

# Hydrochemical characteristics of the major water springs in the Yarmouk Basin, north Jordan

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## ABSTRACT

The water quality of major springs in the Yarmouk Basin (north Jordan) experienced degradation due to rapid urbanization and industrialization. In order to check their suitability for irrigation, drinking and industrial purposes, a research work was conducted to assess the degree of ionic toxicity in these water sources. Thirty-six water samples were analyzed for different elements of dominant cations and anions such as Ca, Mg, Na, K, Fe, and  $\text{HCO}_3$  together with other minor ions P, B,  $\text{NO}_3$ ,  $\text{SO}_4$ , and Cl. To classify water quality, parameters such as sodium adsorption ratio (SAR), soluble sodium percentage (SSP) and residual sodium carbonate (RSC) were calculated. Concentrations of major cations and anions are low compared to their permissible levels in potable water. The total dissolved solids is 617 mg/l or below, which indicates the presence of fresh water. The fresh water condition is also verified by low to moderate electrical conductivity (347-1234  $\mu\text{S}/\text{cm}$ ) and lower than 8.09 pH values. The concentration of total iron (0.0-0.09 mg/l) falls below the maximum permissible limit of 1 mg/l. The low SAR (0.5 to 1.34) coupled with low electrical conductivity, gives the water medium salinity hazard and low sodium hazard. Thus, the water is general of suitable chemical quality for domestic, agricultural and most industrial uses.

**Keywords:** Water Springs; Water Quality; Yarmouk Basin; North Jordan

## 1. INTRODUCTION

Jordan is considered among the poorest countries in the world in terms of water resources. The climate is generally arid to semi arid, where around 90% of the country's land receives an average precipitation of less than 100 mm/year, while only 3% of the land receives an

average annual precipitation of 400 mm. The pattern of rainfall is characterized by an uneven distribution over different regions with strong fluctuation from year to year in terms of quantity and timing. While water resources in Jordan are limited, the depletion of non-renewable resources due to over pumping is considered a serious threat to this important sector. Moreover, the available renewable water resources are dropping drastically due to steep population growth, rapid agricultural/industrial developments and the sudden influx of refugees due to political instability in the region. Several previous studies relating to water sector in Jordan have generally concluded that there is a need to focus attention on the future impact of water shortages through resources planning and development [1-8].

Jordan is characterized by a pronounced scarcity of renewable fresh water resources, which averages at about 680 million cubic meters per year, or approximately 135  $\text{m}^3$  per capita for all uses. Thus, Jordan's water resources, on per capita basis, are among the lowest in the world. The water resources of Jordan consist of groundwater and fossil water which are found in aquifers at different depths throughout Jordan. Other sources of water include surface water flows from precipitation, treated waste water and other non-conventional water resources such as brackish water.

As a result of fast growing population in Jordan (including the inward migration and local growth), an increase demand for water resources is expected. In the present study a detailed geochemical investigation of water samples from the Yarmouk Basin of northern Jordan is carried out to assess the degree of ionic toxicity in the water of major springs. The purpose is to classify water springs on the basis of some standard criteria in terms of their suitability and acceptability for irrigation, drinking and industrial uses.

## 2. MATERIALS AND METHODS

### 2.1. Study Area

The Yarmouk Basin is located in the northwestern

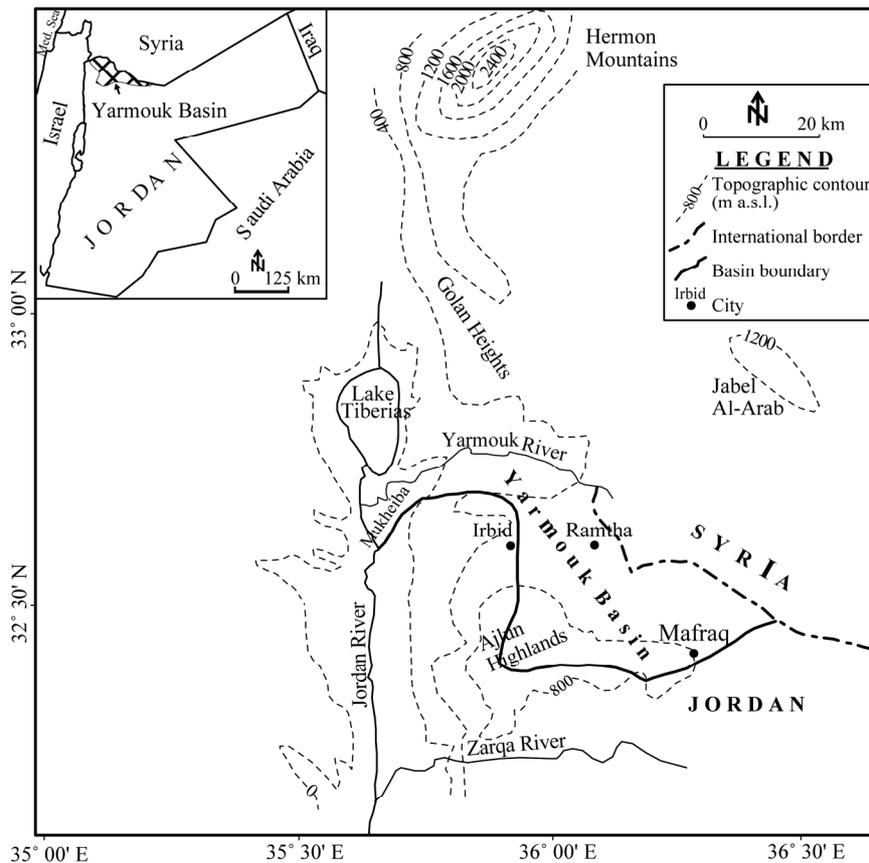
part of Jordan. Seventy-five percent of this basin lies in Syria. In Jordanian territory, the basin is located between latitudes  $32^{\circ} 20'$  to  $32^{\circ} 45'$  N and longitudes  $35^{\circ} 42'$  to  $36^{\circ} 23'$  E, covering an area of about  $1,426 \text{ km}^2$  (**Figure 1**).

The north Jordan area between the Zarqa and Yarmouk Rivers (**Figure 1**) is a key target zone on the hydrological map of the country. However, only few results about the hydrochemical of the major water springs have been reported from the area [9,10]. The adjacent mountainous areas of Ajlun and Golan (**Figure 1**) are the highest elevated lands in the regions east of the Jordan Rift Valley. These areas receive high rainfall. The Yarmouk River, which flows along the border between Syria and Jordan, delineates the northern boundary of the study area, whereas the Jordan River represents its western boundary (**Figure 1**). The Yarmouk River originates from Jabel Al-Arab (Syria) and drains through the Jordanian and Syrian territories.

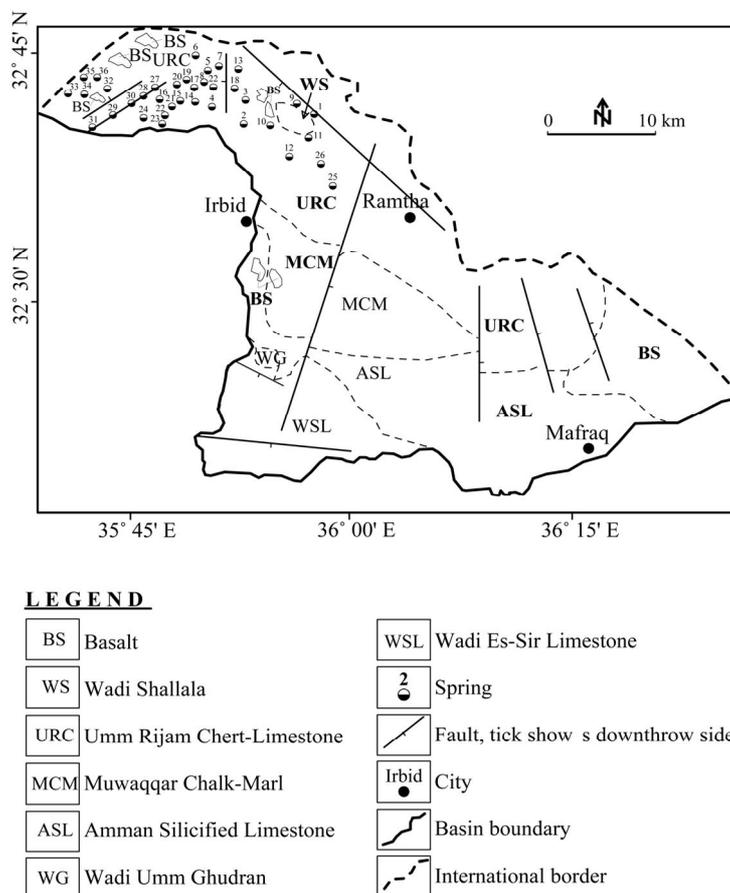
Geologically, the rock formations of the study area are classified as Ajlun Group, Balqa Group and Jordan Valley Group of the Upper Cretaceous to Tertiary age [11,12]. The oldest of these is the Wadi Es-Sir Limestone (WSL) formation of Turonian age belonging to the Ajlun Group. This formation essentially composed of

limestone and dolomitic limestone, which is exposed in the southwestern part of the target basin (**Figure 2**). This formation is overlain by the rocks of the Balqa Group that include, in ascending order: Wadi Umm Ghudran (WG), Amman Silicified Limestone (ASL), Muwaqqar Chalk-Marl (MCM), Umm Rijam Chert-Limestone (URC) and Wadi Shallala (WS) formations. The base of the Balqa Group (the WG formation of Santonian age), which comprises marl, marly limestone, chalk and chert, is exposed in the south Irbid City (**Figure 2**). The overlying limestone, chert, chalk and phosphorite beds, which are exposed in the southern part of the basin, are members of the ASL formation (Campanian age).

Bituminous marl and clayey marl of the MCM formation, which has been dated as Maastrichtian, overlies the ASL formation and is exposed in the central part of the basin. Alternating beds of limestone, chalk and chert of the URC formation (Paleocene age) overlies the MCM formation. In terms of location, the URC formation outcrops in the northern part of the basin (**Figure 2**). In Wadi Shallala area (northeastern part of the Irbid City; **Figure 2**), a limited exposure of chalk and marly limestone with associated glauconite is present, which belong to WS formation of the Eocene age. In the eastern and



**Figure 1.** Location map of north Jordan showing principal physiographic features.



**Figure 2.** Spring location and generalized geologic map of the Yarmouk Basin, north Jordan.

northeastern parts of the basin, basaltic flows (BS formation) of the Jordan Valley Group (Oligocene age) cover the rocks of the Balqa Group. In addition, basalts were found as small exposures scattered to the south, north and northwest of Irbid City (**Figure 2**).

## 2.2. Sampling and Analysis

Water samples for chemical analysis were collected during the year 2006 from 36 major springs of the Yarmouk Basin (**Figure 2**). The samples were stored in polyethylene bottles; which were washed with distilled water and diluted hydrochloric acid. Prior to their filling with sampled water, these bottles were rinsed to minimize the chance of any contamination. These samples were then transported to the laboratory with proper care to prevent possible evaporation effects.

As a part of field procedures, these water samples were analyzed for hydrogen ion concentration (pH), electrical conductivity (EC,  $\mu\text{S}/\text{cm}$  at  $25^\circ\text{C}$ ) and total dissolved solids (TDS) using a pH-meter, a portable EC-meter and a TDS-meter, respectively. Chemical analysis were made in the laboratory for calcium ( $\text{Ca}^{2+}$ ),

magnesium ( $\text{Mg}^{2+}$ ), sodium ( $\text{Na}^+$ ), potassium ( $\text{K}^+$ ), nitrate ( $\text{NO}_3^-$ ), sulfate ( $\text{SO}_4^{2-}$ ), chloride ( $\text{Cl}^-$ ), bicarbonate ( $\text{HCO}_3^-$ ), iron ( $\text{Fe}^+$ ), phosphorus (P) and boron (B).

Chemical analysis for major cations was accomplished in the laboratory using atomic absorption spectrophotometer. The anions nitrate and sulfate were measured by spectrophotometric techniques. Titration methods were used to determine the concentrations of chloride and bicarbonate in the sampled water. Phosphorus and boron were determined calorimetrically, while iron contents were analyzed by atomic absorption spectrophotometer. All these laboratory analyses were performed in the Department of Chemistry and in the Department of Earth and Environmental Sciences, Yarmouk University, Irbid, Jordan.

Water samples were classified as per results obtained from these chemical analyses. Parameters, such as, Sodium adsorption ratio (SAR), soluble sodium percentage (SSP) and residual sodium carbonate (RSC), were calculated on the basis of standard equations as outlined in the reported publications [13-15]. These equations are as follows:

$$\text{Sodium adsorption ratio (SAR)} = \frac{\text{Na}^+}{\sqrt{\frac{\text{Ca}^{2+} + \text{Mg}^{2+}}{2}}}$$

Soluble sodium percentage (SSP)

$$= \frac{\text{Soluble Na}^+ \text{ concentration (meq/l)}}{\text{Total cation concentration (meq/l)}} \times 100$$

Residual sodium carbonate (RSC)

$$= (\text{CO}_3^{2-} + \text{HCO}_3^-) - (\text{Ca}^{2+} + \text{Mg}^{2+})$$

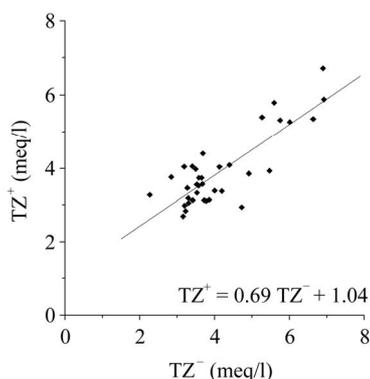
Correlation analyses were conducted between different combinations of quality indicators, such as SAR versus SSP, SAR versus RSC and SSP versus RSC.

### 3. RESULTS AND DISCUSSION

Chemical constituents of the collected water samples are presented in **Tables 1** and **2**. The observed charge balance of < 10% between cations ( $\text{TZ}^+$ ) and anions ( $\text{TZ}^-$ ) calculated by the formula  $(\text{TZ}^+ - \text{TZ}^- / \text{TZ}^+ + \text{TZ}^- \times 100)$  given by Todd [13] and the ratio of TDS/EC (0.5) are within acceptable limits [16], confirming the reliability of the analytical results. Statistical analysis of the data shows that the  $\text{TZ}^+$  and  $\text{TZ}^-$  are coupled by a relation  $\text{TZ}^+ \text{ (meq/l)} = 0.69 \text{ TZ}^- \text{ (meq/l)} + 1.04$  with correlation coefficient of 0.69 for 36 data points (**Figure 3**).

#### 3.1. Dominant Cations and Anions

Among major cations (**Table 1**), calcium ( $\text{Ca}^{2+}$ ) is the dominant constituent, ranging between 1.64 and 2.35 meq/l with average value of 2.05 meq/l. It accounts for 54.5% of the total cations. Sodium ( $\text{Na}^+$ ) is second in terms of cationic abundance, accounting for 23% (0.54-1.76 meq/l) of the total cations. Magnesium ( $\text{Mg}^{2+}$ ) with 19.2% (0.39-1.91 meq/l) and potassium ( $\text{K}^+$ ) 3.3%



**Figure 3.** Sum of base cationic charge ( $\text{TZ}^+$ ; meq/l) versus the sum of anionic charge ( $\text{TZ}^-$ ; meq/l);  $\text{TZ}^+ = (\text{Ca}^{2+}) + (\text{Na}^+) + (\text{Mg}^{2+}) + (\text{K}^+)$ ;  $\text{TZ}^- = (\text{Cl}^-) + (\text{HCO}_3^-) + (\text{NO}_3^-) + (\text{SO}_4^{2-})$ .

(0.01-1.63 meq/l) are the less predominant cations in the spring waters. Among major anions, chloride ( $\text{Cl}^-$ ), bicarbonate ( $\text{HCO}_3^-$ ) and nitrate ( $\text{NO}_3^-$ ) are the dominant contributors, which generally represent 45% (0.15-4.67 meq/l), 28% (0.66-1.48 meq/l) and 21% (0.14-2.03 meq/l) of all the constituents, respectively. Other anions, such as sulfate ( $\text{SO}_4^{2-}$ ) have minor contribution to the total anions. The concentration of sulfate ( $\text{SO}_4^{2-}$ ) ranges between 0.0-0.59 meq/l, accounting 5.5% of the total anions.

As shown in **Table 2**, the pH values of water samples (7.01-8.09) indicate slight alkaline tendency, but well within the safe limit [16]. The upper limit of phosphorus and boron in the studied samples are 91.9  $\mu\text{g/l}$  and 175.6  $\mu\text{g/l}$ , respectively (**Table 2**). In all 36 samples, low values of boron are observed, which is in excellent compatibility with standard classification of the World Health Organization (WHO) [16].

#### 3.2. Quality Assessment as Irrigation Water

The concentration and composition of the dissolved constituents in water determine its suitability for irrigation purposes. Moreover, suitability of water for irrigation depends on total concentration of the soluble salts, relative proportion of the major constituents (*i.e.*, sodium, calcium and magnesium) and the effect of some mineral constituents on both the soil and plants [15].

The estimated amount of TDS ranges from 173.5 to 617 mg/l (**Table 3**). The values of TDS in the studied samples are lower than the maximum permissible level of 1000 mg/l recommended [17] for most domestic uses. The electrical conductivity (EC) of the studied water samples ranges between 347 and 1234  $\mu\text{S/cm}$  (average 637  $\mu\text{S/cm}$ ), where its maximum limit in drinking water is prescribed as 1400  $\mu\text{S/cm}$  [16]. This low mineralization in water sources indicates that the weathered zone has been highly leached soluble minerals and/or water is likely derived from relatively recent recharge. Hence, these low levels of mineralization indicate that the water of all major springs in the Yarmouk Basin can be classified as fresh without any hazardous contaminations.

The sodium adsorption ratio (SAR) is an important parameter to determine the suitability of irrigation water. The SAR values in the studied samples range from 0.5 to 1.34 (**Table 3**), which can be considered as the most suitable for irrigation purposes as per the classification of Todd [13] that count any of the SAR values < 10 as excellent.

There is a significant relationship between the SAR values in the irrigation water and the extent to which sodium is absorbed by the soil [18,19]. If the water used for irrigation purposes is high in sodium and low in calcium, the cation-exchange complex may become saturated with sodium. This can destroy the soil structure

**Table 1.** Cations and anions constituents of water of the major springs in the Yarmouk Basin, north Jordan. SD: Standard deviation. CV: Coefficient of variation.

Sl. no. Figure 2	Spring Name	Ca <sup>2+</sup> meq/l	K <sup>+</sup> meq/l	Mg <sup>2+</sup> meq/l	Na <sup>+</sup> meq/l	HCO <sub>3</sub> <sup>-</sup> meq/l	Fe <sup>-</sup> mg/l
1	Ghazzal	2.15	1.13	1.00	1.52	0.98	0.0062
2	Khureibeh	2.14	0.11	0.57	0.75	1.15	0.0068
3	Qweilbeh	1.97	0.04	0.50	0.60	1.31	0.073
4	Hubras	1.92	0.04	0.44	0.54	0.98	0.0013
5	Al Rafeed	1.98	0.05	0.51	0.73	1.31	0.001
6	Aqraba	2.06	0.42	1.30	1.54	0.98	0.019
7	Umm Ershid	2.18	1.63	1.17	1.73	0.98	0.003
8	Yubla	2.06	0.01	0.50	0.57	1.31	0.002
9	Barrashta	2.10	0.01	0.49	0.60	1.15	0.003
10	Abdah	1.87	0.05	0.59	0.95	0.66	0.000
11	Al Sukkar	1.99	0.05	0.70	1.12	1.48	0.07
12	Esh Sheha	1.97	0.31	0.68	1.12	0.82	0.001
13	Al Jamal	2.05	0.12	0.57	0.82	0.98	0.003
14	El Turab	1.92	0.01	0.48	0.57	1.15	0.0008
15	El Fotaha	2.08	0.08	0.53	0.70	1.31	0.008
16	Al Maghara	1.97	0.04	0.49	0.62	1.31	0.01
17	El Kufeir	1.95	0.06	0.45	0.59	0.82	0.005
18	Sama	1.97	0.02	0.47	0.67	0.82	0.02
19	Baradah	1.82	0.01	0.74	0.81	0.82	0.008
20	Um Arays	2.09	0.21	0.60	0.83	1.15	0.003
21	Al Minqa	1.64	0.02	0.46	0.57	1.15	0.008
22	Um Harathin	2.23	1.02	0.82	1.20	1.15	0.005
23	Al Khanam	1.89	0.01	0.39	0.55	0.82	0.002
24	Um Khiraq	2.20	0.02	0.76	0.77	0.98	0.007
25	Al Moll'aqa	1.95	0.10	0.69	1.20	0.98	0.09
26	Rahoub	1.83	0.04	0.75	1.41	0.98	0.007
27	Malqa	2.10	0.02	0.61	0.60	1.31	0.09
28	Atiyya	2.26	0.01	0.62	0.64	1.15	0.04
29	Kelab	2.35	0.02	0.79	0.83	0.98	0.06
30	El Tasah	2.27	0.01	0.76	0.71	0.82	0.002
31	El Assal	2.12	0.02	1.17	0.75	1.38	0.02
32	Umm Qeis	2.15	0.09	1.58	1.53	1.31	0.001
33	Maquq	2.00	0.21	1.91	1.76	1.31	0.009
34	El Joseh	2.12	0.02	1.30	0.96	1.31	0.002
35	Um Kurum	2.24	0.02	1.00	0.79	1.31	0.0008
36	Dheib	1.31	2.05	0.04	1.69	1.61	0.08
	Range	1.64-2.35	0.01-1.63	0.39-1.91	0.54-1.76	0.66-1.48	0.0-0.09
	Mean	2.05	0.17	0.78	0.92	1.1	0.019
	SD	0.15	0.35	0.38	0.34	0.21	0.028
	CV	0.07	2.1	0.49	0.41	0.19	1.51

**Table 2.** Alkalinity and minor chemicals constituents of water of the major springs in the Yarmouk Basin, north Jordan. SD: Standard deviation. CV: Coefficient of variation.

Sl. no. Figure 2	pH	P µg/l	B µg/l	NO <sub>3</sub> <sup>-</sup> meq/l	SO <sub>4</sub> <sup>2-</sup> meq/l	Cl <sup>-</sup> meq/l
1	7.71	18.4	175.2	0.69	0.59	3.33
2	7.36	23.8	113.0	0.70	0.44	1.38
3	7.50	23.4	98.4	0.69	0.28	1.50
4	7.45	17.1	91.0	1.05	0.13	2.56
5	7.61	17.8	89.6	0.70	0.10	0.15
6	7.26	30.0	138.1	1.10	0.37	3.31
7	7.59	27.6	175.6	0.69	0.56	4.67
8	7.12	36.3	81.1	0.70	0.42	1.44
9	7.23	20.1	83.3	0.84	0.03	1.27
10	7.88	15.4	104.3	0.74	0.28	1.60
11	7.59	14.5	118.5	0.69	0.41	2.34
12	7.43	17.2	111.1	1.19	0.22	2.17
13	7.51	91.9	93.6	0.88	0.06	1.60
14	7.68	10.8	72.6	0.75	0.00	1.30
15	7.27	46.4	79.1	0.94	0.33	1.42
16	7.39	18.3	73.3	1.02	0.05	1.34
17	7.33	25.0	72.4	0.72	0.12	1.64
18	7.39	26.1	72.9	0.93	0.01	1.66
19	8.09	50.0	118.1	1.56	0.32	1.49
20	7.18	45.6	119.0	1.14	0.02	1.36
21	7.33	10.5	102.9	0.61	0.22	1.18
22	7.41	79.6	142.7	2.03	0.18	2.65
23	7.59	19.2	86.6	0.88	0.19	1.34
24	7.33	27.7	91.6	0.80	0.28	1.51
25	7.70	15.9	116.8	1.96	0.28	2.24
26	7.36	16.1	150.8	0.95	0.06	2.14
27	7.62	56.6	79.8	0.77	0.00	1.45
28	7.56	26.7	77.8	0.58	0.35	1.49
29	7.20	28.8	81.7	0.28	0.37	1.86
30	7.01	14.9	81.4	0.50	0.16	1.36
31	7.90	30.3	86.1	0.35	0.08	1.60
32	7.33	20.6	116.3	1.56	0.40	3.37
33	7.27	5.9	131.2	1.92	0.52	3.17
34	7.23	13.6	89.3	0.23	0.23	1.92
35	7.35	16.8	81.8	0.27	0.09	1.52
36	7.20	64.8	133.2	0.14	0.35	3.47
Range	7.01-8.09	5.9-91.9	72.4-175.6	0.14-2.03	0.0-0.59	0.15-4.67
Mean	7.44	28.44	103.6	0.88	0.24	1.94
SD	0.23	19.36	28.01	0.46	0.17	0.88
CV	0.03	0.68	0.27	0.52	0.71	0.45

**Table 3.** Quality classification of water of the major springs of the Yarmouk Basin based on different criteria for irrigation. TDS: Total dissolved solids; EC: Electrical conductivity; SAR: Sodium adsorption ratio; SSP: Soluble sodium percentage; RSC: Residual sodium carbonate; F: Fresh water; P: Permissible; E: Excellent; S: Suitable; G: Good.

Sl. no.	TDS mg/l		EC $\mu$ S/cm		SAR		SSP (%)		RSC		Hazard
	Value	Class	Value	Class	Value	Class	Value	Class	Value	Class	Class
1	499.5	F	999	P	1.21	E	26.0	G	-2.17	S	C3S1
2	315	F	630	G	0.64	E	21.0	G	-1.56	S	C2S1
3	240	F	480	G	0.54	E	19.3	E	-1.16	S	C2S1
4	230	F	460	G	0.50	E	18.4	E	-1.38	S	C2S1
5	260	F	520	G	0.65	E	22.3	G	-1.18	S	C2S1
6	428	F	856	P	1.19	E	28.9	G	-2.38	S	C3S1
7	617	F	1234	P	1.34	E	25.8	G	-2.37	S	C3S1
8	250.5	F	501	G	0.50	E	18.2	E	-1.25	S	C2S1
9	265	F	530	G	0.53	E	18.8	E	-1.44	S	C2S1
10	244	F	488	G	0.86	E	27.5	G	-1.8	S	C2S1
11	291	F	582	G	0.97	E	29.0	G	-1.21	S	C2S1
12	327.5	F	655	G	0.97	E	27.5	G	-1.83	S	C2S1
13	280	F	560	G	0.72	E	23.0	G	-1.64	S	C2S1
14	228	F	456	G	0.52	E	19.1	E	-1.25	S	C2S1
15	279.5	F	559	G	0.61	E	20.6	E	-1.3	S	C2S1
16	247.5	F	495	G	0.56	E	19.9	E	-1.15	S	C2S1
17	234.5	F	469	G	0.54	E	19.3	E	-1.58	S	C2S1
18	241	F	482	G	0.61	E	21.4	G	-1.62	S	C2S1
19	233.5	F	467	G	0.72	E	24.0	G	-1.74	S	C2S1
20	297	F	594	G	0.72	E	22.3	G	-1.54	S	C2S1
21	173.5	F	347	G	0.56	E	21.2	G	-0.95	S	C2S1
22	470.5	F	941	P	0.97	E	22.8	G	-1.9	S	C3S1
23	212	F	424	G	0.52	E	19.4	E	-1.46	S	C2S1
24	310	F	620	G	0.63	E	20.5	G	-1.98	S	C2S1
25	305	F	610	G	1.04	E	30.5	G	-1.66	S	C2S1
26	278	F	556	G	1.24	E	35.0	G	-1.6	S	C2S1
27	252	F	504	G	0.52	E	18.0	E	-1.4	S	C2S1
28	317	F	634	G	0.53	E	18.1	E	-1.73	S	C2S1
29	380	F	760	G	0.66	E	20.8	G	-2.16	S	C3S1
30	340	F	680	G	0.58	E	18.9	E	-2.21	S	C2S1
31	327.5	F	655	G	0.58	E	18.5	E	-1.91	S	C2S1
32	448	F	896	P	1.12	E	28.6	G	-2.42	S	C3S1
33	495	F	990	P	1.26	E	29.9	G	-2.6	S	C3S1
34	356	F	712	G	0.73	E	21.8	G	-2.11	S	C2S1
35	361	F	722	G	0.62	E	19.5	E	-1.93	S	C2S1
36	441.5	F	883	P	1.18	E	29.9	G	-2.43	S	C3S1

owing to dispersion of clay particles. Data of the SAR and EC (**Table 3**) is plotted on the US salinity diagram [13] (not shown here), in which EC is taken as salinity hazard and SAR as alkalinity hazard. As shown in **Table 3**, the water samples 1, 6, 7, 22, 29, 32, 33 and 36 (for spring name see **Table 1**) fall in the C3S1 quality, which have high salinity hazard but low sodium hazard. On the other hand, samples 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 23, 24, 25, 26, 27, 28, 30, 31, 34 and 35 (for spring name see **Table 1**) lie in C2S1, which corresponds to medium salinity hazard and low sodium hazard.

The values of soluble sodium percentage (SSP) are in range between 18 and 35. Based on residual sodium carbonate (RSC) criterion, all the studied water springs are found to be in suitable class (**Table 3**). All the studied samples show negative values of RSC, which indicates that the dissolved calcium and magnesium contents are higher than carbonate and bicarbonate contents.

#### 4. CONCLUSIONS

In order to chalk out a concrete strategy (including planning, development and management) about the water resources in northern Jordan, water samples collected from all major springs of the Yarmouk Basin are evaluated by this study. No harmful constituents including salinity and toxicity have been detected in the water of the study area. According to all quality determining parameters and their comparison with set criteria, water of the study area could safely be used for irrigation and drinking purposes. In terms of Fe concentration, all samples are found below the maximum permissible limit of 1 mg/l. The quality determining factors, *i.e.*, SAR, SSP, RSC, TDS and EC are strongly compatible with each others.

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