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USING SOME SPECTRAL EVIDENCE TO STUDY THE HYDROLOGICAL PROPERTIES OF THE TIGRIS BASIN FROM THE BACK OF THE KUT DAM TO ALI GHARBI

Jawad Ali Falah and Mohammed Kareem Najm
Faculty of Agriculture, University of Wasit, Iraq
Email: jawad1963ali@gmail.com, malasady2013@gmail.com

Abstract

The study area located in the eastern of Iraq between longitudes (30˚45' - 32˚ 46') east and latitudes (30˚ 32' - 30˚ 34') north, which is part of Tigris valley basin in Wasit Governorate, it was determined by adopting the digital elevation model DEM and use Arc gis 10.3 program with an area of 7464 km^2. The quantities of water contained in the main column of the Tigris River, which comes from the north of the study area, as well as the water collected from the rains and floods coming from the eastern basins of the study area, were calculated over two years 2017 -2019. The discharge rate for import from north Tigris for the first year was 167.3 m^3/s, total precipitation was114 mm/year, for the second year the discharge rate was 351m^3/s and total precipitation 427.2 mm/year. Remote sensing RS techniques and geographic information systems GIS were used to monitor changes in Normalize differences Vegetation Index (NDVI), Normalize Differences Water Index (NDWI), and Salinity Index (SI), for two satellite images of the study area.taken in 15/03/2017, the other on 26/02/2019. As part of hydrological study in the valley Tigris Basin for the study area. It was found there is a clear increase in the value of the NDVI in 2019 as well as there is a decline in the SI and a rise in the NDWI, the reason is due to the growth of water imports in 2019 compared with 2017. This indicates the possibility of using studied evidence in hydrological studies and water management.
***Keywords*:** water management, GIS, RS, NDVI, NDWI, SI.

Introduction

Satellite imagery is an excellent way to constantly monitor the Earth's surface cover and changes. Rapid surveillance requires the application of certain techniques to distinguish the image pattern. Variance detection is the process of identifying differences in the state of objects or phenomena by observing them in different periods of time, including the ability to identify temporal effects using a multi-time data set (Arsalan and Ahmad, 2013). Variance detection is an important application of remote sensing technology, providing researchers with information on the spatial distribution of manifestations as well as quantitative and qualitative information of changing parameters. Types of changes in land cover that can be of a certain level of interest can range from short-term phenomena such as snow or floodwater monitoring, assessment of damage to plants and seasonal changes in pasture production, to long-term phenomena such as urban development, desertification monitoring and disaster impacts. Natural like Earthquakes and others (Shaoqing and Lu, 2008). Typically, change detection procedures should include data acquired by the same (or similar) onboard satellite sensor recorded at the same spatial resolution, spectral accuracy, spectral beam and to some extent at the same time of day (Anupam and Manpreet, 2013). The Normalized Difference Vegetation Index (NDVI) is one of the most accurate digital processing techniques for satellite visualization. It is based on the fact that plants exhibit high reflectivity in the near-red wavelength range in the red wavelength range. It represents the ratio between the difference between the spectral reflections at the near infrared wavelength and the wavelength (0.76–0.90) μm and their sum at (0.63–0.69) μm. The following equation (Gilabert *et al.*, 2002) NDVI values have a range from (1 + to 1) - And, in general, if the output is positive, it is an indicator that the cell has a vegetation cover, and the higher the positive value produced the higher the greenery and density of the plant. The opposite is true for negative values indicating non-green surface features.

Materials and Methods

The study area is located in the eastern part of Iraq within the region of Wasit Governorate, its astronomical location between longitudes (30 '45 - 35' 46) east and latitudes, (30 '32 - 30' 34) north, while its location in terms of the path of the satellite Landsat 8. The area of study was determined by the hydrological analysis and the development of morphological characteristics of the area basins and valleys using the digital elevation model DEM and STRM3 model of the internet. The study area consists of four sub-basins which are established Turskh Basin, Badra Basin, Al-Chbab Basin and Zaafaran Basin. These basins contain groups of rivers orders as shown in Figure (1) and (2). Table (1) shows the amount of rainfall during the study period, (Two rainy seasons) based on the data of the Ministry of Transport. Monthly discharge to the study area in the column of the Tigris River from the north of the study area shown in table 2 and the flood water from the eastern valleys of the study area by field monitoring as well as data of the Ministry of Water Resources as shown in Table (3).

Two satellite images taken by Landsat8 of the sincere (Operational Land Imager OLI) were used in the research on 2017-03-15 and the second 2019-02-26 provided by .http://landsat.usgs.govcovering an area of 185 km × 185 km (Path168, Row 37).

The following equations are used to calculate spectral evidence:

NDVI = (NIR-RED)/ (NIR + RED) (Abbas, 2010)

(NDWI = NIR +SWIR /2 ……..…(Abbas, 2010)

SI= (Green + Red) / 2 ……(Abbas, 2010)

Results and Discussion

The hydrological analysis of the study area shows that it represents a water catchment basin with a river network consisting of seven orders and 7464 km^2 of area, the length of the Tigris River within the study area is 99 km. Where the main basin consists of four secondary basins are the Turskh basin network, Badra basin, Chabab basin, and the basin network, Figure (1), this is consistent with what was mentioned by Al-Saadi (2014) and Sahar (2016).

Kut dam located on the Tigris River its regulate water movement and distribution to the north of the study area and passes remaining water towards the south. Usually the water year in Iraq is calculated from the beginning of November to the end of September for the following year, table (1) represents the rates of water discharge from Kut dam to the study area estimated m^3 /s, table (2) indicates the rates of water flow from the eastern basins in the form of floods. Table (3) shown the quantity of rainfall during the years of study (Ministry of Transport Meteorological and Seismic Authority, 2019). It is evident from the information in the tables, increased water releases from the Kut dam during the winter and spring months, as well as rainfall during the same period. However, there was a fluctuation in the quantities of water during the years of research, there was a clear increase in the quantities of water during 2018-2019, the increase in the amount of water affected the indicators of the spectral evidence, it was the value of NDVI for the image that captured on 15 / 03 / 2017 was low ranging between (-0.999876 to +0.550579) Image (1). While the value of the NDVI in the image which captured on 26/02/2019 ranged between - 0.318538 to + 0.583937 Image (2) , note that the standard value of the NDVI is (-1 to +1). The area of vegetation cover for the first image is722 km^2 and for the second image is 1690 km^2, the reason is due to increased amounts of rain and water imports in the Tigris River which helped to increase the agricultural area especially rain fed agriculture in addition to increasing the growth of natural plants, this is consistent with what was explained by Al-Badiri (2018) and Yunus *et al*. (2015).

As for the salinity index SI, the Figures (4) and (5), showing a difference in the area of the salinity cover which reached 877 km^2 in the Figure (4) and then receded in the Figure(5) to 682 km^2. With a decrease of 22% due also to increased imports of water and rain for the season 2018 - 2019, The Figure (4) also show the concentration of salts in the northern and eastern part of the study area in the season 2017 -2018, while the Figure (5) shows a decrease in the area and amount of salt cover due to the erosion and melting of salts in rain water and water slopes as shown in Table No2, this is consistent with the results of Al-Aaragi 2012

For the NDWI, it is clear from the Figures (6) and (7), the area of water cover for Image that captured on 15 / 03 / 2017 reached 111.02 km^2 while 546.66 km^2 the other image, This is a good indicator shows the places of storage and collection, through this indicator can determine the areas of flood discharge or storage, and this is important in water management. This is consistent with the findings of Abbas 2010 and Al-Aaragi 2012.

Table 1 : Monthly discharge to the study area in the column of the Tigris River

Sep	Aug	July	Jun	May	Apr	March	Feb	Jan	Des	Nov	Oct	Discharge / Water Year
194	190	164	160	162	151	189	179	157	180	130	164	2017/2018
240	250	270	285	612	712	413	290	182	217	177	195	2018/2019

Table 2 : The flood water from the eastern valleys of the study area

Sep	Aug	July	June	May	Apr	March	Feb	Jan	Des	Nov	Oct.	Discharge / Port
0	0	0	20	20	20	22	25	25	25	20	0	Turskh
0	0	0	10	25	25	25	20	20	25	20	0	Badra
0	0	0	0	60	120	100	80	30	53	31	0	Chabab
0	0	0	30	105	165	147	125	75	103	71	0	Total

Table 3 : Represents the monthly total rainfall in Kut station based on the data of the Ministry of Transport, Meteorological and Seismic Authority.

Sep	Aug.	July	June	May	Apr	March	Feb	Jan	Des	Nov	Oct	The amount of rain / Year mm
0	0	0	**0**	**0**	11.6	48	46.8	3.2	3.1	1.4	0	2017/2018
0	0	0	0	0	26.4	46.2	46.7	30.3	220.4	57.6	0	2018/2019

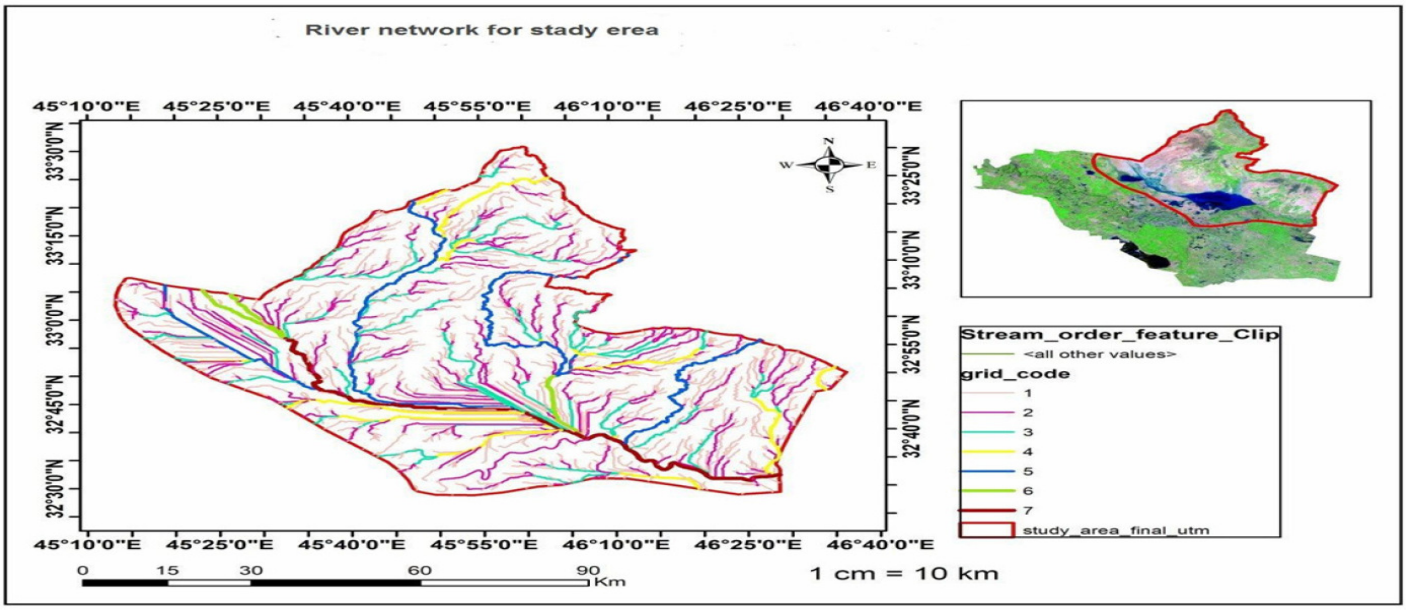

Fig. 1 : represented the river orders in the study area

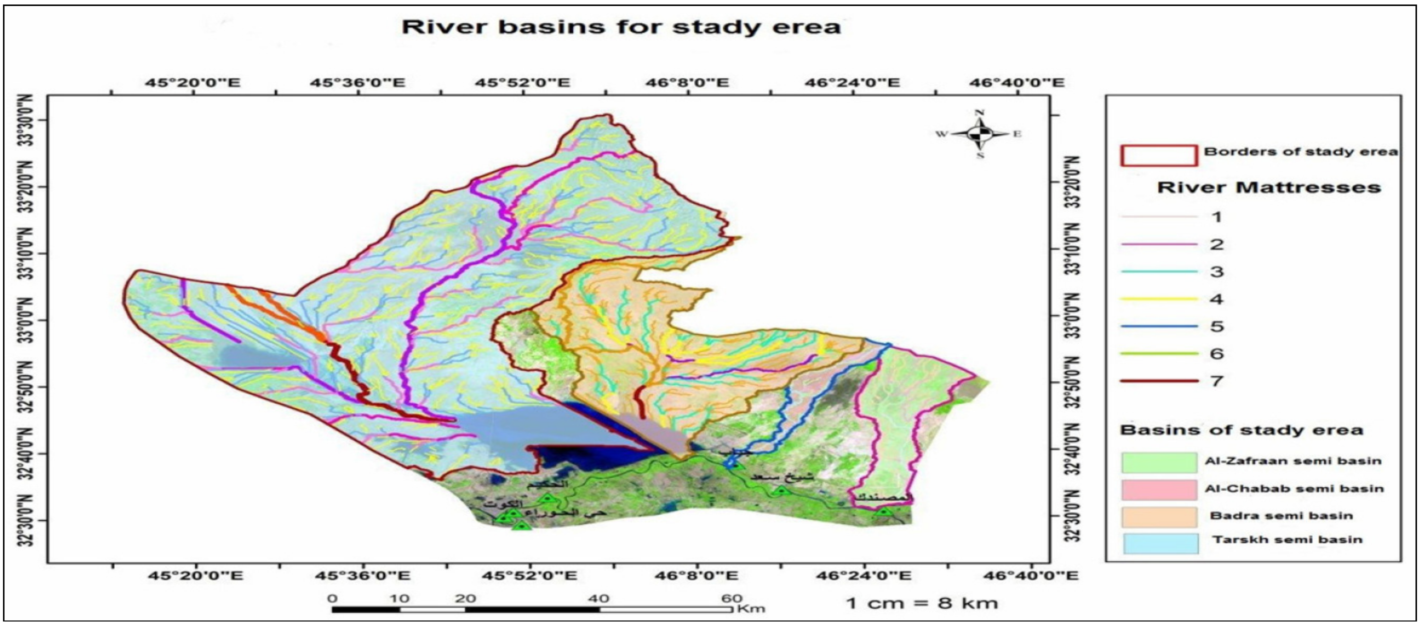

Fig. 2 : Represents secondary basins in the study area

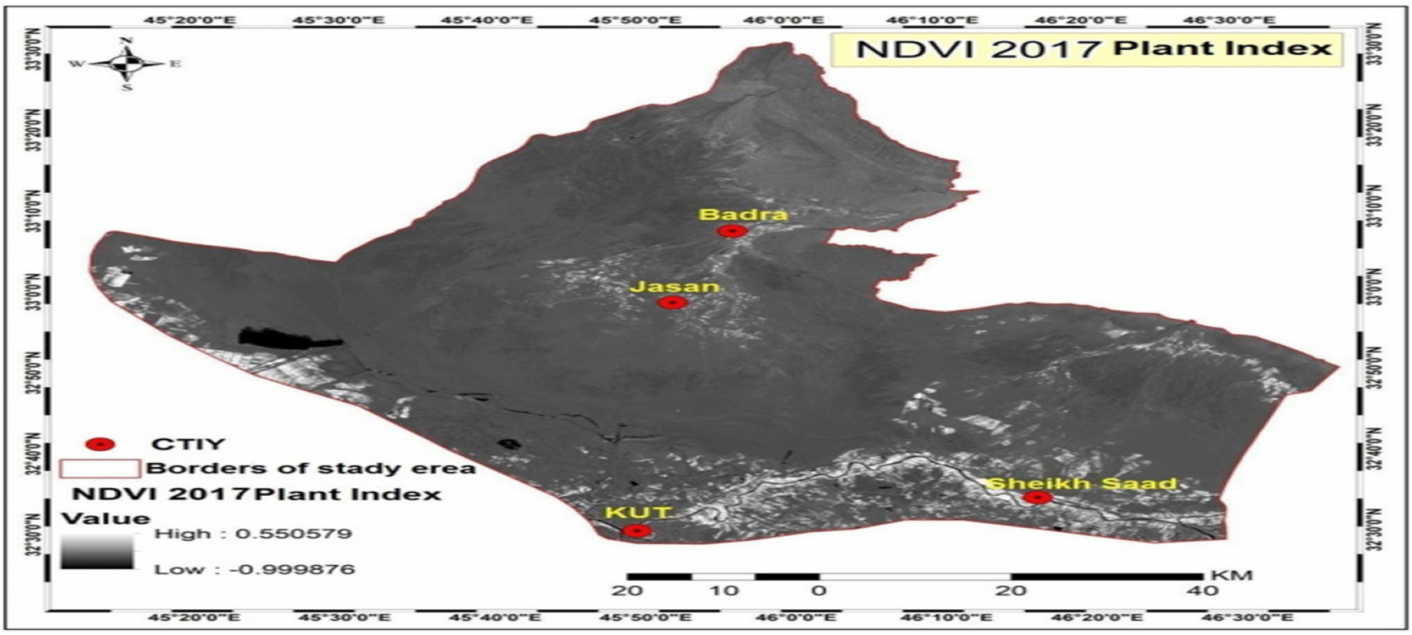

Fig. 3: NDVI For the 2017 study area

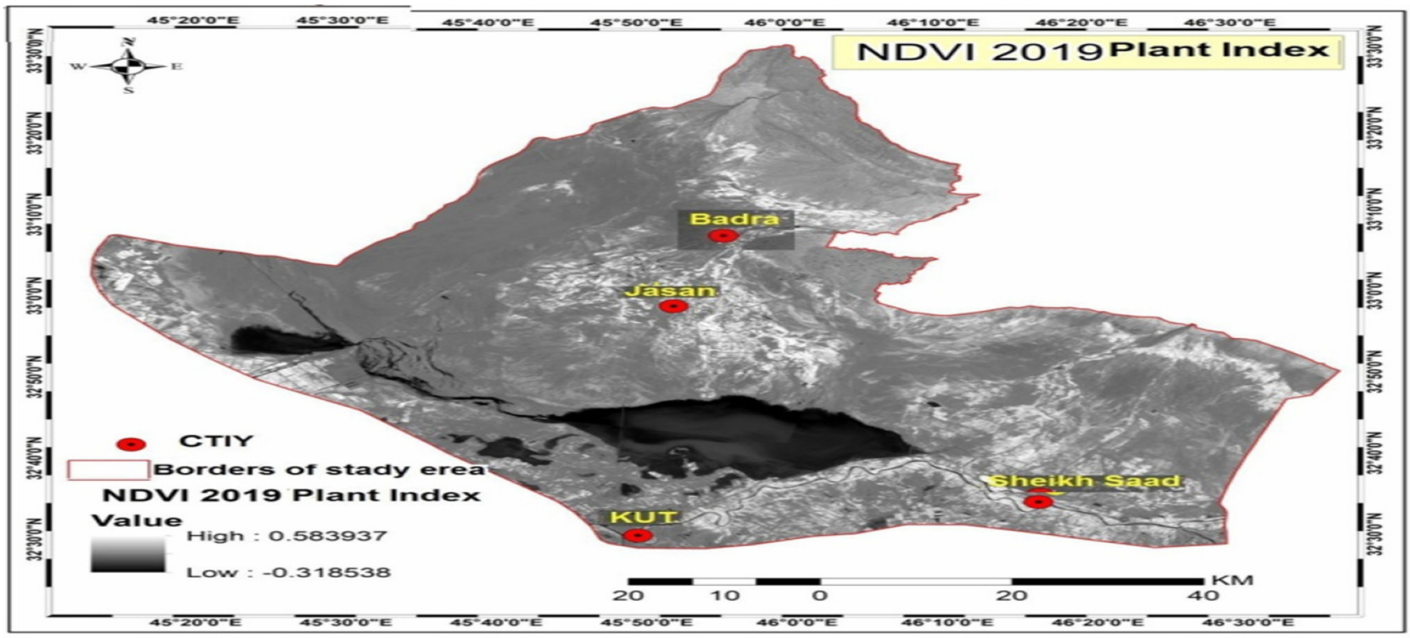

Fig. 4: NDVI For the 2019 study area

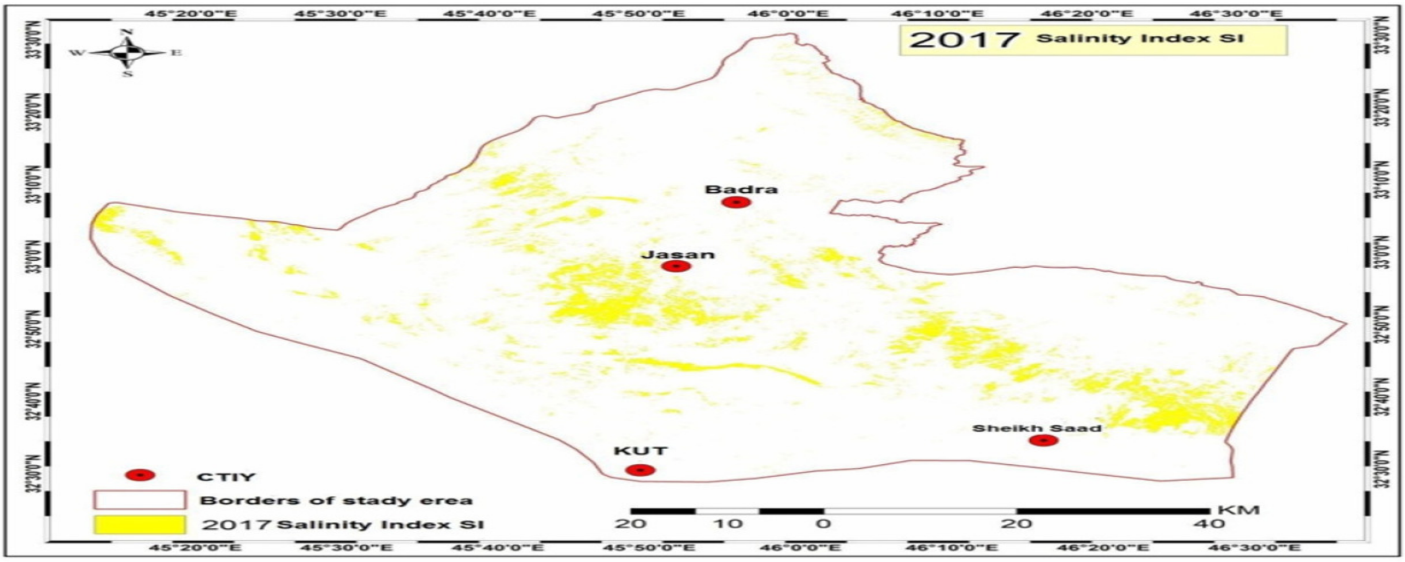

Fig. 5 : SI For the study area 2017

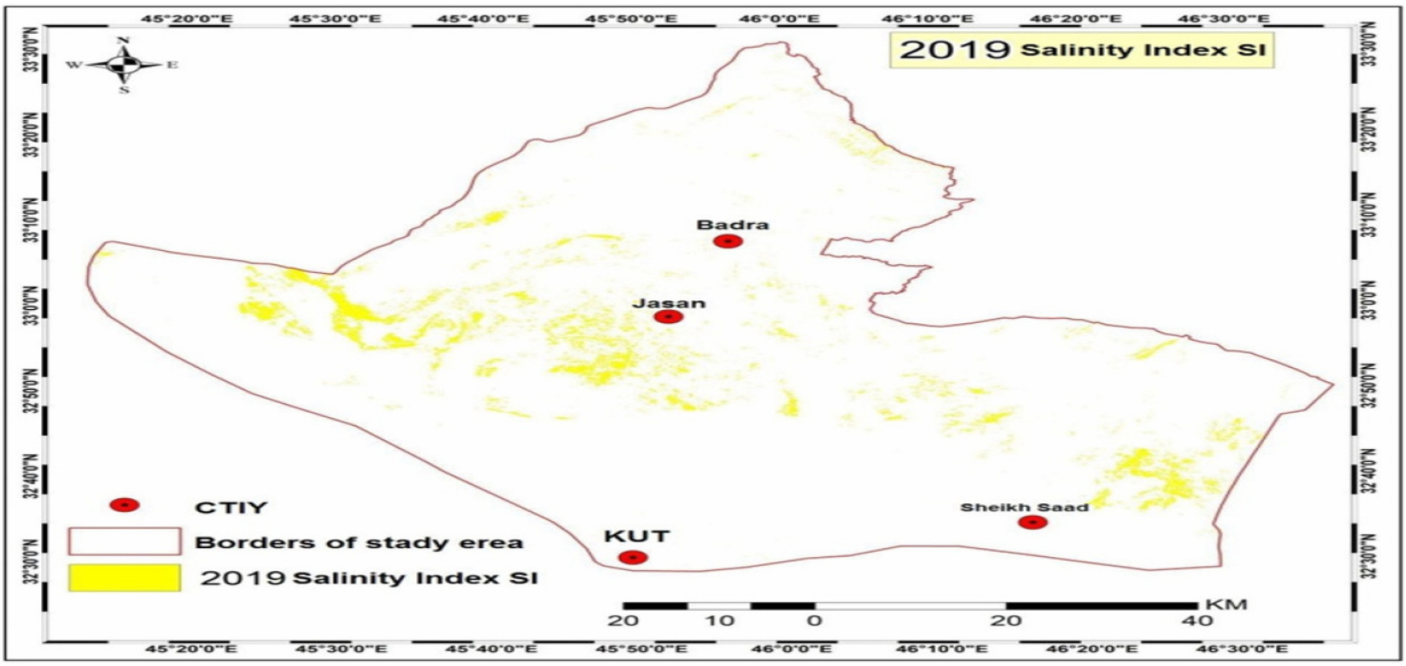

Fig. 6 : SI For the study area 2019

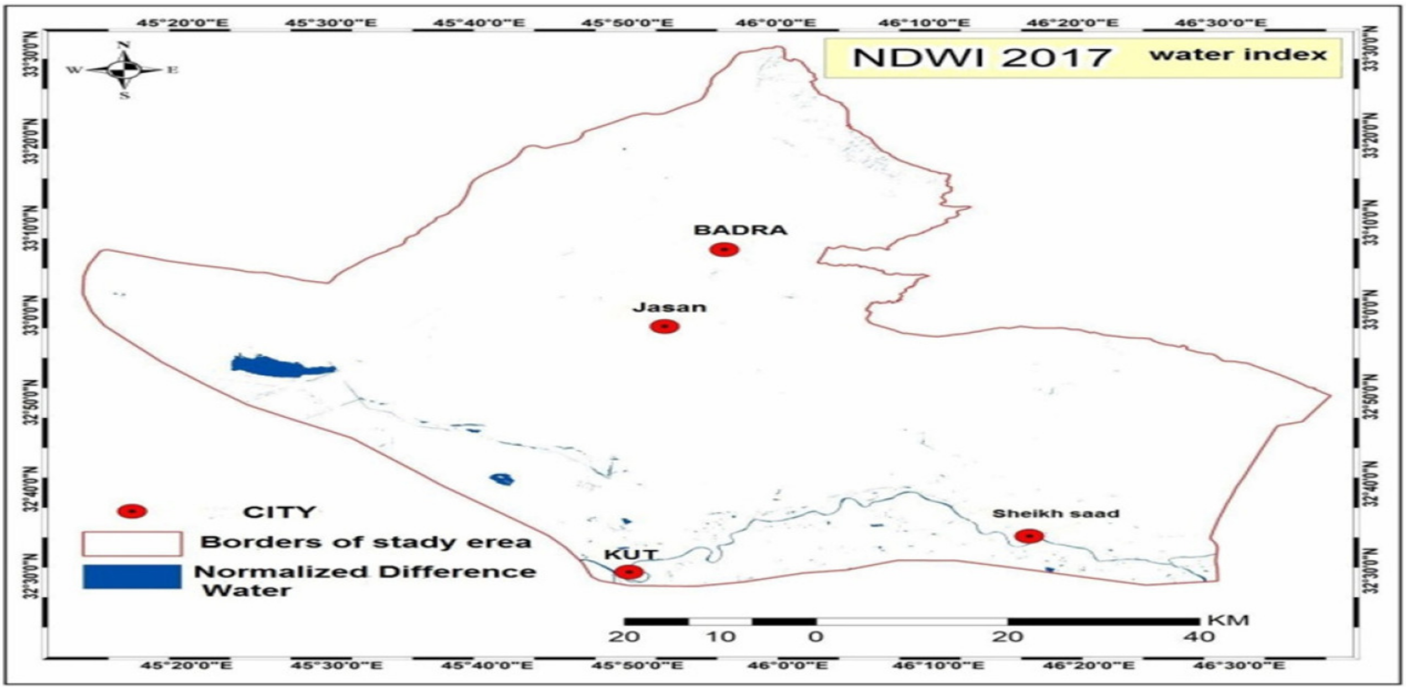

Fig. 7 : NDWI For the study area 2017

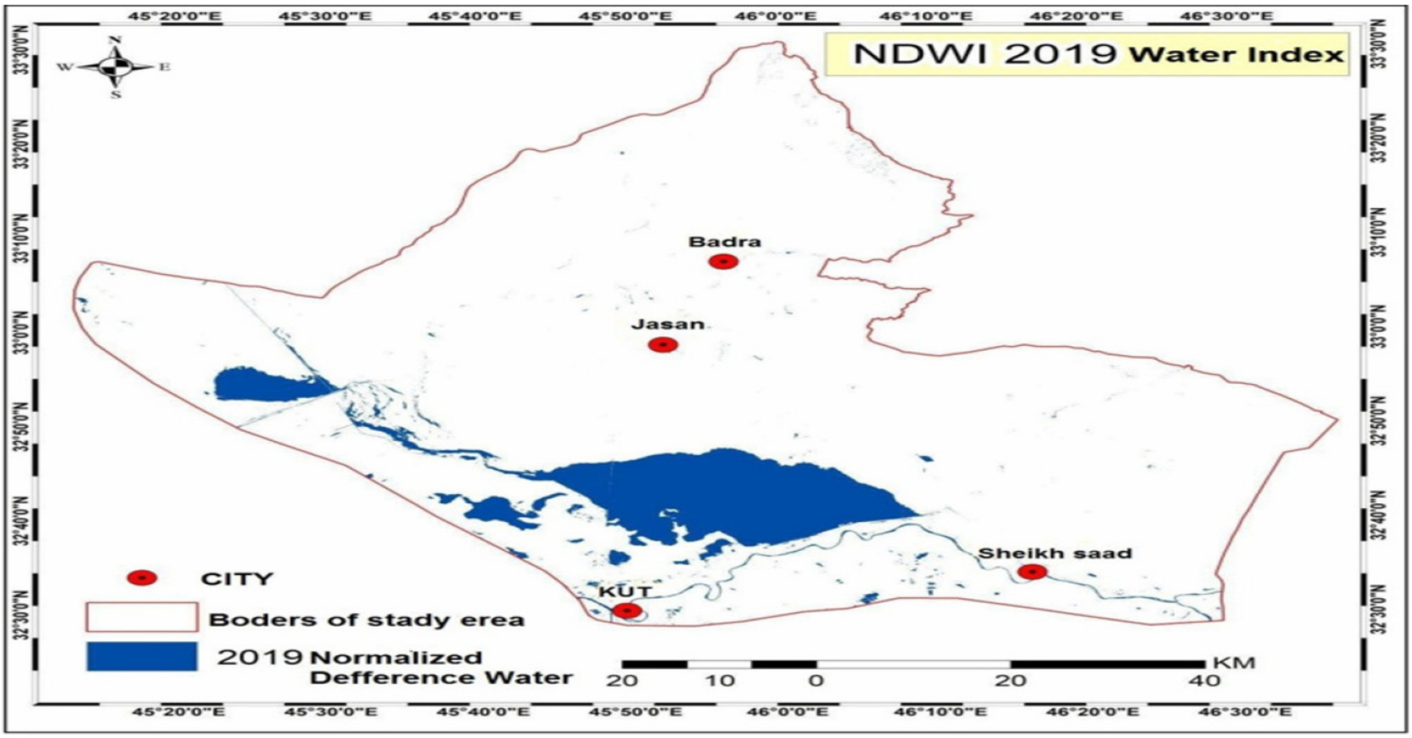

Fig. 8 : NDWI For the study area 2019

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