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Suitability of Ground Water in Southwest Kirkuk for Human Consumptions

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Abstract

Groundwater is one of the important sources of providing the human with water for drinking and other purposes. In Iraq, most of the agricultural land far from surface water sources, which forced these farmers to use groundwater wells as a source to cover the needs of the water and uses for different household. Furthermore, in some areas of Iraq, the available surface water that is suitable for human consumption is insufficient. Hence, the ground water is the viable solution to provide drinking water. The aim of this study is to show the extent validity of the ground water for various human uses. Twenty wells were chosen at different location in the southwest of Kirkuk city. Physical and chemical tests were carried for each water samples which include nitrite- nitrogen, phosphate, total hardness as $CaCo_3$, total dissolved solids, chloride, PH, and turbidity. The results were evaluated and compared accordingly with World Health Organization (WHO) specifications. The results showed that the ground water in the study areas not suitable for drinking because of the contamination with Nitrite – nitrogen, phosphate and high contents of total hardness and TDS.

Keywords:grawndwater,sutibality, consuption,

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1- Introduction

Groundwater is considered an important source of water supply for humans to meet different needs. The demanding for this source of water increases due to the continuing growth in the number of population, Water from wells were not suitable for human consumption according to WHO standards [1]. The quality of drinking water is very important for public health and prosperity. The successive drought years, as well as the lack of availability of surface water in most places, pay the human to depend on groundwater as a source for water supplied.

S.Adnan and J.Iqbal [2] investigated the assessment of groundwater quality by examining some of the chemical and physical properties of the aquifer area of Peshawar, Pakistan.The measured properties include; PH, EC, TDS, T.H, Alkaline, Ca, Mg, Turbidity,Nitrate and Chloride.The study results show increased concentrations of the investigated characteristics except for nitrates and PH in the city center.
M. Dhanasekarapandian et al. [3] studied (29) sample of groundwater to determine their suitability for human consumption and they show exceeded specifications for the limits permitted by WHO.

One of the biggest problems of the developing countries is the pollution of groundwater with various sources of pollution, whether through the raceways, or throw waste or the use of pesticides and agricultural fertilizers or soil which makes them unsuitable for human use.

In this research extensive study has been aims to evaluate the different characteristics of the groundwater for the area southwest of Kirkuk operated by the population of farmers and some of them live in agricultural land owned. Most of the agricultural land far from surface water sources, which forced these farmers to use groundwater wells as a source to cover the needs of the water and uses different household. This study aims to show the extent validity of the water in these areas for various human uses.

2-Methods and Materials

Twenty wells were selected from different locations; Figures (1) and (2). All of these wells were digging by farmers in order to use them as a source of water for domestic use. Water suction from these wells is preformed by pumps powered by electricity or diesel engines. Deep wells ranged between (20-50) meters. Samples were taken by running the pumps operating on wells for (5-10) minutes and then took the samples which stored in glass bottles according the samples requirements [4]. Chemical and physical tests were conducted and repeated many times for different water samples . Therefore the average of four tests for each property was considered for more accurate results .Micro 100 IR Turbidity meter has been used to measure turbidity and the remote Multi Parameter PCS Tester Tm 3sto measure the concentration of each of the PH and total dissolved solids and nitrates. The concentrations of total hardness and chloride were measured by titration. The program (GIS) has been used to represent the chemical and physical properties in the form of maps of the wells under study by S.Venkateswarana and

S.Deepaa[5] the results were compared with World Health Organization standards(WHO)[6].

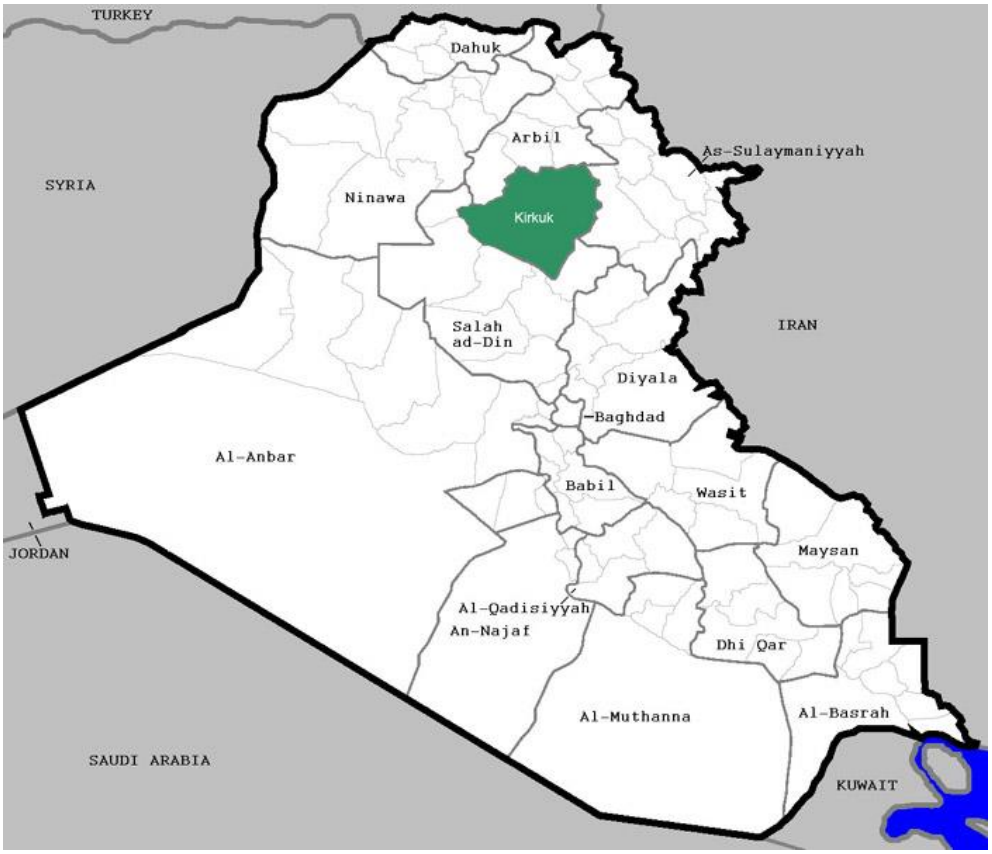

Figure (1) The map of Iraq reveals by the province of Kirkuk site

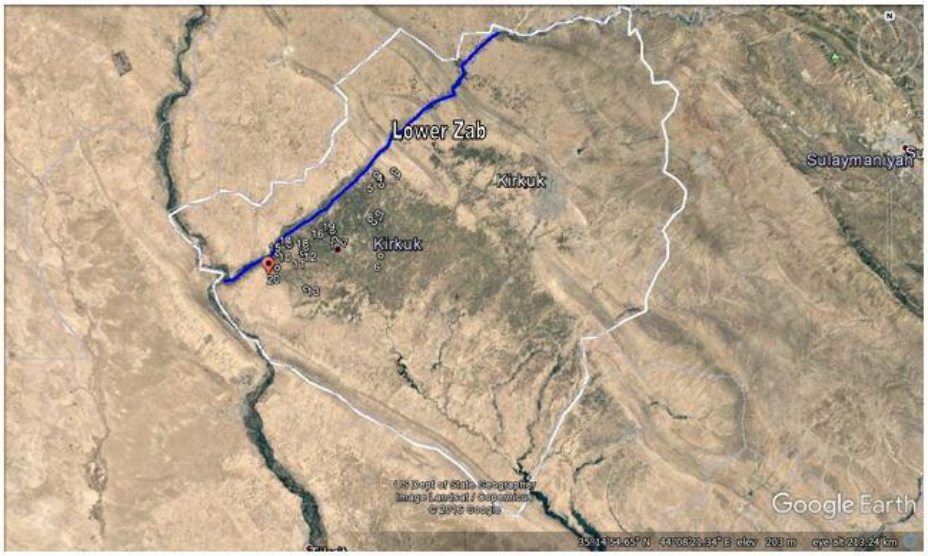

Figure (2) A map of the wells of study area

2.1 Statistical analysis

SPSS software was used to find the correlation between the chemical and physical properties investigated in this study. The statistical analysis also used to explain that the TDS value is directly proportional affected with both TH (0.54) and PO4 (0.537) and the rest of the properties that have been studied with little effect on (TDS) as listed in Table 1.

Table 1 the statistical analysis of the chemical and physical properties of the wells

	NO3	PO4	CL	Turbidity	PH	T.H	TDS
NO3	1						
PO4	0.132	1					
CL	-0.040	-0.157	1				
Turbidity	0.172	-0.235	0.110	1			
PH	0.311	0.281	0.238	0.200	1		
T.H	-0.069	0.380	0.013	-0.284	0.001	1	
TDS	-0.075	0.537	0.008	-0.023	-0.166	0.540	1

3-Results and discussion

To assess the suitability of groundwater for human consumption, various tests for the property characterization of the ground water were conducted and the results listed in Table 2 and Figures (3-9). They compared the results with the allowable limits according to the international standard (WHO). The results showed a wide variation in the values of the properties studied as follows:

Table 2 represents the values of average properties of studied groundwater wells

Wells No	World coordinate		NO_3 Mg/L	PO_4 Mg/L	CL Mg/L	Turbidity (NTU)	PH	TDS Mg/L	T.H Mg/L
	N°	E°							
1	35 20 08	43 47 06	17.8	2.19	45.25	2.4	7.3	1881	1440
2	35 29 14	43 53 32	14.9	2.33	225.5	2.74	7.9	1391	1200
3	35 29 22	43 53 36	8.6	2.29	47.2	2	7.3	2630	1180
4	35 29 48	43 52 54	8.5	2.22	282.5	1.7	7.8	2612	1140
5	35 28 17	43 53 48	9.3	2.36	20.7	2.23	7.75	1195	1020
6	35 18 11	43 53 40	4.8	2.29	220.7	3	7.2	1375	1940
7	35 24 18	43 53 11	9.7	1.85	207.1	2	7.1	1350	1180
8	35 22 58	43 52 31	4.7	2.26	132.6	3.5	7.2	1753	1580
9	35 30 18	43 55 58	4.4	1.88	58.8	2.69	7.34	1102	850
10	35 18 30	43 35 34	18	1.85	90.8	5.1	7.5	1005	900
11	35 18 34	43 40 00	18.6	2.9	51.6	1.53	7.45	1776	1680
12	35 18 35	43 40 00	7.3	2.32	37.9	1.82	7.1	1777	1740
13	35 19 28	43 40 33	4.5	2.31	28.3	1	6.96	1923	1311
14	35 19 41	43 37 35	9.8	1.91	23.5	2	6.93	1928	1450
15	35 19 45	43 37 38	9.8	2.28	45.3	1.96	7.2	1831	1350
16	35 21 43	43 45 06	6.8	2.33	47.9	2.39	7.8	1341	1215
17	35 20 34	43 45 34	8.6	2.62	48.1	3.79	7.7	2580	2000
18	35 19 18	43 40 33	8.2	2.37	116.2	2.64	7.1	2538	2100
19	35 21 41	43 45 10	8.2	2.21	92	2.55	7.2	1145	970
20	35 16 25	43 35 29	6.9	2.25	95.3	3	6.9	1300	1050
WHO			50	2	250	5	6.5-8	1500	500

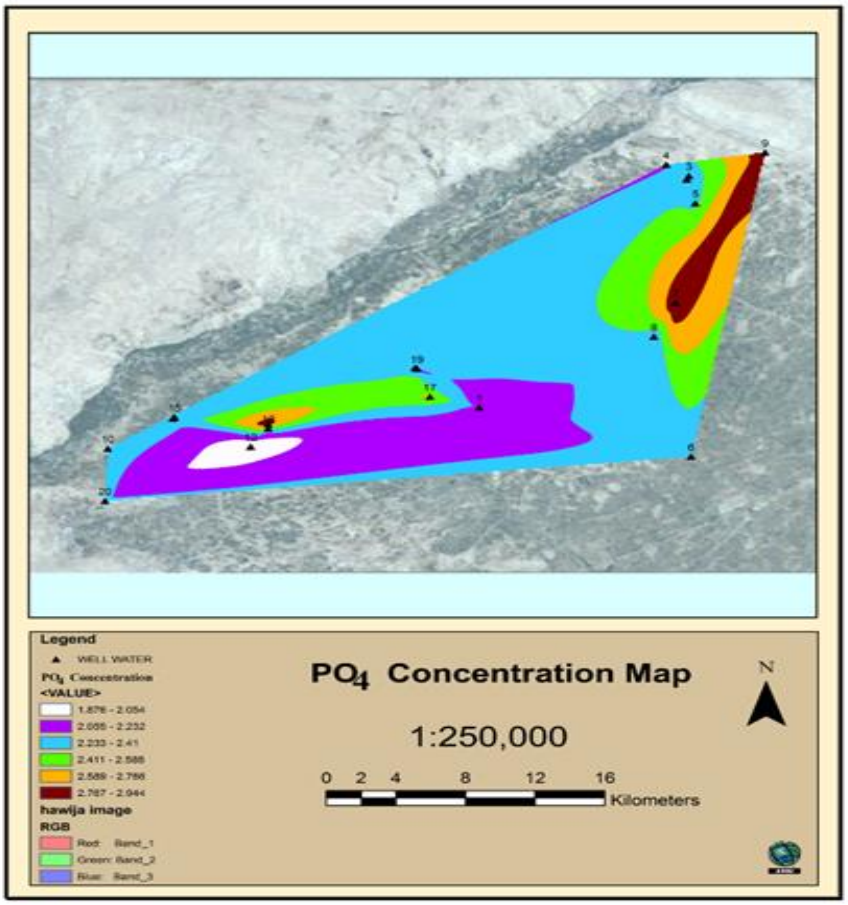

Fig.(3) Nitrat concentration map

3.1 Nitrates:(NO_3)

Figure (3) shows that the wells (1,2,10,11) with high concentrations of nitrate nitrogen as well as the case of the wells (7,14,15) because of wells are located in agricultural areas. The farmers use the fertilizer and pesticides to combat plantings, due to agricultural activities [7]. Nitrates have a negative impact, particularly on fetuses at the age of three months [8]. The remaining wells showed varying concentrations of nitrate but within limits of WHO. Well No. (9) low concentration record for being located in near the Lower Zab river and are fed from the river water, resulting in a reduced the concentration of nitrates .

3.2 Phosphates:(PO_4)

Figure (4) showed that high concentrations of phosphate for all wells, except wells (7,9,10,14) and this is due to the use of farmers phosphate fertilizer compound. the lack of sewage systems in villages, throw waste cleaning and sewage near the wells increasing the concentrations of phosphate. The high value of the concentrationis record well (11) while the less value are record in wells (7, 10).The concentration of (9) within the permissible limited of WHO.

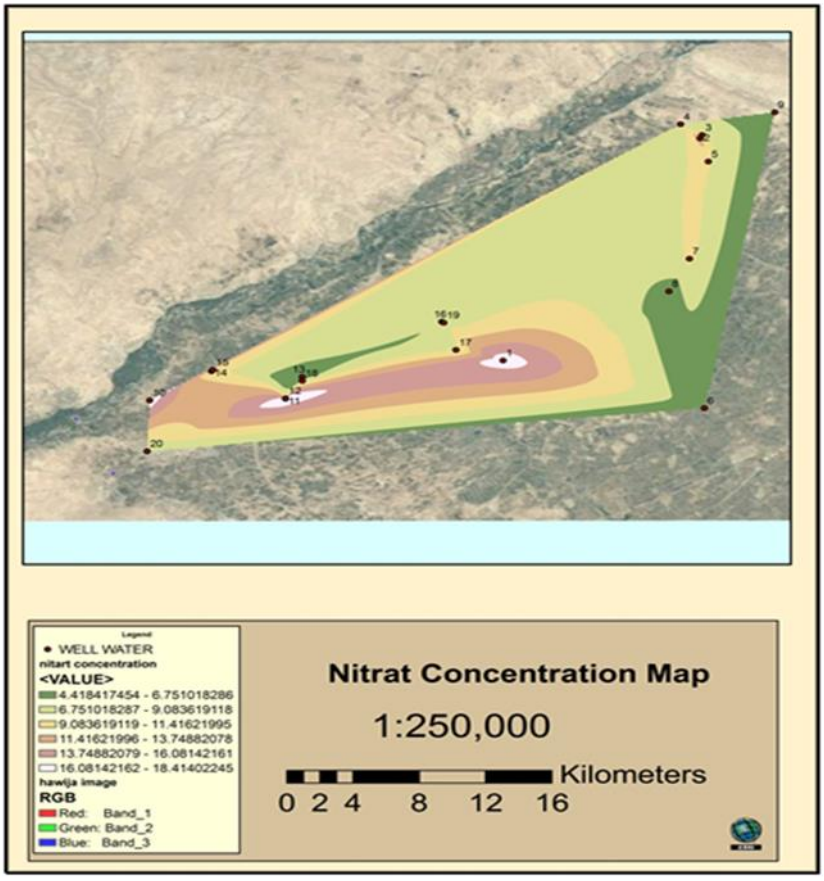

Fig.(4) PO_4 concentration Map

3.3 Chloride:(CL)

Figure (5) represents chloride values for wells. The concentrations of all wells are within the allowable limits, except for the well (4). Well (4) is located near Almahooz village and the leakage of sewage water into the ground water causes a high chloride ratio

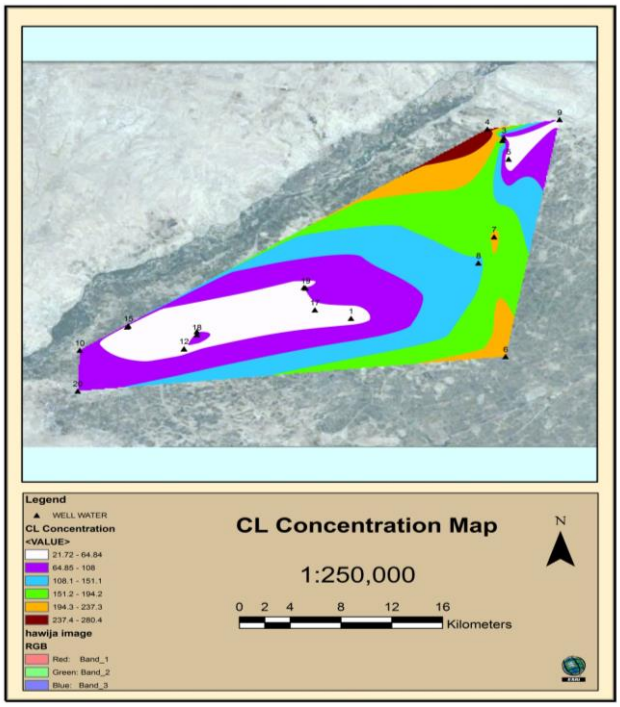

Figure.(5) CL concentration Map

3.4 Turbidity

Figure (6) shows that the average turbidity of all wells within the permissible limit values due to leaching property that characterize groundwater

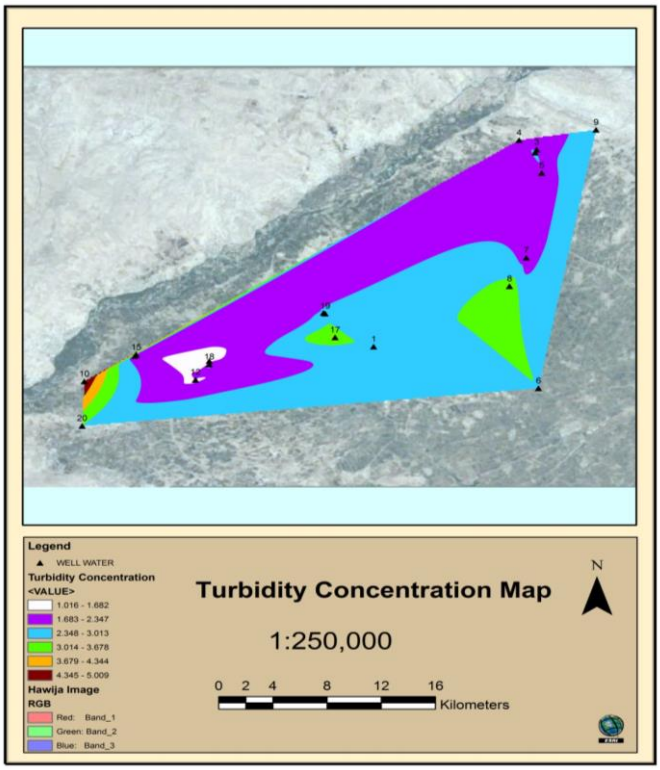

Fig.(6) Turbidity concentration Map

3.5 PH:

Figure (7) shows the concentration (PH) for all wells are within the allowable limits, ranged between (6.9-7.81)

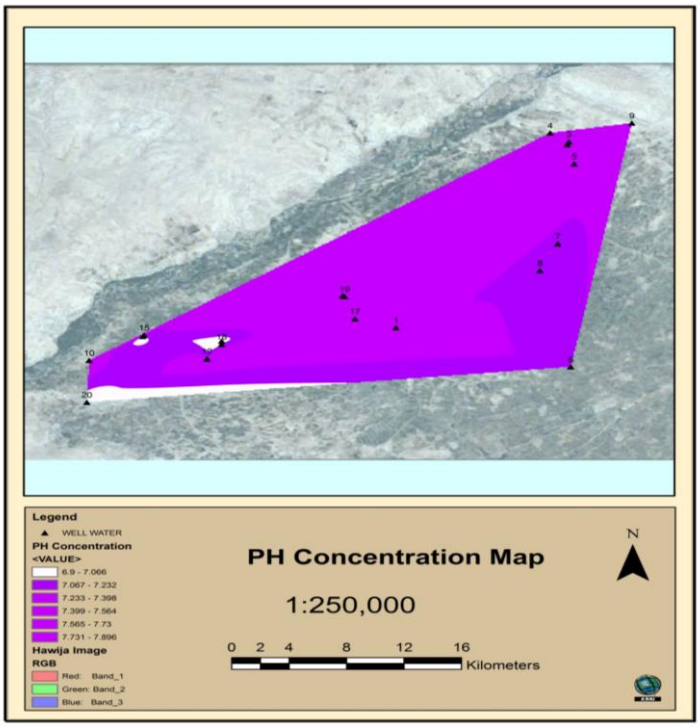

Fig.(7) PH concentration Map

3.6 Total dissolved solids (TDS)

Figure (8) shows the concentrations of total dissolved solids. Most wells have recorded an increase in the concentrations of total dissolved solids permitted except for wells (2, 5, 6, 7, 9, 10, 16, 19, 20) making it unsuitable for use

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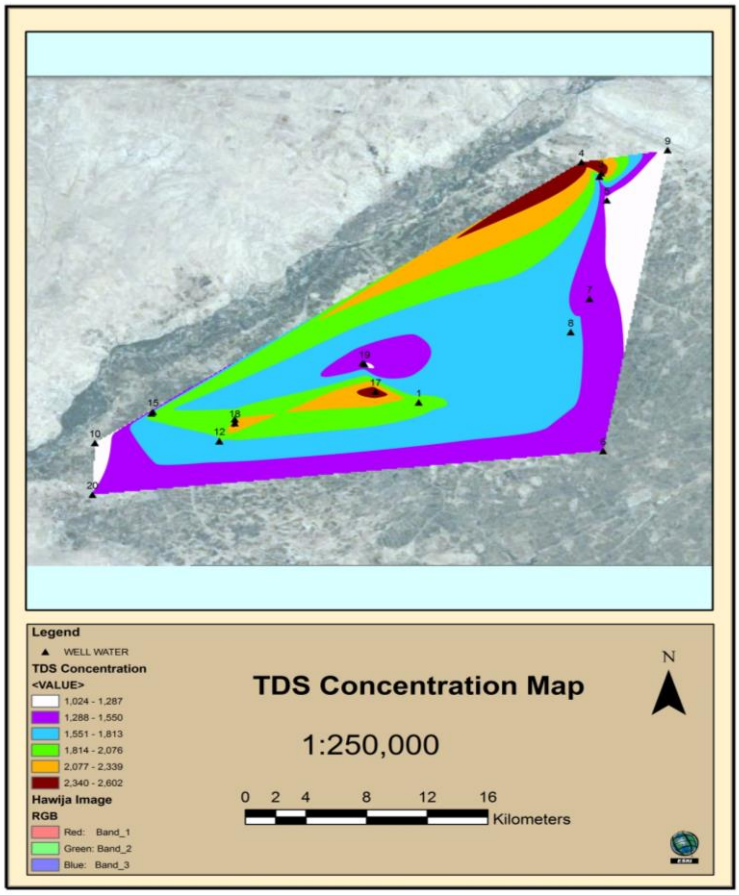

Fig.(8) PH concentration Map

3.7 Total hardness (T.H)

Figure (9) shows the Total hardness. All wells exceeded the allowable limits and recorded high values and are classified as highly hardness, because of the soil quality. The use of hard water may cause taste undesirable, intestinal disorders [9], increasing soap consumption and closes the pores of the human skin. The use of hard water in the tissue industry, paper and packaging may lead to a decline in the quality of production and the use of hard water for boiler be seale and caused the loss in heat transfer.

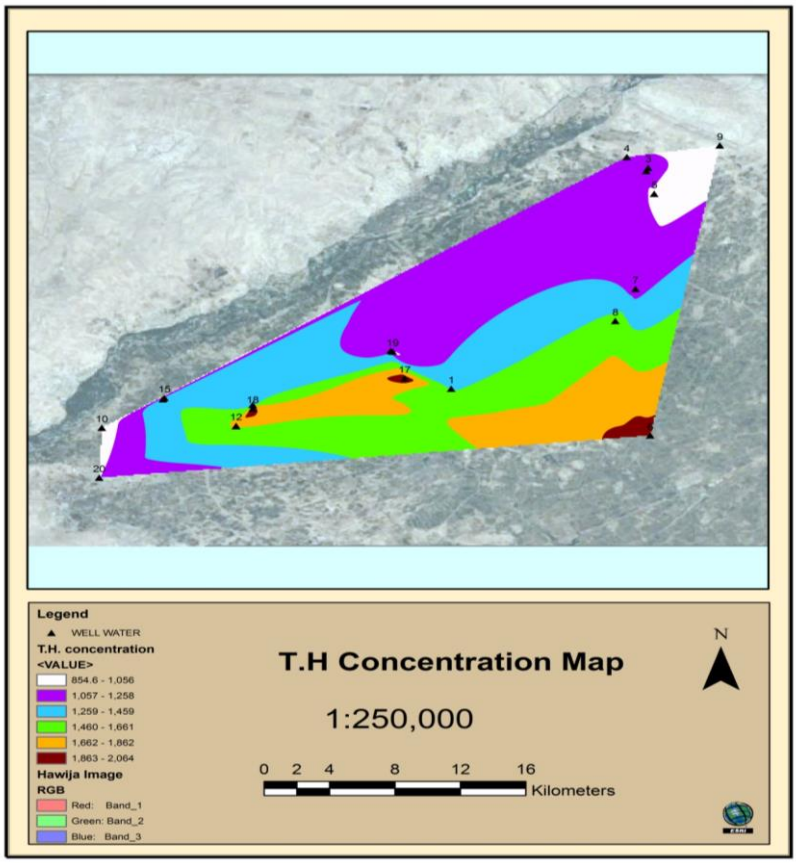

Fig.(9) T.H concentration map

4- Conclusions

1-35% of the wells showed a high concentration of nitrates.
2-80% of the wells showed a high concentration of phosphate.
3. All wells are characterized low turbidity, making it suitable for cleaning and washing.
4. All wells are classified as high salt content and highly hardness, making them unsuitable for household uses, especially drinking.
5. Well No. (9) is suitable for drinking and within specifications of WHO.
6- The results of the statistical analysis (SPSS) show that the concentration of TDS is significantly affected by concentrations of T.H and PO_4.

5- Recommendations

1. Water wells does not suitable for drinking because the high concentration of nitrate and TDS.
2. Well No.(9) is excluding from the recommendation (1) above because the well within the specification limits of WHO .
3. We recommend a bacteriological examination of the well (9) for its safety from bacterial contamination before use for human consumption .

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