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Experimental Study on Physico-Chemical Parameters of Ground Water at Peth Seer Sopore J&K

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ABSTRACT- Human activities, use of fertilizers and chemicals in agricultural fields are the main causes of ground water contamination. Therefore to protect and improve the natural eco system, water quality analysis is essential. The main goal of this work is to study the criteria governing the groundwater quality in the nearby wells of Peth Seer, Sopore J&K. Total 12 groundwater samples and 15 water quality parameters for each sample are considered in this study. The ground water samples of all the selected stations were collected for a physiochemical analysis. For calculating present water quality status, following 16 parameters have been considered Viz. pH, TDS, EC, Chloride concentration, Nitrate concentration, Sulphate concentration, Alkalinity, Fluoride concentration, Total hardness, Magnesium, Calcium, Sodium, Potassium, Temperature, Turbidity, Residual chlorine. The obtained results are compared with WHO (2017). The study reveals that the concentrations of all the constituents are well within the permissible limits of WHO (2017). Groundwater in the study area is suitable for drinking purpose as prescribed by WHO (2017) and irrigation purposes as prescribed by IS-11624(1986).

KEYWORDS- TDS (Total Dissolved Solids), EC (Electrical Conductivity), WHO (World Health Organization), Turbidity.

I. INTRODUCTION

The fundamental natural resource on planet is water. A crucial foundational element of society is a safe and dependable source of water. There has been a huge increase in demand for fresh water recently as a result of both a growth in population and a stepping up of agricultural activity like use of fertilizers, pesticides and other chemicals [1]. The situation is more serious in India because the country ranks second in the world in terms of population and it is challenging to meet the needs of such a sizable population in terms of drinking water. Consequently, many people in India pass away every year as a result of drinking tainted water [2]. There is a severe lack of freshwater resources. The amount of water on earth that is appropriate for human consumption is less than 1%. Therefore, it is necessary to manage and safeguard freshwater resources [3]. Since it is directly related to human welfare, water quality is a crucial problem for humanity. Poor water quality has a negative impact on plant development and human health [4-5]. Without water, life on earth is not possible. The most important and priceless gift of nature to a nation and culture is water. A country may thrive without any other natural resource, excluding water, such as fuels, minerals, forests, etc. This gives it a special position among all the other natural resources [6].

The term "ground water" describes the subsurface water that exists in submerged zones beneath the surface of the earth that are of varying thickness and depth. Current rock fractures and pores, along with unconsolidated crystal layers, form a vast subsurface reservoir where some precipitation is stored. Through wells and tube wells, the groundwater is utilized [7].

Groundwater is a significant component of the water supply system for drinking, agriculture, and industrial uses in arid and semi-arid regions of the world. In India, groundwater is a significant source for irrigation and drinking. It has significantly aided India's economic expansion and served as a major source for the country's socioeconomic advancement, health, and sanitation. Groundwater sources provide more than 80% of India's rural home water needs and around 50% of its urban, industrial, and irrigation water needs [8]. Compared to surface water, groundwater is thought to be cleaner and safer for drinking since the bulk of toxins are destroyed when it percolates into the earth [9]. However, the quality of the soil, rocks, and human activity are all contributing to the progressive decline of groundwater resources. Groundwater supplies have become more susceptible to pollution as a result of rising population and economic growth. The ecology has been negatively impacted by the rapid industrialization and urbanization during the last two decades. Municipal, industrial, and agricultural waste containing insecticides, pesticides, heavy metals and fertilizer residues with water has caused leaching, which has contaminated groundwater [10]. The existence of this crucial natural resource has been taken for granted, but due to rapidly shifting land use patterns and chemical use in agricultural practices, ground water use and pollutant production have both exceeded safe levels in many areas. The most typical method for getting rid of industrial and municipal garbage is still land filling. The significant poisoning of ground water in many locations is also caused by the subsequent leaching of harmful substances through these landfills.

Groundwater quality has been seriously threatened over the past few decades by both increased human activity and intense use of natural resources [11, 12].

Groundwater quality is not only diminishing as a result of agricultural modernization; industrialization and urbanization are also factors in the loss of water quality [13-17]. This decline in groundwater quality could pose a major threat to people's health [18].

Due to overuse of resources and inappropriate waste disposal procedures, the fast growth of some areas has further impacted groundwater quality. As a result, groundwater quality management and conservation are constantly necessary and of importance. The current study was carried out to look into the potential effects of the groundwater quality of some open wells taking into account all the above mentioned components of groundwater contamination. More over the area selected is all over covered by orchard fields and other agricultural practices are being carried throughout the year. Fertilizers, pesticides and other chemicals used in these practices can be a source of contamination for groundwater. So an attempt was made to cover the whole area and twelve (12) wells were selected having a suitable distance from one another. In light of this, the current study examines the quality of ground water for irrigation and drinking based on different water quality parameters in the area of Seer Jagir, Baramulla, J&K (India).

A. Study Area

The study area, Seer Jagir is a small village situated in the town of Sopore. Sopore, known as Suyyapur in antiquity, is a town in the Baramulla district of Jammu and Kashmir, India. It is 45 km north-west of Srinagar, and 16 km north-east from the city of Baramulla. Located at an elevation of none meters (0 feet) above sea level, Sopore has a Marine west coast, warm summer climate. The district's yearly temperature is 13.91ºC (57.04ºF) and it is -12.06% lower than India's averages. Sopore typically receives about 33.85 millimetres (1.33 inches) of precipitation and has 49.47 rainy days (13.55% of the time) annually.The village is located between latitude 34.25360N and longitude 74.44497E. It is situated on bank of river Jhelum. This village's overall geographical area is 471.5 hectares / 4.715 Square Kilometres (km^2) / 1165.1018736177 acres. Map of the concerned area is shown in figure 1.

II. SAMPLING AND ANALYSIS

In tight-capped, high-quality polyethylene bottles, a total of twelve water samples were taken from each station. Twelve wells were included in these samples. Water samples were collected in the town of Sopore from a small village Seer jagir. Before sampling, sampling containers were properly cleaned with distilled water and rinsed with the sample water that will be used for analysis. After 10-15 minutes of pumping to achieve consistent conductivity, groundwater samples were taken. This was done to get rid of the well's standing water. The variables, pH, EC and temperature were assessed in-site using a portable pH meter shown in figure 3, EC meter shown in figure 4 and thermometer respectively. According to the procedures outlined in the American Public Health Association manual APHA (2005), the collected water samples were maintained in iceboxes before being transferred to the laboratory for additional physicochemical examination. Major cations namely the value of sodium (Na^+) and potassium (K^+) were determined by using uv-spectrophotometer which is shown in figure 2. The concentration of TDS was determined by turbidity rod meter. Using the EDTA titration method, the values of magnesium (Mg^{+2}), calcium (Ca^{+2}), and overall hardness were evaluated. The analysis of alkalinity was done using acid-base titration. Silver nitrate ($AgNO_3$) titration was used to calculate the chloride (Cl) concentration value. The spectrometric approach was used to identify the chemical component fluoride. A gravimetric approach was used to determine the sulphate concentration. The concentration of TDS was determined by TDS meter.

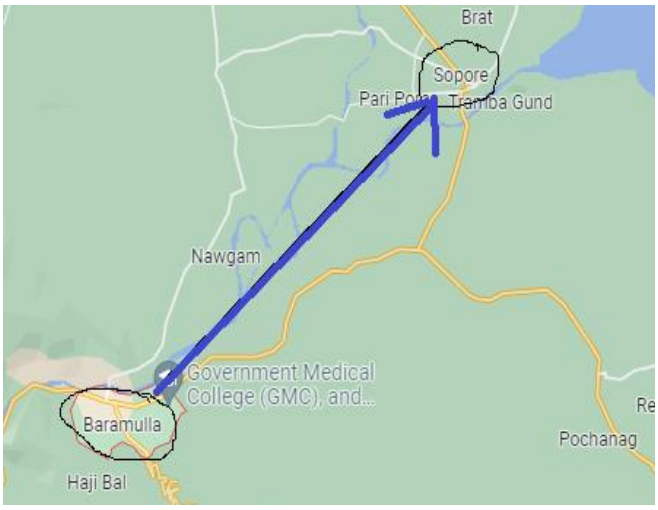

Figure 1: Study areas Map

Figure 2: UV-Spectromete

Figure 3: pH meter

Figure 4: Conductivity meter

III. RESULTS AND DISCUSSION

Table 1 below provides a statistical summary of the assessed groundwater sample parameters for the research area and standards for drinking water set by the World Health Organization (2017) are summed in Table 2 below.

Table 1: Statistical Summary of the Assessed Groundwater Sample Parameters

Parameters	Maximum value	Minimum value
pH	7.23 (station L)	6.82 (station B)
TDS	527 mg/l (station I)	423 mg/l (station E)
EC	1360 µm/cm (station I)	876.7 µm/cm (station C)
Cl−	150 mg/l (station K)	110 mg/l (station G)
NO3 −	40.3 mg/l (station B)	32.6 mg/l (station C)
SO4 −2	323.6 mg/l (station J)	263.2 mg/l (station B)
Alkalinity	442 mg/l (station L)	265 mg/l (station A)
F−	0.4 mg/l (station A)	0.05 mg/l (station C)
Total hardness	461.4 mg/l (station D)	382 mg/l (station F)
Mg+2	100.16 mg/l (station G)	75.08 mg/l (station C)
Ca+2	42.06 mg/l (station F)	24.34 mg/l (station G)
Na+2	165.6 mg/l (station L)	152.3 mg/l (station B)
K+	5.2 mg/l (station D)	3.7 mg/l (station H)
Temperature	24 °C (station H)	17 °C (station E)
Turbidity	0 mg/l	0 mg/l
Residual chlorine	0 mg/l	0 mg/l

Table 2: Standards for drinking water set by the World Health Organization (2017)

Parameters	Permissible Values
pH	6.5-8.5
TDS	500
EC	1500
Cl−	250
NO3 −	11
SO4 −2	250
Alkalinity	500
F−	1.5
Total hardness	500
Ca+2	75
Mg+2	50
Na+2	200
K+	12
Temperature	-
Turbidity	0
Residual chlorine	1

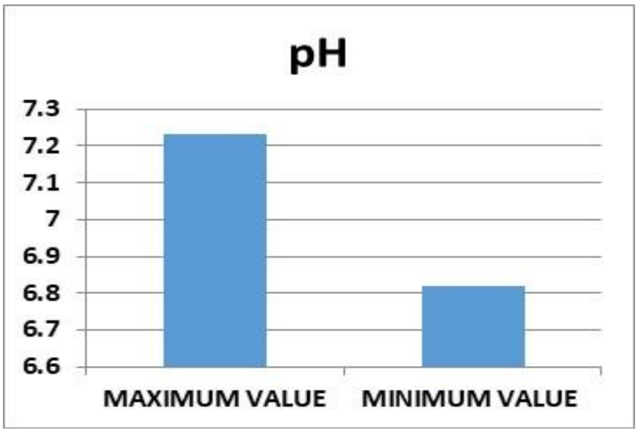

Figure 5: pH value

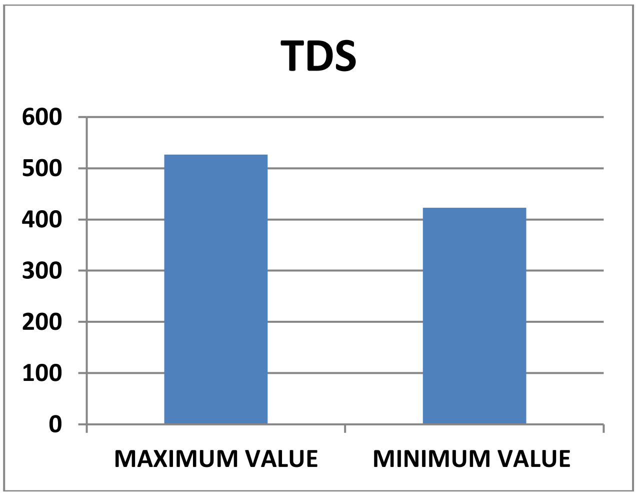

Figure 6: TDS value

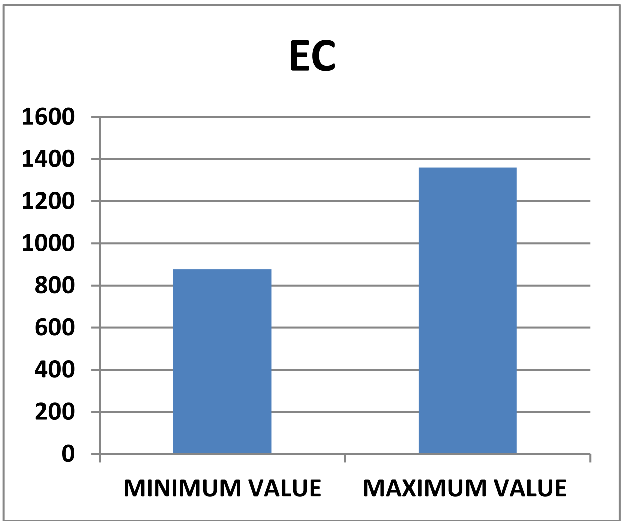

Figure 7: EC value

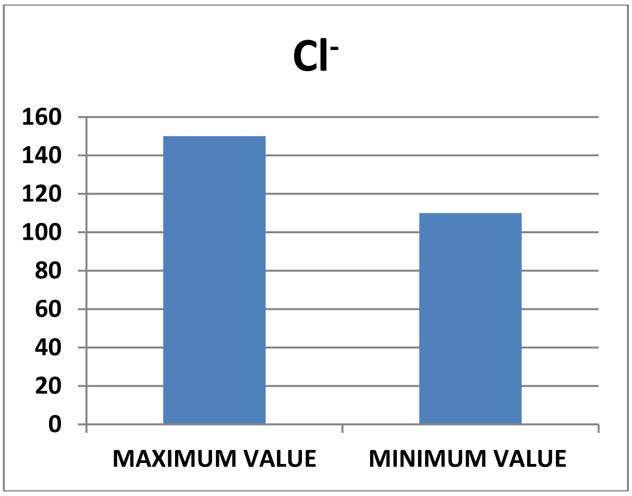

Figure 8: Cl- value

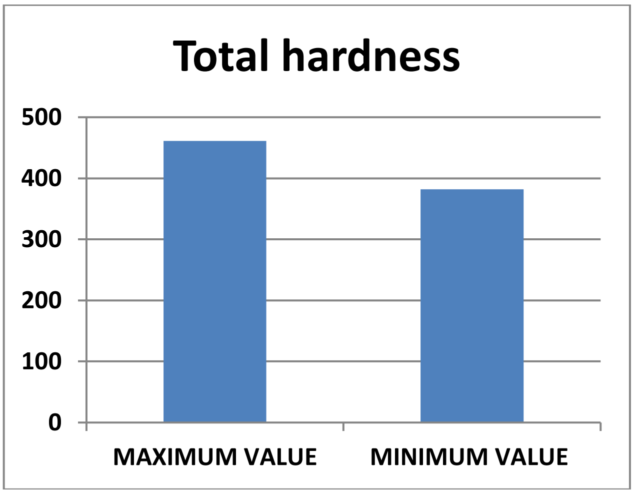

Figure 9: Total hardness value

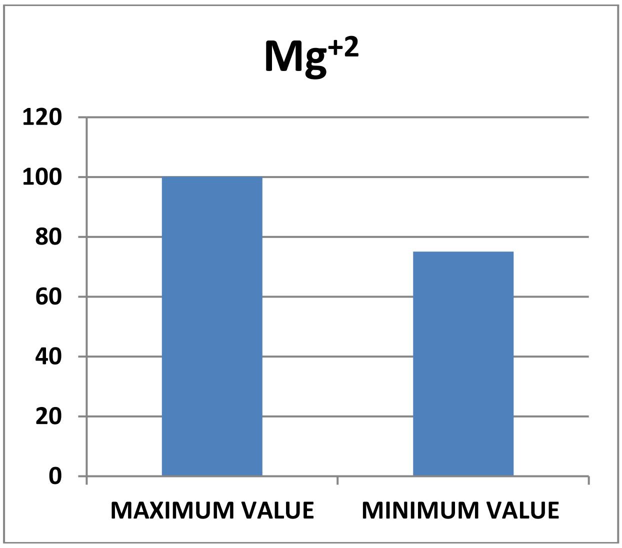

Figure 10: Mg+2 value

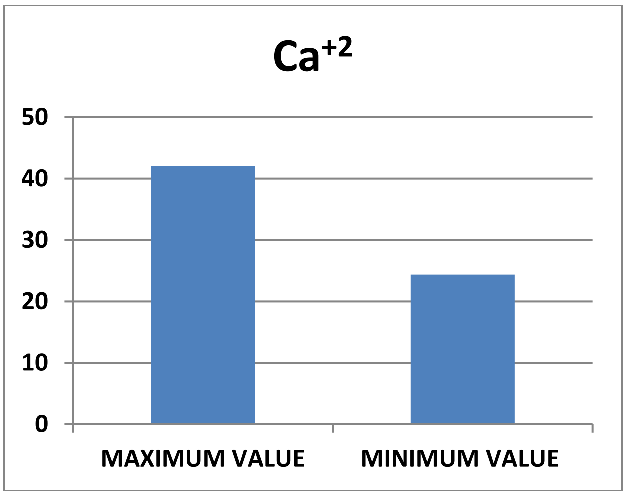

Figure 11: Ca+2value

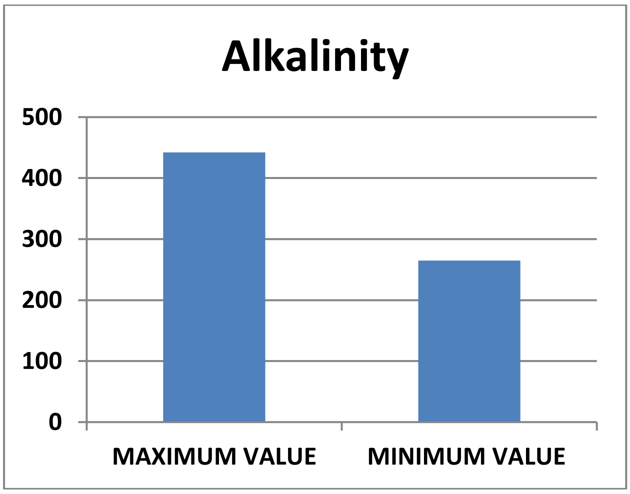

Figure 12: Alkalinity value

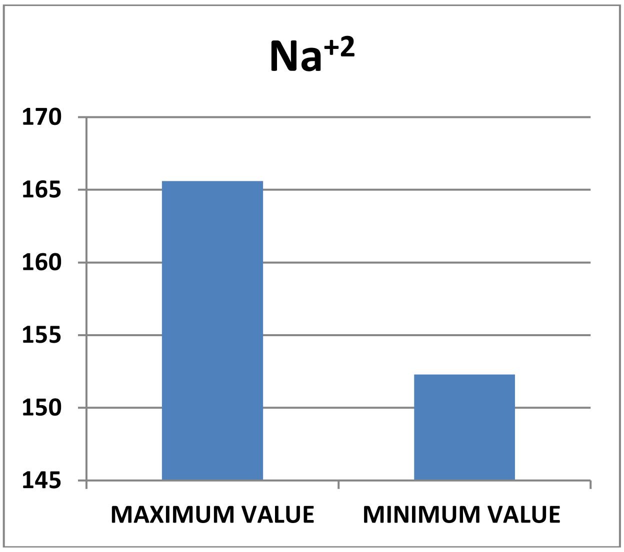

Figure 13: Na+2value

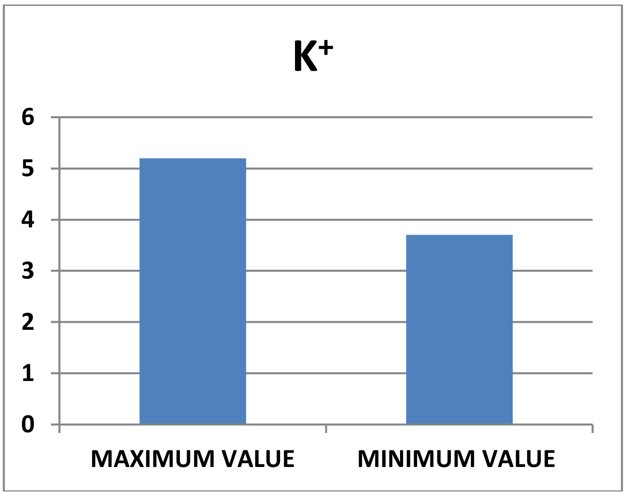

Figure 14: K+ value

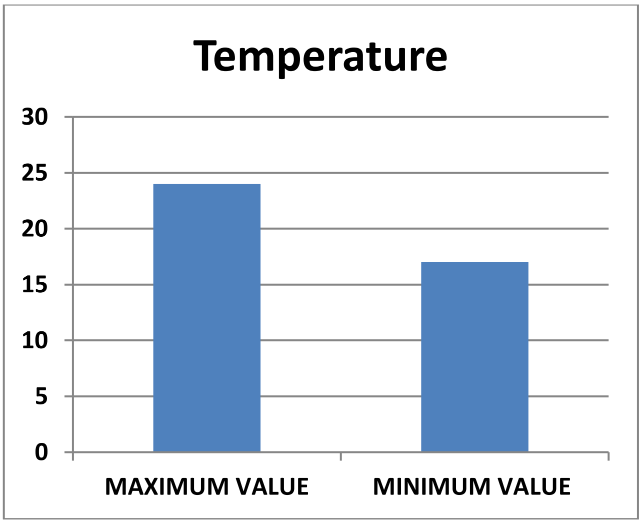

Figure 15: Temperature value

A. pH

One of the most significant system parameters to assess the level of groundwater contamination is pH. However it doesn't directly affect human health, it regulates the amount and chemical composition of a variety of organic and inorganic substances that dissolve in groundwater. The value of pH at station L was highest (7.23) and the value of pH at station B was lowest (6.82), as presented in figure 5. According to the results obtained, the groundwater samples of research area were mildly alkaline. All of the samples are within the acceptable range for drinking consumption. According to WHO guidance WHO (2017) and IS 10500:2012, the acceptable limit of pH value for drinking water quality is between 6.5 and 8.5.

A. Total Dissolved Solids

To assess the status of the pollutants present in the groundwater, estimation of the total dissolved solids (TDS) is important. Groundwater that has a TDS value of less than just 600 mg/L is frequently regarded as suitable, however water with a TDS value of more than about 1000 mg/L is unsuitable for drinking as per WHO (2017). The maximum TDS was recorded at station I with 527 mg/L, and the lowest value is 423 mg/L at station E, as presented in figure 6. As a result, the samples in the study region were categorized as desired or acceptable for drinking. High TDS may result from groundwater spending more time in contact with the aquifer body.

B. Electrical Conductivity (EC)

The ability of dissolved salts in groundwater to transmit electric current is frequently measured by electrical conductivity, which provides details on the enrichment of dissolved salt concentration in groundwater. The quality of groundwater was not as desirable for drinking and agricultural purposes due to an abundance of charged particles. According to WHO 2017, the maximum recommended limit of EC for human consumption is limited to approximately 1,500 µm/cm. The highest EC value 1360 µm/cm, was recorded at station I, and the lowest, 876.7µm/cm, was recorded at station C, as presented in figure 7. The high EC values may be caused by anthropogenic factors like intensive farming and improper waste discharges in the area.

C. Chloride Concentration

Because of weathering, sedimentary rocks and soils, wastewater discharge from home and industrial sources as well as municipal sources, and other factors, chlorides are a widely dispersed element in natural water. Groundwater with high chloride content can impart a salty flavor to drinks and water, whereas an excess of 250 mg/L increases the taste of water (WHO 2017). Additionally, a high concentration of chloride may aggravate human heart and renal conditions, as well as induce corrosion in water distribution systems. At station K, the chloride ion concentration is 150 mg/L, but at station G, it is 110 mg/L, as presented in figure 8. The groundwater samples in the current study area are under the WHO recommended levels (250 mg/L) for safe drinking water (2017). These comparatively greater chloride concentrations in the groundwater samples may be the result of leaching of sewage components and agrochemicals from surrounding farms as well as weathering of the rock and soil.

B. Nitrate Concentration

The most prevalent sources of nitrate in groundwater include excessive fertilizer use on agricultural land, contamination from human or animal waste as a result of ammonia oxidation, and similar sources. The highest nitrate value, 40.5 mg/L, was found at station B, and the lowest -

32.6 mg/L, was found at station C.Groundwater with high levels of chloride and sulphate could have an impact on water distribution network systems and the corrosion phenomenon [19].Due to generation of nitrosamide and nitrosamine in human body, a high nitrate concentration in drinking water is harmful and can lead to diabetes, stomach carcinomas, blue baby syndrome in infants, and other conditions. The high level of nitrates in the groundwater may be caused by an excessively irrigated area and an excessive application of inorganic nitrogenous fertilizers. Additionally, inappropriate storage of the animal manures and leaching from improperly positioned septic tanks and community traditional pit toilets could both contribute to the elevated nitrate levels.

C. Sulphate Concentration

Sulfate concentration must be determined in order to assess the quality of natural groundwater used for irrigation and drinking. Drinking groundwater with sulphate might cause an overt taste. Additionally, it may become unstable when its concentration exceeds the WHO's 2017 standard limit (400 mg/L), and the excess magnesium in the groundwater may have a laxative effect on human health. The highest concentration of sulphate (323.8 mg/L) was recorded in station J and the lowest is 263.2 mg/L at station B. High levels of chloride and sulphate in groundwater may have an impact on water distribution network systems and the corrosion phenomenon.

D. Alkalinity

One important aspect of water quality that can be used to measure an acid's ability to be neutralized is alkalinity. Alkalinity samples from the research area range from 265 mg/L at station A to 442 mg/L at station L, with the latter figure being the highest, as presented in figure 12.

E. Fluoride Concentration

The element fluoride is widely dispersed in rocks and can be found as fluorides in a variety of minerals. It is an essential component for humans because consuming water with less fluoride than 0.6 mg/L contributes to tooth decay. Additionally, a high fluoride concentration in groundwater might result in skeletal and dental fluorosis. In the research area, fluoride concentrations ranged from 0.05 to 0.40 mg/L at station C and station A respectively.

F. Total Hardness

The main contributors to water hardness (TH) are anions such carbonate, bicarbonate, chloride, and sulphate, as well as cation like calcium and magnesium. It frequently manifests as precipitation of soap scum and necessitates the use of additional soap in order to clean.

The measured waters' hardness values ranged from 382 to 461.4 mg/L at station F and station D respectively, as presented in figure 9. Hard water is typically thought to not have a significant negative impact on human health.

G. Magnesium and Calcium (Mg and Ca)

The most abundant elements in natural water are calcium and magnesium, which are mostly present as bicarbonate compounds as well as in the forms of sulphate and chloride. To assess whether the groundwater is fit for human consumption, the concentrations of calcium and magnesium should be found. Magnesium and calcium deficiencies are frequently linked to increased risks for people, including hypertension, osteoporosis, vasoconstrictions, atherosclerotic vascular disease, etc. On the other hand, if you have kidney or bladder stones, you should avoid drinking groundwater because of its high calcium and magnesium concentration. The amount of calcium in the groundwater samples ranged from 24.34 to 42.06 mg/l at station G and station F respectively, as presented in figure 11. In the case of the magnesium, the maximum concentration is 100.16 mg/L at station G and the lowest is 75.08 at station C, as presented in figure 10. Magnesium concentrations for human intake should not exceed 150 mg/l, according to the WHO (2017). The weathering of magnesium minerals and leaching of dolomites are mostly to blame for the relatively higher concentration of magnesium ions in the groundwater samples compared to the concentration of calcium ions.

H. Sodium

The sixth most abundant element in terms of abundance is sodium, a common element that is commonly present in freshwater. The concentration of sodium in groundwater is primarily influenced by the temperature of the solution and the associated anions. At station L, the maximum sodium concentration (165.6 mg/L) and the lowest sodium concentration (152.3 mg/L) at station B were measured, as presented in figure 13.

I. Potassium

One of the most crucial elements in freshwater for healthy humans is potassium, which is present in lesser amounts than Ca, Mg, and Na. Potassium concentrations in groundwater samples from the study area ranged from 3.7 to 5.2 mg/L with lowest at station H and highest at station D, as presented in figure 14.

J. Temperature

The temperature of the water may change due to different assortment timings and the effects of the climate [20]. In a planned system, the water temperature regulates the rate of every complex response and affects fish growth, procreation, and invulnerability. Fish can die when temperatures change unexpectedly [21]. At station H, the maximum temperature (24 °C) and the lowest temperature (17 °C) at station E were measured, as presented in figure 15.

K. Turbidity

Colloidal and very fine scatterings, suspended debris, such as dirt and residue, and finely partitioned organic and inorganic matter are the causes of water turbidity [20]. The WHO's national drinking water recommendations state that turbidity in drinking water should be less than 1 NTU and not more than 5 NTU [20]. The turbidity at all the stations was measures to be as 0 NTU.

L. Residual Chlorine

Residual chlorine is the amount of chlorine that is still present in the water after a specified period of time or contact after its first application. It serves as a crucial barrier against the possibility of post-treatment microbial contamination, which is a special and major advantage for public health. The acceptable limit for residual chlorine in drinking water is between 0.2 and 0.5 mg/l, according to WHO. The permitted limit, under IS 10500-2012, is 0.1 mg/l. At all the station, the amount of residual chlorine was measured to be as 0 mg/l.

IV. CONCLUSION

In this work, the analysis of physico-chemical parameters of groundwater samples at different locations at Peth Seer, Sopore, J&K has been done. 16 groundwater quality parameters from 12 sampling stations were used and compared with the standard values given by WHO for drinking water and irrigation purposes. All the parameters were under the permissible limit. The results of the current study indicate that all of the examined physico-chemical parameters were under permissible limits given by WHO for drinking waters, and they can also be used for irrigation because all the parameters are within the permissible range as per IS 11624(1986). If discharges are reduced by effective waste disposal and by using less chemicals and fertilizers for various agricultural practices, the water quality of this groundwater has the potential to significantly improve more and more. To prevent the groundwater from degrading, it is important to regularly check it and take the necessary corrective actions, such as collecting domestic sewage, avoid using chemicals on crops and using appropriate waste treatment facilities. Future study can be done on salts, trace of organic compounds, heavy metals and other water quality characteristics.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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