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HYDROCHEMICAL ANALYSIS OF GROUNDWATER RESOURCES IN KANAN REGION

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ABSTRACT: - Diyala governorate faces water resources deficiency due to the limited amount of rainfall, drought, and water pollution of Diyala River in addition to the irrational use of water by the residence. The study area (Kannan region) located north east of Baqubba the capital of Diyala governorate depends partially on groundwater as a source of water to meet both agricultural and domestic uses of the region. Several pumping wells has been used for that purposes especially where the surface water is limited. Recently, the surface water has been blocked by transfer it away from the region which enforced residence to relay completely on groundwater. The need of profound hydrochemical study of the region ground water resource become imminent to insure proper groundwater withdrawal and monitor groundwater quality for different uses mainly agricultural and domestic uses. The current study is directed toward investigation of the usability of groundwater for agricultural and domestic uses.

Keywords: ground water, Kanan.

FIELD STUDY DESCRIPTION

The study area is located within Diyala governorate in the middle part of Iraq to the east of Tigris river catchment area. It is located within the flat plain sedimentary region (see fig. (1). from the geological point of view, the region is considered as a recent formation due to river sedimentation from both Tigris and Diyala rivers. This newly sedimentation caused a formation of several perched shallow groundwater spots scattered a way or near the sedimentation areas (Jafer 2011).In most cases, groundwater aquifers in the plain and river valleys are very shallow unconfined within (1 to 5 m) below ground surface. Land exploitation for agricultural uses causes groundwater mining, especially when over withdrawn or unsafe groundwater pumping is practiced. High temperature with very high evaporation rate during the summer season with absent of natural or artificial drainage degrade groundwater quality and increase the amount of water total dissolved solute (TDS). Groundwater located south west of Hamren Hills in Baqubba , Muqdadia , Bldrus and Khan BniSaad are all having very high (TDS)and the current study (Kanan region) is located within the above mention areas (Mohammed 2010). Several wells (about 100 wells) drilled within the study area of Kanan region for both agricultural and domestic uses between 2008 to 2013. The present case study will undertake (25) pumping wells for hydro- chemical investigation see table (1).

PREVIOUS STUDIES

Several studies have been done to evaluate the accessibility of groundwater in Diyala governorate for domestic and agricultural uses. Abd-Allaetal (2010) Evaluate the quality of six shallow wells located east of Diyala River. A comparison had been made between quality of groundwater and Diyala river water quality in order to meet the requirements of WHO standards for agricultural uses. Essaetal (2011) accomplished an environmental study for the nature of Diyala River and Tigris River at the meeting spot for both rivers south of Baghdad. The study showed a clear rise in TDS values and an increase in the concentration of heavy

metals in addition to the rise of bio-Oxygen Demand (BOD). He stated that this due to the groundwater organic contamination nearby the river catchment mainly from sewage waste water. An evaluation study had been done to investigate the usability of groundwater wells in AbuKhames in diyala governorate. The study showed an increase in the value of TDS, Hardness and Sulfate. All the tested parameters lays out of the permissible level using the TODD test. The groundwater has been classified as Brackish with very high hardness value.

FIELD AND LABORATORY TESTS

Twenty five pumping wells were monitored and field data were collected, this include (wells depth, static water table, moving water table, drawdown and well production). The following Chemical ions concentration were measured which include (K^+ , Na^+, Ca^{++}, Mg^{++} , SO_4^{-2}, HCO_3^{-1} , NO_3^{-2} , Cl^{-1} documented using GIS technique) in addition to the following parameters: pH, EC, and TDS.

HYDROLOGICAL INVESTIGATION

Several hydrological parameters have been investigated as Follow:

1. Mining of the aquifer

Groundwater mining occurs where the rate of removal of water exceeds the rate of recharge causing a considerable lowering of water table elevation (Drawdown). Drawdowns of groundwater was investigated in the study area of Kanan due to extensive pumping for both municipal and agricultural uses. The aquifer drawdowns rangesform1.8 to 9.8 m . This enforce the local ground water flow to develop a divide line toward north and south of the region (i.eto ward the pumping wells) as shown in the contour drawdown map and more clearly in the 3-dimensional presentation figures 1 and 2 respectively.

$QC = Q_{pump}/Sw$ …….(1)

Where :Q_{pump} is well pumping discharge in l/s

Sw is groundwater drawdown which is determine as:

Sw= Ds- Dd ……..……(2)

where:

Ds is static water table and

Ddis dynamic water table (after very long time of Pumping)

Table (1) gives the estimated specific capacity of the 25 wells in the region of kanan.

2. Aquifer transmissivity

Aquifer transmissivity can be estimated roughly using the following empirical equation: McWhorter andSunada (1984)

$$\boldsymbol{Q/Sw} = \boldsymbol{T/1.2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (\mathbf{3})$$

Figure (3) shows the counter's map of transmissivity of the region as a rough estimate from the specific capacity of the pumping wells of Kanan region. Results show a very small values of transmissivity range from 27 up to 347 m^2/day. The pumping well depths range from 18 to 25 m below ground surface (i.e the aquifer is considered as a shallow unconfined aquifer).

Ground water Cation concentration

The following Chemical Cations have been measured which include (K^+, Na^+, Ca^{++}, Mg^{++}). Figures (4) shows the level of concentration for the measured Cations in selected pumping wells under study investigation.

Groundwater Anion concentration

Several Anions have been investigated and measured at selected pumping well in the study region which includes: Cl^{-1}, $Hco3^{-1}$, $SO4^{-2}$ and $NO3^{-2}$ as shown in figure (5)

RESULTS AND DISCUSSIONS

Twenty five wells under investigation to evaluate the aquifer capability to be a source of water for domestic and agricultural uses for Kanan region as shown in table (1) .Well depths range from 16 to 26 m below ground surface. The aquifer is considered a shallow groundwater aquifer with very low transmissivity values range from 27- 347 m2/day. Low productivity ranges from 0.26 to 3.33 l/s.m with aquifer mining ranges from 1.5 to 9.8 meter. The chemical analysis considered thirty two wells presented in table 2 and figures 4 and 5.Values of pH ranges from (7.1- 8.44) which give an indication the groundwater in the region is within the low level of alkalinity . The total dissolved salt in the region shows that about 93% exceeded the value of 500 mg/l recommended by EPA for drinking water, 60% of the wells exceeded the 1000 mg/l with six wells having more than3000 mg/l which cannot be used for agricultural purposes. Values for potassium ranges from (0.39- 142 mg/l) with very few well exceeded the recommended value of 15 mg/l for drinking purposes. Almost 43% of wells have exceeded the recommended value of 200 mg/l this is due to the direct influence of agricultural land deep percolation (leaching). In the study area 50% of wells have magnesium concentration greater than 50 mg/l .about 42% of tested well have been greater than the recommended values for the concentration of Calcium as shown in table 2. The concentration of Sulfate ions in about 62% of pumping well exceeded the recommended level and that is due to the nature of agricultural areas and the plant decomposition. Very wide range of the bicarbonate ions concentrations have been seen .Ranges from (11-2899 mg/l) while the nitrate concentration was within the acceptable values for drinking water standard.

CONCLUSIONS AND RECOMMENDATIONS

1. Most of the groundwater pumping wells are not suitable for drinking purposes due to very high concentration of TDS, SO_4, Mg, Ca and Na values.
2. The productivity of all wells are low with very large mining depth reach 9 meters in some cases.
3. Wells number (1, 2, 3, 5, 6, 7 and 9) have acceptable level of concentration to be used for drinking water. This because of their location near to the Kanan river as shown in figure 6
4. Well number 17 has the largest value of TDS due to its location far away from surface water and very close to brick factory and also due to the reuse of drainage water in surrounding area for irrigation purposes due to the lack of surface water (see figure 7).
5. Deep wells in areas far away from Kanan River are recommended to overcome the leaching through deep percolation and increasing the productivity of wells.
6. New wells can be drilled in areas near to river of Kanan to meet the increasing demand for drinking water are recommended.

Acknowledgement

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Table (1): hydrological parameter of pumping wells

Well #	static water depth in m	dynamic water depth in m	Drawdown in m	Well Discharge Q in l/s	Specific Discharge Q/S_w in l/s.m
1	3.5	5	1.5	5	3.33
2	3.5	5	1.5	5	3.33
3	3	5.5	2.5	4	1.6
4	7	14.75	7.75	2	0.26
5	10	15.8	5.8	3	0.52
6	8	10	2	4	2
7	12	15	3	1.5	0.5
8	7	13.8	6.8	5	0.74
9	10	12	2	4	2
10	11	13	2	4	2
11	8	10	2	3.5	1.75
12	16	18	2	3	1.5
13	9	13	4	2.5	0.63
14	13	19	6	2.5	0.42
15	12	16	4	2	0.5
16	8	12	4	3	0.75
17	12	15	3	2	0.67
18	10	15	5	3.5	0.7
19	10	15	5	3	0.6
20	9	14	5	3	0.6
21	13	16	3	1.5	0.5
22	5	14.8	9.8	5	0.51
23	11	15.9	4.9	4	0.82
24	11	15	4	1.5	0.38
25	9	12	3	3	1

Table (2): Measured quality parameters with concentration values for the Anions and Cation in mg/l

Well #	PH	TDS	NO_3	HCO_3	SO_4	Cl	Ca	Mg	Na	K
1	7.8	507	4	67.1	101	142	50.1	20.63	67	1.5
2	7.1	374	4	43	86.4	124	34.06	19.4	60	1.5
3	7.22	763	0.6	128.2	139.2	216	72.1	42.4	90	0.7
4	8.26	2500	13.5	266	770	493	211	11.2	380	2.45
5	8.44	420	0.11	66	120	55	21	14.16	69	1.11
6	8.23	650	0.25	88	200	55	30	18.2	92	0.39
7	8.33	660	3.11	111	173	88	47	16	98	1.17
8	8.35	950	0.11	159	269	111	47	16	98	1.17
9	8.38	380	0.16	37	144	36	22	12.16	58	1.11
10	7.19	6250	8	430	2200	1188	633	304	713	2.72
11	7.8	4419	4	620	1520	790	445	255	470	20
12	7.91	1470	3	179	479	312	163	69	78	2
13	8.41	4271	21	68	1520	777	445	250	471	8.6
14	7.91	1914	4	193	660	355	145	90	286	3
15	7.62	1448	1.8	11	441.8	460	151	87	214	3.7
16	7.7	1071	17	60	480	145	102	81	78	2.5
17	7.63	9780	8	2899	2299	1268	610	320	1010	18
18	7.52	847	4.1	158	145	256	90	42	112	3
19	7.14	1047	3	128	240	146	70	40	90	1
20	7.18	3400	3	465	1121	645	300	138	480	85
21	7.19	1897	4	271	398	480	175	102	208	7.1
22	7.1	2090	3.1	265	512	361	71	34	423	142
23	7.2	2199	1	97	759	503	150	94	359	20
24	7.21	680	1	177	93	137	32	35	78	7.5
25	7.36	1588	6	792	307	750	40	21	239	70
26	7.61	565	2	18	112	100	38	21	52	1.1
27	7.8	698	1.2	122	134	209	68.1	40	83	1.1
28	8.14	2700	8	420	880	404.2	201	88	451	2.3
29	8.27	5000	9.7	480	1330	1149	341	171	880	6.65
30	8.2	680	0.22	55	188	78	30	15.8	97	2.33
31	7.23	590	1.3	24	170	178	61	63	78	1.9
32	7.33	1100	2.4	110	440	176	85	96	86	3.6

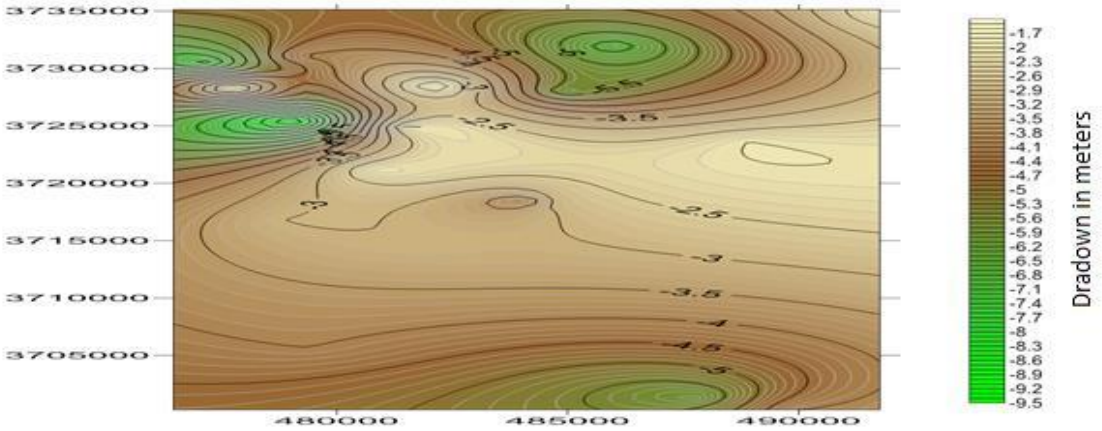


Figure (1) Contour drawdown map

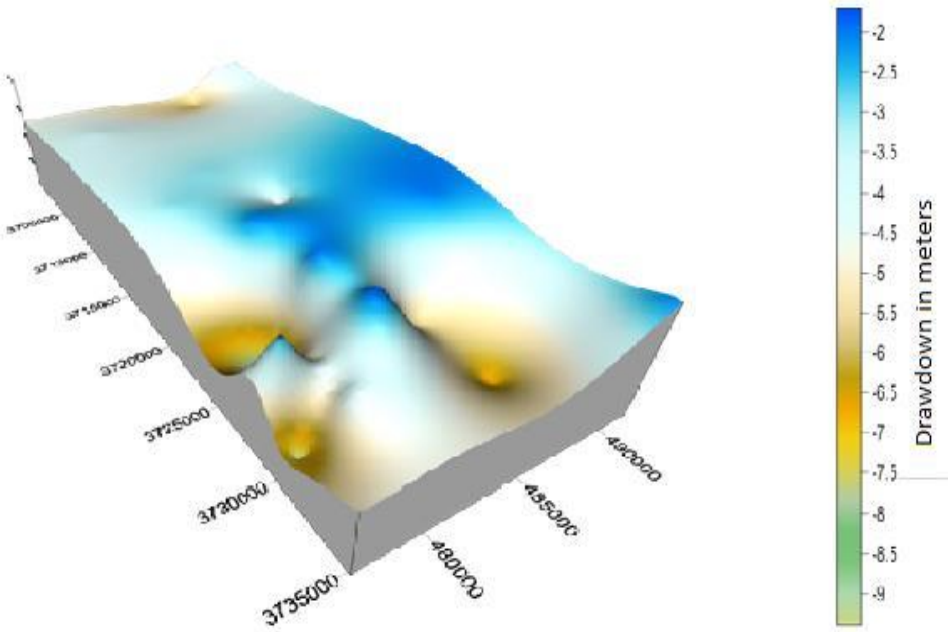


Figure (2): Three dimensional presentation of the aquifer drawdown due to wells pumping

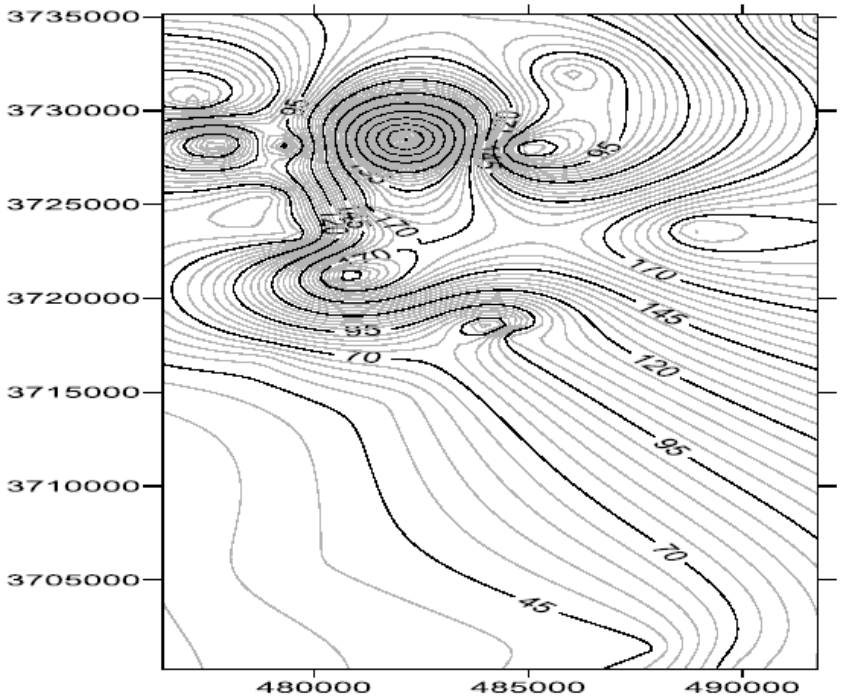
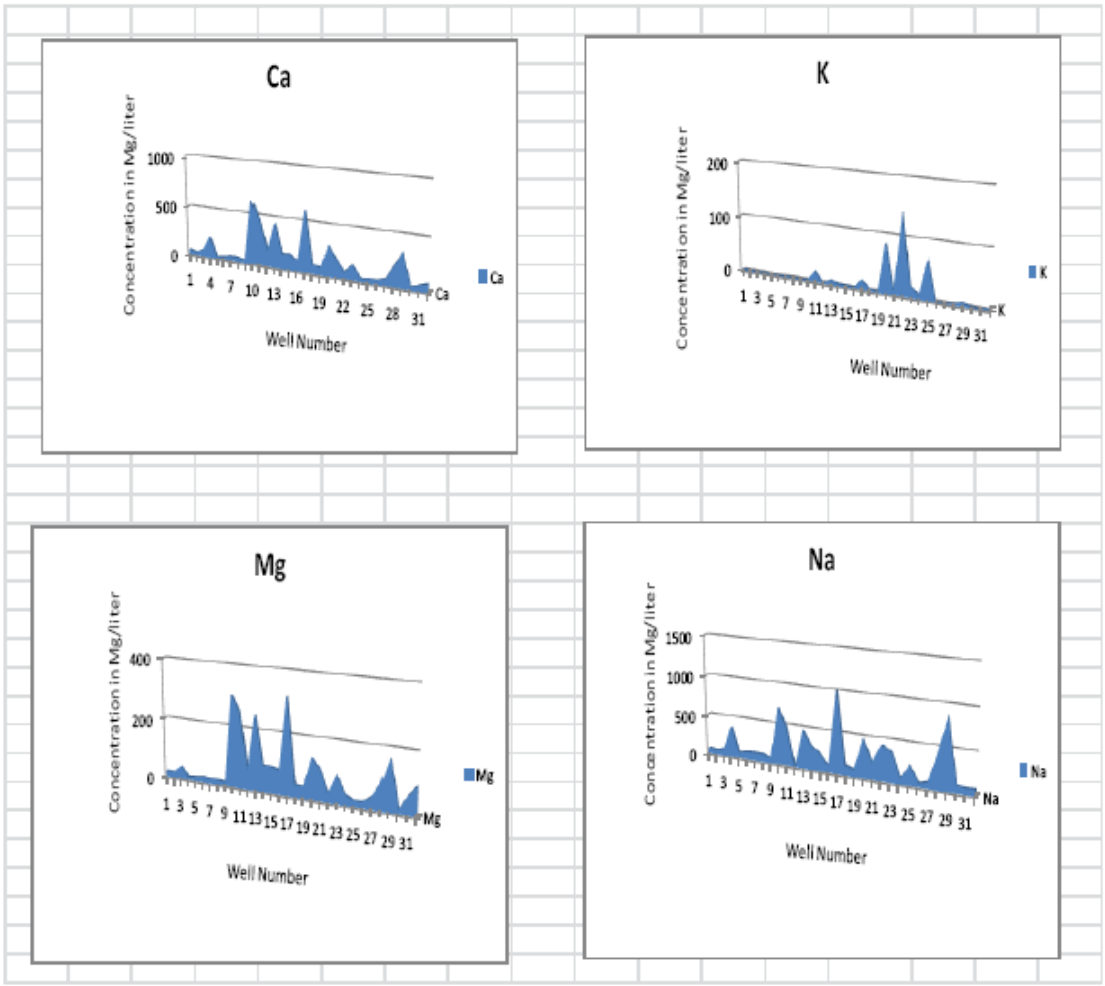


Figure (3) Counter's map of transmissivity(in m2/day) of the region



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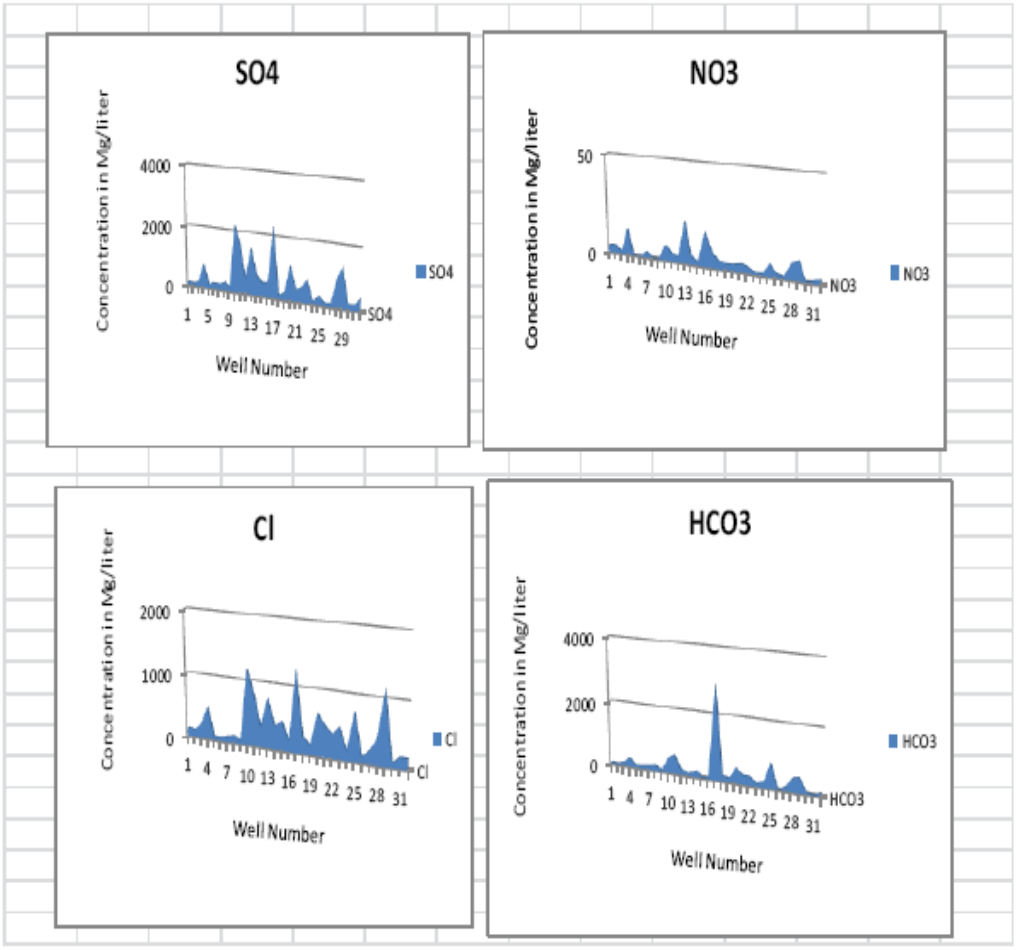

Figures (5) shows the level of concentration for the measured Anions in selected pumping wells.

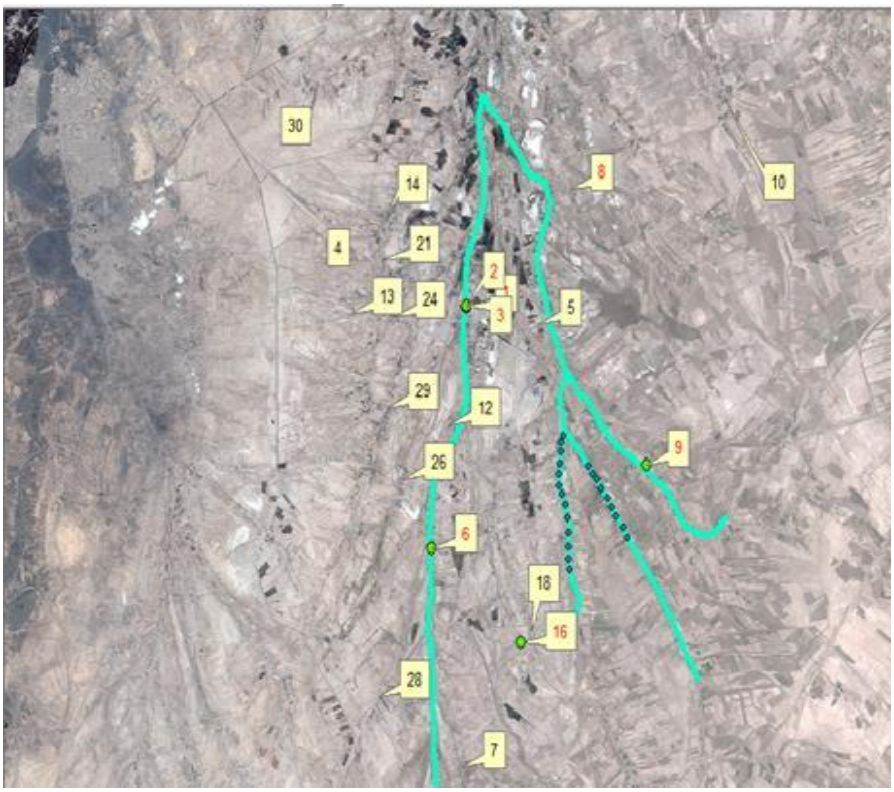

Figure (6) Locations of pumping wells and Kanan River in the study area

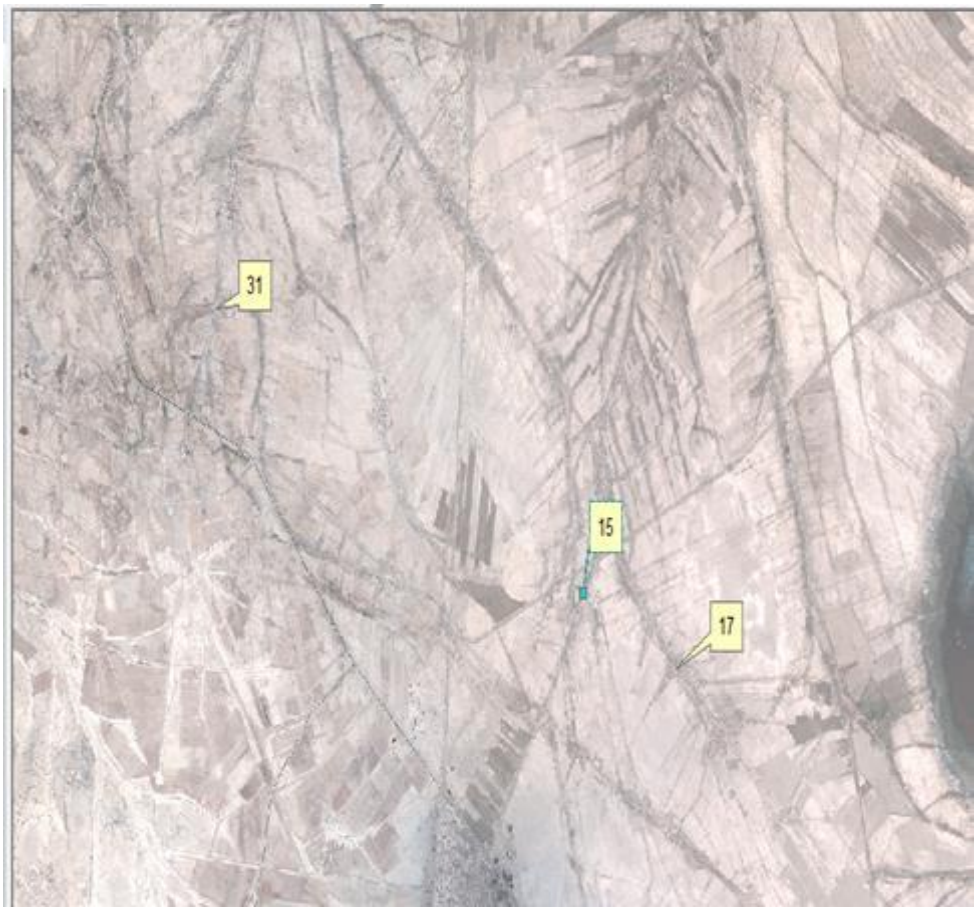

Figure (7) Locations of pumping wells Far away from rivers in study area