LIMITING WATER RESOURCES FOR AGRICULTURAL USES IN RANIA DISTRICT, SULAIMANI GOVERNORATE

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ABSTRACT

This study was conducted during 19th August, 2018 to 12th February, 2019 in Rania district, Sulaimani governorate to classify the water of 24 springs, 25wells and 3 rivers for agricultural purpose. The results indicated that all the studied water had good or excellent class for irrigation depending on global systems of irrigation. On the other hand, depending on USDA classification (1954) the water of (44, 5, 2 and 1) locations had (C_2S_1 , C_3S_1 , C_4S_1 and C_4S_2) classes for irrigation purpose respectively. While the waters of 49 and 3 locations had excellent and very satisfactory class for livestock and poultry uses respectively. Depending on dissolved oxygen (DO mg l⁻¹) value most of the studied water were suitable for fish culture, except the water of two locations were not suitable for all fish species due to low values of dissolved oxygen in these two locations which were 5.20 and 6.30 mg oxygen per ml water.

KEYWORDS: Water classes, Agricultural uses, Dissolved Oxygen. https://doi.org/10.26682/cajuod.2020.22.2.4

INTRODUCTION

Water quality is of essential and significant importance because of its role to human health, aquatic life, ecological integrity and sustainable economic growth. Indeed, without good quality, water sustainable development and environmentally sound management of water resources will be meaningless.

Also, poor irrigation water quality has negative effects on crop productivity, crop product quality, and public health of consumers and farmers who come in direct contact with the irrigation water. The impact of water quality is measured the effect of the irrigation water on soil characteristics and crops (Etteieb et al., 2017).////The Water quality of any specific area or specific source can be assessed using water quality of any specific area or specific source can be assessed using physical, chemical and biological parameters. The values of these parameters are res ponsible in limiting the water quality for agricultural uses (Ayers and Westcot, 1985)Water resources in Kurdistan region are including surface water such as streams, rivers, lakes, groundwater like wells and springs and its crucial to determine the classes of all these water sources to be clear that the main water fit to use

in a specific purpose like irrigation, human drinking, livestock and poultry watering.

Quality of irrigation water depends on or determined by its chemical composition and the conditions of use. All the waters, surface or sub-surface, contain soluble salts which increases the concentration of the soil solution upon irrigation (Husaain *et al.*, 2010). Ayers and Westcot (1985) indicated that water quality depends on physical, chemical and biological characteristics which influence its suitability for a specific use.

All the mentioned investigations have been done depending on several global and local classifications which included different systems of water classifications such as (Richards's classification, 1954) (Deneen classification, 1954) (Wilcox classification, 1955) (Ayers and Westcot cassification, 1985).

GROUNDWATER CLASSIFICATION FOR AGRICULTURAL USES:

There are numerous systems for irrigation water classification such as:

1- Richards's classification (1954).

Richards (1954) classified irrigation water into 16 classes depending on electrical conductivity and sodium adsorption ratio (EC and SAR) as shown in table (1).

Table (1): USDA water classes.					
SAR =S					
EC =C dS m ⁻¹	C1S1	C1S2	C1S3	C1S4	
	C2S1	C2S2	C2S3	C2S4	
	C3S1	C3S2	C3S3	C3S4	
	C4S1	C4S2	C4S3	C4S4	

2- Deneen classification (1954).

The irrigation water was classified depending on salinity potential (SP) and soil permeability to three classes as reported by Deneen in the table (2).

Table (2): water classes depending on SP.						
Salinity potential (SP) = ($CI^{-1} + \frac{1}{2}SO_4^{2-}$) mmol						
Water quality	Permeability					
	Low	Medium	High			
Good	< 7	< 5	< 3			
Moderate	7-15 5-10 3-5					

3- Wilcox classification (1955):

Depending on residual Sodium Carbonate (RSC) = $CO_3^{2-} + HCO_3^{-} - (Ca^{+2} + Mg)$ (mmole_c l⁻¹), Wilcox (1955) classified the irrigation water into three classes table (3).

Table (3	B): Water classes	depending o	n RS			
	Water class					
	•	DCC				
	1-Probably safe	<1.25				
	2- Marginal	1.25-2.5				
	3- Unsuitable	>2.5				

SC.

4-Todd classification (1966):

Todd (1966) classified irrigation water based on (TDS), chloride and sodium percent as shown in (4).

Table (4): Water classes depending on TDS, Cl, and Na%.

Parameter	Suitable	Moderate	Doubtful
TDS(ppm)	700	2000	>2000
CI(ppm)	150	500	>500
Na%	60	60-75	>75

5-Ayers and Westcot classification (1985) :

Depended on EC, SAR other properties as shown in table (5) the irrigation water was classified into three classes according to (Ayers and Westcot, 1985).

Table (5): Ayers and Westcot classification (1985).						
Potential irrigation Problem			Degree			
		Unit	None	Slight to Moderate	severe	
Salinity <i>EC_{iw}</i> at 25° C		dS m ⁻¹	< 0.7	0.7-3.0	>3.0	
Infiltration	0-3		> 0.7	0.7-0.2	< 0.2	
SAR	3-6		> 1.2	1.2-0-0.3	< 0.3	
	6-12 12-20	(<i>mmole</i> c l ⁻¹) ^{1/2}	> 1.9 > 2.9	1.9-0.5 2.9-1.3	< 0.5 < 1.3	
	20-40		> 5	5.0-2.9	< 2.9	
Sodium toxicity (SAR) Surface irrigation			< 3	3-9	> 9	
Sprinkler irrig	ation		< 3	>3		
Chloride (Cl ⁻)	Surface irrigation	<i>mmole</i> _c l ⁻¹	< 4	4-10	> 10	
chionae (Cr)	Sprinkler Irrigation	mmole _c l ⁻¹	< 3	>3		
Boron (B)		mg l ⁻¹	< 0.7	0.7-3.0	> 3.0	
Miscellaneous Effects Nitrogen (NO ₃ – N)		mg l ⁻¹	< 5.0	5.0-30	> 30.0	
Bicarbonate (HCO₃⁻)		<i>mmole</i> _c l ⁻¹	< 1.5	1.5-8.5	> 8.3	
pH.			Normal F	Range 6.5-8.4		

6-Don classification (1995):

Don (1995) classified irrigation water depending up on total salt content (TDS), EC, SAR, Na% and pH to five classes as follow:

/		<u> </u>	,		, ,
Water Quality	EC (dS m ⁻¹)	TDS (ppm)	Na%	SAR	рΗ
Excellent	0.25	175	20	3	6.5
Good	0.25-0.75	175-525	20-4-0	3-5	6.5-6.8
Permissible	0.75-2.0	525-1400	40-60	5-10	6.8-7.0
Doubtful	2.0-3.0	1400-2100	60-80	10-15	7.0-8.0
Unsuitable	>3.0	>2100	>80	>15	>8.0

Table (6): Water classification depending on EC, TDS, Na%, SAR, and pH	H.
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Water classification for animal use:

The water quality for livestock was classified by Altoviski (1962) as recorded in the table below:

 Table (7): Water quality guide for the livestock uses or Altoviski classification.

Parameters (ppm)	Very good	Good	Permissible	Can be used	Maximum limit
Ca ⁺²	350	700	800	900	1000
Na⁺	800	1500	2000	2500	4000
Mg ⁺²	150	350	500	600	700
SO4 ⁻²	1000	2500	3000	4000	6000
CI	900	2000	3000	4000	6000
TDS	3000	5000	7000	10000	15000

Water quality guide for livestock and poultry uses was classified by Ayers and Westcott (1985

Water (EC) dS m ⁻¹	Rating or classes	Using
<1.5	Excellent	Usable for all classes of livestock and poultry
1.5-5.0	Very Satisfactory	Usable for all classes of livestock and poultry. May cause temporary diarrhea in livestock not accustomed to such water watery droppings in poultry.
5.0-8.0	Satisfactory for Livestock	May cause temporary diarrhea or be refused at first by animals not accustomed to such water.
	Unfit for Poultry	Often causes watery faeces, increased mortality and decreased growth, especially in turkeys.
8.0-11.0	Limited Use for Livestock	Usable with reasonable safety for dairy and beef cattle, sheep swine and horses. Avoid use for pregnant or lactating animals
	Unfit for Poultry	Not acceptable for poultry.
11.0-16.0	Very Limited Use	Unfit for poultry and probably unfit for swine. Considerable risk in using for pregnant or lactating cows, horses or sheep, or for the young of these species. In general, use should be avoided although older ruminants, horses, poultry and swine may subsist on waters such as these under certain conditions.
>16.0	Not Recommended	Risks with such highly saline water are so great that it cannot b recommended for use under any conditions.

Table (8): classification	of water for animal	uses (Ayers and	Westcot, 1985).

The water quality for livestock was classified as mentioned by Ayers and Westcot (1985), which referred to upper limit of heavy metals and other ions as shown in table (9):

Table (Table (9): Guidelines for livestock.			
Parameter	Upper Limit (mg I ^{-I})			
Cd	0.05			
F	2.00			
Fe	Not needed			
Pb	0.10			
Mn	0.05			
NO ₃	100			
NO ₂	10			
Zn	24			

Many studies have been done at different locations in Kurdistan region on water quality which included both of surface water and ground water by Esmail, 1986 ,Dohuki ,1997 , Mam Rasul 2000, Khwakarim et al., 2010, Esmail and Salih, 2014, Rajab, 2015, Bapir and Ali, 2016 and Albarwary et al., 2018). Also numerous studies have been done in Iraq by Alhashimi and Mustafa 2012 and Alamar, 2015.

ince there are little or no studies in Rania district about different water resources and their uses for different purpose for this reason this study was selected to classify the water of different resources (rivers ,springs and wells) for irrigation ,livestock and poultry uses and fishing culture.

MATERIALS AND METHODS

The study was conducted in Rania district, Sulaimani, Iraqi Kurdistan region, which included 52 water sources (25 wells, 24 springs, and 3 rivers) ,the GPS reading of the studied locations were recorded in table (10).

Samples Location Elevation (m) N E 1-River Zey bchuk 589 36'12'51.00 44'59'23.20' 2-River Hizop 526 36'10'18.80 44'41'24.0' 3-River Bhave river 768 36'15'24.80' 44'53'00' 5-Spring Qula-Rania 537 36'12'24.06 44'53'00' 5-Spring Qulga-chwarqurna 533 36'12'2.60 44'33'.30' 5-Spring Qula-kanymaran 545 36'12'2.60 44'33'.30' 9-Spring Sarwchaw-sarwchawa 537 36'16'32.40 44'45'19.80' 10-Spring Qula-kanymaran 500 36'2'3'1.80' 44'4'17.30' 11-Spring Pira mlot 927 36'2'3'4.30' 44'4'19.10' 13-Spring Dalwa 1005 36'2'3'4.30' 44'4'17.30' 13-Spring Dalwa 1005 36'2'3'4.30' 44'4'19.10' 14-Spring Damand axa-kawbin 900 36'2'4'1.00' 44'4'2'1.00' 14-Spring Mamzalan		Table (10): GPS reading for selected locations.						
Ariver Hizop 526 36 10 18.80 44 41 12.40 3-River Shawre river 768 36 21 16.90 44 46 37.00 Springs Qula-Rania 594 36 15 24.80 44 '46 37.00 5-Spring Qula-chwarqurna 533 36 12 24.06 44 '56 16.30 6-Spring Qulga-chwarqurna 533 36 12 22.50 44 '45 19.80 6-Spring Qula-kanymaran 545 36 12 26.80 44 '45 19.80 10-Spring Kak ham2-pilngan 500 36 23 41.80 44 '46 91.90 10-Spring Darmana-qantaran 516 36 '12 26.80 44 '45 19.80 10-Spring Qula-kanymaran 545 36 '12 34.020 44 '46 91.01 10-Spring Qalat 1015 36 '23 40.20 44 '46 91.01 13-Spring Dalwka 1080 36 '23 42.100 44 '46 91.01 14-Spring Deman 954 36 '23 42.100 44 '45 28.00 17-Spring Sarwchawa-Galan 1124 36 '23 21.00 44 '45 3.50' 19	Samples	Location		Ν	E			
3-River Shavre river 768 36 21 16.90 44 46 37.00 Springs Springs 4-Spring Qula-Rania 594 36 15 24.80 44 5 6 16.30 ¹ 5-Spring Qulga-chwarqurna 533 36 12 02.50 44 5 2 49.70 ¹ 7-Spring Durmanaw-qamtaran 516 36 10 28.80 44 4 33 4.30 ¹ 8-Spring Qulga-chwarqurna 537 36 16 32.40 44 46 33.00 ¹ 9-Spring Sarwchawa-sarwchawa 537 36 16 32.40 44 46 33.00 ¹ 10-Spring Kak hamza-plingan 500 36 23 41.20 44 46 49.10 ¹ 11-Spring Daman 954 36 23 47.40 44 46 49.10 ¹ 14-Spring Deman 954 36 23 47.40 44 46 28.00 ¹ 14-Spring Deman 954 36 23 47.40 44 46 37.00 ¹ 14-Spring Deman 954 36 23 47.40 44 46 28.00 ¹ 17-Spring Sarwchawa-Gulan 1124 36 23 47.70 44 45 28.00 ¹ 17-Spring Sarwchawa-qalasaiday sarw	1-River	Zey bchuk	589	36°12 ['] 51.00"	44°59'23.20"			
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G-Spring Qulga-chwarqurna 533 36'12'02.50' 44'52'49.70' 7-Spring Darmanaw-qamtaran 516 36'10'28.80' 44'41'17.30' 8-Spring Qula-kanymaran 545 36'12'26.80' 44'43'34.30' 9-Spring Sarwchawa-sarwchawa 537 36'16'32.40' 44'46'33.30' 10-Spring Kak hamza-plingan 500 36'23'31.80' 44'46'33.30' 12-Spring Qalat 1015 36'23'48.30' 44'46'91.10' 13-Spring Dalwka 1080 36'23'48.30' 44'45'1.00' 14-Spring Deman 954 36'23'42.10' 44'45'28.00' 15-Spring Mamand axa-kawbin 890 36'24'21.00' 44'45'28.00' 16-Spring Sarwchawa-Gulan 1124 36'23'42.70' 44'45'28.00' 17-Spring Sarwchawa-Gulan 1124 36'22'1.80' 44'45'1.00' 18-Spring Mamxalan 831 36'21'2.0.10' 44'45'83.10' 22-Spring Sarwchawa-qalasaiday sarw 961 36'20'8.60' 44'45'2.0'<	4-Spring	Qula-Rania	594	36°15'24.80"	44°53'09.00"			
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9-Spring Sarwchawa-sarwchawa 537 36 [°] 16 [°] 32.40 [°] 44 [°] 45 [°] 19.80 [°] 10-Spring Kak hamza-plingan 500 36 [°] 23 [°] 31.80 [°] 44 [°] 46 [°] 04.50 [°] 11-Spring Pira mlot 927 36 [°] 23 [°] 40.20 [°] 44 [°] 46 [°] 04.50 [°] 12-Spring Qalat 1015 36 [°] 23 [°] 48.30 [°] 44 [°] 47 [°] 17.30 [°] 13-Spring Dalwka 1080 36 [°] 23 [°] 48.30 [°] 44 [°] 46 [°] 49.10 [°] 14-Spring Deman 954 36 [°] 23 [°] 47.40 [°] 44 [°] 45 [°] 06.00 [°] 16-Spring Mamand axa-kawbin 890 36 [°] 24 [°] 21.00 [°] 44 [°] 45 [°] 28.00 [°] 17-Spring Sarwchawa-Gulan 1124 36 [°] 23 [°] 24.70 [°] 44 [°] 45 [°] 28.00 [°] 18-Spring Mamxalan 831 36 [°] 24 [°] 21.00 [°] 44 [°] 45 [°] 28.00 [°] 20-Spring Sarukan-dere 633 36 [°] 16 [°] 16.00 [°] 44 [°] 45 [°] 3.50 [°] 21-Spring Sarukany-dere 853 36 [°] 20 [°] 10.0 [°] 44 [°] 46 [°] 51.90 [°] 22-Spring Sarukchawa-qalasaiday sarw 961 36 [°] 20 [°] 20.730 [°] 44 [°] 46 [°] 45.90 [°] <tr< td=""><td>7-Spring</td><td>Darmanaw-qamtaran</td><td>516</td><td>36°10'28.80"</td><td>44°41'17.30"</td></tr<>	7-Spring	Darmanaw-qamtaran	516	36°10'28.80"	44°41'17.30"			
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Inspiration Pira mlot 927 36°23'40.20 44°46'33.30° 12-Spring Qalat 1015 36°23'45.30 44°47'17.30° 13-Spring Dalwka 1080 36°23'48.30 44°49'19.40° 14-Spring Deman 954 36°23'47.40° 44°46'49.10° 15-Spring Mamand axa-kawbin 890 36°24'21.00° 44°45'28.00° 16-Spring Srushk-kawbin 900 36°23'42.70° 44°42'28.20° 17-Spring Sarwchawa-Gulan 1124 36°23'42.70° 44°42'28.20° 18-Spring Mamxalan 831 36°21'20.10° 44°45'33.50° 20-Spring Sarukan-dere 633 36°16'16.00° 44°45'43.50° 21-Spring Saruchawa-qalasaiday sarw 961 36°20'27.30° 44°46'31.90° 23-Spring Saruchawa-nore 1005 36°12'0.11° 44°45'29.00° 24-Spring Tawe-mirabag 660 36°12'3.20° 44°46'40.10° 25-Spring Sarashkawtan 1065 36°12'3.20° 44°46'40.10° <	9-Spring	Sarwchawa-sarwchawa	537	36°16'32.40"	44°45'19.80"			
12-Spring Qalat 1015 36'23'45.30' 44'47'17.30' 13-Spring Dalwka 1080 36'23'45.30' 44'47'17.30' 14-Spring Deman 954 36'23'47.40' 44'46'49.10' 14-Spring Deman 954 36'23'47.40' 44'46'49.10' 15-Spring Mamand axa-kawbin 890 36'22'56.80' 44'45'60.00' 16-Spring Srushk-kawbin 900 36'22'56.80' 44'45'28.00' 17-Spring Saruchawa-Gulan 1124 36'23'42.70' 44'42'28.20' 19-Spring Sardke-daraban 824 36'22'21.80' 44'45'43.50' 20-Spring Zurkan-dere 633 36'16'16.00' 44'45'43.50' 20-Spring Saruchawa-qalasaiday sarw 961 36'20'7.30' 44'46'51.90' 23-Spring Sarwchawa-nore 1005 36'16'50.90' 44'45'29.00' 24-Spring Tawe-mirabag 660 36'20'12.20' 44'46'10.10' 25-Spring Sarashkawtan 1065 36'13'09.50' 44'46'49.10' 26-Spring Kany bnaw 800 36'13'30.90' 44'55	10-Spring	Kak hamza-plingan	500	36°23'31.80"	44°46'04.50"			
13-Spring Dalwka 1080 36'23'48.30' 44'49'19.40' 14-Spring Deman 954 36'23'47.40' 44'46'49.10' 15-Spring Mamand axa-kawbin 890 36'24'21.00' 44'45'06.00' 16-Spring Srushk-kawbin 900 36'22'56.80' 44'45'28.00' 17-Spring Sarwchawa-Gulan 1124 36'23'32.00' 44'42'28.20' 18-Spring Mamxalan 831 36'23'42.70' 44'42'8.20' 19-Spring Sardke-daraban 824 36'21'2.01' 44'45'43.50' 20-Spring Zurkan-dere 633 36'16'16.00' 44'45'3.10' 21-Spring Sarwchawa-qalasaiday sarw 961 36'20'7.30' 44'46'31.00' 22-Spring Sarwchawa-nore 1005 36'20'48.60' 44'45'29.00' 24-Spring Tawe-mirabag 660 36'20'1.20' 44'46'0.10' 25-Spring Kany bnaw 800 36'20'1.20' 44'46'0.10' 26-Spring Kany bnaw 800 36'13'0.9.50' 44'55'22.60' <	11-Spring	Pira mlot	927	36°23'40.20"	44°46'33.30"			
14-Spring Deman 954 36°23'47.40° 44°46'49.10° 15-Spring Mamand axa-kawbin 890 36°23'47.40° 44°45'06.00° 16-Spring Srushk-kawbin 900 36°23'56.80° 44°45'28.00° 17-Spring Sarwchawa-Gulan 1124 36°23'35.00° 44°42'28.20° 19-Spring Mamxalan 831 36°23'22.180° 44°45'43.50° 20-Spring Zurkan-dere 633 36°16'16.00° 44°45'43.50° 20-Spring Zurkan-dere 633 36°12'20.10° 44°45'43.50° 22-Spring Sarukany-dere 853 36°21'20.10° 44°45'29.00° 23-Spring Sarukany-dere 853 36°20'27.30° 44°45'29.00° 24-Spring Sarwchawa-nore 1005 36°10'50.90° 44°45'29.00° 24-Spring Tawe-mirabag 660 36°20'1.20° 44°46'40.10° 25-Spring Sarashkawtan 1065 36°13'0.9.50° 44°46'40.10° 24-Spring Kany bnaw 800 36°13'0.9.50° 44°45'4'7.20° 27-Spring Luse spring-topawa 542 36°13'28.40°	12-Spring	Qalat	1015	36°23'45.30"	44°47'17.30"			
15-Spring Mamand axa-kawbin 890 36 ² 2 ⁴ 2 ¹ .00 ⁷ 44 ³ 4 ⁵ 06.00 ⁷ 16-Spring Srushk-kawbin 900 36 ² 2 ⁵ 6.80 ⁷ 44 ³ 4 ⁵ 28.00 ⁷ 17-Spring Sarwchawa-Gulan 1124 36 ² 2 ³ 35.00 ⁷ 44 ³ 4 ² 28.20 ⁷ 18-Spring Mamxalan 831 36 ² 2 ³ 24.270 ⁷ 44 ³ 4 ² 28.20 ⁷ 19-Spring Sardke-daraban 824 36 ² 2 ³ 24.270 ⁷ 44 ³ 4 ³ 4 ³ 28.07 ⁷ 20-Spring Sardka-daraban 824 36 ² 2 ³ 24.270 ⁷ 44 ³ 4 ³ 4 ³ 5.0 ⁷ 20-Spring Sarukan-dere 633 36 ³ 16 ^{16.000} 44 ³ 4 ³ 6 ³ 2.0 ⁷ 21-Spring Sarukany-dere 853 36 ² 2 ^{17.001} 44 ³ 46 ³ 51.90 ¹ 22-Spring Sarukchawa-nore 1005 36 ³ 20.730 ⁷ 44 ³ 46 ³ 51.90 ¹ 24-Spring Tawe-mirabag 660 36 ² 20 ³ 8.20 ⁷ 44 ³ 46 ³ 51.90 ¹ 25-Spring Kany bnaw 800 36 ² 20 ^{11.20⁷} 44 ³ 46 ³ 40.10 ¹ 26-Spring Kany bnaw 800 36 ³ 1 ³ 0.9.50 ⁷ 44 ³ 5 ² 2.6.0 ¹ 2	13-Spring	Dalwka	1080	36°23'48.30"	44°49'19.40"			
16-SpringSrushk-kawbin90036°22'56.80°44°45'28.00°17-SpringSarwchawa-Gulan112436°23'35.00°44°42'51.40°18-SpringMamxalan83136°23'42.70°44°42'82.20°19-SpringSardke-daraban82436°22'21.80°44°45'43.50°20-SpringZurkan-dere63336°16'16.00°44°48'07.20°21-SpringSarukany-dere85336°21'20.10°44°46'38.10°22-SpringSaruchawa-qalasaiday sarw96136°20'27.30°44°45'29.00°23-SpringSaruchawa-nore100536°20'28.20°44°46'05.60°24-SpringTawe-mirabag66036°20'11.20°44°45'29.00°24-SpringSarashkawtan106536°16'50.90°44°45'29.00°25-SpringSarashkawtan106536°16'50.90°44°45'29.00°26-SpringKany bnaw80036°20'11.20°44°45'47.20°27-SpringLuse spring-topawa54236°12'3.32.0°44°55'22.60°30-WellBoskin 151336°13'28.00°44°55'22.60°30-WellBoskin 252936°13'24.70°44°41'17.90°31-WellHizop 155236°10'28.40°44°41'17.90°32-WellHizop 155236°10'29.20°44°41'14.00°34-WellKlaw sur55436°10'1.10°44°42'19.50°35-WellQaraniaxa53636°10'1.50°44°44'43.8.20°36-WellKany maran53636°10'1.53.0°44°44'43.20°38-We	14-Spring	Deman	954	36°23'47.40"	44°46'49.10"			
17-SpringSarwchawa-Gulan112436°23'35.0044°42'51.40'18-SpringMamxalan83136°23'42.70'44°42'28.20'19-SpringSardke-daraban82436°22'21.80'44°45'83.50'20-SpringZurkan-dere63336°16'16.00'44°46'38.10'21-SpringSaruchawa-qalasaiday sarw96136°20'27.30'44°46'51.90'23-SpringSaruchawa-qalasaiday sarw96136°20'48.60'44°45'29.00'24-SpringSaruchawa-qalasaiday sarw96136°20'48.60'44°45'29.00'24-SpringSaruchawa-nore100536°10'58.20'44°46'05.60'25-SpringSarashkawtan106536°16'50.90'44°46'05.60'26-SpringKany bnaw80036°20'11.20'44°46'40.10'27-SpringLuse spring-topawa54236°13'23.20'44°55'22.60'26-SpringKany bnaw80036°13'28.00'44°55'22.60'27-SpringLuse spring-topawa54236°13'28.00'44°55'22.60'29-WellBoskin 151336°13'28.00'44°55'22.60'30-WellBoskin 252936°13'24.70'44°54'47.20'31-WellChwarqurna53536°11'03.40'44°50'42.60'32-WellHizop 155236°10'29.20'44°41'17.90'33-WellHizop 256436°10'29.20'44°41'41.40'36-WellKany maran53336°10'150.0'44°44'44'38.20'36-WellKany maran53636°10'153.0'44°44'	15-Spring	Mamand axa-kawbin	890	36°24'21.00"	44°45'06.00"			
18-Spring Mamxalan 831 36°23'42.70° 44°42'28.20° 19-Spring Sardke-daraban 824 36°23'42.70° 44°42'28.20° 19-Spring Sardke-daraban 824 36°23'42.70° 44°45'43.50° 20-Spring Zurkan-dere 633 36°16'16.00° 44°45'43.50° 20-Spring Sarukany-dere 853 36°21'20.10° 44°46'38.10° 22-Spring Sarwchawa-qalasaiday sarw 961 36°20'27.30° 44°46'51.90° 23-Spring Sarwchawa-qalasaiday sarw 961 36°20'28.20° 44°46'05.60° 24-Spring Tawe-mirabag 660 36°20'38.20° 44°46'05.60° 24-Spring Sarashkawtan 1065 36°16'50.90° 44°46'48'56.90° 26-Spring Kany bnaw 800 36°20'11.20° 44°46'40.10° Wells Luse spring-topawa 542 36°13'30.950° 44°55'22.60° 29-Well Boskin 1 513 36°13'24.70° 44°56'447.20° 30-Well Chwarqurna 535 36°11'03.40° 44°50'42.60° 32-Well Hizop 1 552 36°10'28.40°	16-Spring	Srushk-kawbin	900	36°22'56.80"	44°45'28.00"			
19-Spring Sardke-daraban 824 36° 22' 21.80° 44° 45' 43.50° 20-Spring Zurkan-dere 633 36° 16' 16.00° 44° 45' 43.50° 20-Spring Sarukany-dere 853 36° 21' 20.10° 44° 46' 38.10° 22-Spring Sarukany-dere 853 36° 20' 27.30° 44° 46' 38.10° 22-Spring Saruchawa-qalasaiday sarw 961 36° 20' 27.30° 44° 46' 51.90° 23-Spring Saruchawa-qalasaiday sarw 961 36° 20' 28.60° 44° 45' 29.00° 24-Spring Saruchawa-nore 1005 36° 20' 88.60° 44° 45' 29.00° 24-Spring Tawe-mirabag 660 36° 20' 58.20° 44° 46' 05.60° 25-Spring Sarashkawtan 1065 36° 12' 33.20° 44° 46' 40.10° 26-Spring Kany bnaw 800 36° 12' 33.20° 44° 56' 46.40° 27-Spring Luse spring-topawa 542 36° 13' 28.00° 44° 55' 22.60° 30-Well Boskin 1 513 36° 13' 32.80° 44° 55' 22.60° 30-Well Boskin 2 529 36' 13' 24.70° 44° 54' 47.20° 31-Well Chwar	17-Spring	Sarwchawa-Gulan	1124	36°23'35.00"	44°42'51.40"			
20-SpringZurkan-dere63336°16′16.00°44°48′07.20°21-SpringSarukany-dere85336°21′20.10°44°46′38.10°22-SpringSarwchawa-qalasaiday sarw96136°20′27.30°44°46′05.190°23-SpringSarwchawa-nore100536°20′88.60°44°45′29.00°24-SpringTawe-mirabag66036°20′88.20°44°46′05.60°25-SpringSarashkawtan106536°16′50.90°44°46′07.20°26-SpringKany bnaw80036°20′11.20°44°46′40.10°27-SpringLuse spring-topawa54236°13′28.00°44°45′29.60°28-WellQurago51936°13′28.00°44°55′22.60°29-WellBoskin 151336°13′28.00°44°55′22.60°30-WellBoskin 252936°11′03.40°44°51′47.20°31-WellChwarqurna53536°11′03.40°44°41′17.90°32-WellHizop 155236°10′29.20°44°41′19.00°33-WellKlaw sur55436°10′1.10°44°42′19.50°35-WellQaraniaxa53636°10′59.30°44°44′29.20°38-WellKany maran53636°10′59.30°44°44′29.20°38-WellPlingan52236°10′59.30°44°44′29.20°39-WellKolin 155036°10′59.30°44°45′56.70°39-WellKolin 153636°10′59.30°44°45′56.70°39-WellKolin 155036°10′59.30°44°45′56.70°	18-Spring	Mamxalan	831	36°23'42.70"	44°42'28.20"			
21-Spring Sarukany-dere 853 36°21'20.10° 44°46'38.10° 22-Spring Sarwchawa-qalasaiday sarw 961 36°20'27.30° 44°46'51.90° 23-Spring Sarwchawa-qalasaiday sarw 961 36°20'27.30° 44°46'51.90° 23-Spring Sarwchawa-nore 1005 36°20'48.60° 44°46'05.60° 24-Spring Tawe-mirabag 660 36°20'11.20° 44°46'05.60° 25-Spring Sarashkawtan 1065 36°10'1.20° 44°46'0.60° 26-Spring Kany bnaw 800 36°20'11.20° 44°46'40.10° 27-Spring Luse spring-topawa 542 36°13'09.50° 44°46'40.10° Well 28-Well Qurago 519 36°13'28.00° 44°55'22.60° 30-Well Boskin 1 513 36°11'03.40° 44°50'42.60° 31-Well Chwarqurna 535 36°11'03.40° 44°50'42.60° 32-Well Hizop 1 552 36°10'01.10° 44°4'11'9.0° 34-Well Klaw sur 554 36°10'01.50° 44°4'4'1'4.0° 35-Well Qartaran 536<	19-Spring	Sardke-daraban	824	36°22'21.80"	44°45'43.50"			
22-Spring Sarwchawa-qalasaiday sarw 961 36°20'27.30° 44°46'51.90° 23-Spring Sarwchawa-nore 1005 36°20'48.60° 44°45'29.00° 24-Spring Tawe-mirabag 660 36°20'58.20° 44°46'05.60° 25-Spring Sarashkawtan 1065 36°16'50.90° 44°46'05.60° 25-Spring Sarashkawtan 1065 36°10'1.20° 44°46'0.05° 26-Spring Kany bnaw 800 36°20'11.20° 44°46'40.10° Wells 28-Well Qurago 519 36°13'09.50° 44°55'22.60° 30-Well Boskin 1 513 36°13'24.70° 44°54'24'7.20° 31-Well Chwarqurna 535 36°10'29.20° 44°41'17.90° 32-Well Hizop 1 552 36°10'29.20° 44°41'17.90° 33-Well Hizop 2 564 36°10'1.10° 44°44'2'19.50° 34- Well Klaw sur 554 36°10'1.50° 44°44'3.82.0° 35-Well Qaratran 533 36°10'1.50° 44°44'3.82.0° 36-Well Kany maran 533 36°10'1.50°	20-Spring	Zurkan-dere	633	36°16'16.00"	44°48'07.20"			
23-SpringSarwchawa-nore1005 $36^{\circ}20^{\circ}48.60^{\circ}$ $44^{\circ}45^{\circ}29.00^{\circ}$ 24-SpringTawe-mirabag660 $36^{\circ}20^{\circ}58.20^{\circ}$ $44^{\circ}46^{\circ}05.60^{\circ}$ 25-SpringSarashkawtan1065 $36^{\circ}16^{\circ}50.90^{\circ}$ $44^{\circ}48^{\circ}56.90^{\circ}$ 26-SpringKany bnaw800 $36^{\circ}20^{\circ}11.20^{\circ}$ $44^{\circ}47^{\circ}26.70^{\circ}$ 27-SpringLuse spring-topawa542 $36^{\circ}12^{\circ}33.20^{\circ}$ $44^{\circ}46^{\circ}40.10^{\circ}$ Wells28-WellQurago519 $36^{\circ}13^{\circ}09.50^{\circ}$ $44^{\circ}56^{\circ}46.40^{\circ}$ 29-WellBoskin 1513 $36^{\circ}13^{\circ}24.70^{\circ}$ $44^{\circ}55^{\circ}22.60^{\circ}$ 30-WellBoskin 2529 $36^{\circ}13^{\circ}24.70^{\circ}$ $44^{\circ}54^{\circ}47.20^{\circ}$ 31-WellChwarqurna535 $36^{\circ}11^{\circ}02.840^{\circ}$ $44^{\circ}45^{\circ}42.60^{\circ}$ 32-WellHizop 1552 $36^{\circ}10^{\circ}29.20^{\circ}$ $44^{\circ}41^{\circ}19.00^{\circ}$ 34-WellKlaw sur554 $36^{\circ}10^{\circ}01.10^{\circ}$ $44^{\circ}44^{\circ}42.19.50^{\circ}$ 35-WellQamtaran533 $36^{\circ}10^{\circ}53.30^{\circ}$ $44^{\circ}44^{\circ}43.820^{\circ}$ 37-WellQaraniaxa536 $36^{\circ}10^{\circ}59.30^{\circ}$ $44^{\circ}44^{\circ}42.20^{\circ}$ 38-WellFlingan522 $36^{\circ}13^{\circ}12.15.80^{\circ}$ $44^{\circ}45^{\circ}56.70^{\circ}$ 39-WellKolin 1550 $36^{\circ}13^{\circ}31.00^{\circ}$ $44^{\circ}51^{\circ}34.00^{\circ}$	21-Spring	Sarukany-dere	853	36°21'20.10"	44°46'38.10"			
24-SpringTawe-mirabag660 $36^\circ 20^\circ 58.20^\circ$ $44^\circ 46^\circ 05.60^\circ$ 25-SpringSarashkawtan1065 $36^\circ 16^\circ 50.90^\circ$ $44^\circ 48^\circ 56.90^\circ$ 26-SpringKany bnaw800 $36^\circ 20^\circ 11.20^\circ$ $44^\circ 47^\circ 26.70^\circ$ 27-SpringLuse spring-topawa542 $36^\circ 12^\circ 33.20^\circ$ $44^\circ 46^\circ 40.10^\circ$ Wells28-WellQurago519 $36^\circ 13^\circ 9.50^\circ$ $44^\circ 56^\circ 46.40^\circ$ 29-WellBoskin 1513 $36^\circ 13^\circ 28.00^\circ$ $44^\circ 55^\circ 22.60^\circ$ 30-WellBoskin 2529 $36^\circ 13^\circ 24.70^\circ$ $44^\circ 50^\circ 42.60^\circ$ 31-WellChwarqurna535 $36^\circ 10^\circ 29.20^\circ$ $44^\circ 41^\circ 17.90^\circ$ 32-WellHizop 1552 $36^\circ 10^\circ 29.20^\circ$ $44^\circ 41^\circ 19.00^\circ$ 34-WellKlaw sur554 $36^\circ 10^\circ 01.10^\circ$ $44^\circ 42^\circ 19.50^\circ$ 35-WellQarnataran533 $36^\circ 10^\circ 59.30^\circ$ $44^\circ 44^\circ 42.20^\circ$ 36-WellKany maran536 $36^\circ 10^\circ 59.30^\circ$ $44^\circ 44^\circ 56.70^\circ$ 38-WellPlingan522 $36^\circ 12^\circ 15.80^\circ$ $44^\circ 45^\circ 56.70^\circ$ 39-WellKolin 1550 $36^\circ 13^\circ 31.00^\circ$ $44^\circ 45^\circ 54.70^\circ$	22-Spring	Sarwchawa-qalasaiday sarw	961	36°20'27.30"	44°46'51.90"			
25-SpringSarashkawtan1065 $36^{\circ}16'50.90'$ $44^{\circ}48'56.90'$ 26-SpringKany bnaw800 $36^{\circ}20'11.20'$ $44^{\circ}47'26.70'$ 27-SpringLuse spring-topawa542 $36^{\circ}12'33.20'$ $44^{\circ}46'40.10'$ Wells28-WellQurago519 $36^{\circ}13'09.50'$ $44^{\circ}56'46.40'$ 29-WellBoskin 1513 $36^{\circ}13'28.00'$ $44^{\circ}55'22.60'$ 30-WellBoskin 2529 $36^{\circ}13'24.70'$ $44^{\circ}54'47.20'$ 31-WellChwarqurna535 $36^{\circ}10'28.40'$ $44^{\circ}50'42.60'$ 32-WellHizop 1552 $36^{\circ}10'28.40'$ $44^{\circ}41'19.00'$ 33-WellHizop 2564 $36^{\circ}10'29.20'$ $44^{\circ}44'119.00'$ 35-WellQamtaran549 $36^{\circ}10'01.10'$ $44^{\circ}44'38.20'$ 36-WellKany maran533 $36^{\circ}10'58.60'$ $44^{\circ}44'38.20'$ 37-WellQaraniaxa536 $36^{\circ}10'59.30'$ $44^{\circ}44'29.20'$ 38-WellPlingan522 $36^{\circ}12'15.80'$ $44^{\circ}45'56.70'$ 39-WellKolin 1550 $36^{\circ}13'31.00'$ $44^{\circ}51'34.00'$	23-Spring	Sarwchawa-nore	1005	36°20'48.60"	44°45'29.00"			
26-Spring Kany bnaw 800 36°20'11'20" 44°47'26.70" 27-Spring Luse spring-topawa 542 36°12'33.20" 44°46'40.10" Wells 28-Well Qurago 519 36°13'09.50" 44°56'46.40" 29-Well Boskin 1 513 36°13'28.00" 44°55'22.60" 30-Well Boskin 2 529 36°13'24.70" 44°54'47.20" 31-Well Chwarqurna 535 36°10'28.40" 44°50'42.60" 32-Well Hizop 1 552 36°10'28.40" 44°41'17.90" 33-Well Hizop 2 564 36°10'02.20" 44°44'19.00" 34- Well Klaw sur 554 36°10'01.10" 44°44'1.40" 36-Well Qamtaran 549 36°10'01.50" 44°44'38.20" 35-Well Qaraniaxa 536 36°10'59.30" 44°44'38.20" 38-Well Plingan 522 36°12'15.80" 44°45'56.70" 39-Well Kolin 1 550 36°12'15.80" 44°45'34.00"	24-Spring	Tawe-mirabag	660	36°20'58.20"	44°46'05.60"			
27-SpringLuse spring-topawa542 Wells $36^{\circ}12'33.20''$ $44^{\circ}46'40.10''$ Wells28-WellQurago519 $36^{\circ}13'09.50''$ $44^{\circ}56'46.40''$ 29-WellBoskin 1513 $36^{\circ}13'28.00''$ $44^{\circ}55'22.60''$ 30-WellBoskin 2529 $36^{\circ}13'24.70''$ $44^{\circ}54'47.20''$ 31-WellChwarqurna535 $36^{\circ}10'28.40''$ $44^{\circ}50'42.60''$ 32-WellHizop 1552 $36^{\circ}10'29.20''$ $44^{\circ}41'17.90''$ 33-WellHizop 2564 $36^{\circ}10'29.20''$ $44^{\circ}41'41.90''$ 34-WellKlaw sur554 $36^{\circ}10'01.50''$ $44^{\circ}44'41.40''$ 36-WellQamtaran533 $36^{\circ}10'58.60''$ $44^{\circ}44'38.20''$ 37-WellQaraniaxa536 $36^{\circ}10'59.30'''$ $44^{\circ}45'56.70'''$ 38-WellPlingan522 $36^{\circ}13'31.00''''''''''''''''''''''''''''''''$	25-Spring	Sarashkawtan	1065	36°16 [°] 50.90″	44°48'56.90"			
Wells Wells 28-Well Qurago 519 36°13'09.50" 44°56'46.40" 29-Well Boskin 1 513 36°13'28.00" 44°55'22.60" 30-Well Boskin 2 529 36°13'24.70" 44°54'47.20" 31-Well Chwarqurna 535 36°11'03.40" 44°50'42.60" 32-Well Hizop 1 552 36°10'28.40" 44°41'17.90" 33-Well Hizop 2 564 36°10'01.10" 44°42'19.50" 34-Well Klaw sur 554 36°10'01.10" 44°44'1.9.00" 35-Well Qamtaran 549 36°10'158.60" 44°44'38.20" 36-Well Kany maran 533 36°10'58.60" 44°44'38.20" 38-Well Plingan 522 36°12'5.80" 44°45'5.6.70" 39-Well Kolin 1 550 36°13'31.00" 44°5'5'34.00"	26-Spring	Kany bnaw	800	36°20'11.20"	44°47'26.70"			
28-WellQurago519 $36^{\circ}13'09.50''$ $44^{\circ}56'46.40''$ 29-WellBoskin 1513 $36^{\circ}13'28.00''$ $44^{\circ}55'22.60''$ 30-WellBoskin 2529 $36^{\circ}13'24.70''$ $44^{\circ}54'47.20''$ 31-WellChwarqurna535 $36^{\circ}10'28.40''$ $44^{\circ}50'42.60''$ 32-WellHizop 1552 $36^{\circ}10'28.40''$ $44^{\circ}41'17.90''$ 33-WellHizop 2564 $36^{\circ}10'29.20''$ $44^{\circ}41'19.00''$ 34-WellKlaw sur554 $36^{\circ}10'01.10''$ $44^{\circ}42'19.50''$ 35-WellQamtaran549 $36^{\circ}10'01.50''$ $44^{\circ}44'41.40''$ 36-WellKany maran533 $36^{\circ}10'59.30''$ $44^{\circ}44'29.20''$ 38-WellPlingan522 $36^{\circ}12'15.80'''$ $44^{\circ}51'34.00'''''$	27-Spring	Luse spring-topawa	542	36°12'33.20"	44°46'40.10"			
29-WellBoskin 151336°13'28.00"44°55'22.60"30-WellBoskin 252936°13'24.70"44°54'47.20"31-WellChwarqurna53536°11'03.40"44°50'42.60"32-WellHizop 155236°10'28.40"44°41'17.90"33-WellHizop 256436°10'29.20"44°41'19.00"34-WellKlaw sur55436°10'01.10"44°42'19.50"35-WellQamtaran54936°10'01.50"44°44'41.40"36-WellKany maran53336°10'58.60"44°44'29.20"38-WellPlingan52236°12'15.80"44°45'56.70"39-WellKolin 155036°13'31.00"44°51'34.00"		W	/ells					
30-WellBoskin 2529 $36^{\circ}13'24.70''$ $44^{\circ}54'47.20''$ 31-WellChwarqurna535 $36^{\circ}11'03.40''$ $44^{\circ}50'42.60''$ 32-WellHizop 1552 $36^{\circ}10'28.40''$ $44^{\circ}41'17.90''$ 33-WellHizop 2564 $36^{\circ}10'29.20''$ $44^{\circ}41'19.00''$ 34- WellKlaw sur554 $36^{\circ}10'01.10''$ $44^{\circ}42'19.50''$ 35-WellQamtaran549 $36^{\circ}10'01.50''$ $44^{\circ}44'38.20''$ 36-WellKany maran536 $36^{\circ}10'58.60'''$ $44^{\circ}44'29.20'''$ 38-WellPlingan522 $36^{\circ}12'15.80''''$ $44^{\circ}556.70''''''''''''''''''''''''''''''''''''$	28-Well	Qurago	519	36°13'09.50"	44°56'46.40"			
31-WellChwarqurna53536°11'03.40"44°50'42.60"32-WellHizop 155236°10'28.40"44°41'17.90"33-WellHizop 256436°10'29.20"44°41'19.00"34-WellKlaw sur55436°10'01.10"44°42'19.50"35-WellQamtaran54936°10'01.50"44°44'41.40"36-WellKany maran53336°10'58.60"44°44'29.20"37-WellQaraniaxa53636°10'59.30"44°45'56.70"38-WellPlingan52236°12'15.80"44°51'34.00"	29-Well	Boskin 1	513	36°13'28.00"	44°55'22.60"			
32-Well Hizop 1 552 36°10'28.40" 44°41'17.90" 33-Well Hizop 2 564 36°10'29.20" 44°41'19.00" 34- Well Klaw sur 554 36°10'01.10" 44°42'19.50" 35-Well Qamtaran 549 36°10'01.50" 44°44'41.40" 36-Well Kany maran 533 36°10'58.60" 44°44'38.20" 37-Well Qaraniaxa 536 36°10'59.30" 44°44'29.20" 38-Well Plingan 522 36°12'15.80" 44°45'56.70" 39-Well Kolin 1 550 36°13'31.00" 44°51'34.00"	30-Well	Boskin 2	529	36°13'24.70"	44°54 47.20			
33-Well Hizop 2 564 36°10'29.20" 44°41'19.00" 34- Well Klaw sur 554 36°10'01.10" 44°42'19.50" 35-Well Qamtaran 549 36°10'01.50" 44°44'41.40" 36-Well Kany maran 533 36°10'59.30" 44°44'38.20" 37-Well Qaraniaxa 536 36°10'59.30" 44°44'29.20" 38-Well Plingan 522 36°12'15.80" 44°45'56.70" 39-Well Kolin 1 550 36°13'31.00" 44°51'34.00"	31-Well	Chwarqurna	535	36°11'03.40"	44°50'42.60"			
34- Well Klaw sur 554 36°10'01.10" 44°42'19.50" 35-Well Qamtaran 549 36°10'01.50" 44°44'41.40" 36-Well Kany maran 533 36°10'58.60" 44°44'438.20" 37-Well Qaraniaxa 536 36°10'59.30" 44°44'29.20" 38-Well Plingan 522 36°12'15.80" 44°45'56.70" 39-Well Kolin 1 550 36°13'31.00" 44°51'34.00"	32-Well	Hizop 1	552	36°10'28.40"	44°41'17.90"			
35-WellQamtaran54936°10'01.50"44°44'41.40"36-WellKany maran53336°10'58.60"44°44'38.20"37-WellQaraniaxa53636°10'59.30"44°44'29.20"38-WellPlingan52236°12'15.80"44°45'56.70"39-WellKolin 155036°13'31.00"44°51'34.00"	33-Well	Hizop 2	564	36°10'29.20"	44°41'19.00"			
36-WellKany maran53336°10'58.60"44°44'38.20"37-WellQaraniaxa53636°10'59.30"44°44'29.20"38-WellPlingan52236°12'15.80"44°45'56.70"39-WellKolin 155036°13'31.00"44°51'34.00"	34- Well	Klaw sur	554	36°10'01.10"	44°42'19.50"			
37-Well Qaraniaxa 536 36°10'59.30" 44°44'29.20" 38-Well Plingan 522 36°12'15.80" 44°45'56.70" 39-Well Kolin 1 550 36°13'31.00" 44°51'34.00"	35-Well	Qamtaran	549	36°10'01.50"	44°44'41.40"			
38-Well Plingan 522 36°12'15.80" 44°45'56.70" 39-Well Kolin 1 550 36°13'31.00" 44°51'34.00"	36-Well	Kany maran	533	36°10'58.60"	44°44'38.20"			
39-Well Kolin 1 550 36°13'31.00" 44°51'34.00"	37-Well	Qaraniaxa	536	36°10'59.30"	44°44'29.20"			
501551.00	38-Well	Plingan	522	36°12'15.80"	44°45′56.70″			
40-Well Kolin 2 533 36°13′25.00″ 44°50′30.00″	39-Well	Kolin 1	550	36°13'31.00"	44°51'34.00"			
	40-Well	Kolin 2	533	36°13'25.00"	44°50'30.00"			

Table (10): GPS reading for selected locations.

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Journal of University of Duhok., Vol. 22, No.2 (Agri. and Vet. Sciences), Pp, 2019 (special Issue) The 3rd international agricultural conference, 2nd -3rd October 2019, Duhok

52-Well	Grjan 2	549	36°12'33.30"	44°46'40.20"
51-Well	Grjan 1	543	36°12'24.90"	44°46'46.80"
50-Well	Daraban	846	36°22'05.05"	44°45'34.09"
49-Well	Nore	821	36°21'05.70"	44°46'09.60"
48-Well	Pashkotal	718	36°18'56.20"	44°48'05.30"
47-Well	Rezena	715	36°18'07.50"	44°48 [°] 59.70 [″]
46-Well	Sarkapkan	649	36°15′57.60″	44°50'09.50"
45-Well	Rania	637	36°15'58.80"	44°50'40.50"
44-Well	Hajiawa	584	36°15'00.00"	44°46 44.20
43-Well	Naqolan	604	36°15'48.70"	44°46 16.30
42-Well	Shkarta	634	36°20'39.40"	44°42'30.90"
41-Well	Garmkadal	617	36°12'22.00"	44°46'06.00"

WATER SAMPLING:

Water samples were collected three times from 19th August 2018 to 12th January 2019 and in 1000 ml disposable polyethylene

The main water analysis included EC, pH, concentration of Ca^{2+} , Mg^{2+} , Na^+ , K^+ , Zn^{2+} , Pb, Cd^{2+} , Mn^{2+} , Fe²⁺, HCO₃⁻⁻, CO₃²⁻, CI⁻, SO₄²⁻. PO₄³⁻ and dissolved oxygen, which were determined according to APHA(1989) the range and the mean of the results were shown in table (11) ,While the mean concentration of them during t

The results of water analyses were classified for agricultural uses depending on some global systems of water classification.

RESULTS AND DISCUSSION

Classification of water for irrigation purpose: The studied waters were classified according to some classifications as follow: Richards (1954) classification (USDA classification):

Depending on USDA classification the water of (44, 5, 2 and 1) locations had $(C_2S_1, C_3S_1, C$ C_4S_1 and C_4S_2) classes for irrigation purpose respectively. It means 84.62, 9.62, 3.84 and 1.92 % of the studied waters had (C_2S_1, C_3S_1, C_4S_1) and C_4S_2) class for irrigation (table ,11). These results indicated that the water of 49 locations were suitable for irrigation and the water of 1spring (Ganaw- Qurago spring) and 2 wells (Qurago and Pashkatol) were not good for irrigation due to high EC value more than 2.25 dSm⁻¹ and moderate SAR value which ranged from 10 18. to

Table (11): shows the chemical properties of the studied water resources in Rania district.

Water Properties			River			Spring		Well			
		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	
рН		7.88	7.94	7.91	6.88	7.55	7.26	6.75	7.55	7.22	
Do (mg l ⁻¹)		8.01	8.2	8.14	4.85	8.46	7.56	6.95	8.38	7.71	
EC (dSm ⁻¹)		0.49	1.45	0.90	0.43	3.83	0.86	0.44	2.46	0.75	
Mg		0.86	3.5	2.31	1.02	7.93	2.41	0.92	3.49	1.84	
Са		2.24	4.96	3.45	2.05	20.64	5.21	2.27	10.55	4.43	
Na	÷	0.35	12.41	4.74	0.12	27.47	1.47	0.19	16.95	1.44	
к	lc I	0.07	0.42	0.21	0.03	3.55	0.23	0.04	0.72	0.12	
HCO₃	mmolc	3.24	16.19	9.08	2.16	44.83	7.90	2.85	24.12	6.48	
CO ₃	=	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
SO ₄		1.08	2.00	1.43	0.73	3.2	1.23	0.69	2.08	1.07	
CI		0.03	0.18	0.08	0.01	0.84	0.07	0.03	0.28	0.081	
PO₄(mg l⁻¹)		0.00	5.81	2.90	0.00	6.22	1.43	0.00	4.67	1.2	
SP		0.29	0.68	0.43	0.40	1.64	0.38	0.23	0.79	0.35	
RSC		1.69	13.32	6.2	0.62	35.94	4.09	0.72	19.62	3.22	

TDS(mg I ⁻¹)	313.60	864	555.73	272	2320	546.27	278.4	1571.2	476.67
SAR		0.24	10.36	4.08	0.12	12.95	0.79	0.18	11.3	1.02
Na%		4.00	67.00	34.00	1.00	56.00	7.00	4.00	64.00	12.00
Pb	mg l ⁻¹	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd
Zn		Nd	0.001	0.0006	Nd	0.002	0.007	Nd	0.001	0.0004
Mn		Nd	0.001	0.0006	Nd	0.002	0.007	Nd	0.001	0.0004
Cd		Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd	Nd
NO ₃ -		5	30	20	4	21	16	6	16	10

Doneen classification (1954):

This classification depends on salinity potential (sp) and according to this parameter and the results in table (11) all the studied water have good class for high, moderate, and low permeable soils since the value of salinity potential was very low ≤ 1.64 mmolc l⁻¹.

Wilcox Classification (1954):

The water for 8 locations number (6, 7, 17, 23, 31, 41, 42 and 52) have probably safe class because the value of residual sodium carbonate (RSC) of them below was $1.25 \text{ mmol}_{c}^{-1}$ whereas the water for locations number (1, 4, 9, 11, 13, 14, 15, 16, 22, 24, 25, 26, 35, 37, 39, 40, 43, 44, 45, 48 and 49) were located within marginal class since the residual sodium carbonate (RSC)value of them was ranged between (1.25-2.5) mmol_c -¹ and d the remain locations (2, 3, 5, 8, 10, 12, 18, 19, 20, 21, , 27, 28, 29, 30, 32, 33, 34, 36, 38, 46, 47, 50 and 51) had unsuitable class because value of RSC for them were more than 2.50 mmol_c l⁻¹, (table .11).

Avers and Westcot (1985) classification: Depending on EC value the studied waters for the locations(1, 4, 6, 7, 8, 9, 11, 13, 14, 15, 16, 17, 20, 22, 23, 24, 25, 26, 31, 34, 35, 37, 39, 40, 41, 42, 43, 44, 45, 46, 47, 49, 51 and 52) were classified as non-saline water, or suitable for irrigation, while the water for locations number (2, 3, 10, 12, 18, 19, 21, 27, 28, 29, 30, 32, 33, 36, 38, 48 and 50) were located within slight to moderate class and only water for location number (5) had sever class since it's EC value was more than 3 dS m⁻¹. On the other hand depending on SAR value water for locations number 2 and 28 have slight to moderate degree of restriction for irrigation use, because SAR value of them was located between (3-9), whereas sample number (5) have sever restriction of use since its SAR value was more than 9, and all other water samples have no restriction use for irrigation.

Depending on HCO_3 concentration the water samples of most locations had slight to moderate restriction use since the value of bicarbonate were ranged between (1.5-8.5) mmol_c l⁻¹ except the water for locations number (2, 5, 12, 18, 28, 32 and 33) had moderate to severe restriction of use for irrigation because the value of HCO_3 was more than 8.5 mmol_c l⁻¹ (Ayers and Westcot, 1985).

Don classification (1995):

Don (1995) classified irrigation water depending up on, EC, TDS, SAR, Na% and pH to five classes as follow: According to Don (1995) classification. depending on EC values, the irrigation water for locations (1, 4, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 20, 22, 23, 24, 25, 26, 30, 31, 34, 35, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 51 and 52) had good class because the EC values were between (0.25 - 0.75) dS m⁻¹, however water for locations (2, 3, 18, 19, 21, 27, 29, 32, 33, 36 and 50) had Permissible class, since their EC were more than 0.75 dS m^{-1} and less than 2 dS m⁻¹, and water for locations (12 and 28) had a doubtful class because EC value was ranged between $(2 \text{ to } 3) \text{ dS } \text{m}^{-1}$, while sample number 5 located within unsuitable class for irrigation because EC value of this water was more than 3 dS m⁻¹.

Depending on total soluble salts the studied waters have different classes, water samples for locations (1, 3, 4, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 17, 20, 22, 23, 24, 25, 26, 29, 30, 31, 34, 35, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 51 and52) have good class for irrigation, since the TDS of these samples was located between (175-525) ppm, while the water for locations (2, 18, 19, 21, 27, 32, 33, 36 and 50) were located within permissible class because the TDS value of them was ranged (from 525 to 1400) ppm, the samples number (12 and 28) were located within doubtful class, since the TDS value was ranged between (1400-2100) ppm, while the water for location number (5) had unsuitable

class due to high TDS value (more than 2100)ppm.

Relying on sodium percentage water samples of (3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51 and 52) had excellent class because Na% value was less than 20%, sample numbers (1, 32, 33 and 34) had good class since Na% was ranged from (20-40)%, the water for location (5) has permissible class since the Na% was located between (40-60)%, and the water sample for locations (2 and 28) were located within doubtful class due to high sodium % value (60-80)%.

Classification of water for animal uses:

Depending on Ayers and Westcot (1985) the studied water for most of locations were excellent for poultry and livestock uses since their EC value was less than 1.50 dS m⁻¹, except the water of Qurago-Ganaw spring and Qurago well which were very satisfactory for poultry and livestock uses because the EC value of them was between 1.50 to 5.0 dS m⁻¹.It means the water for all the studied locations were suitable for poultry and livestock uses or watering.

The water of the studied location were suitable for livestock uses depending on concentration of calcium, sodium, magnesium, Sulfate ,chloride and total dissolved salts according to Altoviski (1962) classification, since their values were less than (300, 800.150, 1000,900 and 3000) ppm respectively as shown in table (11).

According to Ayers and Westcot (1985) the water of the studied locations were suitable for livestock uses since the concentration of the studied heavy metals and nitrate were very low in comparing with allowable concentration of them as shown in table (11). Since the concentration of the studied heavy metals and NO_3^- were very low in comparing with the allowable values by Ayers and Westcot (1985) as recorded in table (9).

Depending on Francis-Floyd (2003) most of the studied waters were suitable for fish culture since the dissolved oxygen of them was between $(4.5 - \text{more than 8}) \text{ mg } 1^{-1}$ which was suitable for most fish species. On the other hand the water for one spring (location number 12 or Daloka spring) and one well (location number 28 or Qurago well) were not suitable for fish culture since the TDS of them was more than 1000ppm or the EC value of them is more than 1.60dS m⁻¹

CONCLUSION

It appears from this investigation that the water of most of the studied locations (rivers, springs and wells) were suitable for irrigation, poultry, livestock uses in additional to fish culture.

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Sample NO.	рH	EC $dS m^{1-}$	DO $mg L^{1-}$	Mg ⁺²	Ca ⁺²	Na ⁺	K ⁺	HCO ₃ ⁻	Cl-	SO_4^{-2}	CO_{3}^{-2}
Jample NO.	7.84	0.51	8.01	0.87	2.24	Na 1.45	0.07	3.25	0.04	30₄ 1.21	0.00
•											
2	7.89	1.40	8.23	2.58	3.17	12.40	0.41	16.19	0.18	2.00	0.00
3	7.83	0.77	8.38	3.50	4.96	0.35	0.14	7.81	0.02	1.08	0.00
4	7.33	0.62	8.20	1.50	3.11	0.20	0.04	3.58	0.02	1.11	0.00
5	7.26	3.61	5.07	4.67	13.24	27.45	3.53	44.87	0.80	3.19	0.00
6	7.53	0.59	7.97	1.68	3.04	0.30	0.08	3.48	0.04	1.33	0.00
7	7.41	0.52	8.32	1.03	2.59	0.28	0.07	2.88	0.06	0.93	0.00
8	7.36	0.80	8.00	1.50	4.54	1.21	0.16	5.70	0.13	1.27	0.00
9	7.34	0.69	8.34	1.75	4.46	0.31	0.06	5.10	0.04	1.35	0.00
10	7.31	0.76	7.50	2.40	4.56	0.20	0.06	6.09	0.05	0.96	0.00
11	7.40	0.70	8.33	2.24	3.95	0.19	0.05	5.20	0.04	1.16	0.00
12	7.13	2.36	6.34	7.94	20.65	0.37	0.20	26.90	0.04	2.03	0.00
13	7.51	0.64	8.38	2.27	3.35	0.18	0.05	4.53	0.06	1.25	0.00
14	7.36	0.67	7.55	2.40	4.01	0.22	0.09	5.34	0.05	1.14	0.00
15	7.53	0.64	8.56	2.22	3.48	0.14	0.05	4.95	0.02	0.89	0.00
16	7.49	0.60	8.40	2.24	3.54	0.17	0.05	4.54	0.03	1.24	0.00
17	7.57	0.44	8.47	1.04	2.05	0.12	0.04	2.17	0.03	1.01	0.00
18	7.13	1.50	6.24	5.31	11.78	0.51	0.16	16.23	0.05	1.41	0.00
19	7.28	0.95	6.87	3.22	5.53	0.57	0.22	8.52	0.07	0.91	0.00
20	7.34	0.71	8.35	2.49	4.82	0.21	0.10	6.48	0.04	1.03	0.00
21	7.25	0.85	7.32	2.61	5.73	0.24	0.10	7.42	0.04	1.19	0.00

Appendix (1): The mean of some physiochemical properties of the studied water resources in Rania district during the hydrological year

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22	7.57	0.63	8.37	1.72	3.29	0.17	0.04	4.38	0.05	0.75	0.00
23	7.59	0.52	8.25	1.11	2.23	0.15	0.04	2.32	0.04	1.01	0.00
24	7.54	0.61	8.07	1.55	3.48	0.21	0.04	3.88	0.03	1.18	0.00
25	7.51	0.57	8.39	1.46	2.74	0.17	0.04	3.60	0.04	0.73	0.00
26	7.49	0.56	8.27	1.47	3.12	0.23	0.05	3.55	0.05	1.10	0.00
27	7.31	0.90	7.93	2.25	5.97	1.51	0.10	8.22	0.17	1.23	0.00
28	7.23	2.44	7.81	2.55	6.43	16.94	0.71	24.11	0.26	2.07	0.00
29	7.33	0.87	8.14	2.02	5.24	1.44	0.10	7.23	0.13	1.09	0.00
30	7.40	0.80	8.25	1.98	4.69	0.98	0.14	6.42	0.12	1.07	0.00
31	7.60	0.49	8.45	1.49	2.29	0.25	0.09	2.87	0.05	0.99	0.00
32	7.03	1.33	7.29	1.09	10.56	3.50	0.09	12.88	0.29	1.14	0.00
33	7.1	1.17	7.38	1.37	7.41	3.01	0.09	10.37	0.23	1.03	0.00
34	7.40	0.66	8.44	1.67	3.53	1.38	0.16	5.23	0.10	1.15	0.00
35	7.52	0.51	8.04	1.02	3.23	0.25	0.05	3.49	0.05	0.91	0.00
36	7.16	1.14	6.97	1.95	5.08	1.54	0.13	7.33	0.23	1.03	0.00
37	7.28	0.74	7.68	2.07	4.25	0.40	0.07	5.50	0.07	1.11	0.00
37	7.33	0.80	7.81	2.56	5.09	0.56	0.20	7.21	0.05	1.05	0.00
39	7.49	0.53	7.48	1.11	2.85	0.24	0.08	3.27	0.05	0.89	0.00
40	7.44	0.49	7.98	1.34	3.07	0.39	0.05	3.64	0.04	1.08	0.00
41	7.58	0.49	7.58	1.23	2.82	0.19	0.06	2.97	0.04	0.98	0.00
42	7.47	0.46	8.08	0.92	3.12	0.21	0.04	2.91	0.03	1.04	0.00
43	7.33	0.63	8.06	1.54	3.95	0.24	0.06	4.32	0.06	1.21	0.00
44	7.47	0.56	8.09	1.64	3.07	0.23	0.05	4.03	0.04	0.84	0.00
45	7.43	0.64	8.21	2.02	4.09	0.28	0.09	5.18	0.06	1.13	0.00
46	7.38	0.61	8.00	1.85	3.88	0.80	0.07	5.56	0.05	0.80	0.00
47	7.36	0.71	8.11	2.30	4.67	0.35	0.10	6.11	0.06	1.10	0.00
48	7.32	0.77	8.01	2.88	3.54	0.35	0.12	5.68	0.06	1.07	0.00
49	7.28	0.71	8.08	2.09	4.30	0.43	0.10	5.57	0.08	1.15	0.00
50	7.21	0.95	7.59	3.49	4.36	1.20	0.23	8.44	0.09	0.69	0.00
51	7.54	0.73	8.16	2.13	5.12	0.39	0.07	6.33	0.06	1.14	0.00
52	7.34	0.67	8.28	2.03	4.67	0.39	0.07	5.97	0.05	1.03	0.00
RLSD.001	0.11	0.23	1.02	0.67	1.85	0.44	0.05	2.30	0.06	0.39	N.S

دیاری کردنی هەندێ سەرچاوەی ئاو بۆ بەکارهێنانی کشتوکاڵی له ڕانیه \ پارێزگای سلێمانی

پوخته

ئەم توێژينەوەيە لە ماوەى نێوان 19 \ 8 \ 2018 ^ي 12 \ 2 \ 2019 لە ړانيە \ سلێمانى ئەنجام درا بە مەبەسـتى پـۆڵێن كردنـى ئـاوى 25 بيـرو و 24 كـانى و 3 رووبـار بـۆ بەكارهێنـانى كشـتوكاڵى. ئەنجامەكان ئەوەيان دەرخست كەوا ئاوەكان لە جۆرى باش يان باشترين بوون بە پێى پێوەرە جيهانيەكان، بەڵام بە پێى پێوەرى ئەمريكى ئاوى شوێنى ژمارە (44، 5، 2 و 1) لە جۆرى (C4S2, جيهانيەكان، بەڵام بە پێى پێوەرى ئەمريكى ئاوى شوێنى ژمارە (44، 5، 2 و 1) لە جۆرى (C4S2, بيهانيەكان، يەڵام بە پێى پێوەرى ئەمريكى ئاوى شوێنى ژمارە (44، 5، 2 و 1) لە جۆرى (C4S2, باشترين و قبول كراو بوون يەك بەدواى يەك. لەھەمـان كاتـدا ئـاوى شوێنى ژمـارە (49 وە 3) باشترين و قبول كراو بوون بۆ ئاژەڵا و پەلەوەر.بە پێى رێژەى ئوكسجينى تواوە لە ئاودا سەرجەم ئاوەكان گونجاون بۆ بەخێوكردنى ماسى جگە لە ئاوى 2 شوێن كەوا نەگونجاو بوون لەبەر ئەوەى يرى ئۆكسجينى تواوە لەناوياندا 5.20 و 6.30 ملگم لتر-1 ئاو بوو.

تحديد صلاحية بعض مصادر المياه للاستخدامات الزراعية في المنطقة رانية\ محافظة السليمانية.

الخلاصة

اجريت هذه الدراسة في الفترة الواقعة بين 19\8\2018-21<2018 في قضاء رانية\ محافظة السليمانية لتصنيف المياه (24) عين و (25) بئراً و(3) نهراً للاغراض الزراعية. دلت النتائج الـى انـة جميع المياه المدروسه جيده او ممتازه للـرى استنادا الـى بعـض التصانيف العالمية. أما استنادا الى التصنيف الامريكي فان مياة (44، 5، 2، و 1) موقعا لهم صنف (2431, C451, C452) على التوالي. في نفس الوقت مياه (3, 49) موقعا صنفت تحت صنف ممتاز و مقتنع للحيوانات و الدواجن على التوالى. اما مياه جميع المواقع صالحة للتربية الاسماك باستثناء مياة موقعين كانت غير صالحة بسبب قلة تركيز الاوكسيجين الذائبة في المياه (6.30) ملغم لتر⁻¹ على التوالي.