Studies on the Physicochemical parameters of Surface and Groundwater in Coimbatore District, India

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Abstract: - The present investigation pays attention on the physico-chemical parameters of both surface water and underground water in different regions of Coimbatore in winter season (July- December 2021). The surface water samples were collected at lakes in Mettupalayam, Muthannakulam, Vellalore, Thamaraikulam, Kurichi and Perur. The underground water samples were collected at Premier nagar, Pollachi, Mettupalayam, Hope college, Thudiyalur and Saravanampatti. The physico-chemical parameters like pH, Turbidity, TDS, Alkalinity, Total hardness, Dissolved oxygen, Chloride, Nitrates, Nitrites, Fluorides, Calcium, Potassium and Sodium were analyzed. The results suggested that the overall quality of surface and ground water is suitable for domestic purpose not for suitable for drinking.

Key-Words: -Physicochemical parameters, surface water, ground water, hardness, alkalinity, dissolved oxygen, turbidity, total dissolve solids.

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1 Introduction

Water is the basic constituent of life. It is the rare gift given by God. It is indispensable, limited and vulnerable resource. It is the primary need for life on earth and availability of the same makes the earth incredible planet. It forms lakes, seas, and oceans by filling depressions in the earth's crust. Approximately 96.5% of the total amount of water existed on the earth is present in the seas which is saline in nature. Its salinity is approximately 35%. The remaining 2.5% is only fresh water on the earth having less than 1%of ocean's salinity [1]. 87% of the total fresh water is present in lakes, 11% in swamps andonly2%inrivers.Distribution of water is thoroughly discussed. Civilization is known as the backbone of our glittering heritage, rivers and fresh water resources are the strong and brawny limbs on which our life stands. Water resources have played most vital role in forming, enhancing and developing our rich culture throughout the ages. As plenty of food, water and other living facilities are available along the river sides, due to which civilization grown-up along the bank of rivers. As increased for domestic use followed by industrial

This rapid explosion of population increases the demand of water which in turn returns inferior quality water and deterioration in quality of water is called pollution of water. Hence rapid increase in industrialization, urbanization and burgeoning increase in population raise the demand for water. As water consumption inflated, it deteriorates the quality of output water [2].The availability and distribution of fresh water in river systems is essential to the progress of civilization. As the civilization developed, use of water got increased up to the indefinite level and after use polluted water having different types of contaminant is excreted out. These polluting substances are introduced into water resources. Physical, chemical, biological, and metabolic processes may transform them as they are moved from one location to another. To determine the impact of the substance on the water system, analytical strategies are performed for surface and underground water assessments related to the present and future water pollution.

1.1 Study Area

Coimbatore district is located in the western region of Tamil Nadu, India, between the latitudes of $10^0 10'$ N and $11^0 30'$ N and the longitudes of $76^0 40'$ E and $77^0 30'$ E. The district covers 4850 square kilometres. The annual rainfall in the district ranges from 550 to 900 millimetres. The Bhavani, Noyyal, Amaravathi and Ponnani are main rivers running through the district. The district's temperature fluctuates in the range from 19.8 and 35.9^0C.

The physicochemical water quality criteria are crucial in evaluating the water environment, ecosystem, hydrochemistry, and ecology, as well as improving water quality. The current study examines the physicochemical parameters of surface and groundwater water in Coimbatore. Since the quality of water affects our lives in many ways, water must be of good quality for healthy survival of organisms. Water quality can have a great influence on the ability of aquatic plants and animals to exist and to grow in a stream, pond or lake.

1.2 Parameters Studies and their significance

Various physicochemical water quality parameters are discussed in this paper which is listed below,

1.2.1 Turbidity

The cloudiness of water is called turbidity.

The suspended particles in water such as clay, silt, organic material, plankton and other particulate elements are responsible for turbidity. The presence of turbidity in water gives unappealing appearance to drinking water.

1.2.2. Color

Water takes on the hue of decomposed organic matter, such as flora, and inorganic debris, such as dirt, stones, and rocks, which is disagreeable for aesthetic rather than health reasons Potable water should be free from color.

1.2.3 Taste and odor

Foreign matter, such as organic contaminants, inorganic compounds, or dissolved gases, can alter the taste and odour of water. These materials can come from a variety of places, including natural, household, and agricultural sources.

High levels of naturally occurring sodium, magnesium, or potassium may cause a salty taste. Green or blue water: Usually caused by corrosion of copper plumbing. Black or dark brown water: The common cause is due to manganese in water or pipe sediment

Brown, red, orange or yellow water: Usually caused by iron rust. Milky white or cloudy water: Usually caused by tiny air bubbles.

1.2.4 Total dissolved solids

The molecular, ionised, or micro-granular suspended content of all inorganic and organic substances present in a liquid is measured as total dissolved solids. Brackish water: TDS = 1,000 to 10,000 ppm. Fresh water: TDS < 1,000 ppm. Saline water: TDS = 10,000 to 35,000 ppm

1.2.5 Alkalinity

Alkalinity refers to the ability of water to resist acidification. Alkalinity is influenced by the sort of rocks that surround the stream. Phosphates, limestone, and borates increase the alkalinity and buffering capacity of the water. A high alkalinity level in a body of water can help to reduce pH changes caused by acid rain, pollution, and other reasons. The Permissible Limit is 200 mg/L.

If it exceeds it may contains carbonate, bicarbonate, and hydroxide compounds that dissolve and travel with the water, raising its pH level.

1.2.6. Hardness

The presence of soluble bicarbonates, chlorides, and calcium and magnesium sulphates causes water hardness. Dry skin and hair can be aggravated by hard water. Washing your hair with hard water on a regular basis can irritate your scalp. The pH balance of your skin can be altered by hard water minerals, making it less effective as a barrier against harmful bacteria and infections. The Permissible Limit is 600 mg/L.

It forms scales in hot water pipes, heaters, boilers where the temperature of water is increased and leads of boiler corrosion.

1.2.7. Dissolved Oxygen

Dissolved oxygen (DO) is a measure of how much oxygen is dissolved in the water - the amount of oxygen available to living aquatic organisms. The amount of dissolved oxygen in a stream or lake can reveal a lot about the water quality. When dissolved oxygen levels are too low, fish and other aquatic creatures cannot survive. The Permissible Limit is 6.5-8 mg/L.

1.2.8. pH

A pH metre is a scientific equipment that determines the acidity or basicity (alkalinity) of a solution by measuring hydrogen-ion activity A pH metre is a scientific equipment that determines the acidity or basicity (alkalinity) of a solution by measuring hydrogen-ion activity. Water taste can turn bitter when the pH level exceeds 8.5. While a higher pH isn't harmful to your health, it might produce dry, itchy, and irritated skin. The pH scale is 0-14, If pH=0-7 solution is Acidic, pH=7-14 solution id Alkaline and pH= 7 solution is neutral.

1.2.9. Chloride

Basically chloride is found in most natural fluids. It is most commonly found as a component of salt (sodium chloride), but it can also be found in combination with potassium or calcium. High chloride intake can result in high levels of chloride in the bloodstream, i.e., hyperchloremia, The Permissible Limit is 250 mg/L.

Chloride has the capacity to alter the reproduction rates of freshwater organisms and plants, as well as

increase species mortality and alter the ecosystem's general properties

1.2.10. Fluoride

Fluoride levels in water are usually insufficient to prevent tooth decay; however, fluoride levels in groundwater and natural springs can be naturally high. Dental fluorosis, skeletal fluorosis, arthritis, bone damage, osteoporosis, muscular damage, weariness, joint-related difficulties, and chronicle issues can all be caused by high levels of fluoride ions in drinking water.The Permissible Limit is 0.5–1 ppm.

1.2.11. Nitrate

Nitrates are necessary plant nutrients, but excessive levels can cause serious water quality issues. Consuming too much nitrate can affect how blood carries oxygen and can cause methemoglobinemia (also known as blue baby syndrome). The Permissible Limit is 50 ppm. Excessive levels can promote eutrophication, resulting in substantial increases in aquatic plant growth as well as changes in the species of plants and animals that reside in the stream.

1.2.12. Nitrite

Nitrite occurs naturally in the form of salt or esters of nitrous acid in ground water. Run-off water, sewage, and mineral deposits all contain nitrates, which come from fertilizers. Humans and animals, especially babies, are poisonous to high quantities of nitrites. It can enter the body as nitrate, a nutrient necessary for plant growth, and then be changed to nitrite, a chemical that prevents haemoglobin from transporting oxygen throughout the body. The Permissible Limit is 3 ppm

1.2.13. Calcium

Hard water is defined as water that has a high concentration of calcium and magnesium dissolved in it. Excess calcium can form crystal-like deposits that solidify and turn into stones over time. Hypercalcemia has an effect on the central nervous system, which can cause electrical impulses that control your heartbeat to be disrupted. The Permissible Limit is 200mg/l. Because high temperatures create carbonate hardness, it also includes hardening of household equipment.

1.2.14. Potassium

Clay particles in soil hold a lot of potassium, which is a useful fertilizer. As a result, only coarse-textured soils have significant potassium leaching through the soil profile and into ground water. Hyperkalemia (excess potassium in the blood) and its health consequences, including kidney injury. The Permissible Limit is 12 mg/l. Potassium in high water soluble concentrations harms developing seedlings, hinders the uptake of other minerals, and lowers crop quality.

1.2.15. Sodium

As a result of erosion or salt water penetration, sodium and chloride naturally occur in water. Residential, commercial, and industrial activity, such as road salting, can cause sodium to enter both ground and surface water supplies. Most people are unconcerned about sodium in their drinking water, but those with hypertension, congestive heart failure, or a sodium-restricted diet may be. The Permissible Limit is 200 mg/l. Salt can be lethal to some aquatic species at high amounts. Salt can alter the way water mixes, resulting in the production of salty pockets near the lake's bottom, resulting in biological dead zones.

2 MATERIALS AND METHODS

2.1. Collection of samples for water quality analysis

The physicochemical parameters of both surface water and underground water were analysed in different regions of Coimbatore in winter season (July- December 2021). The surface water samples were collected at lakes in Mettupalayam, Muthannakulam, Vellalore, Thamaraikulam, Kurichi and Perur. The underground water samples were collected at Premier nagar, Pollachi, Mettupalayam, Hope college, Thudiyalur and Saravanampatti. Samples were collected in 1000 ml polyethylene bottles and protected by adding alkaline KI to prevent any fungal or pathogenic attacks. The samples were kept in the refrigerator until further analysis in sealed containers with proper labelling.

2.2 Methods

The pH, alkalinity, turbidity, Total Dissolved Solids (TDS), Total hardness, dissolved oxygen, chlorides, fluorides, nitrates and nitrites, sodium, calcium, and potassium were among the physicochemical characteristics examined. APHA, AWWA, and WEF (1998) standard procedures were used to assess each of the 13 water samples for their physicochemical characteristics (Table 1).

Table -1-The methods of analysis of different parameters of water quality

S. No	Parameter	Analytical Method used
1	pH	Electromagnetic method

2	Turbidity	Nephelometric method
3	Total hardness as $CaCO_3$	Complexometric Method
4	Total alkalinity	HCl Titrimetric method
5	Chloride content	Argenometric method
6	Total Dissolved Solids	TDS meter
7	Dissolved oxygen	Winkler's method
8	Nitrate	Colorimetric method
9	Nitrite	Colorimetric method
10	Calcium	Complexometric Method
11	Potassium	Flame Emission Photometric Method
12	Sodium	Flame Emission Photometric Method
13	Fluoride	SPANDS method

3. Results and Discussion

Physicochemical properties of water

The physicochemical parameters, such as turbidity, color, taste, odour, total dissolved solids, pH, alkalinity, hardness, dissolved oxygen, Chloride, fluoride, nitrite, nitrate, calcium, potassium and sodium were recorded for surface and ground water for different seasons for twelve samples are shown in Table 3.

1. Color, Taste and odor:

The surface water samples (S1 to S6) and the ground water samples (G1 to G6) collected were colorless, odorless and tasteless.

2. pH:

Fluctuations in pH indicate that concentration of certain contaminants or effluents were changing seasonally which results in altered pH values. As per the study, pH ranges from 7 to 8 for surface water and 6.5 to 10 for ground water. It shows that increase in pH for ground water is due to the groundwater flowing hrough soil or bedrock layer it includes carbonate, bicarbonate, or hydroxide compounds, those materials get dissolved and travel with the water will increase the pH (Fig. 1).

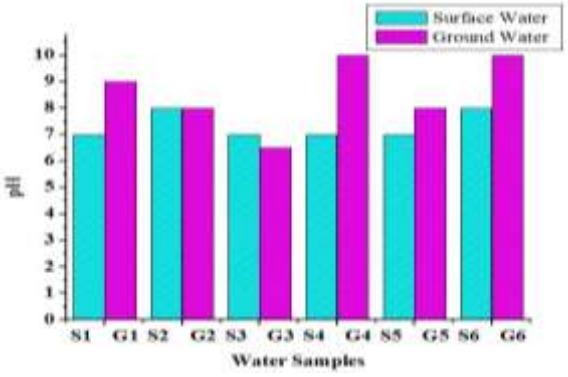


Figure 1 pH variation in surface and ground water samples

3. Turbidity:

Turbidity gives the measure of finely suspended particles in water such as clay, silt, non-living organic particulates, plankton and other microscopic organisms in addition to suspended organic and inorganic particles [3]. The turbidity levels in this investigation ranged from 3.7 to 11.5 NTU. In comparison to ground water (G1 to G6), the highest value of turbidity was detected during the monsoon season in surface water (S1 to S6) samples, which could be attributable to increased runoff from hills, human settlement areas, industrial areas, and agricultural fields due to rain water drainage. Rains bring clay, sand, and organic materials from the river's adjacent areas (Fig.2).

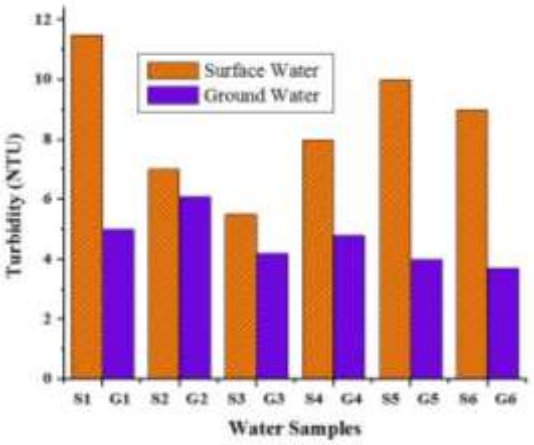
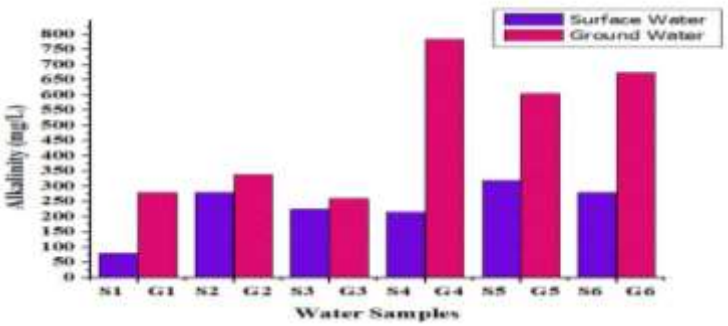


Figure-2 Turbidity variation in surface and ground water samples

4. Total Dissolved Solids:

The amount of solid in dissolved form in water is referred to as TDS. The total dissolved solids concentration in a water body has been



discovered to be a valuable metric in defining the chemical density of water. Increase in value of TDS clearly indicates that materials whether organic or inorganic are introduced through external sources and ultimately affects the quality of water [4]. TDS levels beyond a certain threshold increase the density of water. Higher dense water has lesser gas solubility which decreases the superior quality water availability for drinking, irrigation, industries and for other water related uses [5]. The desirable limit for TDS in drinking water is 500 mg/L very rarely TDS up 1500 mg/L is allowed [6]. In the present study, TDS of all the water samples are in the desirable limit except G3 and G4 samples In the present study, TDS is higher for ground water samples (G1 to G6) 378 to 601 mg/L than surface water samples (S1 to S6) 149 to 201 mg/L (Fig.3).

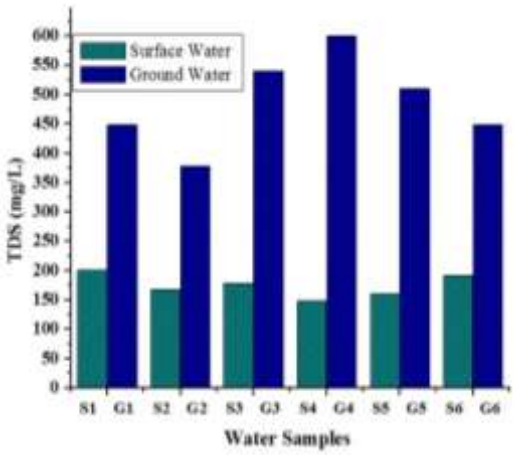


Figure-3 - TDS variation in surface and ground water samples

In groundwater, dissolved solids concentrations are more likely to be an issue than in surface water. This is because some minerals in the rocks and sediments that make up an aquifer dissolve when groundwater passes through them, a process known as "weathering." Groundwater that has been in an aquifer for a long time has had more time to react with and weather the materials in the aquifer than groundwater that has recently been recharged.

5. Alkalinity

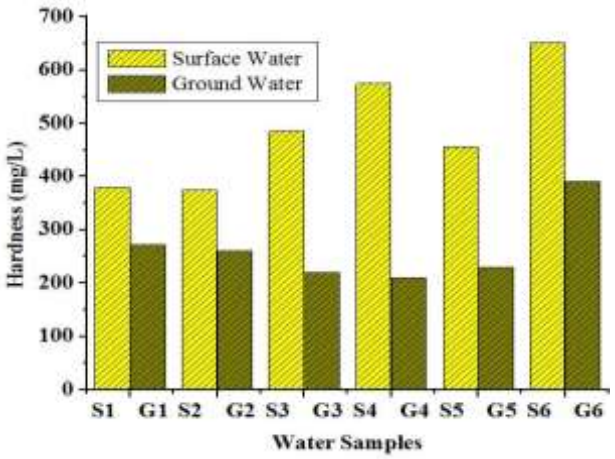
The capacity of water to neutralise a strong acid is measured as alkalinity. Alkalinity is caused by minerals in the soil that dissolve in water. Bicarbonate, hydroxide, phosphate, borate, and organic acids are some of the ionic species that contribute to alkalinity. The value of alkalinity in water gives you an estimate of how much natural salt are in it. In potable water, the standard desired limit of alkalinity is 120 mg/L. The maximum allowed concentration is 600 mg/L [7]. The total alkalinity of surface water samples (S1 TO S6) and underground water samples (G1 to G6) is in between 80.0 to 320 mg/l and 260 to 785 mg/l (Fig. 4).

Figure-4 Alkalinity variation in surface and ground water samples

The results shows that the total alkalinity content of surface water samples have not exceeded the prescribed limits except underground water. The high value of alkalinity in underground water samples may be due to the discharge of wastewater containing alkaline or basic chemicals into the soil. The intrusion of municipal sewage, domestic sewage, and urban wash into ground water has resulted in a higher alkalinity value of water [8].

6. Total Hardness as calcium carbonate:

Salts, such as sulphates, chlorides, silicates, calcium, magnesium, sodium, potassium,



and aluminium salts of organic or inorganic substances, exist naturally in soil, rocks, and water to some extent. These salts can build up in water as a result of soil interaction. Natural calcium present in water regulates osmosis for controlling the required level of salts for heart, muscle and nerve function. The amount of salts in water may grow as a result of direct contamination by human activities, increasing the hardness of the water [9]. From the value it was observed that ground water sample (G1 to G6) hardness was found to be higher than the surface water (S1 to S6) because groundwater naturally contains lesser impurities than the average surface water, it does tend to have higher mineral content due to the dissolving action of water and it is called as hard water due the presence of high mineral content (Fig.5).

Figure-5 Hardness variation in surface and ground water samples

7. Dissolved oxygen:

The gases to some extent are soluble in water. In the same manner oxygen also shows the solubility in water which is significant in determining water quality and making it a key test for regulating water pollution policies. Some biological and physical processes i.e. decomposition of organic matter, microbial growth and photosynthetic activities occur in water in which consumption and formation of oxygen occurs simultaneously and dissolved oxygen are dependent on these factors. From the Table 3, it was observed that value ranges between 2.9 to 6.3 mg/L dissolved oxygen of surface water samples (S1 to S6) was more than the ground water samples (G1 to G6) value ranges between 6.85 to 15.87 mg/L (Fig.6).

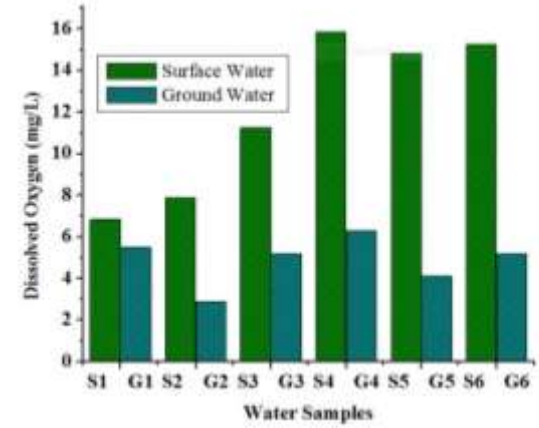


Figure-6- Dissolved oxygen variation in surface and ground water samples

The temperature of water, the amount of dissolved salts present in the water (salinity), and atmospheric pressure all influence the amount of oxygen that can be dissolved in water. During photosynthesis, phytoplanktons release oxygen into the surface water but in ground water initially it has low concentrations of DO, but it is also often colder than stream water. Therefore, groundwater may at first lower the DO concentration, but as groundwater cools the stream or river, the ability of the water to hold oxygen improves.

8. Chloride

Chloride is considered as one of the most important indicator in assessing the water quality. Chloride is a natural substance present in all portable water as well as sewage effluents as metallic salt. Chloride levels in drinking water are restricted to 250 mg/L [10]. The chloride of surface water samples (S1 TO S6) and underground water samples (G1 to G6) is in between 30.0 to 120 mg/l and 70 to 320 mg/l respectively (Fig.7).

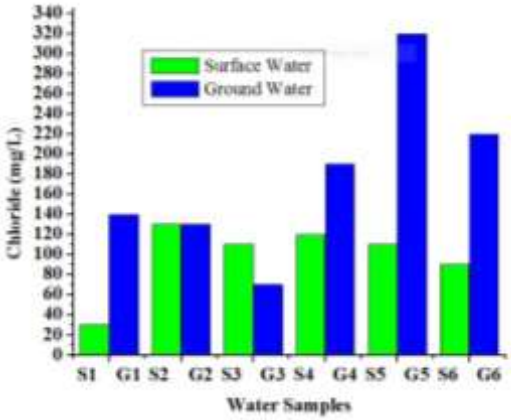


Figure-7- Chloride variation in surface and ground water samples

The chloride content of all the samples except G5 are in the permissible limit. The slightly increased levels of chloride in G5 could be attributable to natural processes like as water passing through natural salt formations in the ground, or it could be a sign of pollution from industrial or home use. [11].

9. Nitrates and Nitrites

Nitrates are significant nutrient aspect in aquatic ecosystems; in general, water bodies contaminated by organic matter have greater nitrate levels [12]. The variation of nitrate content in surface water and underground water samples ranges from 3.2 to 5.5 mg/l and 6.4 to 12.4 mg/l (Fig.8). The nitrates seem to be in prescribed limit in all sampling locations. The nitrate content in underground water samples are high compared to surface water which may be due to the fertilizers and sewage from cities.

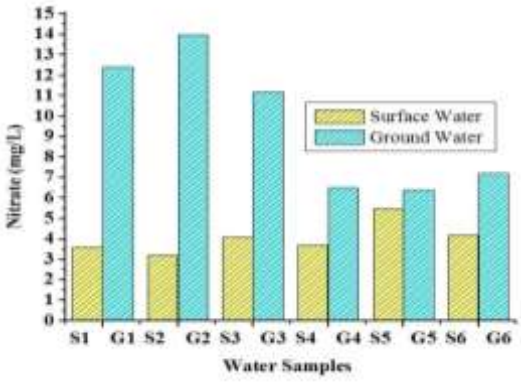


Figure-8- Nitrate variation in surface and ground water samples

The presence of nitrite in water is either due to oxidation of ammonium compounds or due to reduction of nitrate. Since nitrite is the intermediate in the nitrogen cycle, its presence in water is quiet unstable [13]. The surface (S1 TO S6) and underground water samples (G1 to G6) collected were not found to contain nitrite content.

10. Fluorides

Fluoride can be found in a variety of rocks. Fluoride appears to be present in Indian waters as a result of fluoride being leached from rocks and soils through weathering and circulation, and then dissolved in ground water. Fluoride, at a lower quantity of 1 mg/L on average, is considered as a significant component of drinking water as it prevents the dental caries of children. The concentration of fluoride more than 3 ppm can lead to dental fluorosis or mottled enamel in children [14]. Fluoride concentrations were found to be in the range of 0 mg/L to 1 mg/L in both surface water (S1 to S6) and subsurface water samples (G1 to G6) collected. (Fig. 9).

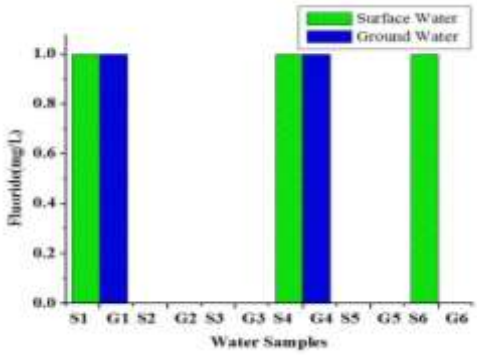


Figure-9 - Fluoride variation in surface and ground water samples

11. Calcium:

The most abundant alkaline earth in water is calcium. From the study, it shows that the presence of calcium in surface water ranges from 82 to 98 mg/L and in ground water ranges from 110 to 144 mg/L (Fig. 10).

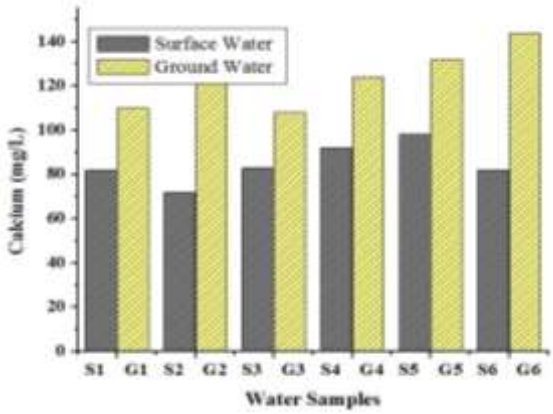


Figure-10- Calcium variation in surface and ground water samples

Ground water has the highest calcium levels because it flows through carbonate rocks, such as limestones and dolomites, which are dissolved by carbonic acid in groundwater [15].

12. Potassium:

Potassium is found in a variety of minerals and can be dissolved during weathering. Potassium compounds, particularly potassium nitrate, are widely used synthetic fertilisers. Synthetic fertilisers include 95 percent of commercially applied potassium. Potassium salts and magnesium and calcium compound combinations are also used on a regular basis. The leaching of potassium fertilizer through the soil can contribute potassium to the groundwater. From the Table 3, it was observed that potassium level was found to be high in ground water (G1 to G6) samples 21 to 172 mg/L than surface water samples (S1 to S6) 0.9 to 2.1 mg/L (Fig. 11).

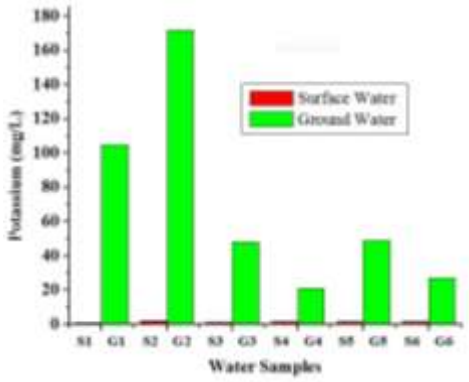


Figure-11- Potassium variation in surface and ground water samples

The sources of potassium is probably due to silicate minerals, orthoclase, microcline, hornblende, muscovite, and biotite in igneous and metamorphic rocks, as well as evaporate deposits gypsum and sulphate, which release significant amounts of potassium into groundwater. Agricultural activities are the primary cause for increasing potassium levels in groundwater.

13. Sodium:

Water naturally contains number of different dissolved inorganic constituents. Sodium is the world's sixth most abundant element, found in soils, plants, water, and food. The significant deposits of sodium containing minerals in particularly sodium chloride are present in the most of the world. Table 3 shows

the level of sodium was high in ground water samples (S1 to S2) 102 to 148 mg/L than surface water samples (G1 to G2) 60 to 78 mg/L (Fig.12).

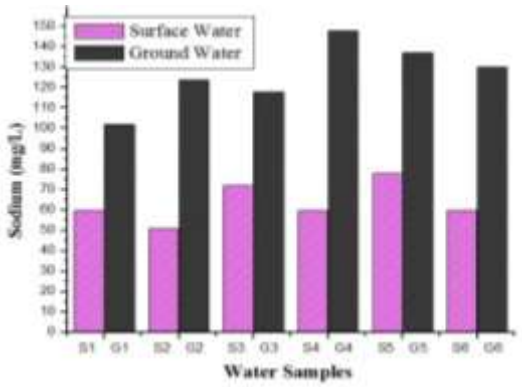


Figure-12- Sodium variation in surface and ground water samples

The increasing sodium in to groundwater is likely due to leaching of soaps influence and study area near to agriculture area to use of fertilizer. As most of the rocks and soils have sodium compounds which are easily dissolved contribute to some extent of sodium in ground water.

14. Conclusion

In conclusion, the concentrations of the investigated chemical parameters like pH, alkalinity, Total Dissolved Solids (TDS), Total hardness, Dissolved oxygen, Chlorides, Fluorides, nitrates and nitrites, sodium, calcium and potassium chloride in surface and ground water around Coimbatore regions were found few variations with the permissible limits for drinking water recommended by BIS (1991) and WHO (1984). Above cited results shows that the overall water quality of the surface and ground water is suitable for domestic purpose not for suitable for drinking.

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