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Research Journal of Agricultural Sciences
Volume 14; Issue 01; pp 335–340

ISSN: 0976-1675 (P)
ISSN: 2249-4538 (E)

Full Length Research Article

Environmental Impact Assessment of Water Quality Using Physico-chemical Parameters of Sankari Regions, Salem District, Tamil Nadu, India

C. Sakthivel*[1], A. Thirunavukkarasu[2], C. Kasilingam[3] and R. Suresh[4]

[1-4] Department of Geology, Periyar University, Salem - 636 011, Tamil Nadu, India

Abstract

The Water is an essential natural resource for sustaining life and environment but over the last few decades the water quality is deteriorating due to it is over exploitation. Limestone rock mining in the district started about a decade ago to meet the requirements of the cement plants of the area. In recent years, number of cement plants and quantum of limestone mining have increased drastically leading to severe environmental problems ranging from deforestation and degradation of land to water pollution and water scarcity. This study reports the impact of limestone mining on water quality based on analyses of various physico-chemical parameters of water samples of the area and its comparison with the results of unaffected water body. The physico-chemical status of water samples from ten major part of locality in Sankari was assessing. The sampling points were selected based on their importance. The physicochemical parameter like, temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), total alkalinity (TA), total hardness (TH), calcium (Ca) magnesium (Mg), sodium (Na), potassium (K), chloride (Cl), fluoride (F), nitrate (NO3) sulphates (SO4) and phosphate (PO4) of Open Well and Bore well was determined. The results were compared with standards prescribed by WHO (1973) and ISI (10500-91). It was found that the ground water was contaminated at few sampling sites namely Karumapurathanur, Sankari, ICL Colony and Kasthuripatti While the sampling sites Devannagoundanur, Chinnagoundanur, ICL Plant, Veerachipalaiyam, Sanniyasipatti and Padaiveedu showed physicochemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose.

Key words: Groundwater, Physicochemical parameters, Open well, Bore well, Sustainable development

The water is the basic need for the survival of all living organisms and the environment. Groundwater is an important source of drinking, and its quality is currently contaminated due to industrial effluents. The use of the contaminated water by human population results in water borne diseases. Hence it is important to check the water quality at a regularly. The present study some important physicochemical parameters of water samples collected and do a statistical inference on the same. Surface water is becoming highly scarce and susceptible to pollution due to rapid urbanization, industrialization, and intensification of agriculture. Surface water resources that are not witnessing pollution are drying up, probably due to climate change as well as increasing demand for development. As a result, pressure on groundwater for domestic, municipal, industrial and irrigation activities is growing from time to time [1].

Groundwater differs from surface water through its physical and chemical environment. It is stored in and transmitted through underground reservoir rocks/soils called aquifers [2]. Groundwater is the largest reserve of drinking water due to its long retention time and natural filtering effect of earth materials [3]. Nowadays, it has become the major source of water supply in most sectors of many countries. The groundwater will also be vulnerable to contamination due to the release of contaminants through several activities caused by natural processes (geological formation, dissolution and precipitation of minerals, groundwater velocity, infiltration rate, quality of recharge waters and interaction with other types of water aquifers) and the anthropogenic disturbances [4-5].

Poor-quality water affects human health and plant growth [6]. In developing countries like India, around 80% of all diseases are related to poor drinking water quality and unhygienic conditions [7]. Understanding the quality of groundwater is the prerequisite for determining its suitability for domestic, agricultural, and industrial purposes. Many factors will have to be considered before making comments on

Received: 26 Nov 2022; Revised accepted: 05 Feb 2023; Published online: 20 Feb 2023

Correspondence to: C. Sakthivel, Department of Geology, Periyar University, Salem - 636 011, Tamil Nadu, India, Tel: +91 8675254348; E-mail: petrosakthi25@gmail.com

Citation: Sakthivel C, Thirunavukkarasu A, Kasilingam C, Suresh R. 2023. Environmental impact assessment of water quality using physico-chemical parameters of Sankari regions, Salem district, Tamil Nadu, India. *Res. Jr. Agril Sci*. 14(1): 335-340.

groundwater quality [8]. The use of the physicochemical and bacteriological parameters to assess water quality gives a good impression of the pollution status of the groundwater body [9] which help to assess the chemical status and pollution levels of the aquifer [10]. Monitoring of the physicochemical water quality parameters plays a pivotal role in assessing the water environment, ecosystem, hydrochemistry, and ecology, and restoring water quality [11-13].

MATERIALS AND METHODS

The physico-chemical characteristics of water are important determinant of the aquatic system. Their characteristics are greatly influenced by climatic vegetation and general composition of water. The water samples were collected from different sites in plastic bottles and transported immediately to the laboratory in bottles to avoid unpredictable changes in different physico-chemical parameters. The Water samples were immediately brought into Laboratory for the Estimation of various Physico -chemical parameters, and pH were recorded at the time of sample collection by using Thermometer and Pocket Digital pH Meter. While other Parameters Such as TDS, Free CO_2, Hardness, Alkalinity, Chlorides, Phosphate and Nitrate were estimated in the Laboratory by using Indian Standard Procedures (Titration method, Atomic Absorption Spectrophotometer (AAS).

Description of the study area

The present study area, Salem district, south India has been chosen for conducting the study. The study area is located between latitude 11° 29’56.59” N to 11° 30’15.92” N and longitude 77° 51’19.50” E to 77° 51’40.49” E. The areal extent of the selected study area is 65.25 Km^2. The limestone mines and the surrounding areas are well connected with roads. Physiographical, the area is characterized by plain topography with a gentle slope, which consists of mainly Limestone associated with gneiss with hard rock formation. The climatically the area belongs to a tropical wet and dry climate. The average annual rainfall of the study area is 950.5 mm. Southwest and Northeast monsoon together account for approximately 85% of the rainfall.

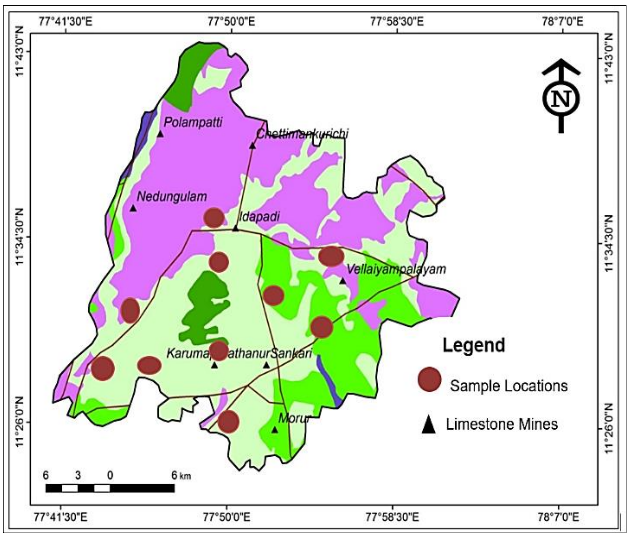

Fig 1 Water sample location map of the study area

RESULTS AND DISCUSSION

Physico chemical parameters

Determination of pH

The Study at limestone and dolomite mines showed slightly alkaline in nature having pH ranging from 7.25 to 8.95. Except for S_3, S_4, S_5 and S_8, pH values slightly increased from sampling sites. However, this alkaline nature of water may be due to limestone mining. Since, major chemical constituent of limestone is calcium carbonate which on encountering water generates alkalinity. However, the WHO standard recommends that drinking water suppliers keep their water supply at a pH of 6.5 to 8.5. The higher pH values observed suggests that carbon dioxide, carbonate-bicarbonate equilibrium is affected more due to change in physico-chemical condition [14-15].

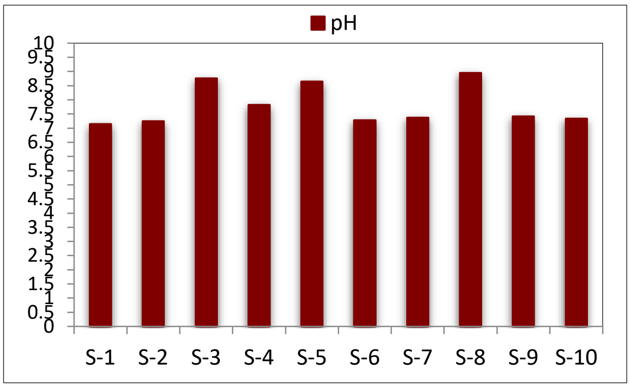

Fig 2 Physicochemical parameters in pH

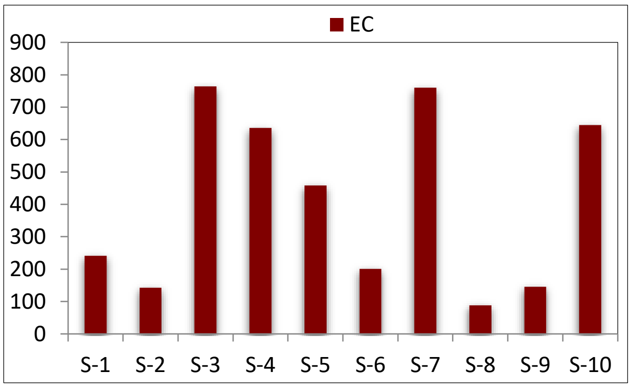

Fig 3 Physicochemical parameters in EC

Determination of electrical conductivity (EC)

The electrical conductivity (EC) is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts. The present study EC values are range from 88 to 764. High EC values were observed for five sampling points namely S_3, S_4, S_5, S_7, and S_{10} Indicating the presence of high amount of dissolved inorganic substances in ionized form. Increase in EC values indicates the presence of higher concentration of ions [16].

Determination of total dissolved solids (TDS)

These are the solids of water present in dissolved state including carbonates, bicarbonates, chlorides, calcium, phosphate etc. In this investigation the TDS ranged from 52 to 527. The investigation reported higher concentration of Sample S_3, S_5, S_6 and S_{10}. TDS increased due to increased amount of surface run off. The total dissolved solids (TDS) may increase salinity of the water and thus may render it unfit for irrigation and drinking purposes. Consumption of water with high concentrations of total dissolved solids has been reported to cause disorders of alimentary canal, respiratory system, nervous system, coronary system besides, causing miscarriage and cancer [17].

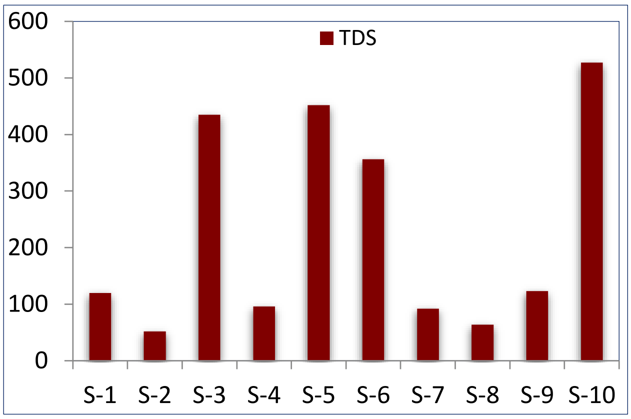

Fig 4 Physicochemical parameters in TDS

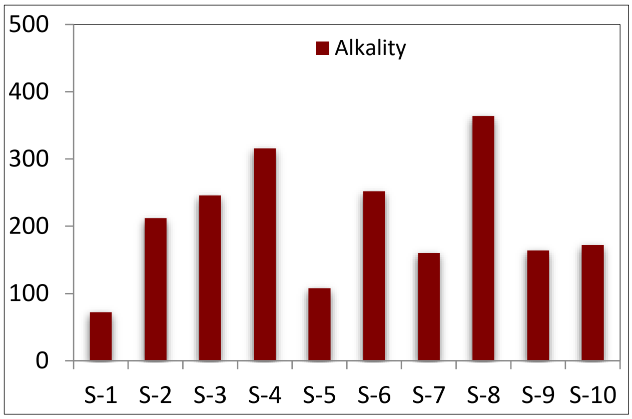

Fig 5 Physicochemical parameters in TA

Determination of total alkalinity (TA)

The alkalinity of water is caused mainly due to carbonate and bicarbonate ions. It is an estimate of the ability of water to resist change in pH upon addition of acid. During this study, the total alkalinity ranged from 72 to 364. The investigation reported higher concentration of sample S_2, S_3, S_4, S_6 and S_8. In the present study, the higher value of alkalinity is due to decomposition of organic waste in the open well and bore well may increase the level of alkalinity [18].

Determination of total hardness (TH)

The Total Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water. Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. The hardness values shown range from 120 to 448. The investigation reported higher concentration of sample S_2, S_3, S_4 and S_5 higher than the prescribed limit. Water with hardness above 300mg/l may cause scale deposition in the distribution system and results in excessive soap consumption and subsequent scurry formation hence it cannot be used for industrial purposes.

Table 1 Results of water analysis of the study area

Sample locations	pH	EC	TDS	Alk	T.H	Ca	Mg	F	So4	Cl	No3	Na	K
S_1	7.73	241	120	72	120	30.4	10.6	0.4	74	32	7	34	6
S_2	7.25	142	52	212	352	86.4	32.6	2.2	74	116	15	48	7
S_3	8.76	764	435	246	448	94.4	50.9	2.0	277	148	21	164	14
S_4	7.82	636	96	316	340	72.0	38.4	2.0	260	72	15	108	16
S_5	8.64	458	452	108	412	46.4	17.3	0.2	153	36	9	57	9
S_6	7.28	201	356	252	264	60.8	26.9	1.8	177	72	15	124	15
S_7	7.37	760	92	160	180	44.8	16.3	1.8	126	52	12	83	10
S_8	8.95	88	64	364	216	54.4	19.2	0.4	154	56	10	79	9
S_9	7.41	145	123	164	296	67.2	30.7	0.4	237	76	12	98	13
S_{10}	7.34	645	527	172	164	43.2	13.4	0.2	93	52	11	83	7
Average	7.85	408	231.7	206.6	279.2	60.0	25.63	1.14	162.5	71.2	12.7	87.8	10.6

S_1: Devannagoundanur, S_2: Chinnagoundanur, S_3: Karumapurathanur, S_4: Sankari, S_5: ICl Colony, S_6: ICL Plant, S_7: Veerachipalaiyam, S_8: Kasthuripatti, S_9: Sanniyasipatti, S_{10}: Padaiveedu

Determination of calcium (Ca)

The calcium content for all the water samples. The estimate calcium content ranged from 30.4 to 94.4. The investigation reported higher concentration of sample S_2 and S_3 higher than the prescribed limit. The calcium content of water samples is within the permissible limit of 75 mg/l. In the present study, the high concentration of calcium in the surface and ground water are due to rapid industrialization and urbanization. The high concentration of iron in water affects target organs which are the liver, cardiovascular system, and kidneys.

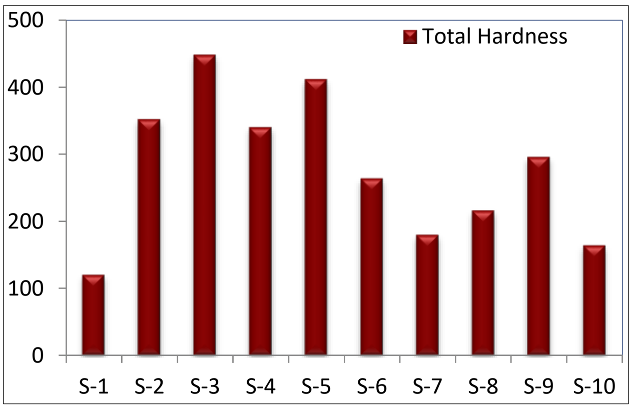

Fig 6 Physicochemical parameters in TH

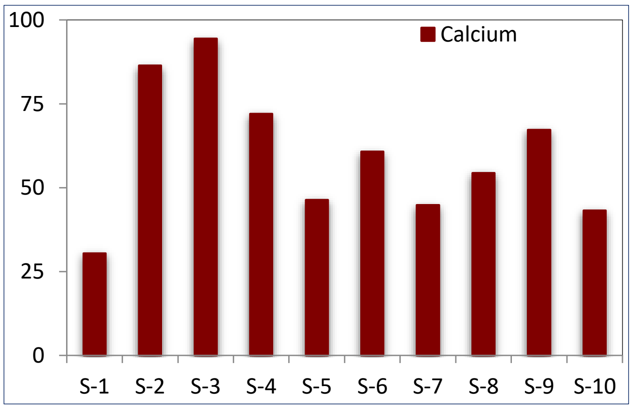

Fig 7 Physicochemical parameters in Calcium

Determination of magnesium (Mg)

The magnesium content for all the water samples. The estimate magnesium content ranged from 0.2 to 2.2. The investigation reported higher concentration of sample S_2, S_3 and S_4 higher than the prescribed limit. The magnesium content of water samples is within the permissible limit of 30 mg/l. Eating food or drink contaminated with large amounts of magnesium can cause stomach irritation. Extremely high magnesium exposure in children may affect brain development.

Determination of fluoride (F)

The probable source of high fluoride in Indian waters seems to be that during weathering and circulation of water in rocks and soils, fluorine is leached out and dissolved in ground water. Excess intake of fluoride through drinking water causes fluorosis on human being. The estimate fluoride content ranged from 0.2 to 2.2. The investigation reported higher concentration of sample S_2, S_3, S_4, S_6 and S_7 higher than the prescribed limit. The fluoride content of water samples is within the permissible limit of 1.5 mg/l. Probable source of high fluoride in Indian waters seems to be that during weathering and circulation of water in rocks and soils fluorine is leached out and dissolved in ground water [19]. Fluoride, although known to prevent early-stage tooth decay, high level of its concentration in drinking water and food have been found to have serious health effects in humans and animals, like mottled teeth that occur in children [20].

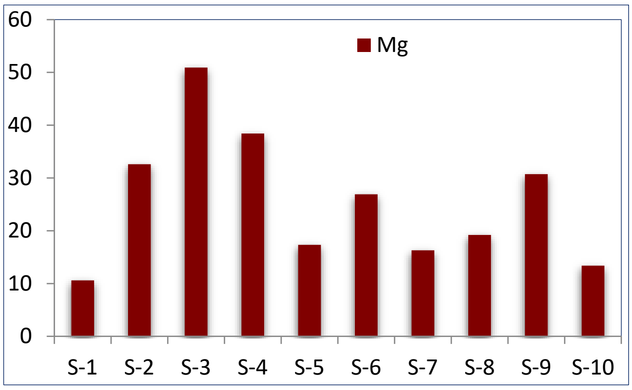

Fig 8 Physicochemical parameters in magnesium

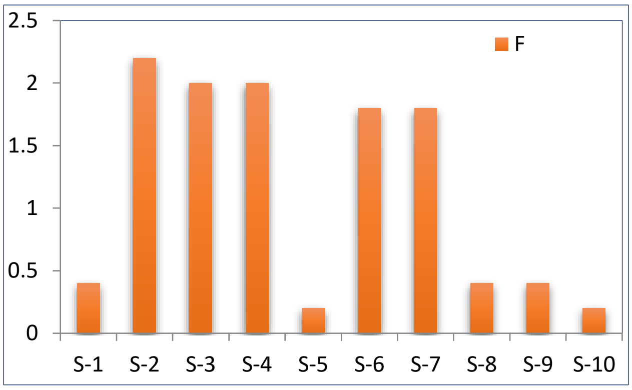

Fig 9 Physicochemical parameters in fluoride

Determination of sulphate (So_4)

The sulphate occurs naturally in water because of leaching from gypsum and other common minerals. Discharge of industrial wastes and domestic sewage tends to increase its concentration. the estimate sulfate content ranged from 74 to 277. The investigation reported higher concentration of sample S_3 and S_4 higher than the prescribed limit. The sulfate content of water samples is within the permissible limit of 250 mg/l. There are subpopulations that may be more sensitive to the cathartic effects of exposure to high concentrations of sulfate. Children, transients, and the elderly are such populations because of the potentially high risk of dehydration from diarrhea that may be caused by high levels of sulfate in drinking-water.

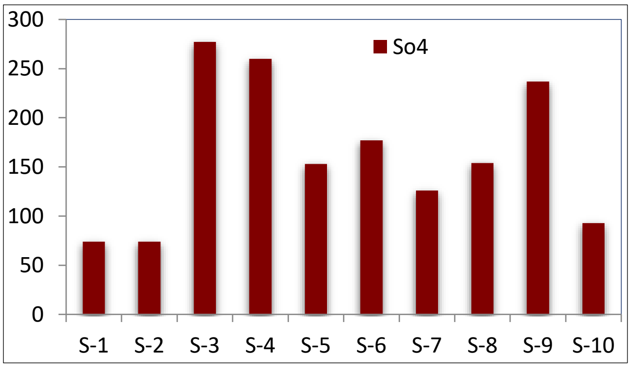

Fig 10 Physicochemical parameters in sulphate

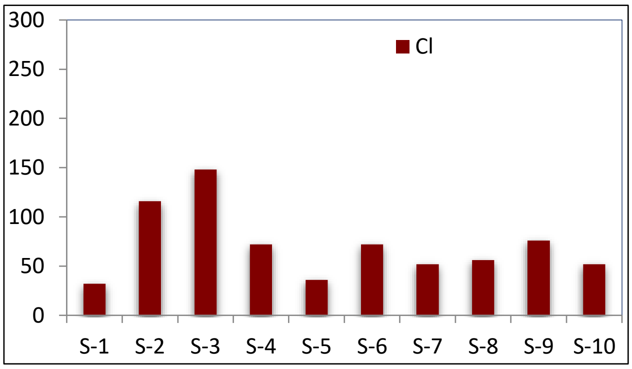

Fig 11 Physicochemical parameters in chloride

Determination of chloride (Cl)

The chloride concentration serves as an indicator of pollution by sewage. People accustomed to higher chloride in water are subjected to laxative effects. The estimate chloride content ranged from 32 to 148. The investigation reported all Sample prescribed limit. The chloride content of water samples is within the permissible limit of 250 mg/l. When chlorine enters the body because of breathing, swallowing, or skin contact, it reacts with water to produce acids. The acids are corrosive and damage cells in the body on contact.

Determination of nitrate (No_3)

The groundwater contains nitrate due to leaching of nitrate with the percolating water. Groundwater can also be contaminated by sewage and other wastes rich in nitrates. The estimate nitrate content ranged from 7 to 21. The investigation reported higher concentration of sample S_2, S_3, S_4, S_6, S_7, S_9 and S_{10} higher than the prescribed limit. The nitrate content of water samples is within the permissible limit of 10 mg/l. The Consuming too much nitrate can affect how blood carries oxygen and can cause methemoglobinemia (also known as blue baby syndrome). Bottle-fed babies under six months old are at the highest risk of getting methemoglobinemia. Methemoglobinemia can cause skin to turn a bluish color and can result in serious illness or death. Other symptoms connected to methemoglobinemia include decreased blood pressure, increased heart rate, headaches, stomach cramps, and vomiting [21-22].

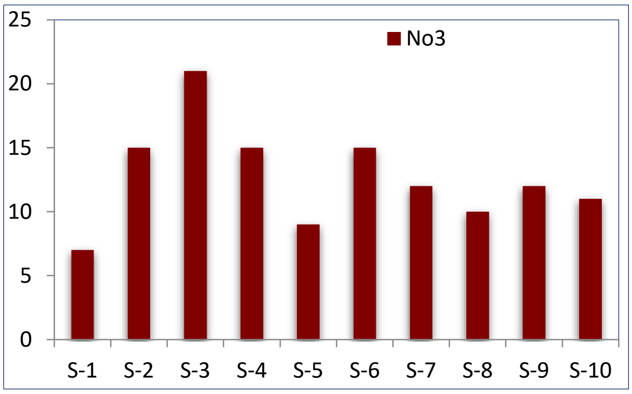

Fig 12 Physicochemical parameters in nitrate

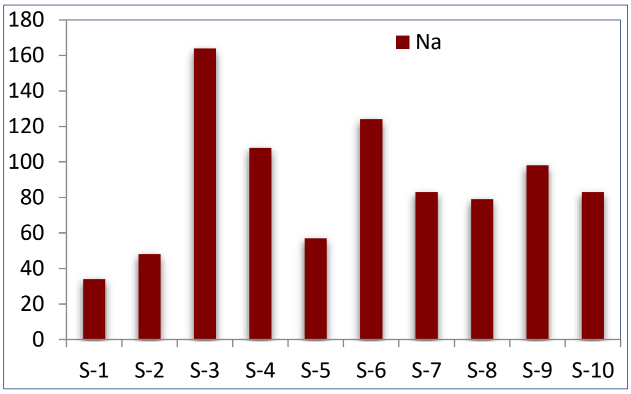

Fig 13 Physicochemical parameters in sodium

Determination of sodium (Na)

The sodium content for all the water samples. The estimate sodium content ranged from 34 to 164. The investigation reported higher concentration of sample S_3, S_4, S_6, S_7, S_8, S_9 and S_{10} higher than the prescribed limit. The sodium content of water samples is within the permissible limit of 60 mg/l. The high sodium consumption can raise blood pressure, and high blood pressure is a major risk factor for heart disease and stroke. Most of the sodium we consume is in the form of salt [23-24].

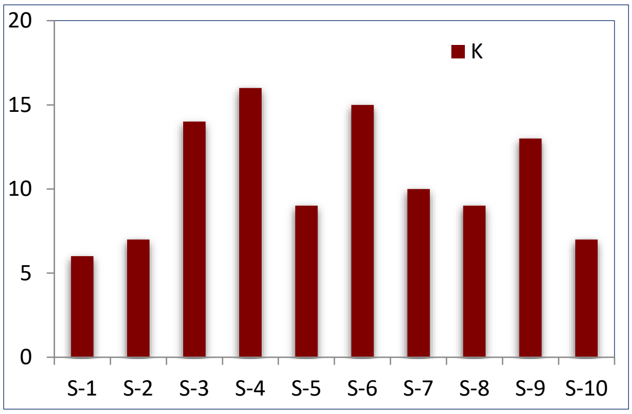

Fig 13 Physicochemical parameters in sodium

Determination of potassium (K)

The major source of potassium in natural fresh water is weathering of rocks but the quantities increase in the polluted water due to disposal of wastewater. The estimate potassium content ranged from 6 to 16. The investigation reported higher concentration of all samples higher than prescribed limit. The potassium content of water samples is within the permissible limit of 5.0 mg/l. high potassium happens suddenly and you have extremely high levels, you may feel heart palpitations, shortness of breath, chest pain, nausea, or vomiting. This is a life-threatening condition that requires immediate medical care.

CONCLUSION

The pH, temperature, turbidity, electrical conductivity, total hardness, nitrate, nitrite, sulphate, sulphite, dissolved oxygen, chemical oxygen demand, chloride and total dissolved solids were studied. From the present study, most of the parameters are within the permissible range of WHO and ISI Open well and bore well. Results suggest that the quality of water in Karumapurathanur, Sankari, ICL Colony and Kasthuripatti Non-drinking and polluted water Condemned. and then Devannagounur, chinnagoundanur, ICL Plant, Veerachipalaiyam, Sanniyasipatti and Padaiveedu its adjoining areas is potable for drinking water and irrigation purpose of useful in the groundwater.

LITERATURE CITED

1. Yadav RK, Goyal B, Sharma RK, Dubey SK, Minhas PS. 2002. Post-irrigation impact of domestic sewage effluent on composition of soils, crops and ground water—A case study. *Environment International* 28(6): 481-486.
2. Lerner DN, Harris R. 2009. The relationship between land use and groundwater resources and quality. *Land Use Policy* 26(3): 265-273.
3. Sebiawu EG, Fosu SA, Saana SBBM. 2014. A physico-chemical and bacteriological analysis of borehole water samples from the Wa Municipality of the Upper West Region, Ghana.
4. Deshmukh SV, Wharekar SR. 2021. Physico-chemical analysis of ground water sample from Dnyaneshwari Nagar, Amravati, India. *International Research Journal of Science and Engineering* 9(1): 12-16.
5. Shigut DA, Liknew G, Irge DD. 2017. Assessment of physico-chemical quality of borehole and spring water sources supplied to Robe Town, Oromia region, Ethiopia. *Appl. Water Science* 7: 155-164. https://doi.org/10.1007/s13201-016-0502-4
6. Rasulmeera S, Kungumapriya R, Revathi K, Sundaravalli K, Anitha A, Smith JA. 2020. A study on the physico-chemical parameters and the microbial flora of a Eutrophic Lake – Pallavaram Lake (Periyar Lake), Zamin Pallavaram, Chennai, Tamil Nadu, India. *Annals of R.S.C.B.* 24(1): 730-743.
7. WHO. 2006. Guidelines for drinking water quality, First Addendum to Third Edition, Vol 1. Recommendations. Available from: http://www.who.int/water_sanitation_health/dwq/gdwq0506.pdf.
8. El-Mostafa K, El Kharrassi Y, Badreddine A, Andreoletti P, Vamecq J, El Kebbaj MS, Latruffe N, Lizard G, Nasser B, Cherkaoui-Malki M. 2014. Nopal cactus (*Opuntia ficus*-indica) as a source of bioactive compounds for nutrition, health and disease. *Molecules* 19(9): 14879-14901. doi: 10.3390/molecules190914879.
9. Vasanthavigar M, Srinivasamoorthy K, Prasanna MV. 2012. Evaluation of groundwater suitability for domestic, irrigational, and industrial purposes: a case study from Thirumanimuttar river basin, Tamilnadu, India. *Environ. Monit. Assess* 184: 405-420. https://doi.org/10.1007/s10661-011-1977-y

10. Tank DK, Chandel CPS. 2010. A hydrochemical elucidation of the groundwater composition under domestic and irrigated land in Jaipur City. *Environ. Monit. Assess* 166: 69-77. https://doi.org/10.1007/s10661-009-0985-7
11. Whitehead MR, Lanfear R, Mitchell RJ, Karron JD. 2018. Plant mating systems often vary widely among populations. *Front. Ecol. Evol*. 6: 38. doi: 10.3389/fevo.2018.00038
12. Sarkar A, Lehto SM, Harty S, Dinan TG, Cryan JF, Burnet PWJ. 2016. Psychobiotics and the manipulation of bacteria-gut-brain signals. *Trends Neurosci*. 39(11): 763-781. doi: 10.1016/j.tins.2016.09.002.
13. Islam M, Khan M, Alam R, Khan M, Nur-A-Jahan I. 2013. Adequacy check of existing crest level of sea facing coastal polders by the extreme value analysis method. *IOSR Jr. of Mechanical and Civil Engineering* 8: 89-96.
14. Reda AH. 2016. Physico-chemical analysis of drinking water quality of Arbaminch town. *Journal of Environmental and Analytical Toxicology* 6(2): 1-5.
15. Adeosun, Akin-Obasola, Oyekanmi, Kayode. 2014. Physical and chemical parameters of lower Ogun River Akomoje, Ogun State, Nigeria. *Fisheries and Aquaculture Journal* 5(1): 1-5.
16. Maheswaran G, Elangovan K. 2014. Groundwater quality evaluation in Salem district, Tamil Nadu, based on water quality index. *Nature Environment and Pollution Technology* 13: 547-552.
17. Shanmugasundaram K, Nikhila R, Janarthanan B. 2014. Physico-chemical analysis of drinking water from different sources in Coimbatore district, Tamilnadu and India. *International Journal for Research in Science and Advanced Technologies* 1(3): 5-12.
18. Solanki M, Saraswat H. 2020. Analysis of water quality using physico-chemical parameters of River Narmada, Madhya Pradesh, India. *International Journal of Advanced Research* 9(1): 754-757.
19. Murhekar GH. 2011. Assessment of physico-chemical status of ground water samples in Akot city. *Research Journal of Chemical Sciences* 1(4): 117-124.
20. Devi S, Premkumar R. 2018. Physico-chemical analysis of water samples near industrial area, Kurinjipadi block, Cuddalore district, Tamilnadu, India. *International Journal of Chem Tech Research* 11(6): 69-78.
21. Nayar R. 2020. Assessment of water quality index and monitoring of pollutants by physico-chemical analysis in water bodies: A review. *International Journal of Engineering Research and Technology* 9(1): 178-185.
22. Usmani N, Nigam RS. 2019. Analysis of physico chemical parameters of underground water sample from selected area of Satna District (M.P.). *International Research Journal of Engineering and Technology* 6(6): 3362-3365.
23. Alsubih M, Mallick J, Abu Reza M, Islam T, Almesfer MK, Kahla NB, Talukdar S, Ahmed M. 2022. Assessing surface water quality for irrigation purposes in some Dams of Asir Region, Saudi Arabia using multi-statistical modeling approaches. *Water* 14: 1-20.
24. Tamilchelvan P, Mahadevan M, Jagatheesh V, Kailash T, Mukesh R. 2020. Evaluation of physico-chemical parameters in and around Salem district in Tamilnadu. *International Journal of Innovative Research in Science, Engineering and Technology* 9(3): 361-367.