Evaluation of Ground Water Quality For AL Shuwayja area –Wasit Provence Using GIS Technique

Dr. Ali Nasser Hilo

Civil Engineering Department – University of Wasit

ABSTRACT

The low level of water in rivers in Iraq leads to poor water quality, on that basis; we need to assess Iraq's water resources for uses of irrigation and drinking water. This study present a model accounts for ground water quality by using a water quality index (WQI) for the region defined between the city of Kut and the city of Badra in Wasit province. this study relies on a system of wells set up along the path through the Badra –Kut and around it up to 78 wells. The study showed poor quality of ground water in the region of study and it is unsuitability for irrigation and drinking water, as well as provided a solution to the water accumulated in the Shuwayja to reduce the bad effect on groundwater by using a system of branch and collection canals then pumping at the effluent of Al Shuwayja in seasons of rainy season ..Water quality index calculated depend on the basis of various physic-chemical parameters as PH, Ec , TDS, TSS, Nacl , SO4 ,Na , and Mg.

The resultant and analytical are present with use of Arch GIS program – geostastical analysis for the water index and water quality parameters.

دراسة نوعية المياة الجوفية في الشويجة ضمن محافظة واسط باستخدام تقنية ال GIS

م.د.علي ناصر حلو

جامعة واسط/ كلية الهندسة/ قسم الهندسة المدنية

الخلاصة:

ان انخفاظ مناسيب مياة الانهر في العراق يؤدي الى رداءة نوعية المياة ، على هذا الاساس نحتاج الى تقييم مصادر المياة في العراق للاستخدامات الخاصة بالري ومياة الشرب . هذة الدراسة تقدم نموذج حسابات لنوعية المياة الجوفية باستخدام مؤشر نوعية المياة (WQI) للمنطقة المحددة بين مدينة الكوت ومدينة بدرة ضمن محافظة واسط وهذة الدراسة تعتمد على منظومة من الابار انشأت على طول مسار طريق بدرة كوت وما حولة وبحدود 78 بئر . حساب مؤشر نوعية المياة يعتمد على مجموعة من العوامل مثل (PH, Ec , TDS, TSS, Nacl , SO4 ,Na , and Mg) . بينت الدراسة رداءة المياة الجوفية في المنطقة وعدم صلاحيتها للري ومياة الشرب وكذلك قدمت حلا للمياة المتجمعة في منخفض الشويجة لتقليل تاثيرها السلبي على المياة الجوفية باستخدام منضومة قنوات ثم محطة ضخ في مخرج هور الشويجة في المواسم ذات الغزارة المطرية . النتائج والتحليل تمت باستخدام برنامج GIS وملحقة الاحصائي .

INTRODUCTION

Climate change will increase temperatures and change rainfall across Tigris river catchment area and source of river, this will modify patterned of river flow and ground water recharge, affecting the availability of water and water quality. the study present an evaluation the water quality of ground water for an important area in Iraq wasit province extended between al kut and baddra city, the area under study known al Shuwayja marshes that was dry in last few years ago as in fig (1), the area of study recharge ground water from Tigris river and flood coming from mountain border with Iran. the present study investigate the ground water in the area of study as a water resources intended to serve isolated area that west of jassan and how to use the large stream of water stored in aquifers in on temporary deposit (2).

Samples and laboratory works:

Groundwater can be found almost everywhere. The water table may be deep or shallow; and may rise or fall depending on many factors. The heavy rains or recharges from Tigris River as in this study, or recharge from al Shuwayja marsh in the state when the water fill the Shuwayja marsh

Samples of ground water are collected from well net work of pore wells which were distributed a long al kut badraa road and around it it all over 78 samples were obtained during the period of march 2009 , and the list of samples are tabulated in table (3) . the samples of each well testes in the laboratory of civil engineering of wasit with the use of equipments of WTW company to determined the parameters of water quality as PH , ,Ec , TDS, TSS, Nacl , SO4 ,Na , and Mg (1).

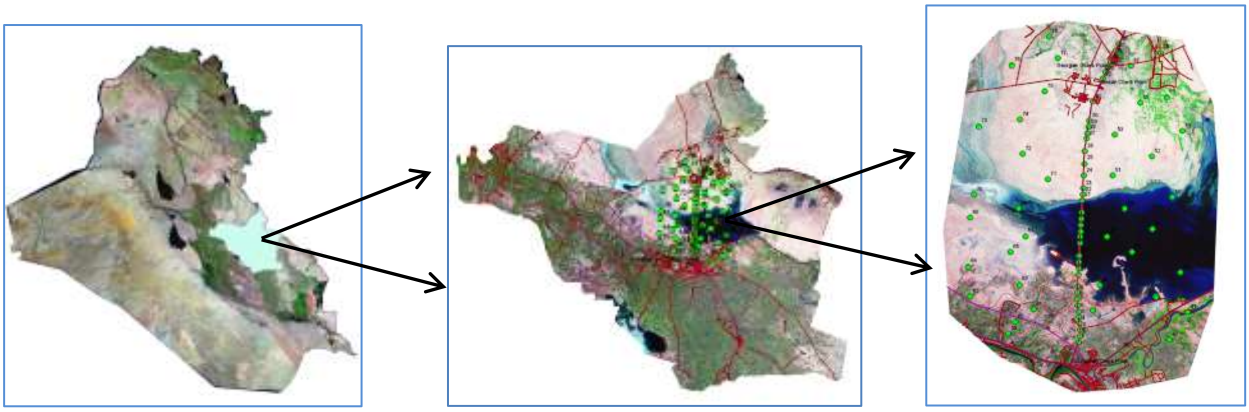

Fig. (1): Location of area of Study

WATER QUALITY INDEX (WQI)

Water quality index (WQI) has been calculated by using the standard of drinking water quality recommended by (WHO), the weight arithmetic index method has been used for calculation of (WQI) as in table (1) where (1)(3).

On the quality rating of sub index (qn) by

$$q_n = \frac{[V_{actual} - V_{ideal}]}{[V_{standard} - V_{ideal}]} \quad \ldots\ldots (1)$$

Where

n: water quality parameter and quality rating or sub index (q_n) corresponded to n^{th} parameters

q_n : Quality rating for the n^{th} water quality parameter.

V_{actual} : Value of water quality parameters obtained for laboratory test.

V_{ideal} : Value of water quality parameters obtained for standard test and for PH=7 and for other parameters is equal to zero.

And let

$$W_n = K/S_n \quad \ldots\ldots (2)$$

Where:

W_n: Unit weight of the n^{th} parameters

S_n : Standard value for the n^{th} parameters

K: constant for proportionally

And for overall water quality index

$$WQI = \sum q_n W_n / \sum W_n \quad \ldots\ldots (3)$$

Based on above WQI values of ground water quality are list in table (2).

Table (1): Standard of Water Quality Depend on WHO Criteria

Parameter	standard (who) (x)	1/x	unit weight
ph	8.5	0.11765	0.694083
EC	300.0	0.00333	0.019666
TDS	1200.0	0.00083	0.004916
TSS	500.0	0.00200	0.011799
NACL	300.0	0.00333	0.019666
SO4	250.0	0.00400	0.023599
NA	200.0	0.00500	0.029499
MG	30.0	0.03333	0.196657
		0.1695	0.999884

GENERATION OF MAPS

The water quality index data was establish from the sample location for the regions bounded by and are tabled in an axel table with sample number , coordinates E, N , PH, Ec , TDS, TSS, Nacl , SO4 ,Na , and Mg. The calculation of water quality index tabulated by the using of equation of part with the dependency of water quality by WHO, each well with the water quality parameters obtained the water quality index as in table (3) .

Data digitized by Arc Map 9.2 software by using the technique of stastical. The analysis of water quality parameters with the study area are showing in plates (plate 1-6), (5) (6).

Table (2): Water Quality Index (WQI) and Status of Water Quality

WATER QUAILTY INDEX	DESCRIPTION
0-25	EXCELLENT
26-50	GOOD
51-75	POOR
76-100	VERY POOR WATER QUALITY
100	Unsuitable for drinking and irrigation

Table (3): Wells system location in study area

well No.	E	N	Z	well No.	E	N	Z	well No.	E	N	Z	well No.	E	N	Z
1	575437.0			23	576143.0	3626558.0	17.3	45	591557.7	3612089.6	17.3	67	558281.6	3619879.8	16.2
2	575652.0	3603084.0	16.6	24	576243.0	3627543.0	18.8	46	583880.2	3614132.3	17.4	68	565954.8	3622797.5	15.0
3	575628.0	3603993.0	16.0	25	576326.0	3629505.0	19.6	47	579936.3	3617457.4	16.6	69	558890.3	3624279.6	15.5
4	575546.0	3605033.0	15.6	26	576399.0	3631435.0	22.0	48	587170.0	3619818.0	16.2	70	570560.4	3626561.4	16.7
5	575459.0	3605995.0	15.0	27	576701.0	3633404.0	24.3	49	582755.6	3620988.8	15.2	71	566588.2	3628885.1	18.8
6	575382.0	3607007.0	15.9	28	576839.0	3635349.0	26.5	50	590289.7	3624330.6	15.7	72	559630.4	3632960.4	22.0
7	575296.0	3607953.0	15.6	29	576993.0	3636323.0	27.6	51	580785.2	3626105.8	17.3	73	566155.2	3637363.3	26.5
8	575197.0	3608959.0	16.2	30	577139.0	3637302.0	28.7	52	587061.0	3629487.4	19.6	74	570061.9	3638399.7	28.7
9	575244.0	3609941.0	17.4	31	577661.0	3638293.0	29.9	53	581164.0	3632625.9	24.3	75	564834.2	3642921.7	33.0
10	575302.0	3610901.0	17.7	32	579267.0	3641213.0	33.0	54	591856.6	3635979.4	27.6	76	572175.6	3647051.8	33.9
11	575399.0	3611890.0	17.3	33	579705.0	3644953.0	33.5	55	585221.5	3636573.4	29.9	77	570749.7	3648107.6	34.8
12	575464.0	3613844.0	17.2	34	580077.0	3645893.0	33.9	56	589399.1	3641024.5	33.5	78		3651704.7	39.5
13	575515.0	3614838.0	17.4	35	580508.0	3646695.0	34.0	57	583699.1	3642006.1	34.0				
14	575572.0	3615780.0	17.2	36	580895.0	3647621.0	34.8	58	588386.3	3646969.7	37.0				
15	575678.0	3616787.0	16.6	37	581343.0	3648472.0	37.0	59	564293.7	3649057.7	41.0				
16	575720.0	3618721.0	16.2	38	581780.0	3649446.0	39.5	60	565401.3	3604365.0	16.6				
17	575780.0	3619727.0	16.2	39	582043.3	3650379.0	41.0	61	568287.6	3606191.8	15.6				
18	575820.0	3620661.0	15.0	40	589754.0	3601762.7	16.6	62	558286.5	3608288.0	15.9				
19	575876.0	3621622.0	15.2	41	592726.0	3603323.5	16.0	63	566056.1	3610301.1	16.2				
20	575932.0	3622632.0	15.5	42	577642.9	3607896.6	15.0	64	557961.7	3612182.0	17.7				
21	576022.0	3623624.0	15.7	43	587705.7	3608152.6	15.6	65	564677.2	3615063.9	17.2				
22	576079.0	3625586.0	16.7	44	578757.9	3610213.0	17.4	66	567040.1	3617305.4	17.2				

Table (4): Wells System Water Parameter Quality and WQI for each Well

well No.	ph	EC	TDS	TSS	NaCL	SO4	Na	Mg	sum (qn)	wn *Qn	wqi
1	7.72	10430.0	7300.0	9400.0	5800.0	1000.0	1000.0	674.2	20794.69	844.6779	844.7624
2	7.75	20000.0	14000.0	18000.0	11000.0	1000.0	431.0	589.0	36094.52	1071.291	1071.398
3	7.8	33000.0	17100.0	22700.0	14200.0	1000.0	503.0	602.7	48107.85	1305.122	1305.252
4	7.99	33630.0	23541.0	29110.0	18496.5	1000.0	387.0	596.0	58649.27	1490.203	1490.352
5	8.10	16234.0	11340.0	14710.0	8928.7	1000.0	512.0	599.0	29890.75	963.839	963.9354
6	8.13	10720.0	7500.0	9648.0	5430.0	1000.0	563.0	613.0	19795.12	786.1802	786.2588
7	7.78	11250.0	7900.0	10200.0	6310.0	1000.0	689.0	623.1	21972.19	834.2659	834.3493
8	7.54	10733.0	7521.0	9608.7	5909.0	1000.0	1000.0	7240.0	43059.84	5147.767	5148.282
9	8.11	18410.0	12900.0	16600.0	10800.0	1000.0	1000.0	599.8	35113.35	1064.676	1064.783
10	7.65	32760.0	22402.0	24033.0	11543.0	1000.0	1000.0	6700.0	63995.12	5201.168	5201.688
11	7.66	10580.0	7421.0	9456.0	5800.0	1000.0	1000.0	10000.0	51951.97	6948.026	6948.721
12	7.4	23476.0	14326.0	14231.0	2314.0	1000.0	1000.0	2740.8	26611.72	2159.514	2159.73
13	7.68	19564.0	8429.0	9119.0	4607.0	1000.0	1000.0	4530.0	34343.9	3380.43	3380.768
14	7.83	17734.0	9544.0	11070.0	5300.0	1000.0	1000.0	2760.9	29706.02	2243.196	2243.42
15	7.94	19016.0	7438.0	9624.0	5820.0	1000.0	1000.0	6431.4	42943.65	4669.56	4670.027

16	7.61	10843.0	7694.0	9655.0	5986.0	1000.0	1000.0	10000.0	52474.19	6957.663	6958.359
17	7.52	10646.0	7560.0	9760.0	5922.0	1000.0	1000.0	10000.0	52290.35	6954.041	6954.736
18	7.85	11090.0	7780.0	9980.0	6100.0	1000.0	1000.0	7114.3	43237.69	5076.369	5076.876
19	7.62	30101.0	17120.0	19140.0	5590.0	1000.0	1000.0	10000.0	60784.02	7094.755	7095.464
20	7.62	29113.0	19790.0	21102.0	6206.0	1000.0	1000.0	10000.0	62301.59	7118.258	7118.97
21	7.66	25486.0	11726.0	14934.0	5950.0	1000.0	1000.0	10000.0	58674.99	7066.505	7067.212
22	8.11	12100.0	8344.0	10325.0	5700.0	1000.0	1000.0	1462.0	24049.35	1369.797	1369.934
23	7.90	12377.0	8590.0	11046.0	6750.0	1000.0	1000.0	2105.0	28549.72	1835.525	1835.708
24	8.21	15780.0	11078.0	13542.0	6700.0	1000.0	1000.0	1087.0	26897.25	1196.696	1196.816
25	8.5	16900.0	11830.0	15210.0	4320.0	1000.0	1000.0	1004.0	22630.19	1060.213	1060.319
26	7.97	11540.0	8082.0	9400.0	5800.0	1000.0	1000.0	987.5	22191.83	1000.128	1000.228
27	7.75	10811.0	7578.0	9732.0	5341.0	1000.0	1000.0	8705.4	46863.92	6085.074	6085.683
28	7.78	22044.0	12356.0	15895.0	5523.0	1000.0	1000.0	6797.0	46159.33	4876.613	4877.101
29	7.74	33077.0	9360.0	12044.0	7360.0	1000.0	1000.0	5969.6	49815.49	4526.895	4527.348
30	8.0	18000.0	12600.0	16200.0	6900.0	1000.0	405.0	2023.0	31435.83	1772.567	1772.744
31	7.72	18312.0	7504.0	9648.0	5432.0	1000.0	400.0	1326.6	24544.93	1243.482	1243.606
32	8.31	19700.0	14000.0	17730.0	6300.0	1000.0	336.0	1478.0	29374	1406.643	1406.784
33	7.90	10743.0	8521.0	9668.0	5921.0	1000.0	473.0	1923.0	25113.18	1604.829	1604.989
34	7.88	30500.0	21400.0	12500.0	18100.0	1000.0	774.0	1074.5	55018.67	1675.599	1675.767
35	8.61	32760.0	18610.0	24333.0	11235.0	1000.0	679.0	334.0	41660.27	960.8105	960.9066
36	7.90	7100.0	5000.0	6400.0	3800.0	1000.0	399.0	93.5	12574.5	289.9944	290.0234
37	8.02	8900.0	6100.0	8100.0	4900.0	1000.0	640.0	116.5	16003.33	368.22	368.2568
38	7.88	12400.0	8700.0	11200.0	7000.0	1000.0	505.0	525.5	23502.5	747.9521	748.0269
well No.	ph	EC	TDS	TSS	NaCL	SO4	Na	Mg	sum (qn)	wn *Qn	wqi
39	7.72	10430.0	7300.0	9400.0	5800.0	1000.0	1000.0	674.2	20711.99	787.4803	787.5591
40	7.75	20000.1	14000.1	18000.1	11000.1	1000.1	431.1	589.1	36012.51	1014.166	1014.267
41	7.8	33630.0	23541.0	29110.0	18496.5	1000.0	387.0	596.0	58566.57	1433.006	1433.149
42	7.99	10720.1	7500.1	9648.1	5430.1	1000.1	563.1	613.1	19713.11	729.0554	729.1283
43	8.10	10733.0	7521.0	9608.7	5909.0	1000.0	1000.0	7240.0	42977.15	5090.569	5091.078
44	8.13	32760.1	22402.1	24033.1	11543.1	1000.1	1000.1	6700.1	63913.11	5144.043	5144.558
45	7.78	23476.0	14326.0	14231.0	2314.0	1000.0	1000.0	2740.8	26529.02	2102.316	2102.526
46	7.54	17734.1	9544.1	11070.1	5300.1	1000.1	1000.1	2761.0	29624.01	2186.071	2186.289
47	8.11	10843.0	7694.0	9655.0	5986.0	1000.0	1000.0	10000.0	52391.49	6900.465	6901.155
48	7.65	11090.1	7780.1	9980.1	6100.1	1000.1	1000.1	7114.4	43155.68	5019.244	5019.746
49	7.66	29113.0	19790.0	21102.0	6206.0	1000.0	1000.0	10000.0	62218.89	7061.06	7061.767
50	7.4	12100.1	8344.1	10325.1	5700.1	1000.1	1000.1	1462.1	23967.34	1312.672	1312.804
51	7.68	15780.0	11078.0	13542.0	6700.0	1000.0	1000.0	1087.0	26814.56	1139.499	1139.613
52	7.83	11540.1	8082.1	9400.1	5800.1	1000.1	1000.1	987.6	22192.18	1000.164	1000.264
53	7.67	22044.0	12356.0	15895.0	5523.0	1000.0	1000.0	6797.0	46158.99	4876.577	4877.064
54	7.45	18000.1	12600.1	16200.1	6900.1	1000.1	405.1	2023.1	31436.18	1772.603	1772.781
55	7.33	19700.0	14000.0	17730.0	6300.0	1000.0	336.0	1478.0	29373.66	1406.607	1406.748

56	7.56	30500.1	21400.1	12500.1	18100.1	1000.1	774.1	1074.6	55019.01	1675.636	1675.803
57	7.88	7100.0	5000.0	6400.0	3800.0	1000.0	399.0	93.5	12574.16	289.9581	289.9871
58	8.22	12400.1	8700.1	11200.1	7000.1	1000.1	505.1	525.6	23502.84	747.9884	748.0633
59	8.45	10430.1	7300.1	9400.1	5800.1	1000.1	1000.1	674.3	20712.68	787.5531	787.6318
60	7.78	33000.0	17100.0	22700.0	14200.0	1000.0	503.0	602.7	48025.16	1247.924	1248.049
61	7.89	16234.1	11340.1	14710.1	8928.8	1000.1	512.1	599.1	29808.74	906.7142	906.8049
62	8.34	11250.0	7900.0	10200.0	6310.0	1000.0	689.0	623.1	21889.49	777.0683	777.146
63	7.65	18410.1	12900.1	16600.1	10800.1	1000.1	1000.1	599.9	35031.34	1007.551	1007.652
64	7.45	10580.0	7421.0	9456.0	5800.0	1000.0	1000.0	10000.0	51869.27	6890.829	6891.518
65	7.4	19564.1	8429.1	9119.1	4607.1	1000.1	1000.1	4530.1	34261.89	3323.305	3323.637
67	7.45	19016.0	7438.0	9624.0	5820.0	1000.0	1000.0	6431.4	42860.96	4612.363	4612.824
68	7.83	10646.1	7560.1	9760.1	5922.1	1000.1	1000.1	10000.1	52208.34	6896.916	6897.606
69	7.94	30101.0	17120.0	19140.0	5590.0	1000.0	1000.0	10000.0	60701.32	7037.557	7038.261
70	7.65	25486.1	11726.1	14934.1	5950.1	1000.1	1000.1	10000.1	58592.98	7009.38	7010.081
71	7.75	12377.0	8590.0	11046.0	6750.0	1000.0	1000.0	2105.0	28467.02	1778.327	1778.505
72	7.70	16900.1	11830.1	15210.1	4320.1	1000.1	1000.1	1004.1	22548.18	1003.088	1003.188
73	7.99	10811.0	7578.0	9732.0	5341.0	1000.0	1000.0	8705.4	46781.22	6027.877	6028.479
74	8.20	33077.1	9360.1	12044.1	7360.1	1000.1	1000.1	5969.7	49733.48	4469.77	4470.217
75	8.33	18312.0	7504.0	9648.0	5432.0	1000.0	400.0	1326.6	24544.59	1243.445	1243.57
76	7.78	10743.1	8521.1	9668.1	5921.1	1000.1	473.1	1923.1	25113.53	1604.865	1605.026
77	7.54	32760.0	18610.0	24333.0	11235.0	1000.0	679.0	334.0	41659.92	960.7742	960.8703
78	7.33	8900.1	6100.1	8100.1	4900.1	1000.1	640.1	116.6	16003.68	368.2564	368.2932

Discussions and results:

The main water resources in this area comes from the water as a result of rain over the mountains when the Iran-Iraq border in rainy years and that flow to gather in Shuwayja marsh .This feed water and groundwater, as well as of the Tigris River, fed by seepage from river

The area of study works as a lake of water deposit water in the shallow aquifer and the extra surface water flow to Tigress River by escape canal. During summer and dry season the water in the lack works in the form of lake evaporation. The water quality becomes very bad parameters, and then the water will seep to ground water with bad quality this will lead to make the ground water with very bad quality parameters as in the result of this study.

The study shows that the concentration of water quality parameters may discuses in the following arrangement:

PH: The values of PH of well system around the study area in comparison with who vale are less than the standard when the value around 7

Ec: due to the high salinity observation the values of Ec with high value reach more than 30000 mhos/cm and the distribution of these values around the area of study are show in plate (1)

Nacl: The mean manner of the ground water of the study area are in high of salinity in comparison with standard values of Nacl that the values of nacl of well of study area more than 10000 mg/l the concentration of salinity is very high for the use of ground water in irrigation or for drinking water as shown in plate (2)
Mg: the study show a high concentration of mg more than 7000 , theses values lcate in the center of study and around it as in plate (2)
Na: the distribution of Na shows a high values in the center of when water rest the high values reach more than 1000 as in plate (3) .
NACL: the study show a high concentration of more than 9000 , theses values locate in the area around the center of study as in plate (4)
SO4: plate (5) shows a high concentration of so4 more than 1000 and distributed as a point of concentration.
TDS and TSS: the study show a high values of TDS and TSS more than 20000 and 17000 rcepectily , as in plate (6) and plate (7)

As a result for the above parameters calculations , and by using the water quality index with the criteria of WHO for drinking and iirrigation we find :

1. The ground water quality is unsuitable for drinking and irrigation in comparison with criteria of WHO
2. As in plate (8) we observation that the quality of ground water in comparison with water quality index in the center of study more than 7000% of it and gradually to outside in a radial to concentration of 94%
3. The flood collection in AL Shuwayja in rain –rich season seep to ground water during summer season with bad quality if detention time more than three months
4. The evaporation of water from AL Shuwayja marsh leads to make the water in bad quality.
5. May using a system of branch and collection canals through AL Shuwayja marsh and pumping station at effluent to pumping the flood water to Tigris river during rainy season to reduce the detention time of water and to get a more benefit of flood water.

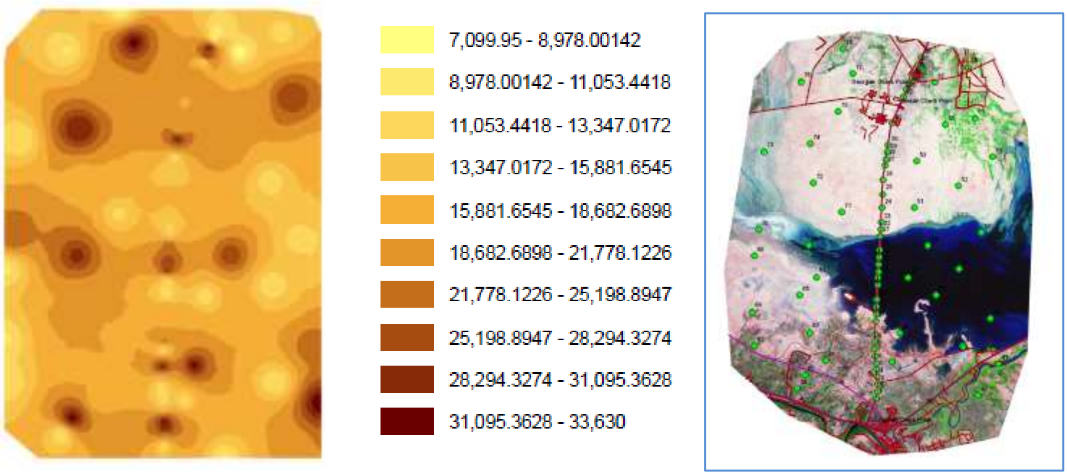

Plate (1): distribution of Ec on study area

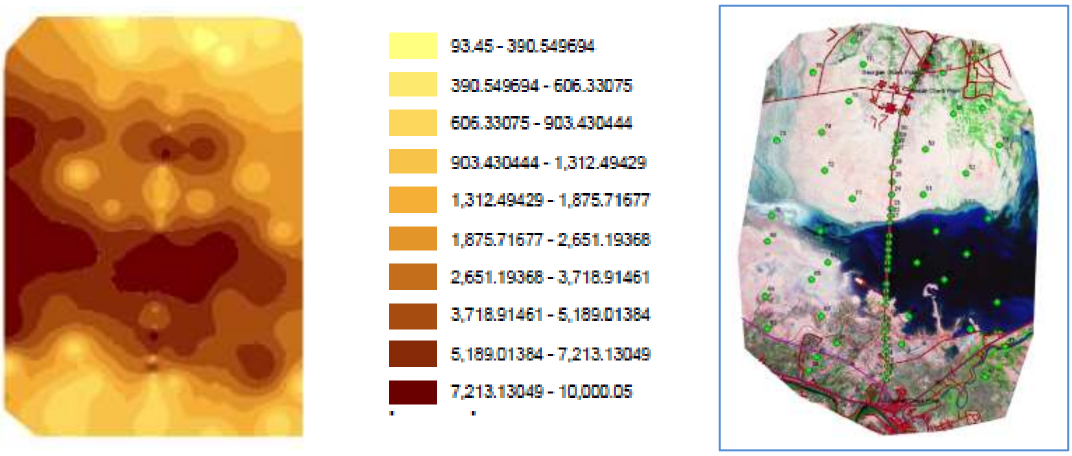

Plate (2): distribution of mg on study area

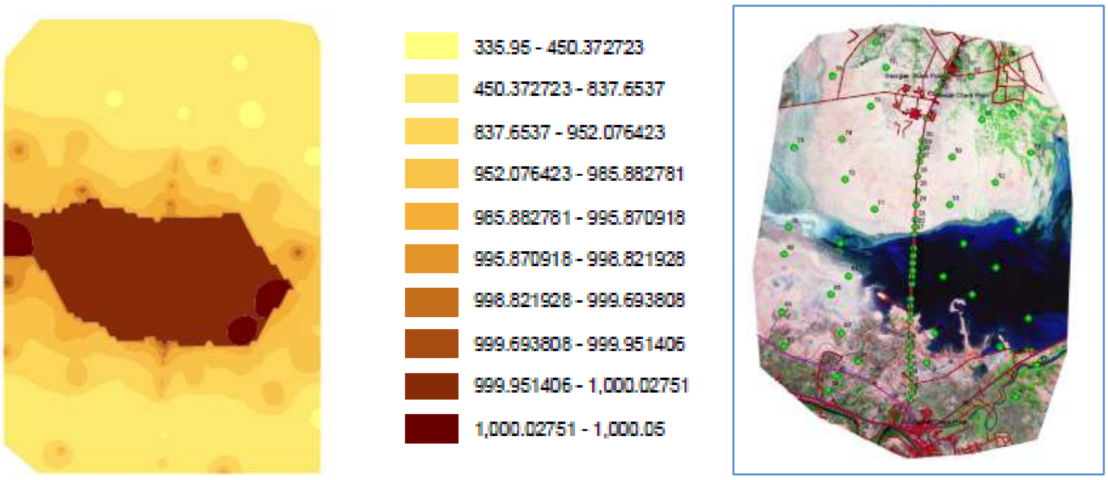

Plate (3): distribution of Na on study area

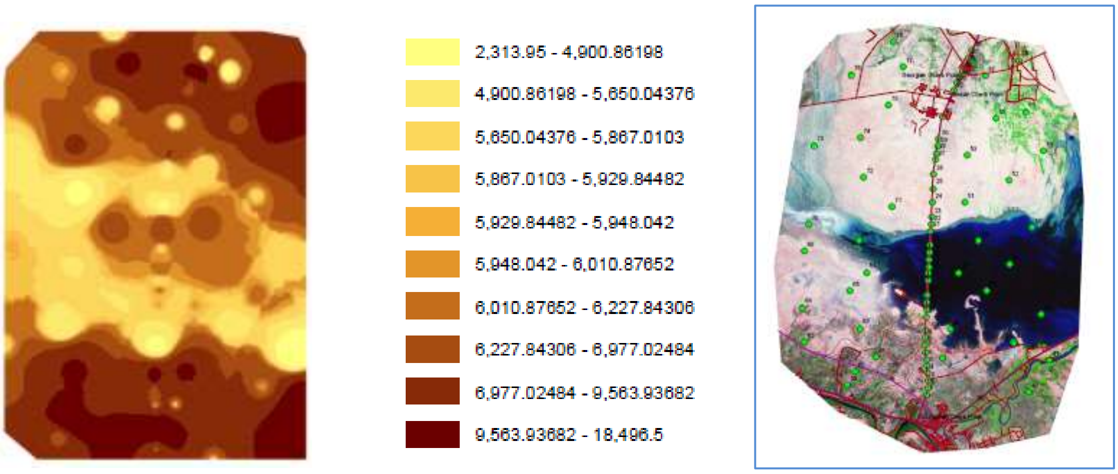

Plate (4): distribution of Nacl on study area

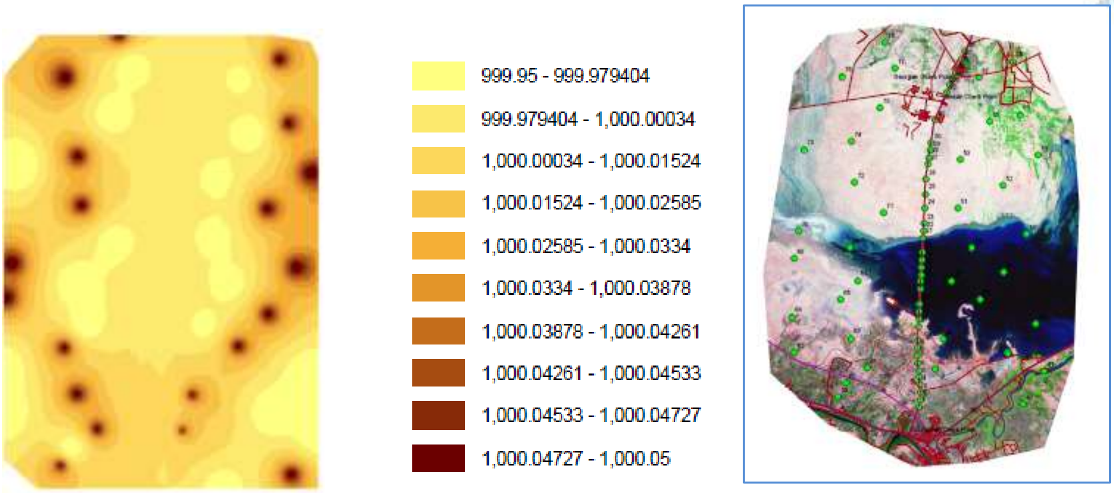

Plate (5): distribution of SO4 on study area

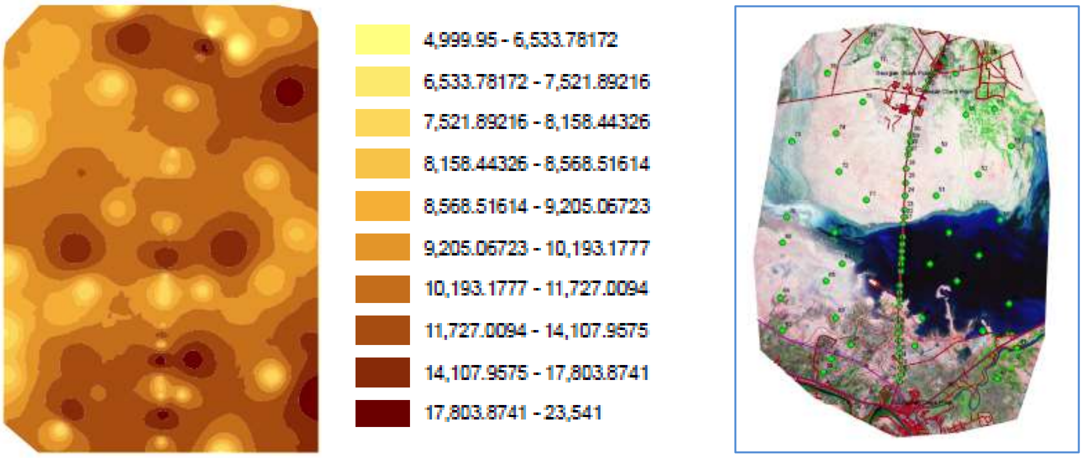

Plate (6): distribution of TDS on study area

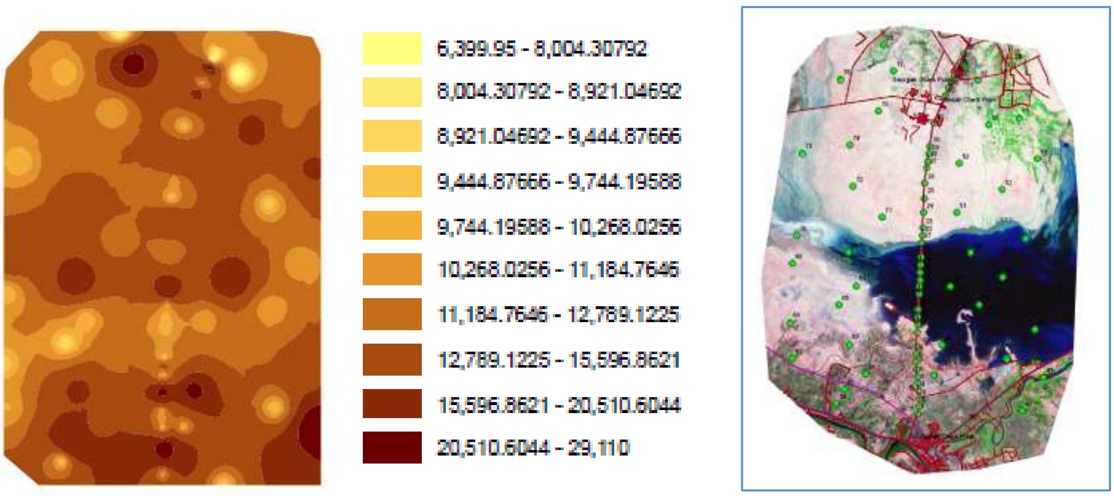

Plate (7): distribution of TSS on study area .

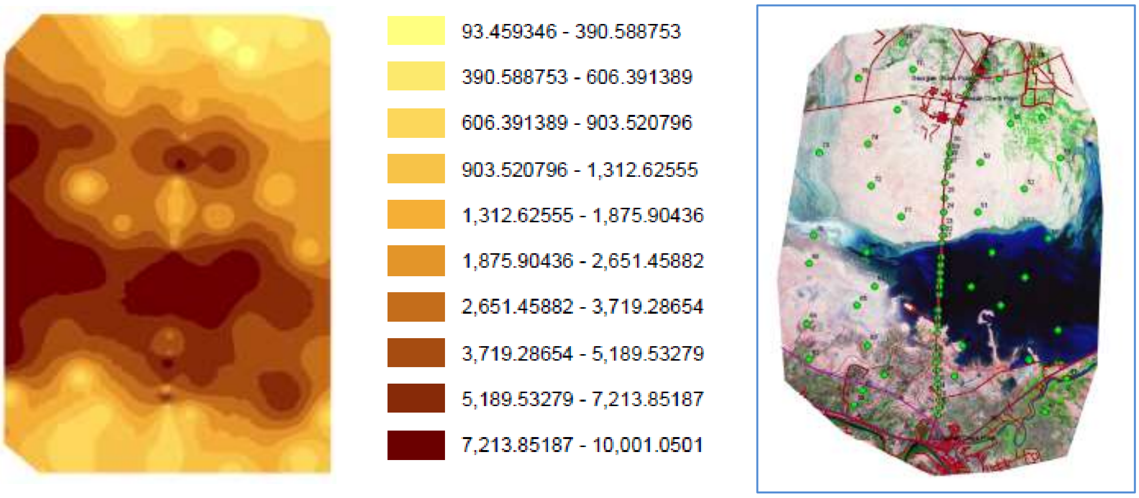

Plate (8): distribution of wqi on study area .

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