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Determination of Physio-Chemical Parameters in Fresh Water of District Killa Saifullah

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Abstract

The water sources in Killa Saifullah are either in the form of dams, streams or tube wells. To check the ground water quality of Killa Saifullah, dissolved heavy metals and Physico-Chemical method were utilized. Eight water Samples were collected from fresh water reserves at different stations of District Killa Saifullah. Standard Analytical Techniques were used for determination of Physico-Chemical parameters such as pH (6.84-8.04), Temperature (20^{0}C), Alkalinity (200mg/L-400mg/L), Hardness (225mg/L-461mg/L), Conductivity 340µs/cm-1360 µs/cm), Total Dissolved Solids TDS(297mg/L-400mg/L) and for elemental levels of (K, Mn, Fe, Pb, Cu, Cd, and Co) the samples were processed through Atomic Absorption Spectroscopy. This technique is reliable for detection of about 62 Elements up to concentration limit of ppm. The metal Concentration in mg/L for Fe ranged from (0.195-0.534), for Mn (0.025-0.040), for K (1.422-3.627) for Cu (0.036-0.067) for Pb (0.336-0.409) for Cd (0.016-0.019) and for Co (0.007-0.019). Unfortunately, the samples mostly crossed the safe level of drinking water that has been described by WHO (2008). The results indicate the alarming situation of Killa Saifullah ground water used for drinking purpose, drinking such water could bring out critical situations for the residents of the region and is not suitable for drinking without filtration. Such water is also not suitable for poultry, cattle and other organisms along with human beings, because it can cause kidney issues, digestion malfunctions, mental retardation and many other complex diseases.

Keywords: Physico-chemical Parameters, Spectroscopy, Conductivity, Ground water, Killa Saifullah

INTRODUCTION:

"Water is the most important in shaping the land and regulating the" climate. It is one of the most important compounds that profoundly influence life. Majority of fresh water resources are found as ground water [1] it is an important source for drinking. Clean water is the reason of good health and guarantees a nation's growth. Estimates say, there will be about 3 billion more people living in the cities in the next forty years. Anthropogenic activities are changing Earth's temperature, due to which the climate pattern is altering to an extreme level. The pattern of rainfall is changing [2] making

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some regions drier while others wetter. Ground water levels are declining globally and also contaminated by human activities and natural activities. Now a day the presence of heavy metals and trace metals in water and change [3] in its physical behavior is one of the most important issue. Most of the diseases caused in humans, livestock and poultry are due to water [4]. Plumbism, which causes neural disorders, Cadmium poisoning causes kidney damage and lungs cancer, Nickel poisoning causes skin allergies and respiratory disorders [5], Copper poisoning may cause stomach cramps, vomiting and diarrhea. According to a study [6] over 212 million people are dying because of polluted water each year.

Alkalinity is referred to as the ability of water to neutralize acids. The three main agents are CO_3^{2-}, [7] HCO_3^{1-}, and OH^{1-}. pH, conductivity and hardness is directly affected by this property. Its permissible value is 200µg/L for drinking water that was exceeded in most of the samples collected.

Chlorides, Sulfates, carbonates and bicarbonates cause TDS. The permissible limit of TDS is 1000µg/L and water having TDS less than 600µg/L is considered good for drinking [8]. High level of TDS causes scaling of equipments. TDS of the given samples exceeded the permissible limit described by WHO.

Ca and Mg sulfates, chlorides, carbonates and bicarbonates cause hardness of water. Its value must be less that 200µg/L and most of the samples area exceeded the limit.

pH does not have direct effect on the organism that consume water but it leaves impact on other characters of water [9]. WHO suggests that water with pH less than 6.5 and higher and 9.2 would have serious effects on health. pH of all the collected samples was within the permissible limit.

Water has the ability to conduct electricity. Conductivity is affected by factors like temperature [10], ionic concentration and mobility etc. Conductivity is an important factor in determining the source of pollution in water. Conductivity of certain samples were higher than the permissible limit of WHO i.e. 1000s/cm.

Cadmium is widely distributed element found mostly in ores of Zinc. It is used in steel, electroplating and dyes industries [11]. Cadmium concentration in potable water is usually less than 1µg/L. Its high dosage may cause kidney failure, high rate of osteoporosis, and respiration disorders.

Cobalt exists in various oxidation states i.e. 0, +2, and +3. It is an important component of Vitamin B12, also found in ground water and surface water. Water is exposed to Cobalt both due to anthropogenic activities and natural activities. Its quantity ranges from 0.1-5µg/L [12]. It has been revealed that Cobalt has clastogenic effect on cells of mammals by conducting experiments.

Iron is the second most abundant element in the earth crust and exist mostly as Fe^{+2} or Fe^{+3} compound. Fe^{+2} cannot retain in drinking water and reacts with water to form $Fe(OH)_2$ [13] and precipitates out. Without any symptoms of turbidity ground water may contain several hundred milligrams of Fe^{+2}. Such water is used for Iron deficient patients, in building supplies, dyes production, and plastic industry. Necrosis, gastrointestinal complications may develop if more than 40mg/kg is utilized, in severe conditions overdosing may be fatal.

Manganese is a trace element required for biochemical processes and is considered very essential. It does not occur naturally but found in Iron ores along with Iron [14]. If someone is exposed to its over dosage for long term, it may alter appetite and cause low level of Hemoglobin.

Nickel exists in several isotopic form, it is white glossy hard metal. It occurs in ground water due to dissolution of ore bearing rocks in ground water and exist in oxidation states +1, +2 and +3. It acts as catalyst [15], and is used in welding, electroplating and production of alloys. Higher consumption of Nickel [16] may cause diarrhea, Nausea, headaches and shortness of breath. It may be cause cancer in some cases.

Lead is the most prevalent heavy metal having various isotopes. It is used in our daily life as Alloy component, Anti-knocking agent, in dyes and batteries [17]. The Joint Expert Committee on Food Additive (JECFA) prescribed 3.5 g of lead per kg of body weight per day as the tolerated lead quantity in 1986.The WHO states that both short-term and long-term lead exposure can cause neural disorders, kidney problems, mitochondrial damage, interference in enzyme activity, insomnia, abdominal pain, joint issues, headaches and insomnia.

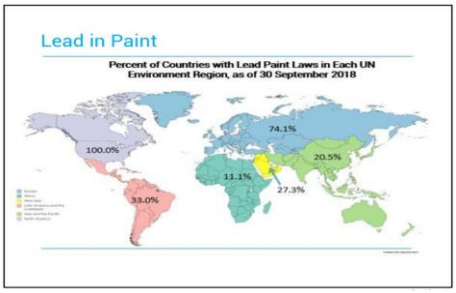

Fig 1. Regions around the globe that allow %age of Lead in Spray Paints.

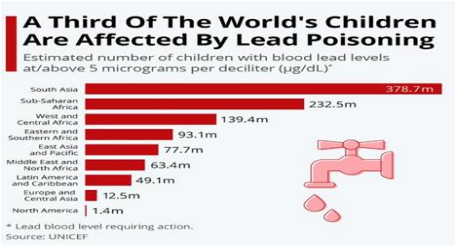

Fig 2. Number of children affected by Lead pollution around the World.

The cation of copper, a transition metal is +1 and +2. It is a good conductor of electricity and head, is ductile and malleable. Commonly it is a part of fungicide, algaecide and insecticide synthesis. Drinking water's copper content varies based on the pH and carbonate level. Headache, vomiting, nausea, diarrhea and stomach issues may occur due to both short and long term exposure to copper. [18]

Determining on local level the physical and chemical parameters of groundwater is very necessary. It is crucial for the authorities to appropriately treat the water before use if their content exceeds the recommended standards for drinking water [19].

To control such diseases related to exposure of toxic metals require monitoring of water quality, treatment of contaminated water sources and use of safe plumbing materials. Killa Saifullah is a district of Balochistan located in the northwest region of the province. It shares border with Afghanistan to the west, to District Zhob in North and Loralai to the East. This district lies in the foothills of Suleman range hence is mountainous and rugged terrain. This district contains various ethnic groups

containing mainly Pashtuns, but Baloch and Hazaras as minorities. The main occupation of the occupants is mainly agriculture, livestock and trade.

The region contains various sources of groundwater i.e. Karezat, dams, tube wells etc. This groundwater sources are used for all the basic needs of the region i.e. drinking, washing for agricultural use etc. Water analysis was carried out for the metal ions present in the water to check the suitability of water for drinking purpose mainly. Ground water is also used for agriculture, irrigation, and commercial purpose.

The water from various parts of Killa Saifullah district were collected according to the instructed technique and were analyzed for the concentration of various elements by Atomic Absorption Spectroscopy (AAS). These elements may cause harm to living organisms in various ways if exceed permissible limit prescribed by WHO[20]. The elements analyzed in the research are Cd, Pb, Cu, K, Mn, Fe and Co.

MATERIALS AND METHODS:

Sites for Analytical Procedures:

The samples were collected from several different locations of District Killa Saifullah, Balochistan. These location include Killi Bandat Musazai, Killi Rabat Karez, Killi Ghutai, Killi Jahangeer, Killi Baharwall, Killi Shagai, Killi Lahore, and Killi Yawala.

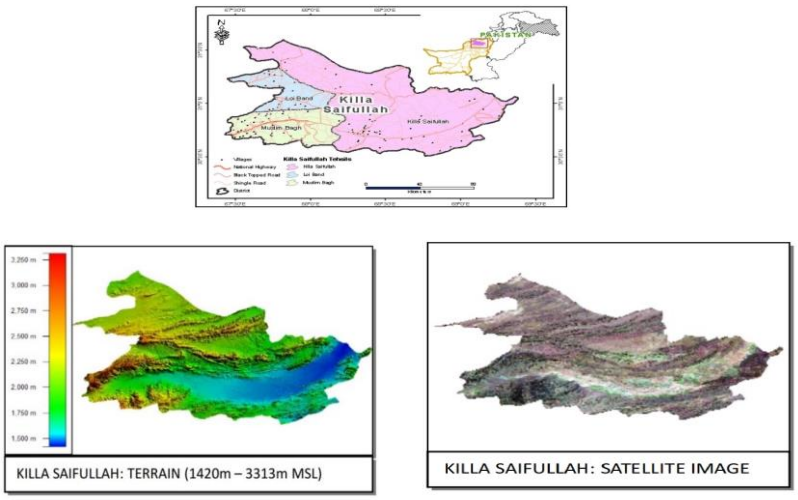

Fig 3. Map of Killa Saifullah

Following the same rules 8 samples were collected from tube wells, karezat and other ground water sources of Killa Saifullah and nearby villages.

A1	Killi Bandat Musazai
A2	Killi Rabat Karez
A3	Killi Ghutai
A4	Killi Jahangeer
A5	Killi Baharwall
A6	Killi Shagai
A7	Killi Lahore
A8	Killi Yawala

Table: 1 Sample codes used for study area

APPROACH AND PROPORTIONS EVALUATION

Specimens were collected from the particular specified sites in October-November (2020). The analysis and valuation of the aquatic specimens were implemented by means of A.A.S (atomic-absorption-spectrophotometry) Thermo Scientific - SOLAAR S Series ge711544 v1.30 AA [21] spectrometer. Sampling technique was in accordance to the guidelines provided by American Public Health Association (APHA) [22]. For collection of samples clean plastic bottles were used. The sampling bottles were flushed again and again at the sampling sites to assure purity. Each sample container was clearly marked, carefully transported to the lab to prevent contamination, filtered through Whatsmann Filter Paper No. 4 and stored in the dark at 4-5^{0}C.

Materials and methods:
To avoid contamination, the glassware was pre-cleaned with 25%HCl for 24 hours, then completely rinsed with ultra-high purity (UHP) deionized water (Elga, Purelab Option UK), and then stored in plastic zip bags before use. Except where otherwise noted, all reagents and salts used in the study were of analytical quality (BDH, Merck). Solutions and stocks were produced using these salts in UHP deionized water, and commercially available Atomic Absorption Standards (1000 ppm) for metals were utilized. Before usage, [23] UHP water was used to dilute each of these solutions.

Instrumentation and Procedure:
The American Public Health Association (APHA)- [25] recommended procedures were used to evaluate the physical and chemical characteristics of the water samples that were collected. The physical parameters of all water samples, including conductivity, pH, and temperature were measured at the time of sample collection using a digital portable water analyzer kit, while the other physical parameters were measured in a lab. Electrometric titration [26] was used to measure total alkalinity, and concordant results were observed for phenolphthalein, mixed indicator (Methyl Orange + Bromocresol), and the end points.

The evaporating dish method was used to calculate the total dissolved solids (TDS). At 110 ^{0}C, each sample was filtered and evaporated. The dish was weighed as the final weight after evaporation [27], which was calculated using the initial weight, and the readings were recorded. Erichrome black T (EBT) was utilized as an indicator in a complexometric EDTA titration to evaluate the total hardness. NH_4Cl + NH_4OH [35] was employed as a buffer to keep the pH of the solution between 9 and 10, and the readings were logged for concordant results. A turbidimeter was used to measure turbidity. Hexamethylenetetramine (4000 NTU) and hydrazine sulphate (5 ml each), which had been diluted to 200 NTU, were combined to create the standard solution. The instrument's calibration used this concentration. The reading through instrument was noted for all the samples.

A.A.S (atomic-absorption-spectrophotometry) Thermo-Scientific - SOLAAR S Series ge711544 v1.30 AA spectrometer was used for the elemental analysis. Using an AAS, the amount of Cd, Pb, Cu, K, Mn, Fe & Co were calculated after obtaining calibration curves for each element using five standards. Before usage, the AAS instrument was given 30 minutes to stabilize.

RESULTS AND DISCUSSION

Table 1 and 2 present the findings of different physical and chemical parameters and levels of various cations of water samples that were obtained. All of the data are compared to the guidelines provided by WHO [24]. Numerous variables affect these parameters' concentration in ground water, including the depth of the water table (a greater distance reduces the likelihood of contamination due to soil/filtration reactions) and precipitation levels (less precipitation will result in fewer contamination due to soil/filtration reactions) and precipitation levels (less precipitation will result in fewer contaminants [28] entering the ground water during recharge). The water table in Killa Saifullah is almost at 220 m depth, and the region will experience a water shortage in future.

Physical Parameters

The results of an analysis of various physical characteristics of the water samples are displayed in table 1.No change in color,odor,and taste was observed in any sample. The temperature of samples at the time of sampling ranges from 24^0C to 29^0C. conductivity (312µs/cm to 1314µs/cm), Alkalinity (216mg/L to 410 mg/L), pH(6.62 to 8.22), total hardness(200mg/L to 428mg/L), and TDS mainly due to sulfates, chlorides, carbonates and bicarbonates (280 to400mg/L) are mostly within the WHO standard value ranges. The pH varies throughout the samples.

Table 1: Physical parameters of water samples

Parameters	Sample ID								†WHO
	A1	A2	A3	A4	A5	A6	A7	A8	
Taste	**ND	ND	ND	ND	ND	ND	ND	NONE	NONE
Odor	ND	ND	ND	ND	ND	ND	ND	NONE	NONE
Color	ND	ND	ND	ND	ND	ND	ND	ND	≤15TCU
Temperature	25	24	25	29	26	26	25	27	***NA
Total Hardness	428	292	296	338	394	419	336	200	250
TDS	400	296	365	300	287	312	324	336	≤1000
pH	6.71	6.62	7.16	7.41	7.51	7.23	8.22	6.91	6.5-8.5
Alkalinity	394	316	338	367	389	400	312	267	≤200
Conductivity	1000	1300	1200	960	750	350	400	500	1000

†WHO, drinking water standards
** Not detected
*** Not Available

Chemical Parameters

The results of analysis of chemical parameters are shown in table 2. demonstrates the concentration of K,Mn, Co, Pb, Cd, Fe and Cu in ppm in each water sample. Fig 1, 2 and 3 represent that concentration of Potassium, Manganese, Cobalt [26] are within the permissible limit given by WHO in all water samples. the concentration of Fe is with in permissible limit of all the samples except A3 (Killi Ghutai) samples is explained in Fig 4.

The concentration of heavy metals Cadmium and Lead is above the permissible limit in all water samples as shown in Fig 5 and 6 which is so alarming for the resident of this district.The burning of fossil fuels, sewage sludge, wind-borne dust, volcanoes, phosphate fertilizers, marine biogenic emissions, mining and smelting of cobalt ores, processing of cobalt alloys and industries that use or process cobalt compounds are some of the sources of Cobalt and Cadmium include anticorrosive, electroplated onto steel, plastic pigments, electric batteries, electronic components, phosphate fertilizers and batteries.

The region of Killa Saifullah and its surroundings are agricultural fields that require various fertilizers, and automobiles using fossil fuels and storage batteries is also rising exponentially. Storage batteries are utilized by solar systems in residences as well as by autos, which are switching from main power supplies to them. Therefore, these anthropogenic activities could be blamed for the increased cobalt and cadmium concentrations.

The concentration of Copper is explained by fig2.which is with in the limit in Sample A1, A2 and A3 while its concentration is above the required limit in sample A4, A5, A6, A7 and A8 defined by WHO.

Table 2. Result of chemical parameters of water samples in ppm.(n=3)

Parameters	Sample IDs								WHO
	A1	A2	A3	A4	A5	A6	A7	A8	
K	1.54	1.42	2.21	2.30	3.63	1.73	1.92	1.56	50
Cd	0.0184	0.0176	0.0157	0.0169	0.0179	0.0181	0.0192	0.0191	0.003
Mn	0.0247	0.0347	0.0404	0.0313	0.0291	0.0311	0.0313	0.0311	0.4
Co	0.0068	0.0094	0.0152	0.0096	0.0196	0..0194	0.0175	0.0266	0.05
Fe	0.195	0.251	0.534	0.230	0.238	0.236	0.260	0.270	0.3
Pb	0.3363	0.3659	0.3954	0.3846	0.3917	0.4099	0.3925	0.3921	0.01
Cu	0.0388	0.0472	0.0358	0.0614	0.0654	0..0527	0.0672	0.0612	0.05

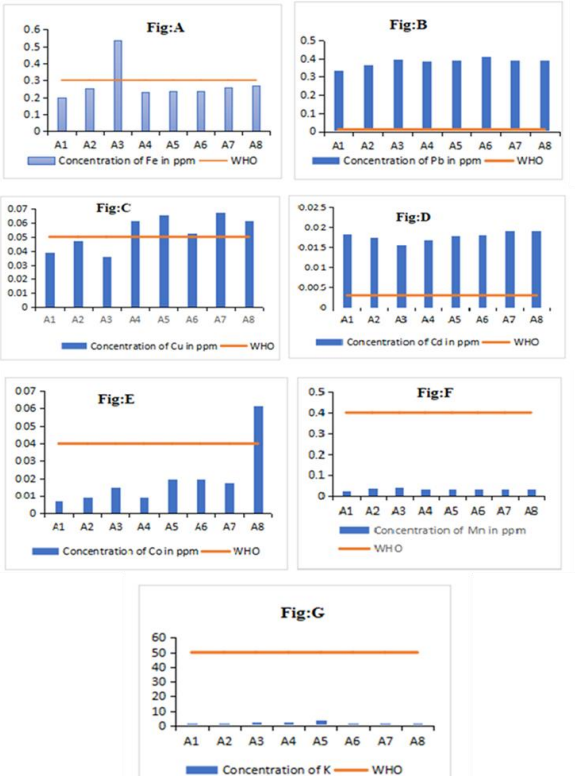

Figure 1: Concnentartion of Metals in water samples; (A) Fe, (B) Pb, (C) Cu, (D) Cd, (E) Co, (F) Mn, (G) K

CONCLUSION

The present study reveals that Drinking water of studied area of district killa saifulla is either suitable for drinking or not, it must be screened for heavy metal contamination and its physical parameters must be determined as well. Water i.e. ground or surface water is contaminated due to both natural and human activities. Physical and chemical parameters of ground water from various regions of District Killa Saifullah were compared to the standards defined by WHO. Electrical conductivity and Total Hardness were found to be higher than the permissible limits. The concentration of Cadmium,was found above the limit defined by WHO. Iron was found above the limit only in the samples of killi Ghutai and was in limit in all the other samples.Lead and Copper were found to be exceeding the permissible limit prescribed by WHO in most of the samples. Concentration of Cobalt, Manganese and Potassium were found to be within the limit defined by WHO.

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