marsh. This area is covered the three waterways (Garmah, Mashub, and Al-Sallal) that all located within Al-Harthah Town southwestern Basra City. It is flat areas 7m above sea level, and the depths of Al-Hammar Marsh ranged between (15-90 cm).

3- Methods and Materials

Five stations were selected for measuring the salinity and water level. These stations were Hareer St. on

Al-Sallal waterway, Al-Mas`hab *St.* on the Al-Mas`hab waterway, Garmah Bridge *St.* near on Garmah waterway, Haritha, and Maqal stations on Shatt Al-Arab River table 1. Field observations in-situ of the salinity were used by monitoring Instruments (WTW Cond 3110 SET1) and HOB0 conductivity logger onset). While, the water level was measured using (Hobo water level logger Onset). During winter season, the measurements were taken for salinity and water level every hour over 30-day period from 12 February to 12 March/ 2014. These measurements were synchronized with the days of spring tide on 17 Feb.

2014, and the neap tide on 03 Mar. 2014. Similarly, the summer season was measured as well as synchronized with the days of spring tide on 13 Jul. 2014 and the neap tide 28 Jul. 2014. Series of Landsat 8 imagery, Operational Land Imager (OLI) sensor are acquired from USGS for the study area. These data are geometrically corrected and geographically projected for (WRS-2 Path 166, Row 39). These data were necessary for monitoring and mapping the salt areas in the study area. The spatial distribution of salinity was drawn using geostatistical interpolation technique (kriging approach) in ArcGIS 10.1.

Table 1 The stations locations of the study area

Longitude	Latitude	Station Name
47° 40' 04.834" E	30° 37' 17.201" N	Al-Sallal
47° 41' 36.137" E	30° 38' 22.752" N	Mas`hab
47° 45' 29.943" E	30° 34' 17.533" N	Garmah
47° 47' 18.160" E	30° 33' 57.575" N	Maqal
47° 45' 37.759" E	30° 38' 52.981" N	Hartha

4- Results and Discussions

In the summer season the salinity accumulates in the soil because of increasing of evaporation rates results in high temperatures where it essential

character of the arid and semi-arid environments, as shown in the satellite image of the Landsat-8. It is shown the salt flats (Sabkhas) north to northwestern study area. Fig. 1.

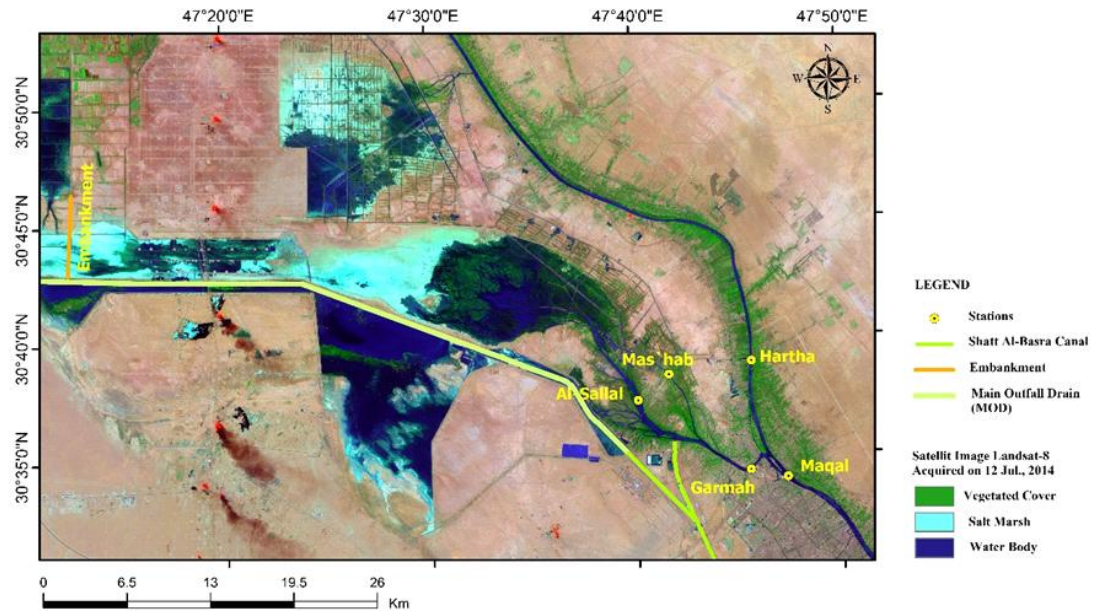


Fig. 1. Satellite image was shown salt flats neighboring marshes areas. Image acquired in 12/07/2014

It was found through field measurements in summer season during the spring-tide and neap-tide days to all stations in the study area, that salts concentrations in water were relatively low ranged between (972-2542) gm/L as compared with the winter season (Fig. 2,3). The Lack of rain in summer season is cause for preventing the arrival of

accumulated salts to Mas`hab and Al-Sallal areas then Garmah. However, the area of Mas`hab and Al-Sallal has a much greater salinity than Garmat Ali waterway, because of their nearness to the salt marsh areas.

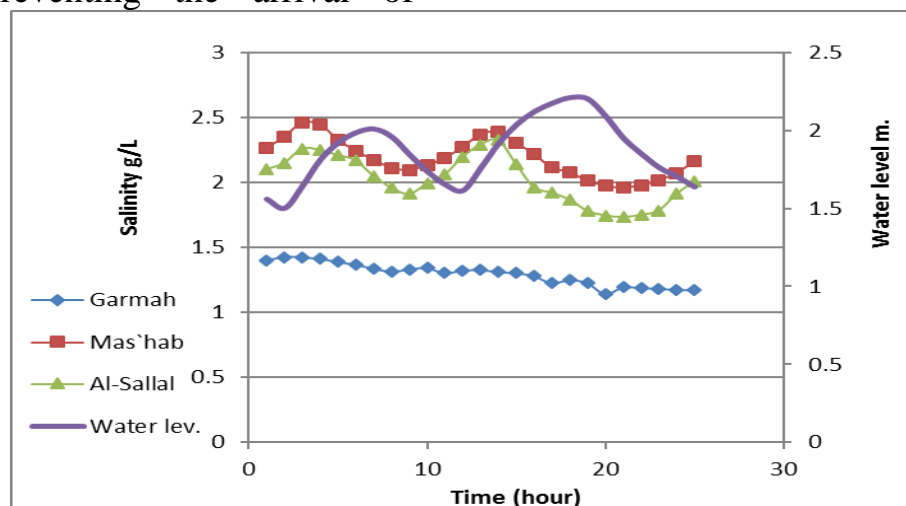


Fig. 2. Salt concentrations during the spring-tide on summer season.

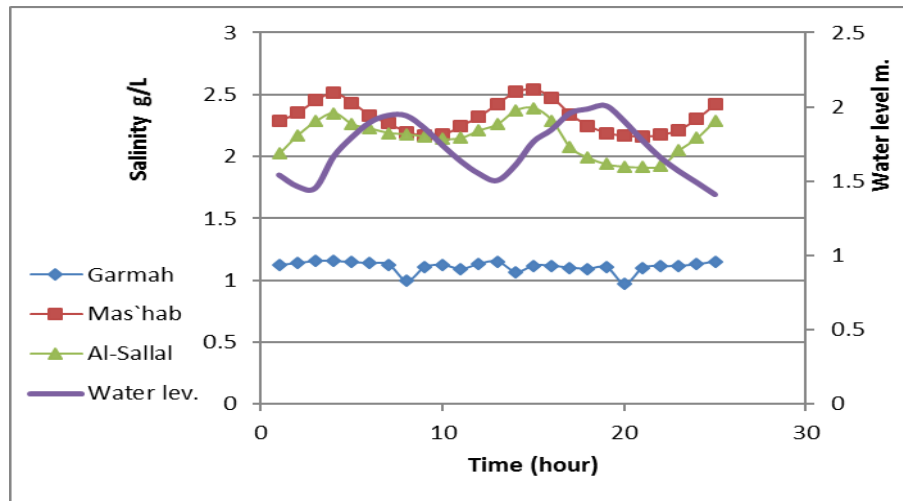


Fig. 3. Salt concentrations during the Neap-tide on summer season.

When the water of Mas`hab and Al-Sallal and Garmah waterways was entering Shatt Al-Arab River during ebb-tide hours are higher salinity than the water entered these rivers from Shatt Al-Arab River during flood-tide hours. In

the winter season, the salt swamps was submerged with rainwater during this season. This led to wash out the accumulated salts and drained to Mas`hab and Al-Sallal waterways toward Garmah then Shatt Al-Arab. Fig. 4.

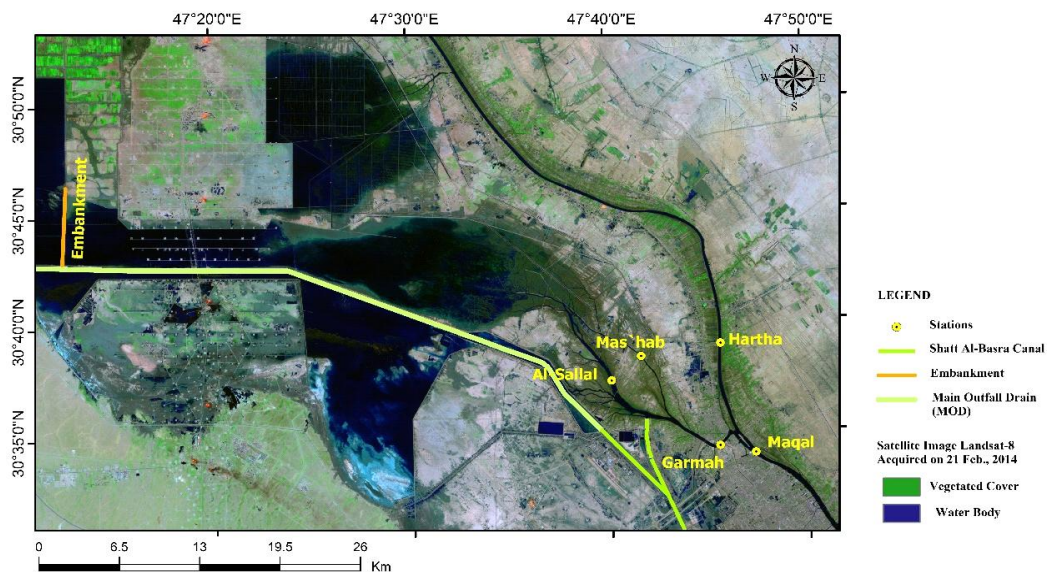


Fig. 4. Satellite image is study areas during winter season. Image acquired in 21/02/2014

It was noted that through the field measurements in winter season during the spring and neap tide, the salinity concentrations were high in all stations in the study area (3.715-11.268) gm/L as compared with the summer season. The waterways of Mas`hab and AL-Sallal were higher salinity than Garmah waterway because their vicinity to the salt marsh areas that it submerged with rainwater as well as the saline water permeating into the artificial embankment were built to prevent the water of Sulain Marsh from entering Basra marshes. The salinity values were exceeding 11.800

g/L, before the embankment. The high concentrations result in the main outfall drain (MOD) flooded the Slayen Marsh. The water of Mas`hab and Al-Sallal and Garmah waterways was entering Shatt Al-Arab River during ebb-tide hours were higher salinity than the water of Shatt Al-Arab River. It was confirmed that the washing and dilution processes had been taking place in the marshes during flood-tide hours, then it was leaving marshes toward Shatt Al-Arab during ebb-tide hours. This leads to increasing of salinity values in the Shatt Al-Arab (Fig. 5,6).

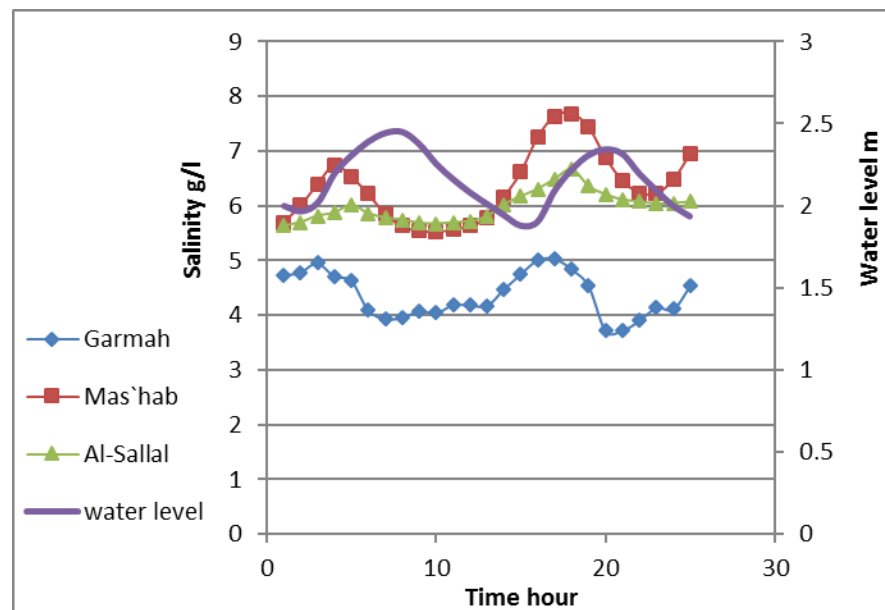


Fig. 5. Salt concentrations (g/L) during the spring-tide on winter season.

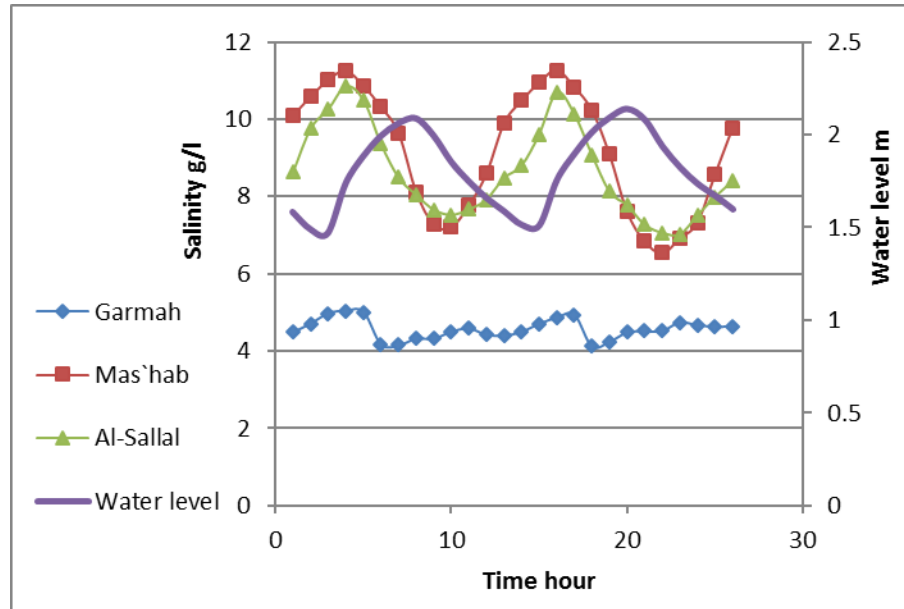


Fig. 6. Salt concentrations (g/L) during the neap-tide on winter season.

The distribution of salinity in study area was mapped by using kriging approach in ArcGIS 10.1. It was showed

the rates of salinity concentrations in two seasons (summer, winter) during flood-tide period (Fig. 7, 8)

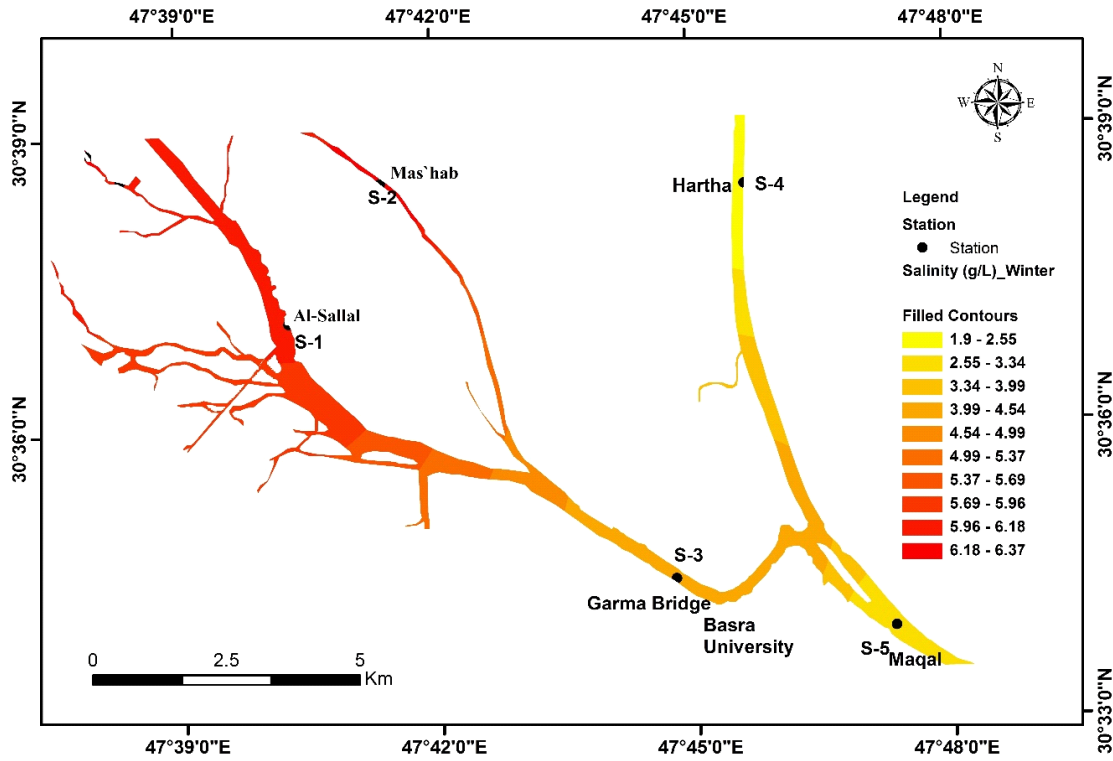


Fig. 7. The rates of salinity concentrations (g/L) in winter season (Spring-Tide)

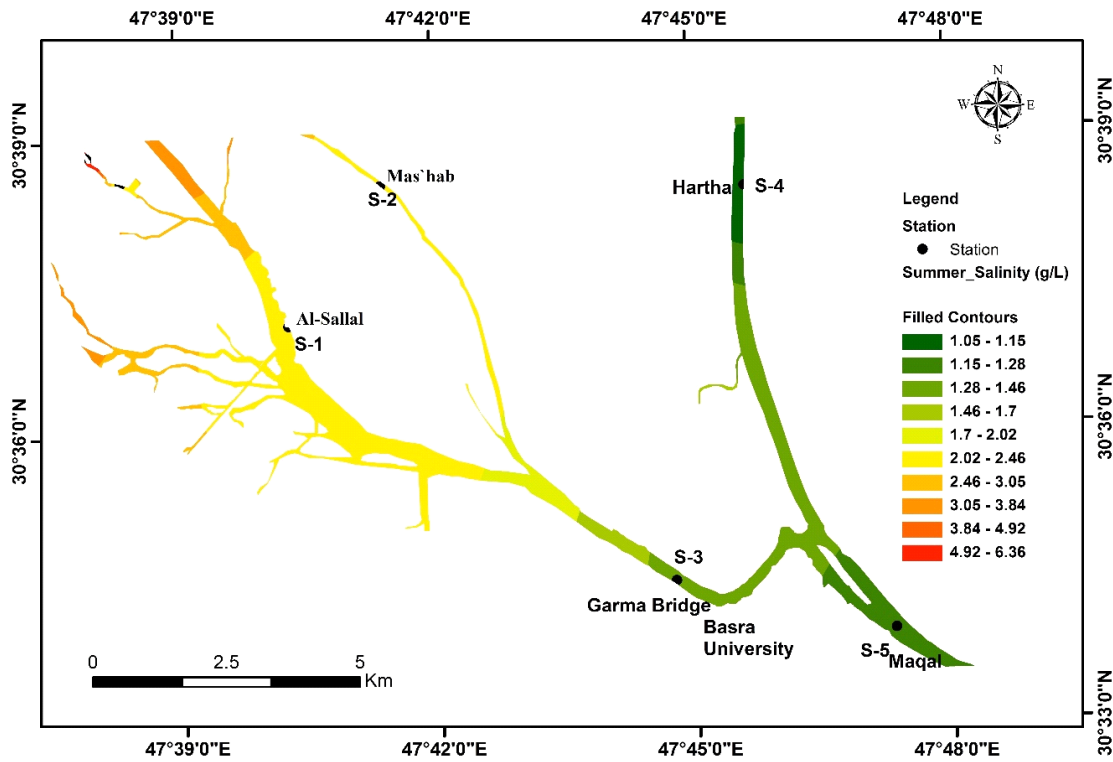


Fig.8. The rates of salinity concentrations (g/L) in summer season (Spring-Tide)

The figures 7, 8 displays the areas had low salinity located in the north of Shatt Al-Arab River (Hartha Station), because of the freshwater flow coming from Al-Kassarah barrage. While the areas located in North to northwestern (Hammer Marsh) have highest salinity.

Consequently, the water in Garmah and Al-Maqal are relatively high salinity as compared with the water of Shatt Al-Arab river (Hartha Station), and lower than Mas'hab and Al-Sallal waterway. Therefore, the water quality in the study area was determined by the proportion between the water coming from Amara and the water permeates from marshes into Mas`hab and Al-Sallal waterways.

5- Conclusion

The water of Mas`hab and Al-Sallal entering Garmah waterways then Shatt

Al-Arab during ebb-tide period are negatively affected on water quality of Shatt Al-Arab, because of increasing of salinity concentrations.

It is necessary to establish drainage channel connected with Main Outfall Drain (MOD) for draining salt water from the salt marshes to the MOD channel and preventing its reach into Mas`hab and Al-Sallal waterways. Likewise, it should be establish a barrage on Garmah waterway to keep water at constant levels to prevent water rising then reaching to the saline marshes areas during flood-tide hours, as well as to prevent water from retreating back to Shatt Al-Arab during ebb-tide hours. (Fig. 9)

Periodic maintenance and reinforcement of the embankment should be performed.

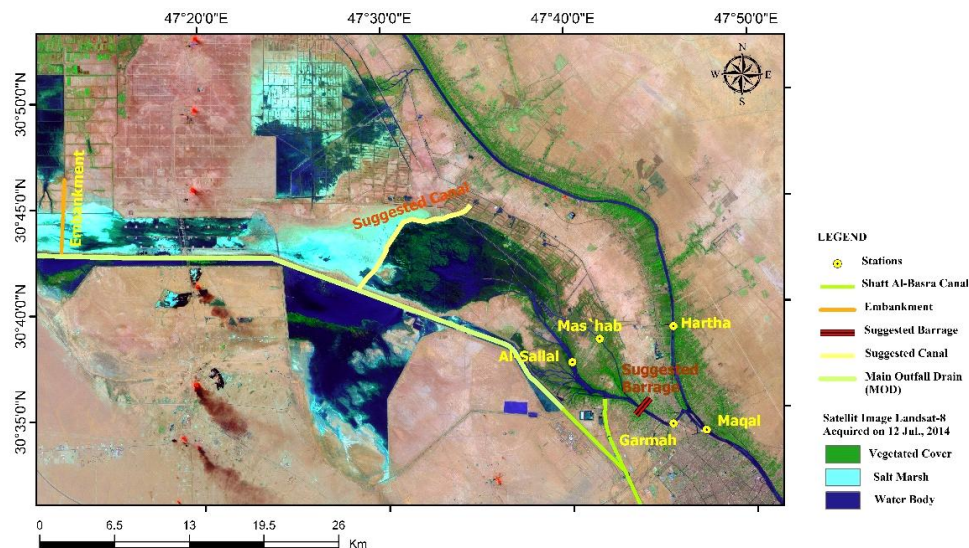


Fig. 9 Map for the suggestions had been discussed above.

انتشار الأملاح بين مناطق شرق هور الحمار و شط العرب شمالي مدينة البصرة

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المستخلص

تكررت في السنوات الاخيرة مشكلة ارتفاع التراكيز الملحية في مياه شط العرب مما اثر بشكل مباشر على الواقع الحياتي و الصحي والنشاط الزراعي لهذه المناطق. تقع منطقة الدراسة في الجزء الأدنى من حوض وادي الرافدين. تم اختيار خمس محطات لقياس نوعية المياه ومستوى عمود الماء هي حرير على نهر الصلال والمسحب على نهر المسحب وجسر الكرمة على نهر الكرمة ومحطة الهارثة ومحطة المعقل على شط العرب. أخذت القياسات بواقع قراءة للملوحة ولمستوى عمود الماء كل ساعة ولجميع المحطات على مدى 30 يوم للموسمين الشتوي والصيفي ولشهر شباط وتموز متزامنة مع أيام المد الربيعي والمد المحاق في هذه الأشهر. استخدمت جزء من بيانات القمر الصناعي لاندسات-8 من موقع USGS لتغطية منطقة الدراسة ورسم خرائط لمراقبة الأملاح. رسم التوزيع المكاني للأملاح بواسطة تقنيات geostatistical interpolation بطريقة (kriging approach) في برنامج ArcGIS 10.1. توصلت الدراسة إلى أن المياه الخارجة من جدولي المسحب والصلال إلى شط الكرمة ومنه إلى شط العرب خلال عملية الجزر تؤثر سلبيا على نوعية مياه شط العرب حيث تسبب زيادة تراكيز الاملاح. قدمت الدراسة الحالية حولا لتفادي مشكلة نوعية مياه جدولي المسحب والصلال وتأثيرهما على نوعية المياه في شط الكرمة ومن ثم شط العرب.

كلمات مفتاحية: نوعية المياه، الملوحة، المد الربيعي والمحاق، أهوار ملحية، الاستشعار عن بعد ونظم المعلومات الجغرافية.