

**ARTICLE**

# **Analysis of Groundwater Quality in Jabal Sarage and Charikar Districts, Parwan, Afghanistan**

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**ABSTRACT**

This groundwater research is carried out groundwater quality in Jabal Sarage and Charikar Districts. The main objective of this research is to find out natural causes of drinking water contaminations (toxic elements and components), that are leaching from soluble arrangement of rocks, sediments and soil by surface water at the infiltration time, toward the groundwater. For completion this research I used two categories of water analysis; one is areal analysis, and another is laboratory analysis. In areal analysis ten wells have been recovered by this research in Jabal Sarage and Charikar Districts, a number of Electro-Conductivity, water temperature, dissolved oxygen in water, Total Dissolved Solids (TDS) and the Resolved Salt in Water (SSW), determination Partible ground at areal complete. For laboratory works I used chemical device of Spectra- photo model. From comparing mean of chemical and physical parameters with standards. pH, K, Na, Mg, Cl, Fe, F, TH, Ca and SO<sub>4</sub> all are normal and we can use them for drinking and irrigation waters. The challenges that I faced during this research are; absence of research in this area and lack of geological equipment's.

## **1. Introduction**

Afghanistan is a country dominated by a dry climate, with most of the area Characterized by effects of global climate changes on hydrological systems, especially on mountain snow and glacier melting, can modify the timing and amount of in mountain watersheds. Therefore, accurate stream flow simulation and forecast is of great importance to water resources management and planning [25]. The key watercourses drain at the snowmelting times (from January to May), raining periods (March to April) and occasionally through quick overflowing terms (May

to August), the main elevations of snow cover is Parwan Maintains series, Wardak, Loger, Baba, Spingher, Salang, Kohkurugh, Koha Safi, Hindu Kush mountains ranges in Afghanistan" [1,24,25], as well as here is certain cold provinces for example; Bamyan, Wardak, Loger, Badakhshan, Pangeshher, Parwan, some parts of Kabul, snow covers these areas from September to November and its storing is used for water in Afghanistan [5,6,24].

Likewise, in north sides of Afghanistan, here are specific glaciers; Pamir Badakhshan, Mymai Badakhshan, Panjsher mountains range that belong to the Hindu Kush mountains series in Afghanistan. These are main sources

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for Panjsher, Helmand and Koner Rivers<sup>[2-4]</sup>. In particular provinces, we use rivers as a mean for irrigations and water supply (Drinking water), such as; Bamyar, Panjsher, Wardak, Parwan, Helmand and Kandahar, Kapisa, but in some of these provinces for instance; Wardak, Parwan, Panjsher spending from spring, and in several provinces for drinking and irrigation benefit from Kariz water, and some other provinces benefit from wells<sup>[3]</sup>.

In these basins, all regolith and sediments are transported from different points of Parwan, mountains by sudden floods and Panjsher, Sanlang, Gurband and Shetal Rivers its accumulated at the different thickness in different locations of this basin. The Parwan Basins belongs to Quaternary (Pleistocene) and Neogen geological periods, different sediments are deposited after one another and forms of morphology, which we can see at the different reliefs. Types of sediments in this basin directly belong the kinds of rocks located in surrounding mountains. In these sediments, we can see Garnete, Biotite and Muscovite minerals particles. The surrounding mountains of this basin are formed from metamorphic rocks like; Schist, Gneiss and Slate that is called Crystalline<sup>[19]</sup>.

Hydrogeological and geological studies are very important for these sedimentary basins, because in all villages, health centers and industrial organizations groundwater is from wells, Kariz and spring. The Panjsher, Sanlang, Gurband and Shetal Rivers are main rivers flows between these basin and more groundwater recharge from river bank and bed, especial in snowmelting season. The aquifers of this sedimentary basin are located prolonging of these Rivers and its tributaries. The more aquifers are between different sizes of sediments (sands and gravels). The hydrogeology of Jabal Sarage and Charikar sedimentary basins belong to the different aquifer that are located prolonging mountain range in longitudinal valley. The thickness and depth of aquifers are related to the slope and distance from mountain range, generally near to mountain and slope areas there are gravels and angular materials, but far from mountains are rounded and fine materials like bolder, cobble, pebble, granule, sands and silts. For drinking water generally using shallow wells, deep wells, but in some places benefit from spring water at the fracture zones and they install pipe scam for gravity pumping system and distributed water among villages<sup>[22]</sup>.

The Degree of acidic is belonging to the soils pH, and formation of acids belong to the chemical characteristics of soils. Also related to the elements and components that are located at the air and after rains washing the air and infiltrate in the soils. Activities of some animal and different plants also will be acidification of soils. In addition mutual effect of biochemical, solution particles of rocks

and minerals that located between soils and its absorption by colloids done some reactions of Cation exchange capacity and basic exchange capacity in some parts of soils mass. The groundwater movements from aquifer layers by different speeds and wash soluble materials from different layers. Some soluble load from parent materials produced different elements and components. Industrial activities for example; burn coal and oil in the predictable materials factory, vehicles and permanent melting of plastics and metals at the result more amount of different gases gone to the atmosphere with different type of precipitations again come down to the earth surface and product different toxic elements between soils. Due to many years of wars we couldn't conduct many researches. So, many researches are accommodated to be carried out and one of these research is soil, air and water pollution<sup>[23]</sup>.

The basins can be described as a valley fill basins, where are filled with Quaternary and Tertiary sediments, gravels, and sedimentary rocks. Quaternary sediments are typically less than 80 m thick in the valleys. The underlying Tertiary sediments have been estimated to be as much as 1000 m thick in the valley Center. The gravel and sand were deposited mainly in the river channels. Describe the Lataband Formation as Quaternary terrace sediments younger Pleistocene age overlying conglomerates. The surrounding mountains are primarily composed of Paleoproterozoic gneiss and Late Permian through Late Triassic sedimentary rocks. The interbasin ridges, composed of metamorphic complex rocks, are Paleoproterozoic gneiss. The Khengal and basement rocks are over thrust by schist mélange, which has been called the Cottagay Series, in the northern Salang range. The sediments of Khengal series is started from Jurassic and belongs to the Thythes Ocean in Afghanistan<sup>[20]</sup>.

Triassic clays and Paleozoic schist form impermeable substratum of this aquifer. These carbonate formations burrow under the Mio-Plio-Quaternary cover in the basins, which forms a deep confined aquifer. The depth of the Miocene Marls forming the impermeable roof of this aquifer is about 1500 m in the contact with Prerif Ridges at drilling point. The fracture rocks constitute the groundwater reservoirs. The main parameters for the migration of fluids in fractured rocks are the main geological characteristics of the fracturing, drainage, topography and rainfall. The hydrogeological context of different regional structures implies the existence of groundwater tables. El Hajeb-Ifrane Tabular is a free water table circulating in the Limestone's and Dolomites. It is supplied directly by precipitation<sup>[12-15]</sup>.

Three rivers flow 12 months, such as Helmand, Panjsher, Koner, but particular rivers related to snowmelting sea-

sons and rainy periods for example Kabul, Paghman, and Loger River. The third river is related to the flooding seasons, its involving of some valleys and mountains areas [8,9]. As the result of 20 years climate change and drought in Afghanistan, the irrigation and drinking water using from groundwater storages (wells, Kariz and springs), its percolated from surface waters, during snowmelting periods [5,2]. In Afghanistan, for one year storing 75 million meter cubic fresh water, from this water is 57 million meter cubic consist of surface water, from these only 18 million meter cubic involves groundwater. Meant from 100 % in Afghanistan 76 % waters consist of surface water and 24 % water consist of groundwater [7,10].

### 1.1 The Main River Basins of Afghanistan

Afghanistan mainly has four river basins that contains:

Amodarya Basin, it consists the Wakhan, Kokcha, Konduz, Andrab and Khenjan Basins; North Rivers Basin, Balkhab and Sarepol Rivers Basins; West River Basin, Harirud, Marghab, Shrine Tagab, Adraskan, Koshan, Kaysar, Gulran and Khasherud; Helmand River Basin, Arghandab, Gazny, Trang, and Musa Qala [11].

In this research I investigated water quality in Jabal Sarage and Charikar Districts have of Parwan Province. The main independent of this study is to nominate dissimilar kinds element, components in Groundwater in Jabal Sarage and Charikar Districts. The Parwan is placed in north sideways of Kabul Province. The climate of this province is simi-arid, wind direction is flows from north toward south, and it is started from Hindu Kush Mountains Ranges [6,18]. The hydro - meteorological situations in the winter seasons snow fall and at the spring seasons having rain fall, the amount of whole annual precipitation is 300-400 mm, and at Salang Mountain total annual precipitation is 800-1000 mm, the higher mean air temperature is between 25 - 30 °C at the summer season and lower air temperature winter season is -25 at the Salang and at the Jabal Saraj is -5 to -10 °C. The landscape of Parwan Province has been formed from mountains, the main mountains of Parwan province are Salang and Pangeshir mountains to plain areas of Kohdaman, the Hundukush mountains range is like wall at the north part of this province continues. The Jabal Saraj, Dowshakh and Paghman mountains range is located at the west side of this province [27].

### 1.2 The Main Rivers of Parwan

Here are four main streams contain of: Panjsher, Salang, Gurband and Shetal Rivers. The Gurband River sourced from 2911 m a.s.l. Besides its flows from west

to northwest of 11km among Hindu Kush and Paghman Mountain, afterward some km at Shekh Ali valley, Gurband and Surkh Parsa joining with Panjsher watercourse. Panjsher River starts from Khawak Kotal, Kotal Anjiman and Bazark from 3000 m a. s. l then 150 km link with Kabul River, the total length of this river is 320 km and 125 km is in the Panjsher Province [5,8]. The south Salang River, begins from south Salang, after transient from Jabal Sarage connected with Panjsher River and in Sarobi District join with Kabul River, the total length of this river is 438mm [28] (Figures 1 and 2).

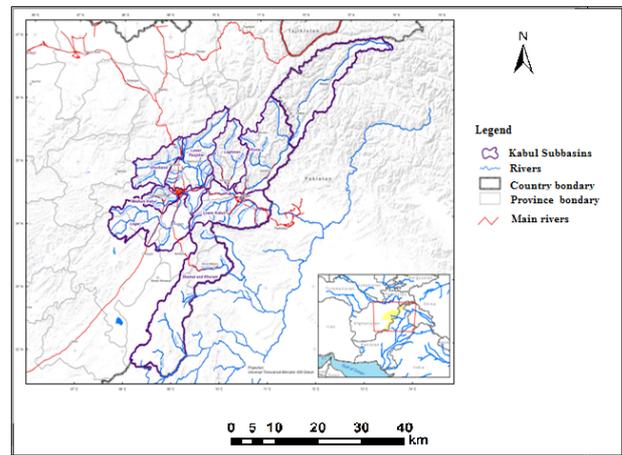


Figure 1. Watercourses map of Parwan and Kabul Basins, Afghanistan.

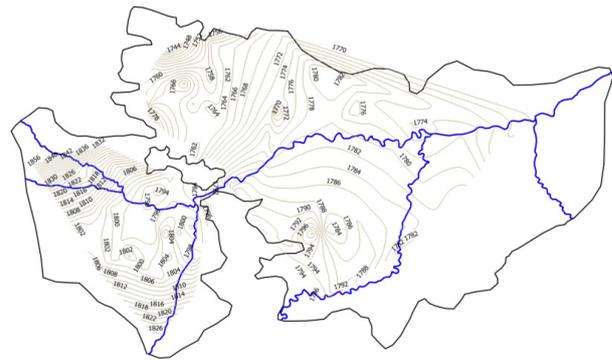
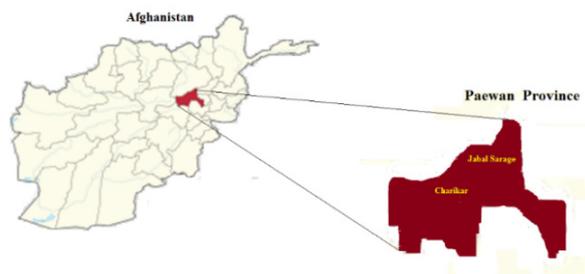


Figure 2. Contour line map of Parwan and Kabul subbasins.

## 2. Study Area

Parwan Province is located in the north side of Kabul Province (Figure 3). The environment of this province is Simi-arid, additional wind route from Hindu Kush Mountains series. In winter terms consuming snowfall and in spring seasons covering by rainfall, overall yearly precipitation is 300-400 mm, and the whole annually precipitation in Salang highlands from 800-1000 mm, higher mean air temperature at summer season exists among 25-30 °C

and minor air temperature in winter periods minimum temperature in Salang is  $-25$  and in Jabal Saraj are  $-5$  to  $-10$  °C. The setting of Parwan Province Mountains form area and the main highlands of Parwan are Salang and Pangesh Mountain towards plain areas of Kohdaman, remain similar barrier at northern sections of this region<sup>[9-11]</sup>.



**Figure 3.** Location map of Jabal Sarage and Charikar districts, Parwan, Afghanistan.

### 3. Discussions on Groundwater Parameters

Previously wherever distributed the Chemical and Physical factors in Jabal Sarage and Charikar Districts, now I want to give brief information about some physical and chemical happening, that are involved in groundwater of this investigations:

#### 3.1 Electro-Conductivity of Water

The conductivity is measurement principles of current in any solution, and its shows the quantity of salt solved in water. At some time the electro-conductivity related to the water temperature that having at the period of measurement. One of the aids of this study is very easy it can be conducted at the site. In this research we need for three times<sup>[12-15]</sup>. At the usual situations agreeing to the norms of Afghanistan (ANSA, 2011) the EC<sup>[29]</sup>, the world health organization (WHO) and Asian Countries the electro conductivity is  $1500\mu\text{s}/\text{cm}$ <sup>[34]</sup>.

#### 3.2 pH

For pH demonstrations used acidic and basic situations of water, in this research we found the pH of water via pH-meter<sup>[29]</sup>. The normal conditions pH agreeing to 6.5-8.5, the pH<sup>[31,16]</sup> and giving the World Health Organization (WHO) and Asian Countries are 6.5-8.5<sup>[32]</sup>.

#### 3.3 Hardness of Water

The resistance of water belongs to particular anions and cations in the present water, these are particular salts which consist of;  $\text{Mg}^{2+}$ ,  $\text{K}^+$ ,  $\text{Sr}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Ca}^{2+}$

and with some anions  $\text{CO}_3^{2-}$ ,  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$ ,  $\text{SiO}_3^{2-}$  and  $\text{HCO}_3^-$ , it's continuously exist in the form of Solutes (mg. L<sup>-1</sup>) conditions,<sup>[17]</sup>. The main method for measurement of Total Hardness is consisting 2340-CEDTA titrimetric. For this method we must use buffer of  $(\text{NH}_4\text{OH} + \text{NH}_4\text{Cl})$ , in addition the pH = 10-10.1 must be<sup>[32]</sup>. The common circumstances TH according to ANSA (2011) is 500 mg/l, the TH<sup>[31]</sup>, and the world health organization (WHO) and Asian Countries is 500 mg/l<sup>[32]</sup>.

### 3.4 Cations and Anions

#### a. Calcium (Ca)

In this research we found the quantity of Ca in groundwater by Photometer tool (test- Ray). Additional Ca we can discover in natural water, it's placed in mother rocks that are transitory from rock. Usually calcium is found in Carbonates, bicarbonates and sulfides<sup>[34]</sup>. Similarly, in salty water we can discover at form of Calcium chlorides and Calcium bicarbonates, nevertheless for some time if we find the Calcium bicarbonates its related hardness of waters and Calcium sulfites, Calcium nitrites and Calcium chlorides are main reasons for continuously hardness of waters. For Ca ions 10 mL adding in water, afterward 0.4 ml Sodium hydroxide for basic environment, it must be pH = 8-12, after one spoon of Monoxide indicator ( $\text{C}_6\text{H}_8\text{N}_6\text{O}_6$ ) adding and via solution E.D.T.A to changing the color. In normal conditions Ca according to<sup>[30]</sup>, 200 mg/l, quantity of Ca according to the World Health Organization (WHO) and Asian Countries is 200 mg/l<sup>[29]</sup>.

#### b. Sodium (Na)

This element is solvable and can be found in groundwater. In salty water this element is more than 1-100 gr. L<sup>-1</sup>. When we want to modification water to soft water using  $\text{NaCO}_3$  via exchange of Na basic element add to this solution. At the usual situations water necessity consuming lesser amount of Na to protect water from toxic waste. In usual conditions Na is according to 200 mg/l<sup>[30]</sup>, and Na according to World Health Organization (WHO) and Asian Countries is 200 mg/l<sup>[30]</sup>.

#### c. Potassium (K)

As all know the K is one of the elements, that is often found in nature, but not exceeds from 30 mg. L<sup>-1</sup>. Agreeing to European Union, the more concentration of salts in the water is among 10-12 mg.-L determined. The normal conditions K is allowing to 10 mg/l<sup>[23]</sup>, and the World Health Organization (WHO) and Asian Countries is 10 mg/l<sup>[29]</sup>.

#### d. Iron (Fe)

For Iron amount we use two tubes A and B, in this case we acquire some potable water and wash these tubes. At the same time in every tube we add 20 mL potable water. After three minutes determined the quantity of Iron. Here

is diverse colors and compare color with chart for selection the amount of irons in water. This test must be repeated three times. The normal conditions Fe 0.3 mg/l, and the World Health Organization (WHO) and Asian Countries quantity of Fe is 0.3 mg/l [27].

**e. Sulfides (SO<sub>4</sub>)**

This measuring Turbidity meter, via this device presentation the amount of Sulfides in water and this test is necessary to repeat three times. The concentration of sulfides in water is 100 mg. L. From changed origin sulfides solved in water, the main sources of its Gypsum and other sulfides. Sulfides in sea water added as of oxidation of sulfides, sulfites and Neosulfites [13,14]. Extra sulfides at the groundwater added from industrial activities and some factories using H<sub>2</sub>SO<sub>4</sub>, for example paper and Leeds factories its dispersal from chimney of factories. At the normal conditions according to, 250 mg/l [31], the Sulfides and the World Health Organization (WHO) and Asian Countries is 250 mg/l [34].

**f. Chlorides**

The method for chlorides determination of groundwater, we can fix on the surface and groundwater, now this technique 10 ml groundwater collected in flask and two drops of Potassium chromite added, after that 0.0141 N Slurnitrites (AgNO<sub>3</sub>) also added to altered color towards yellow and red. The Chlorides normal conditions rendering to 250 mg/l, the World Health Organization (WHO) and Asian Countries select 250 mg/l. At changing color Chromite precipitated in waters. Chlorides can be calculated by the next formula [12-16].

$$\text{mg CL- / L} = (A-B) \cdot \text{F.N.} \cdot 354 \cdot 50/\text{mL of model}$$

A = Titration solution for sampling

F = factor (1.03)

B = Titration solution for potable water (0.1)

N = Normality Slurnitrites

**g. Fluorine (F)**

In this investigation for fluorine determination, added 10 mL in flask, after 2 CC solution for three minutes staying. The F normal conditions according to 1.5 mg/l, and F via World Health Organization (WHO) and Asian Countries consist of 1.5 mg/l [30-34].

**h. Arsenic (Ar)**

For determination amount of Ar in groundwater, 50 mL sample of water added, afterwards add Zink for 20 mins, and after comparing filter with Chart for finding amount of Ar in water [31].

**i. Magnesium (Mg)**

For Mg, I used software. In this software I can find the quantity of Mg. In normal situations Mg giving to mg/l, the World Health Organization (WHO) and Asian Countries quantity of Mg is 30 mg/l [29-33].

**4. Method and Materials**

This inquiry completes two categories of water analysis: one is a real analysis, and another is research laboratory analysis. In areal analysis I investigated and tested ten wells in Jabal Sarage and Charikar Distracts, a number of electro - conductivity, water temperature, dissolved oxygen in water, Total Dissolved Soled (TDS) and the Resolved Salt in Water (SSW) at areal complete, and at laboratory works selected chemical and physical analysis used for determination 18 parameters.

In this research measure dissimilar physical and chemical consideration at the groundwater of Jabal Sarage District, as it's explain in Tables 1 and 2:

**Table 1.** The physical parameters devices as used for this research.

No	Parameter	Unite	Name of measurement devices	The location of measurement
1	EC	s/Cmμ	Partible ground, Water temperature Conductivity, Electro - Conductivity meter and pH-meter, 2340-CEDTA titrimetric ,	Areal (site)
2	pH			
3	Hardness	Mg/L		
4	Color	Mg/L		
5	T	C°		

**Table 2.** Chemical parameters that found in this investigation in groundwater of Jabal Sarage district.

No	Elements	Unite	Device of measurements	Type of test
1	Ca	Mg/L	Spectra- photo model DR3900	Laboratory analysis
2	K			
3	Na			
4	SO <sub>3</sub>			
5	NO <sub>4</sub>			
6	Cl			
7	F			
8	Fe			
9	NO <sub>3</sub>			
10	SO <sub>4</sub>			
11	Mg			
12	Ca/H			
13	HCO <sub>3</sub>			
14	CO <sub>3</sub>			
15	AlK			
17	Cl <sub>2</sub>			
18	TDS			

**5. Results and Discussion**

In this research I used physical and chemical limitations at the groundwater of SamadKhankhel, Chingay, Hashamkhel, Nasratkhel, and Qasamkhel villages have in Jabal Sarage District and Malakhel, Salehkhel, Azizbigkhel and Babakhel villages related to Charikar District of Parwan Province, Afghanistan. These parameters involves; Hardness, Turbidity, Color, Temperature, Electro-conductivity (EC), pH, Ca, K, Na, SO<sub>3</sub>, NO<sub>4</sub>, Cl, Fe, NO<sub>3</sub>, SO<sub>4</sub>, Mg, F,

Ca/H, Fe, HCO<sub>3</sub>, CO<sub>3</sub>, AlK, Cl<sub>2</sub> and TDS.

As described follows:

### 5.1 Hardness

In this research for measurement of Total Hardness consisting 2340-CEDTA titrimetric, in this method I use buffer of (NH<sub>4</sub> OH+NH<sub>4</sub> Cl), in addition the pH = 10 -10.1 must be. The Maximum amount of hardness is in Salehkhel village well its 857 (mg.L<sup>-1</sup>), and minimum amount of is in Qasamkhel which is 535 (mg.L<sup>-1</sup>). The main reason of high amount of Hardness in Salehkhel is Cl in groundwater, which is acidic, but the minimum amount of in Qasamkhel village that belongs to basic is 8. For better understand we can see (Figure 4).

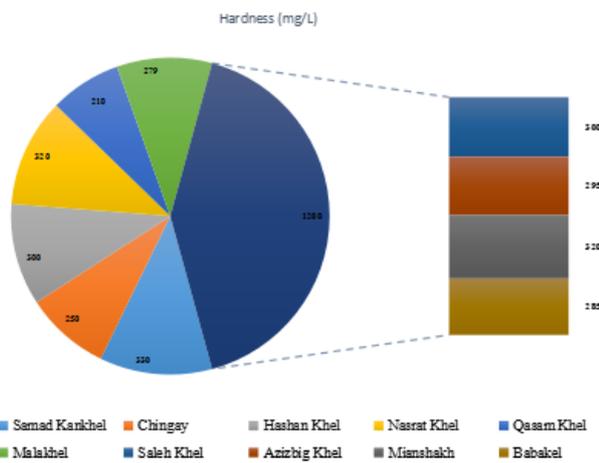


Figure 4. Hardness of groundwater in Jabal Sarage and Charikar districts.

### 5.2 Turbidity

Turbidity belongs to the amount of solution and smaller particles in water, which change its color. In this research we used for measuring the turbidity of water by turbidity mater (mg.L<sup>-1</sup>). For this we can use TDS (Total Dissolved Solid). Generally the turbidity of water in this research was no problem and all groundwater was clear and we can use for drinking. The turbidity in all well and groundwater water was zero which is equal to the international standards for groundwater's. For better understand we can use (Figure 5).

### 5.3 Color

Generally, the color of water is almost green, but the other colors belong to the existence of organic and inorganic materials, which is solvable in waters (mg.L<sup>-1</sup>). In inorganic materials, existence of some elements and components that are existing in rock, sediments and soils

in ground and surface waters. In this research the color of groundwater is almost green and having no any problems we can use for drinking and irrigation. For better understanding see (Figure 6).

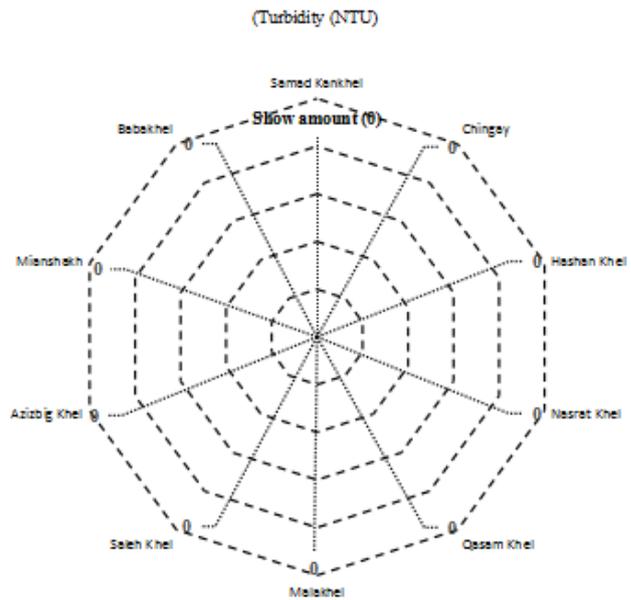


Figure 5. Turbidity of groundwater in Jabal Sarage and Charikar districts.

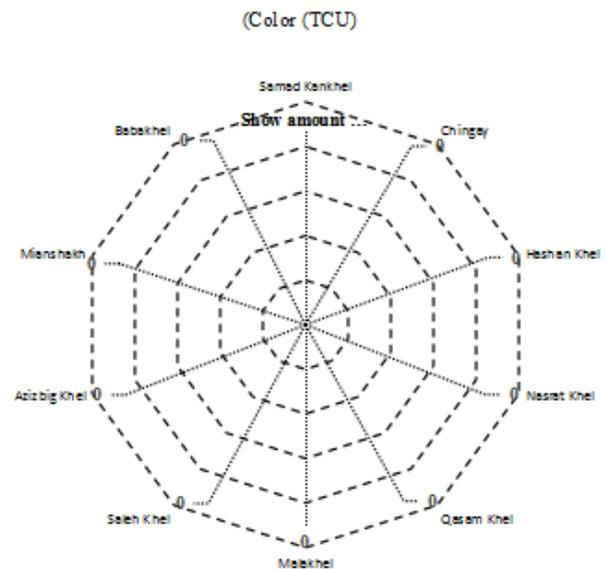


Figure 6. Color of groundwater in Jabal Sarage and Charikar districts.

### 5.4 Temperature

The Temperature of groundwater belongs to the depth of groundwater, volcanic eruptions and geographical locations. From view point of temperature the ground divided in six categories', it consists of: very cold (5 °C), lately

cold (10 °C), warm water (18 °C), almost warm (25 °C), Warm (37 °C) and very warm (more than 40 °C). In this research in all groundwater temperature is around 22 °C, and this is better and suitable for drinking and all uses. For better understand we can use (Figure 7).

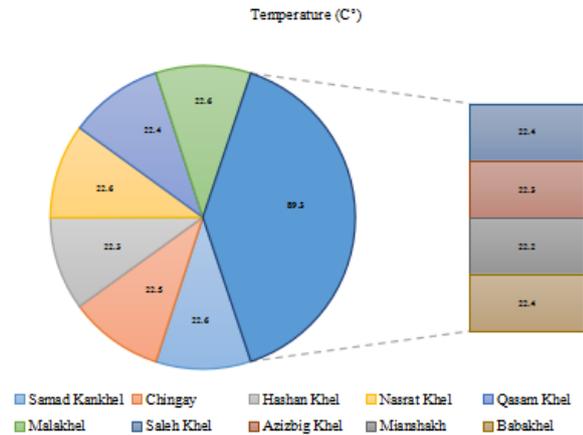


Figure 7. Temperature of groundwater in Jabal Sarage and Charikar districts.

### 5.5 Electro-Conductivity (EC)

The Electroconductivity shows the amount of salts ( $\mu\text{s/cm}$ ). In this research we used Electroconductivity meter for measurement of groundwater, in same time the electroconductivity related to the water temperature that having at the period of measurement. It is worth to mention that, this research has been done three times for every sampling. The EC of this research is normal and can be used for drinking water. For better understanding we can use (Figure 8).

### 5.6 pH

As all know pH show demonstration of acidic and basic situations in waters, in this research we found the pH of water by pH- meter. The pH of this research neutral (7), but in two villages (SamadKhankehel, Chingay) are basic its 8.1 and 8, but no higher basic we can use for drinking and irrigations water . For better understand we can use (Figure 9).

### 5.7 Chemical Parameters

The chemical parameters consisting elements and components that exist at the composition of rocks, sediments and soils, that are leaching by surface waters during percolation washing from one horizon to another horizon and eventually adding to the groundwater and saturation zone. As well as during movements of groundwater among different layers and washing mining carried to at the

solved groundwater's. In this research I found different elements and components such as Ca, K, Na,  $\text{SO}_3$ ,  $\text{NO}_4$ , Cl, Fe,  $\text{NO}_3$ ,  $\text{SO}_4$ , Mg, F, Ca/H, Fe,  $\text{HCO}_3$ ,  $\text{CO}_3$ , AlK,  $\text{Cl}_2$  and TDS. In all villages wells of this research are normal and equal to international standards and we can use for drinking and irrigations. For better understand we can use (Figure 10).

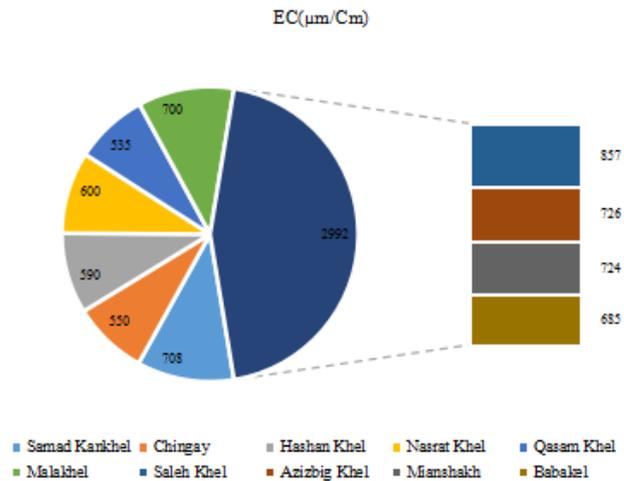


Figure 8. Electroconductivity of groundwater in Jabal Sarage and Charikar districts.

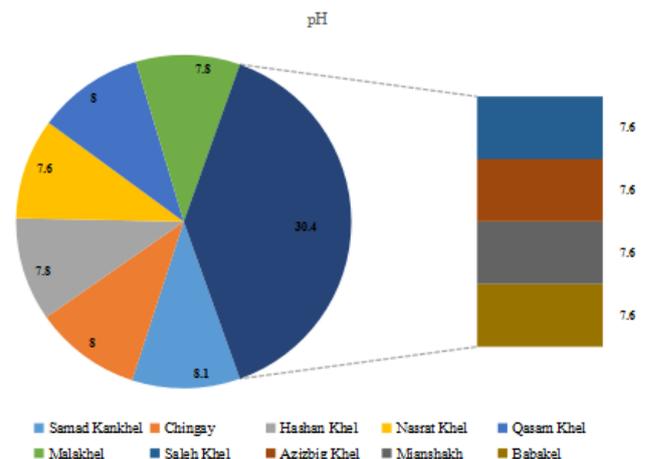


Figure 9. pH of groundwater in Jabal Sarage and Charikar districts.

### 5.8 Comparing Means and International Standards

In this research for better understanding and accurate research works, I compared mean of some parameters such as EC, pH, K, Na, Mg, Cl, Fe and F are equal permitting to the global values, but TH, Ca and  $\text{SO}_4$  are minor from universal and international values besides its not toxic aimed at health and we can using for drinking and irrigation water. For better understanding, we can use (Figure 11). The Physical and Chemical of groundwater

**Table 3.** Physical parameters for groundwater of this research.

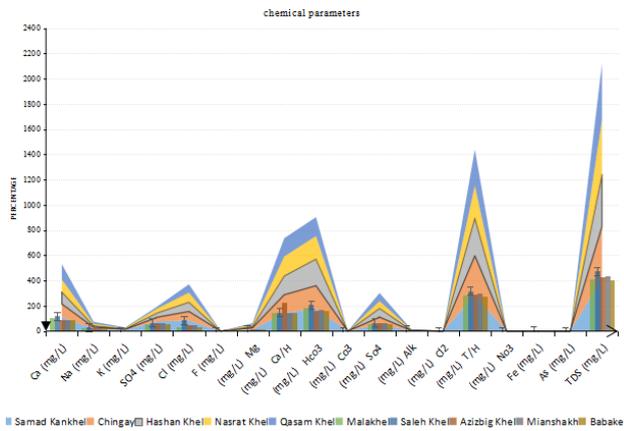
District	Villages	Parameters					
		Hardness ( <sup>1</sup> mg/L)	Turbidity ( <sup>2</sup> NTU)	Color ( <sup>3</sup> TCU)	Temperature ( <sup>4</sup> C°)	EC ( <sup>5</sup> µs/Cm)	pH
Jabal Sarage	Samad Khankhel	330	0	0	22.6	708	8.1
Jabal Sarage	Chingay	250	0	0	22.5	550	8
Jabal Sarage	Hasan Khel	300	0	0	22.3	590	7.8
Jabal Sarage	Nasrat Khel	320	0	0	22.6	600	7.6
Jabal Sarage	Qasam Khel	210	0	0	22.4	535	8
Charikar	Qasam Khel	279	0	0	22.6	700	7.8
Charikar	Saleh Khel	300	0	0	22.4	857	7.6
Charikar	Azizbig Khel	295	0	0	22.3	726	7.6
Charikar	Mianshakh	320	0	0	22.2	724	7.6
Charikar	Babakhel	285	0	0	22.4	685	7.6

**Table 4.** Chemical parameters for groundwater of this research.

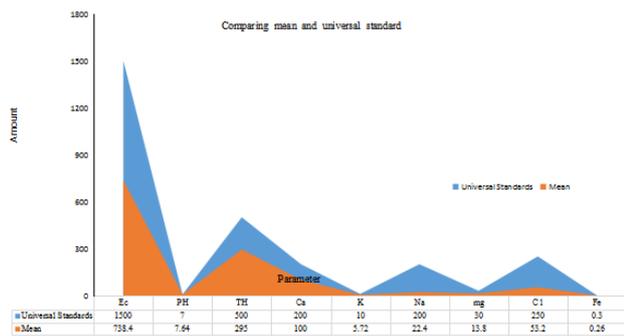
District	Villages	Parameters																	
		Ca (mg/L)	Na ≈	K ≈	SO4 ≈	Cl ≈	F ≈	Mg ≈	Ca/H ≈	HCO <sub>3</sub> ≈	CO <sub>3</sub> ≈	SO <sub>4</sub> ≈	AlK ≈	Cl <sub>2</sub> ≈	T/H ≈	NO <sub>3</sub> ≈	Fe ≈	As ≈	TDS ≈
Jabal Sarage	Samad Khankhel	110	19	9.2	78	84	0.3	14	143	180	0	55	2.3	0	287	0	0.2	0	414
Jabal Sarage	Chingay	105	12	4.6	32.3	72	0.3	12	145	180	0	56	3.3	0	310	0	0.3	0	412
Jabal Sarage	Hasan Khel	95	13	5.2	34.7	74	0.2	11	150	212	0	70	3.4	0	300	0	0.3	0	415
Jabal Sarage	Nasrat Khel	100	14	5.3	33.1	75	0.1	14	153	181	0	56	2.7	0	256	0	0.2	0	433
Jabal Sarage	Qasam Khel	120	16	5.4	16.3	66	0.2	12	145	150	0	65	3.1	0	285	0	0.2	0	445
Charikar	Qasam Khel	105	26	5,4	58	37	0,3	11	145	190	0	58	3.8	0	285	0	0.3	0	413
Charikar	Saleh Khel	120	32	9,1	70	88	0,2	13	150	210	0	70	4.2	0	320	0	0.3	0	476
Charikar	Azizbig Khel	95	25	5,1	67	52	0,2	15	225	167	0	67	3.3	0	295	0	0.2	0	433
Charikar	Mianshakh	90	27	5,5	65	52	0,3	15	150	170	0	65	3.4	0	300	0	0.2	0	439
Charikar	Babakhel	90	25	3,5	59	37	0,2	15	145	166	0	59	3.1	0	279	0	0.3	0	410

1 Mille gram/ Liter  
 2 Nepeleo Turbite Unite  
 3 Total Color Unite  
 4 Centigrade  
 5 Micro Semins/Centi meter

quality in the Tables 3 and 4 are detail explained.



**Figure 10.** Chemical parameters in Jabal Sarage and Charikar Districts, Parwan, Afghanistan.



**Figure 11.** Comparing mean chemical, physical limitations and universal standards of its in Jabal Sarage and Charikare district.

## 6. Conclusions

The groundwater quality analysis is used to determine physical and chemical parameters from Jabal Sarage and Charikar Districs (drinking water 10 rings of wells), Parwan Province, in Afghanistan. The calculated mean of physical and chemical parameters EC, hardness, temperature, pH, color and turbidity for Samad Khankhel, Chingay, Hasankhel, Nastrat Khel and Qasam Khel, are 597  $\mu\text{m}/\text{Cm}$ , 282  $\text{mg}/\text{L}$ , 22.48  $^{\circ}\text{C}$ , 7.8, 0 TCU and 0 NTU respectively, and for Malakhel, Saleh Khel, Azizbig Khel, Mianshakh and Babakhel are 738.4  $\mu\text{m}/\text{Cm}$ , 295.5  $\text{mg}/\text{L}$ , 22.38  $^{\circ}\text{C}$ , 7.6, 0 TCU and 0 NTU respectively. The mean of these parameters show good results with equal to international standards. The chemical parameters of Ca, Na, K, SO<sub>4</sub>, Cl, F, Mg, Ca/H, HCO<sub>3</sub>, CO<sub>3</sub>, SO<sub>4</sub>, Alk, Cl<sub>2</sub>, T/H, NO<sub>3</sub>, Fe As and TDS are almost appropriate and equal to the international standards, we can used for drinking and irrigations water. The results obtained suggest that the water quality can be used efficiently in the other province

of groundwater in Afghanistan.

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