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Analysis of Drinking Water Quality in Honakere Hobli

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Abstract: Water is the most essential and valuable natural gift to mankind as well as the producer and consumer of this planet. Without water there would have been no life, hence it is a matrix of life. It is vital for many aspects of economic and social development. To analyse water quality, different approaches like statistical analyses of individual parameters, multi-stressors water quality indices. Rivers are the lifeline of living beings and constitute an integral part of both rural and urban communities as a source of drinking and cooking purposes. Water used by the public must be free from disease-causing bacteria, toxic chemicals, and excessive amounts of minerals and organic matter. It is important to test the suitability of water quality for its intended purpose, whether it is livestock watering, irrigation, spraying, or drinking water. The purpose of this section is to provide water quality testing information for the village of Nagamangala Taluk that will assist residents using a water supply. It provides information on the importance of water quality monitoring. Out of 20 villages, 8 villages' water samples are not ideal for drinking purposes because of the higher concentration of TDS, TH, Cl, Ca, SO4, Fe, alkalinity, Mg, and Cd is more in that water samples. And other village water samples are suitable for drinking purposes. Since most of the families from the economically weaker sections of the society directly consume the tap water supplied by the village water supply system without any treatment. However, it is important to monitor the quality of drinking water regularly in rural areas where there is more population growth.

I. INTRODUCTION

A. General

Water is one of the most important of all natural resources known on earth. It is important to all living organisms, most ecological systems, human health, food production, and economic development. The safety of drinking water is an ongoing concern within the global village. Traditionally, the safety of potable water supplies has been controlled as water is one of the most important compounds of the ecosystem, but due to increased human population, industrialization, use of fertilizers in agriculture and man-made activity. The natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to pollute water quality and depletionof aquatic biota. It is the, necessary that the quality of drinking water should be checked at regular time of interval, because due to use of contaminated drinking water, human population suffers from varied of water borne diseases. It is difficult to understand the biological phenomena fully because the chemistry of water revels much about the metabolism of the ecosystem and explain the general hydro - biological relationship. It has been reported that coliform-free potable water may not necessarily be free of pathogens.

Access to safety potable drinking water is one the basic amenities of humankind, especially in urban areas of the world because of the high consumption pattern of the large population inhabiting these urban areas. Among the various sources of water, groundwater is considered to be the safest source of drinking water in urban as well as rural areas. In India rural population in particular is more dependent on groundwater sources for their households and agriculture purpose.India is self-sufficient in terms of its freshwater resources, but due to rapid industrialization, high population growth rate and various anthropogenic activities the water resources are getting highly polluted with a number of harmful contaminations. These contaminants can be chemical or microbiological. such contaminants cause various health problems to the consumers. according to the report of the world health organization about 80 percent of all dieses in the world are directlyor indirectly related to the contamination of water.

Water, whether for a public municipality, water facility must be tested regularly to keep thesource safe and free of potential health and environmental risks. Monitoring water quality by having it tested regularly is an important part of maintaining a safe and reliable source. Testing thewater allows a knowledgeable approach to addressing the specific problems of a water supply.

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Water Quality can be defined as the chemical, physical and biological characteristics of water based on the standards of its usage. It is most frequently used by reference to a set of standards against which compliance, generally achieved through treatment of the water, can be assessed.The most common standards used to monitor and assess water quality convey the health of the ecosystem, safety of human contact, extend of water pollution and condition of drinking water. Water quality has a significant impact on water supply and oftentimes determines supply options. The parameters for water quality are determined by the intended use. Work in the area of water quality tends to be focused on water that is treated for potability, industrial/domestic use,or restoration.

B. Importance In Rural Areas

Water is recognized as a human right that "entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses". The United Nations 2030 Agenda for Sustainable Development acknowledges the role of water in eradicating poverty and ensuring sustainable green growth as essential. The Sustainable Development Goal (SDG) on clean water and sanitation aims to put the right to water into practice and to ensure the availabilityand sustainable management of water and sanitation for all. Many other SDGs are closely linked to water-related issues, and water can be considered a fundamental driver of green growth. The United Nations Declaration on the Rights of Peasants and Other People Working in Rural Areas recognizes that their access to natural and productive resources such as water is an increasing challenge, and underscores the importance of the right to access to water and sanitation.

Rural livelihoods are often dependent on adequate water supply, and increasing water scarcity andcompetition for water resources are threatening these livelihoods. It is therefore of vital importance to ensure access to sufficient, clean, and easily accessible water sources. Globally over 2 billion people live in countries suffering from high levels of water stress, with 22 countries being in a situation of serious water stress. An estimated 4 billion people suffer from severe water stress for at least one month a year. water demand will continue to increase, and it has been estimated that by 2030 nearly half of the population will live in areas of high-water stress, which will result in the displacement of populations. While water scarcity is likely to limit opportunities for economic growth and the creation of decent jobs in rural areas, the increased demand for waterin areas with reduced water availability or high competition for water calls for increased diversification of water sources, such as low yielding wells and springs, rainwater or storm water harvesting, urban runoff, and wastewater recycling. This not only has the potential, through technological development, to create jobs in the operation and maintenance of treatment plants to

Target Groups

1) *Women in Rural Areas:* Women in rural areas are often responsible for water fetching, which may lead to health and security risks, and they are primarily involved in household chores. Their access to water for ensuring food security and hygiene is therefore essential. A lack of basic services such as water and sanitation increase the burden on women and further reduces their participation in the labor market. Innovative solutions to water fetching, as well as improved water sources and other infrastructure, can alleviate this burden and increase their time available for education and paid employment opportunities, and help them to participate in community life on an equal footing.
2) *Smallholder Farmers:* Smallholder farmers often live in poverty and have to cope with food insecurity and malnutrition. They have low resilience to shocks and are highly vulnerable to the impacts of climate change. They often have limited access to natural resources such as water, and face competition from other water users. The lack of water for irrigation has repercussions on productivity, and their situation is further challenged by the increased unreliability of rainfall.Many smallholders who have access to small-scale irrigation may be unwilling to register their water use officially as they may be liable for higher fees.
3) *Indigenous and Tribal Peoples:* Indigenous and tribal peoples are over-represented among the poor; they are also among the most water-deprived populations worldwide, and lag behind others in accessing many basic services – including water supply and sanitation services. Under the ILO Indigenous and Tribal Peoples Convention, 1989 (No. 169), their right to be consulted regarding measures that will affect their lands is guaranteed.
4) *Sanitation Workers:* Sanitation workers involved in pit emptying and sewerage works, including manual scavenging practices, have to endure unsanitary and hazardous working conditions that often lead to relatively

C. Objectives

1) To identify suitable surface and sub-surface water sampling points in the study area.
2) To collect the samples identified in sources.
3) To the analysis of water quality according to standard procedures.
4) To the suggestion of suitable remedies measures if any are required.

II. WATER QUALITY ANALYSIS

A. Drinking Water Quality

According to the World Health Organization's 2017 report, safe drinking water is water that "doesnot represent any significant risk to health over a lifetime of consumption, including different sensitivities that may occur between life stages". Parameters for drinking water quality typically fall within three categories: physical, chemical, and microbiological. Physical and chemical parameters include heavy metals, trace organic compounds, total suspended solids (TSS), and turbidity. Chemical parameters tend to pose more of a chronic health risk through the build-up of heavy metals although some components like nitrates/nitrites and arsenic can have a more immediate impact.

Physical parameters affect the aesthetics and taste of the drinking water and may complicate the removal of microbial pathogens. Microbiological parameters include Coliform bacteria, E. coli, and specific pathogenic species of bacteria (such as cholera-causing Vibrio cholerae), viruses, and protozoan parasites. Originally, fecal contamination was determined by the presence of coliform bacteria, a convenient marker for a class of harmful fecal pathogens. The presence of fecal coliforms (like E. Coli) serves as an indication of contamination by sewage. Additional contaminants include protozoan oocysts such as Cryptosporidium sp., Giardia lamblia, Legionella, and viruses (enteric). Microbial pathogenic parameters are typical of greatest concern because of their immediate health risk.

Table 2.1 Drinking water quality standards

Sl.No	Parameters	BIS Standards (IS-101500:2012)		WHO Limits
		Desirable Limits	Permissible Limits	
Physical parameters				
1	pH	6.5	8.5	6.5-9.2
2	colour (Hazen units)	5	15	5-50
3	Turbidity (NTU)	1	5	5-25
4	Total dissolved solids (mg/l)	500	2000	-
Chemical parameters				
5	Total hardness (mg/l)	300	600	-
6	Chloride (mg/l)	250	1000	200-600
7	Calcium (mg/l)	75	200	75-200
8	Fluoride (mg/l)	0.5	1	1-1.5
9	Sulphate (mg/l)	200	400	200-400
10	Iron (mg/l)	0.3	1	0.3-1
11	Copper (mg/l)	0.05	1.5	1-1.5
12	Mercury (mg/l)	0.01	-	-
13	Manganese (mg/l)	0.10	0.5	0.1-0.5
14	Lead (mg/l)	0.05	-	-
15	Zinc (mg/l)	15	15	-
16	Nitrate (mg/l)	45	100	50-100
17	Aluminum (mg/l)	0.03	0.2	0.2
18	Alkalinity	200	600	
19	EC (s)	300	-	-
20	Magnesium (mg/l)	30	100	50-100
21	Arsenic (mg/l)	0.01	-	0.2
22	Mineral oil (mg/l)	0.01	0.03	0.03
23	Boron (mg/l)	0.5	1	0.5-1
24	Cyanide (mg/l)	0.05	-	0.01
25	Cadmium (mg/l)	0.05	-	-
26	selenium (mg/l)	0.01	-	0.01
Bacteriological parameters				
27	Escheria coli, /100ml	Shall not be detectable in any 100 ml sample		
28	Total coliform bacteria, /100ml	Shall not be detectable in any 100 ml sample		

B. Water Quality Index (WQI)

WQI aims to give a single value to the Water Quality of a source reducing a great number of parameters into a simpler expression and enabling easy interpretation of monitoring data. Water Quality Index (WQI) is a technique of rating that provides the composite influence of individual parameters on the overall quality of water. WQI is a well-known method as well as one of themost effective tools to express water quality that offers a simple, stable, reproducible unit of measure and communicates information about water quality to policymakers and concerned citizens. The weights for various water quality parameters are assumed to be inversely proportional to the recommended standards for the corresponding parameters. One of the major advantages of WQI is that it incorporates data from multiple water quality parameters into a mathematical equation that rates the health of water quality with numbers. In this study for the calculation of the water quality index, twelve important parameters were chosen. The WQI has been calculated by using the standards of drinking water quality recommended by the World Health Organization (WHO), the Bureau of Indian Standards (BIS), and the Indian Council for Medical Research (ICMR). The weighted Arithmetic index method has been used for the calculation the of WQI of the water body. Further quality rating or sub-index was calculated using the following expression,

$$qn = 100 \times \frac{Vn - Vi}{Sn - Vi}$$

Were,

qn =Quality rating for the nth water quality parameter

Vn= Estimated value of the nth parameter of a given sampling station.S =Standard permissible value of n parameter.

Vio Ideal value of n parameter in pure water.

All the ideal values (Vio) are taken as zero for the drinking water except for pH = 7.0 and dissolved oxygen = 14.6 mgL-1

The concept of indices to represent gradation in water quality was first proposed by Horton(1965). The water Quality Index indicates the quality of water in terms of an index number, whichrepresents the overall quality of water for any intended use. It is defined as a rating reflecting the composite influence of different water quality parameters on the overall quality of water. The indices are among the most effective ways to communicate the information on water qualitytrends to the general public or the policy-makers and also water quality management.

Evaluation of overall water quality is not an easy task, particularly when different criteria for different uses are applied. Moreover, the classification of water quality follows various definitionsconcerning the contents of different water quality parameters. Dozens of variables have been developed and are available to be used in management governmental or environmental programs, but the high price because of water analysis to attend these programs generally makes it difficultto use them.

The application of the water quality index has the objective of providing a simple and valid method for expressing the results of several parameters to more rapidly and conveniently assess the water quality. Combining different parameters into one single number leads to an easyinterpretation of the index, thus providing an important tool for management purposes. As described, WQI employing thirteen parameters can give an indication of the health of the water body at various points and can be used to keep track of and analyse changes over time, but other options can be used economically.

C. WQI Calculation

For the calculation of WQI, the selection of parameters has great importance. Since the Selection of too many parameters might widen the water quality index and the importance of various parameters depends on the intended use of water fourteen Physio-chemical and biological parameters namely Temperature, pH, Turbidity, EC, TDS, Total alkalinity, Total hardness, Calcium hardness, DO, BOD, COD, Chloride, Sulphate, and Nitrates were used to calculate WQI.The WQI is calculated using the weighted arithmetic index method (Brown et al., 1972) in the following steps.

1) Calculation of Sub-Index of Quality Rating (Qn)

Let there be 'n' water quality parameters and the quality rating or sub-index (Qn) corresponding toan nth parameter is a number reflecting the relative value of this parameter in the polluted water concerning its standard permissible value. The Qn is calculated using the following expression.

$$Qn = 100 \times \frac{\text{Vn}-\text{Vi}}{\text{Sn}-\text{Vi}}$$

Where,

qn =Quality rating for the nth water quality parameter

Vn= Estimated value of the nth parameter of a given sampling station.S=Standard permissible value of n parameter

Vi Ideal value of n parameter in pure water.

All the ideal values (Vi) are taken as zero for the drinking water except for pH = 7.0 and dissolvedoxygen = 14.6 mgL-1

2) Calculation of Unit Weight (Wn)

The unit weight (Wn) for various water quality parameters is inversely proportional to therecommended standards for the corresponding parameters.

$$W_n = \frac{K}{Sn}$$

Were,

Wn = unit weight for n parameters

S = Standard value for n parameters

K = constant

$$i.e.\ k = \frac{1}{\left(\frac{1}{S1}+\frac{1}{S2}+\frac{1}{S3}+ \dots\dots\dots + \frac{1}{Sn}\right)}$$

3) WQI is Calculated by the Following Equation

Water Quality Rating as per Weight Arithmetic Water Quality Index Method

$$WQI = \sum_{n=1}^{n} q_n w_n / \sum_{n=1}^{n} w_n .$$

WQI Value	Water Quality
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very Poor
>100	Unsuitable For Drinking

D. Advantages

1) It encompasses the values of various Physio-chemical parameters of water quality into amathematical equation, which indicates the water's ecological state;
2) It reflects the importance that each parameter has in the evaluation and management ofwater quality
3) It can be used to describe the suitability of both surface and underground water sourcesfor human consumption.

E. Disadvantages

1) This index may not provide enough information about the real situation of the waterquality;
2) This index does not include all the parameters which can describe the quality of a body ofwater
3) This index only quantifies the direct effect of pollution on a body of water.

III. LITERATURE SURVEY

A. Previous Studies

Slno	Title	Journal nameand year of publication	Abstract	Results
1	Assessment of Drinking Water Quality and Hazard Events in Water Supply System in Mysuru city, Karnataka	International Journal of Applied Environmental Sciences, January 2019 S. Pallavi	A detailed Physico-chemical and bacteriological analysis of water samples were carried out in pre-monsoon, monsoon, and post-monsoon to the seasonal variation in water quality. Variations in water quality and intermittent cross-contamination routes in water supply networks were studied. Important water quality parameters, which play important role in humans, were considered and the water quality index was calculated to know the suitability of water supply in the city from the perspective of public health.	The results obtained indicated the physicochemic al water quality parameters within permissible limits other than hardness and iron contents in a few areas of the city in all seasons. Bacteriological parameters indicated that most of all the water samples analyzed were highly contaminated with pathogens were that attributed
				to a failure in the water supply systemof the city andabsence of residual chlorine contents in all seasons.
2	Water qualityindex to determine thesurface waterquality of Sankey tankand Mallathahalli lake, Bangalore urban district	P. Ravikumar, Mohammad Aneesul Mehmood, R. K. Somashekar(24 January2013)	By monitoring three sampling locations withinthe Sankey tank (viz., A, B, and C) and Mallathahalli lake (viz., Inlet, Centre, and outlet) for a period of 3 months from March to May 2012. The surface water samples were subjected to comprehensive Physico- chemical analysis involving major cations, anions besidesgeneral parameters	Sankey tank and Mallathahallilake water were, respectively hard and veryhard in nature. Further,it is apparent from WQI values that Sankey tank water belongs ato good water class with WQI values ranging from 50.34 to

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				63.38. The Mallathahallilake water with WQI value ranging from 111.69 to
				137.09, fallunder poor water category.
3	Water quality analysis of Urun-IslampurCity, Maharashtra, India	(11 March 2020)Applied Water Science, Shrikant Kate	The Urun-Islampur city is divided into fourteen wards. The values of WQI of those fourteen wards were compared, wherefromeach ward three water samples were taken for the test. In order to assess the water quality, we calculate the WQI.	The Water Quality Index (WQI) in the range of 86 to 90 was also good. But it may be affected by water distribution lines which were older than30 years, so there is a need for proper maintenance ofthe distribution system and chlorination to avoid waterborne diseases.
4	Assessment ofDrinking Water Qualityof Bangalore West Zone, India	Society for Environment andDevelopment, (India) Abdul Khayum	Assessment of drinking water quality was carriedout in Bangalore city and samples were collected from different parts of Bangalore's west zone ward wise namely Rajarajeshwari Nagar,	About 60% ofthe samples showed above desirable limit of drinking water standard valuesfor TDS. This
			Vijayanagar, Rajajinagarand, Nagarbhavi.	may be due todifferent topography, in water distribution thesystem and impact of domestic waterpollution which imparts in water quality. Drinking water is contaminatedby human or animal waste and also due to the breakage of pipelines.
5	Assessment of groundwater quality for drinking and irrigation uses in taluka Ratodero, district Larkana, Sindh, Pakistan	International journal of environmentalanalytical chemistry (29 May 2020) Muhammad Farooque Lanjwani	The samples from hand pumps were collected from25 different locations during October 2019. The parameters like Electrical conductivity (EC), total dissolved solids (TDS), pH,total hardness, Cl, alkalinity, SO4, Na, Mg, K,Ca, Fe, Zn, Pb, Cd, Ni, Cr, Cu, Mn, Co, As and fluoridewere examined.	The treatmentmethods are recommendedfor unsuitablegroundwater samples for drinking purposes. The results of water quality for irrigation indicated that 60–80% of the samples were
				suitable for irrigation.

6	Evaluating Drinking Water Quality Using Water Quality Parameters andEsthetic Attributes	Meseret B Addisie January 4, 2022Air, Soil, and Water Research	The study considered a combination of users perceptions with the measured water quality parameters determined using the water quality index (WQI) tool. Data were collected using a cross-sectional research design for a household survey, and water quality samples were collected from improved and unimproved alternative sources. Nine physicochemical and two bacteriological analyses were performed.	the study suggests that due consideration of esthetic factors as measured parameters is fundamental for the sustainable useof drinking water infrastructures
7	Drinking- Water QualityAssessment, Kathmandu, Nepal.	Journal of NepalHealth ResearchCouncil September 2012Aryal J	A cross-sectional study wascarried out using a random sampling method in Arthunge VDC of Myagdi district from January to June 2010. 84 water samples representing natural sources, reservoirs and collection taps from the study area werecollected. The physicochemical and microbiological analysis was performed	The results obtained fromthe Physico-chemical analysis of water sampleswere within national standards and WHO standards except for arsenic. The
				study also found coliformcontamination to be the key problem with drinking water.
8	Water Quality Index for measuring drinking waterquality in rural Bangladesh	Journal of Health, Population, and Nutrition (2016)Tahera Akter	The study was conducted on 24 randomly selected Upazilas, arsenic was measured in drinking waterin the field using an arsenictesting kit, and a sub- sample was validated in the laboratory drinking water samples were collected from 12 outof 24 Upazilas.	Higher values of iron, manganese, and arsenic reduced drinking water quality. Awareness- raising on chemical contents in drinking water at the household levelis required to improve public health.

IV. METHODOLOGY

A. *Description Of Study Area*

Honakere is the largest village of Nagamangala taluk, It is a village located in the southern state of Karnataka, Honakere hobli is a division of Nagamangala taluk located in Mandya district of Karnataka India. There are 126 villages under honakere hobli which belongs to the Mysore division,

The main water source for honakere hobli is from Hemavathi River. The total population in honakere hobliis around 516 as per the 2011 census. It is located 34km towards the west of district head quatres Mandya, and 11km from nagamangala, 118km from state capital Bangalore.

Honakere is surrounded by Pandavapura Taluk towards the south, Mandya Taluk towards the east, and Krishnarajapet taluk towards the west. It is hot in summer. The normal temperature of honakere hobliis 23.0℃ to 34ºC. the average temperature of honakere hobli in January is 25ºC, February is 27º,March is 29ºC.

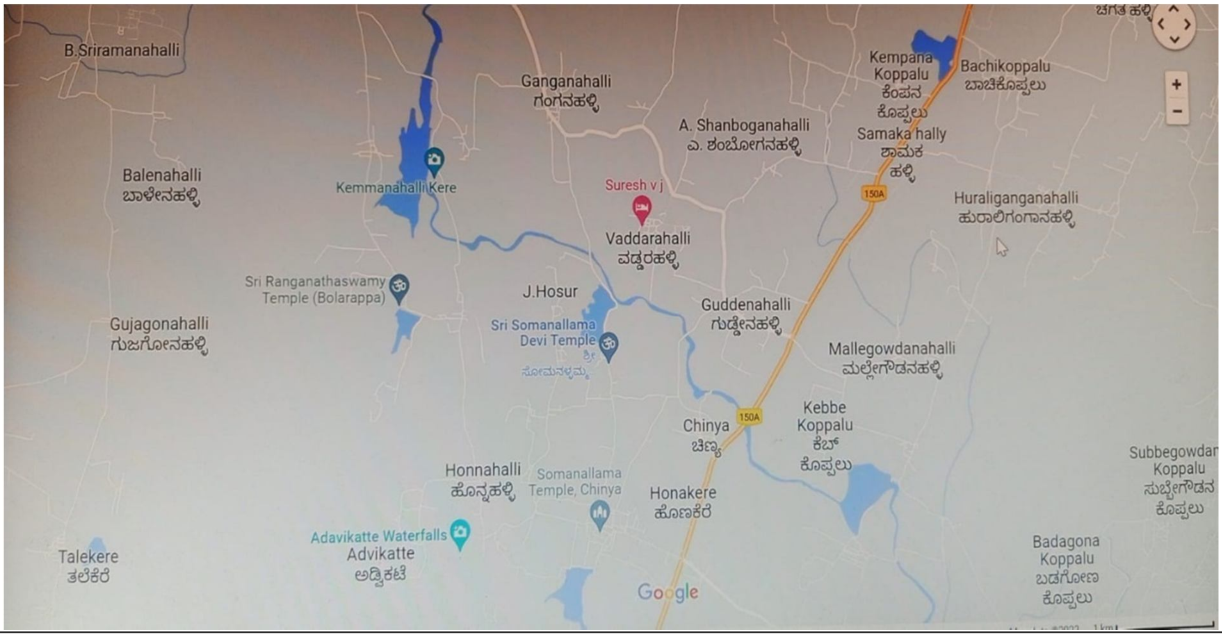

Figure 4.1: Sampling villages in study area (Honakere Hobli)

Table 4.1 list of villages with a population

Sl.no	Name of the Village	Code	Population	Geographical locations
1	Honakere	A1	516	12°58'53.1"N 76°43'49.9"E
2	Honnahalli	A2	213	12°58'19.8"N 76°43'38.8"E
3	Kemmanahalli	A3	285	12°58'21.3"N 76°43'34.3"E
4	Kangonahalli	A4	240	13°00'16.9"N 76°43'08.1"E
5	Siddegowdana Koppallu	A5	193	13°00'27.2"N 76°44'06.5"E
6	Jodihosuru	A6	198	13°00'24.2"N 76°44'46.3"E
7	Alapahalli	A7	870	12°58'15.9"N 76°41'48.0"E
8	A. Shanbhoghana Halli	A8	199	12°58'29.4"N 76°45'32.8"E
9	Guddenahalli	A9	238	12°57'37.0"N 76°42'47.7"E
10	Kavadihalli	A10	443	13°07'25.9"N 76°39'11.4"E
11	Kebbekoppalu	A11	180	12°58'42.0"N 76°41'36.3"E
12	Mallegowdanhalli	A12	300	12°58'56.9"N 76°42'19.6"E
13	Huruligaganahalli	A13	389	12°58'56.6"N 76°41'55.1"E
14	Vaderhalli	A14	416	12°57'29.3"N 76°41'43.4"E
15	Gaganahalli	A15	897	12°57'04.8"N 76°43'54.6"E

B. Sampling Programs

To obtain representative water samples and to preserve their integrity until they are analyzed in the laboratory requires a series of steps, procedures, and practices. The objective of the sampling is to collect a portion of material small enough in volume to be conveniently transported to and handled in the laboratory while still accurately representing the material being sampled. The analytical methods used to measure the physicochemical and bacteriological parameters in rural water samples collected in the study area is provided here.

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C. Data Collection

Preliminary survey was conducted in the selected villages to identify the drinking water sources inthe villages. At each village, two to three samples were collected in a day and combined to get composite sampling. The samples were collected on April 2023 at all the villages. During sampling period, total samples were collected and transported to the Environmental Engineering laboratory at BGS institute of technology for physio-chemical and microbiological analysis. The rural water samples were collected using polyethylene bottle rinsed with distilled water.

1) Photos Taken While Collecting Samples

Fig 4.2: Sample collection in Kanagonahalli

Fig 4.3: sample collected

Fig 4.4: Sample collection in Kavadihalli

Fig 4.5: Sample collection in Gaganahalli

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Fig 4.6: Sample collection in Kemmanahalli

Fig 4.7: Sample collection in Alapahalli

D. Sampling Procedures

Sampling procedures are carried out with the reference to ISO 5667 PART-5

Table 4.2: Details of Analytical procedure adopted for sample analysis

Sl no	Parameters	Analytical Techniques
1	pH	Electrode method
2	EC (mmhos/cm)	Electrode method
3	Colour	Visual method
4	Temperature ^{0} C	Thermometric method
5	Total Dissolved Solids (mg/L)	Gravimetric method
6	Total hardness	Titration method
7	Chlorides, Cl (mg/L)	Argentometric titration method
8	Sulphate $SO4^{2-}$ S (mg/L)	Turbidimetric method
9	Nitrates, NO3 -N (mg/L)	Kieldahl method
10	Cd, Pb, Cr, Mn, Hg, Cu, Zn, Fe, Al,(mg/L)	Atomic Absorption Spectrophotometric method
11	Turbidity (NTU)	Turbidity method
12	Calcium (mg/L)	Titration method
13	Fluoride (mg/L)	Ion analyser
14	Sulphate (mg/L)	Spectrophotometric method
15	Arsenic (mg/l)	Atomic Absorption Spectrophotometric method
16	Manganese (mg/l)	Atomic Absorption Spectrophotometric method
17	Alkalinity	Titration method
18	Boron	Spectrophotometric method
19	Mineral oil (mg/l)	Separating Funnel method
20	Selenium	Spectrophotometric method
21	Cyanide	Spectrophotometric method
22	E. coil	Membrane filtration technique
23	Total coliform bacteria/100ml	Membrane filtration technique

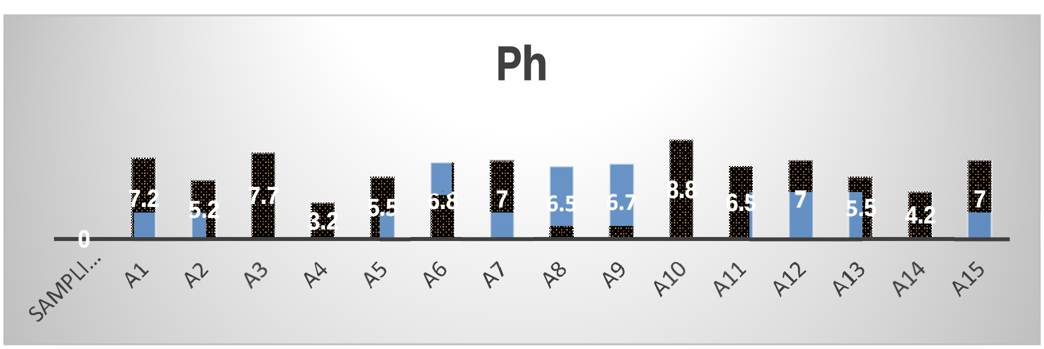
1) Photos Taken While Doing Experiments

Fig 4.9: Analysis of drinking water conducted in an Environmental lab

V. RESULTS & DISCUSSION

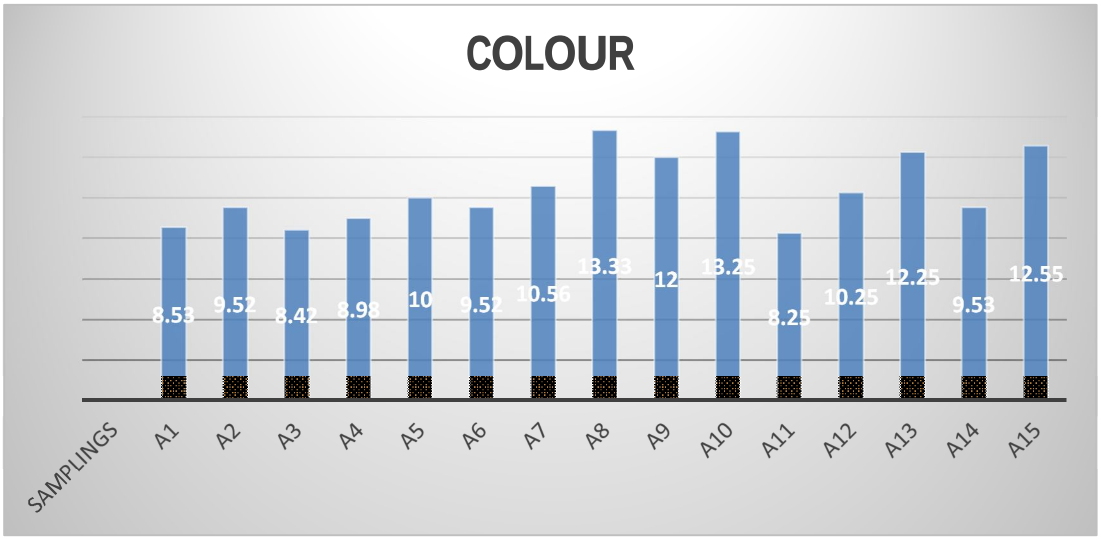
A. pH

The obtained ph value while conducting the water quality analysis of honakere hobli was in between BIS standards (6.5-8.5) hence there is no problem noticed in this parameter.



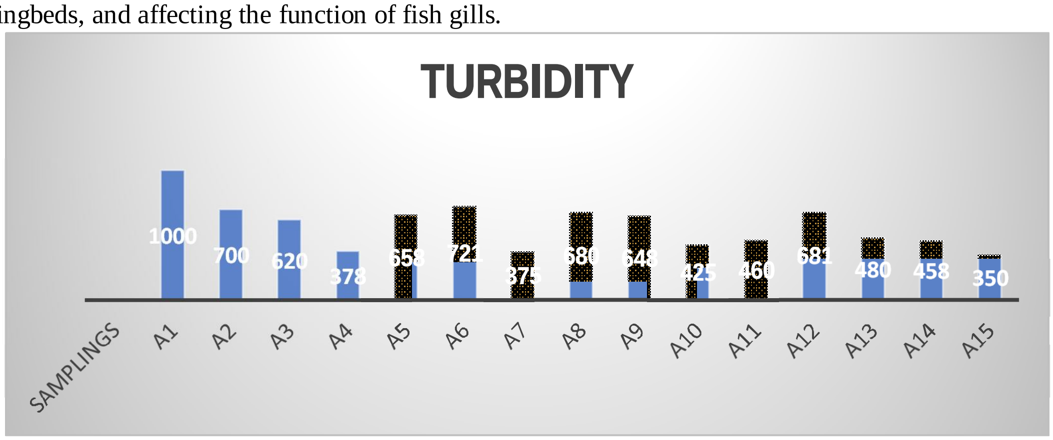
B. Color

The obtained color value while conducting the water quality analysis of honakere hobli was inbetween BIS standards (5-15 mg/L) hence there is no problem noticed in this parameter



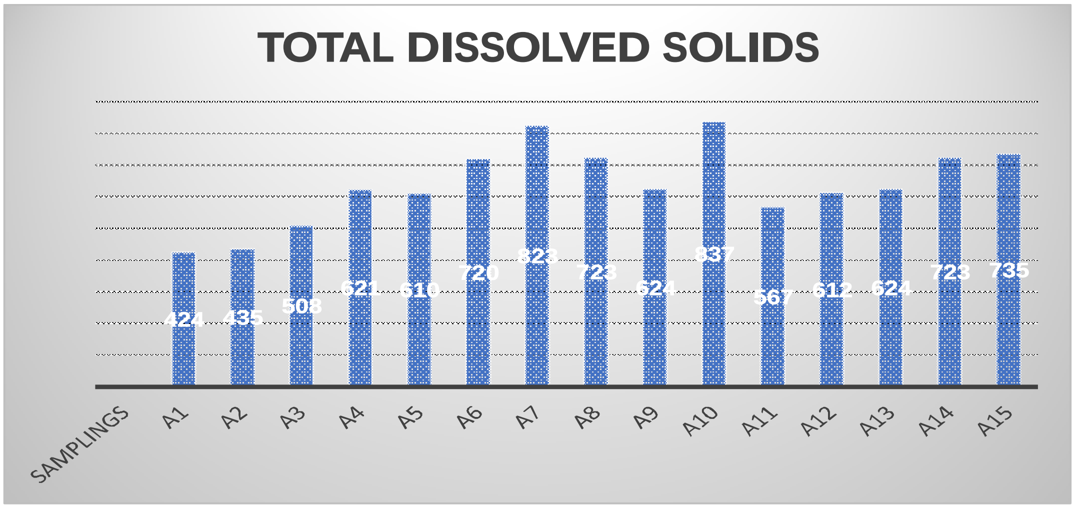
C. Turbidity

Turbidity in water is caused by suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms. in this study, wehave obtained turbidity in Kebbekoppalu villages which are more than BIS standards (1-5 NTU). Excess turbidity can cause heavy metals to be added to the water supply. These metals may include lead, mercury, and cadmium, which are toxic to humans. Turbidity can harm aquatic life by reducing the food supply, degrading spawningbeds, and affecting the function of fish gills.



D. Total Dissolved Solids

Excess minerals can also get dissolved in the water from agricultural and urban runoff as well as from urban wastewater and industrial wastes and contaminate drinking water or water bodies. These dissolved minerals in water are referred to as Total Dissolved Solids (TDS), but in this study, the obtained values of total dissolved solids are between BIS standard values (500-2000 mg/l). Total Dissolved solids (TDS) of waterers to the inorganic salts and organic matter presentin water which may be due to the presence of sodium, potassium, calcium, magnesium, carbonates, hydrogen carbonate, and ions of chloride, sulphate, and nitrate (WHO,1996). The increase in TDS is mainly due to seawater intrusion and an increase in salts.



E. Total Hardness

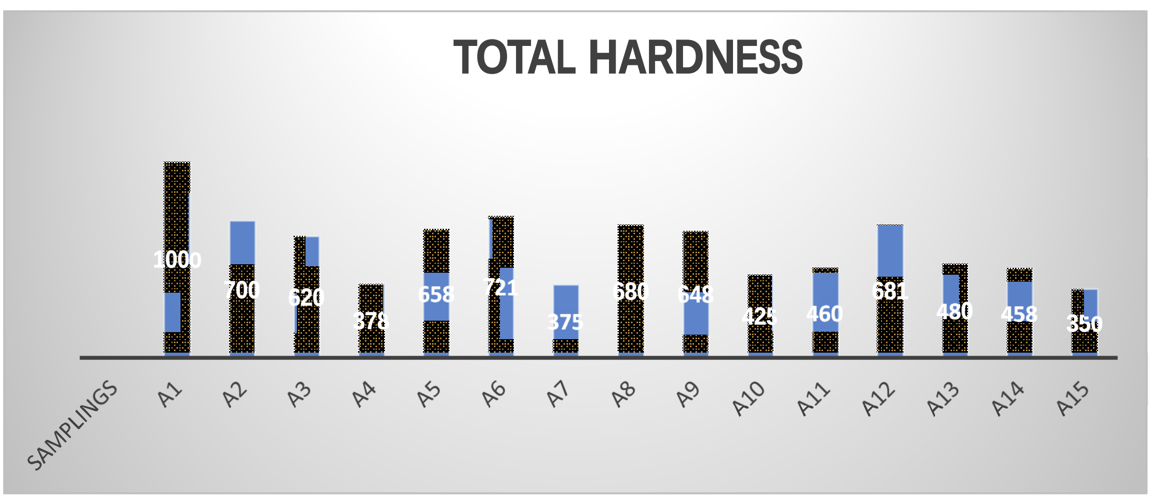
Total hardness of water is an important consideration in determining its suitability of water for domestic and industrial uses. Hardness is caused by multivalent metallic cations and with certain anions present in the water to form scale. The principal hardness-causing cations are the divalent calcium, magnesium, strontium, ferrous ions, and manganous ions.

We have not obtained the values of total hardness in between the BIS standards (200-600 mg/l) but, in Mallegowdanahalli, the hardness value is 780.5mg/l which is not good for drinking purposes. Water described as "hard" contains high amounts of naturally occurring dissolved calcium and magnesium. Total hardness is the sum of the calcium and magnesium concentrations, both expressed as calcium carbonate, in milligrams per liter (mg/L). You can determine your water's hardness based on these concentrations of calcium carbonate:

- below 75 mg/L - is generally considered soft

76 to 150 mg/L - moderately hard

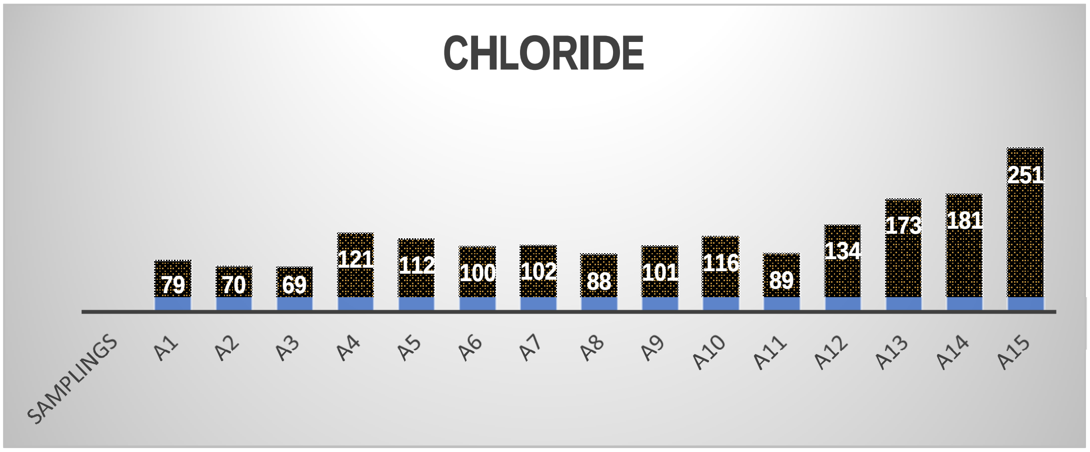
- 151 to 300 mg/L - hard
- more than 300 mg/ - very hard



F. Chloride

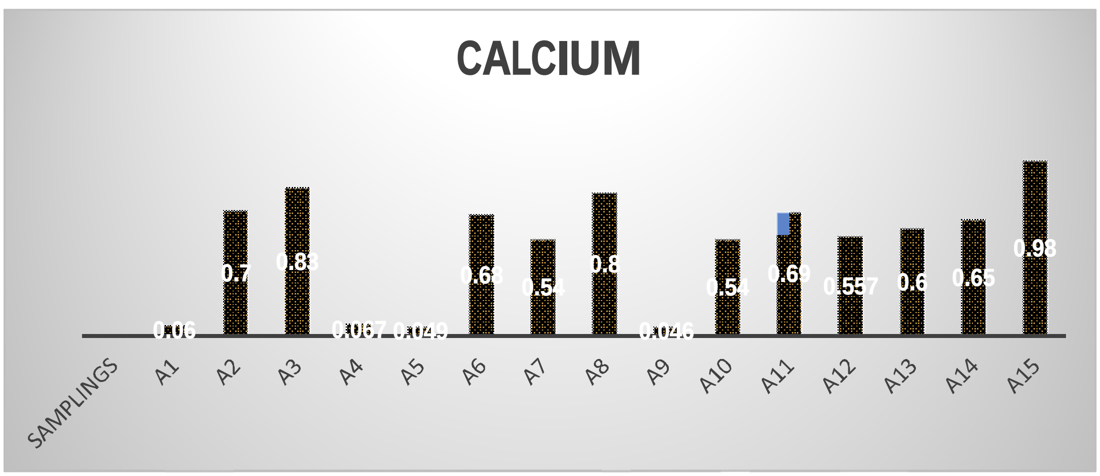
The obtained chloride value while conducting water quality analysis of honakere hobli was in between BIS standards (200-400mg/l). Chlorides occur naturally in all types of waters. A high concentration of chlorides is considered to be an indicator of pollution due to organic wastes of animal or industrial origin.

Chlorides troublesome in irrigation water and also harmful to aquatic life.



G. Calcium

The obtained calcium value while conducting the water quality analysis of honakere hobli was inbetween BIS standards (75-200 mg/L). Calcium collects in water when water pushes through rock and soil, extracting their minerals. This makes the water "hard". Hardwater has high concentrations of calcium and magnesium You are also at an increased risk of developing kidney stones. That's because excess calcium can leave crystal-like deposits that eventually harden and turn into stones. Hypercalcemia affects the central nervous system and can disrupt the electrical impulses that govern your heartbeat



H. Fluoride

The obtained fluoride value while conducting the water quality analysis of honakere hobli was in between BIS standards (1-1.5 mg/L) except Kemmanahalli and Gaganahalli where Gaganahalli as reported highest fluoride content in honakere hobli. Fluoride (F-) concentration is an important aspect of hydrogen chemistry, because of its impact on human health. The recommended concentration of F- in drinking water is 1.50 mg/l. Low F- content (<0.60mg/l) causes dental caries, whereas high (>1.20mg/l) fluoride levels result in fluorosis. Bureau of Indian Standardfor drinking water (BIS, 2012) has specified a fluoride limit between 1.0 and 1.5 mg/l for drinking water. Honakere had a higher level (2.0mg/l) and may cause dental fluorosis, skeletal fluoros, which are non-vertebral fractures, especially hip fractures. Apart from fluorosis, a high intake of fluorides may also cause gastrointestinal complaints such as loss of appetite, nausea, vomiting, ulcer pain in the stomach, constipation, and intermittent diarrhea and flatulence. The adolescent age group is the most vulnerable to fluoride pollution and it is a worldwide problem (WHO, 2004). Samples exceeding the fluoride level greater than 1.5mg/l are needed to be defluorinated with immediate attention to negativize the impacts of high fluoride levels on human consumption in the Honakere area.

- Immediate symptoms include digestive disorders, skin diseases, dental fluorosis
- Fluoride in larger quantities (20-80 mg/day) taken over a period of 10-20 years results in crippling and skeletal fluorosis which is severe bone damage.

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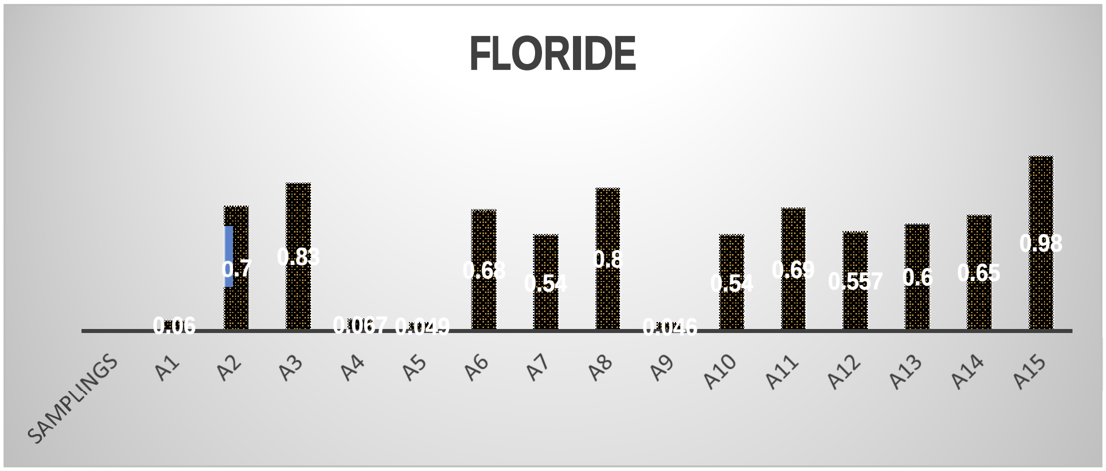
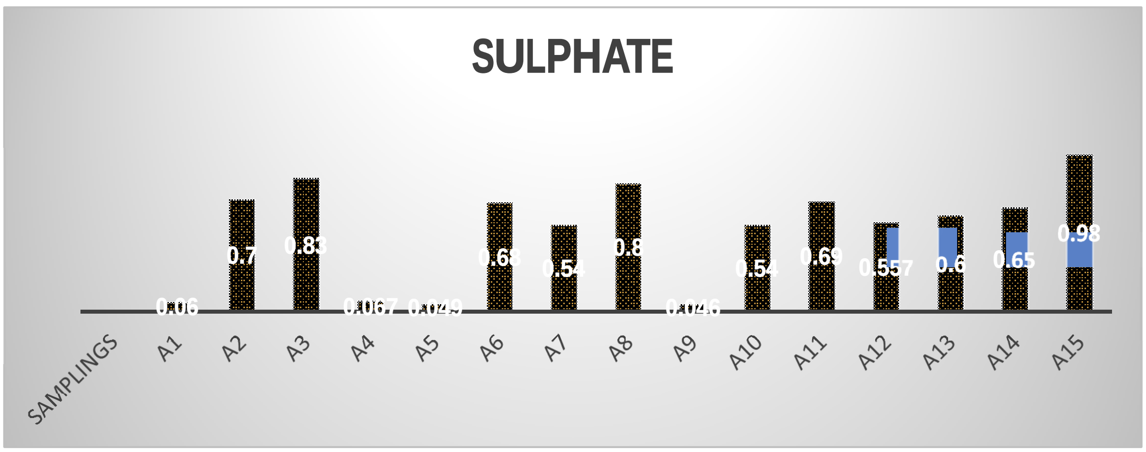


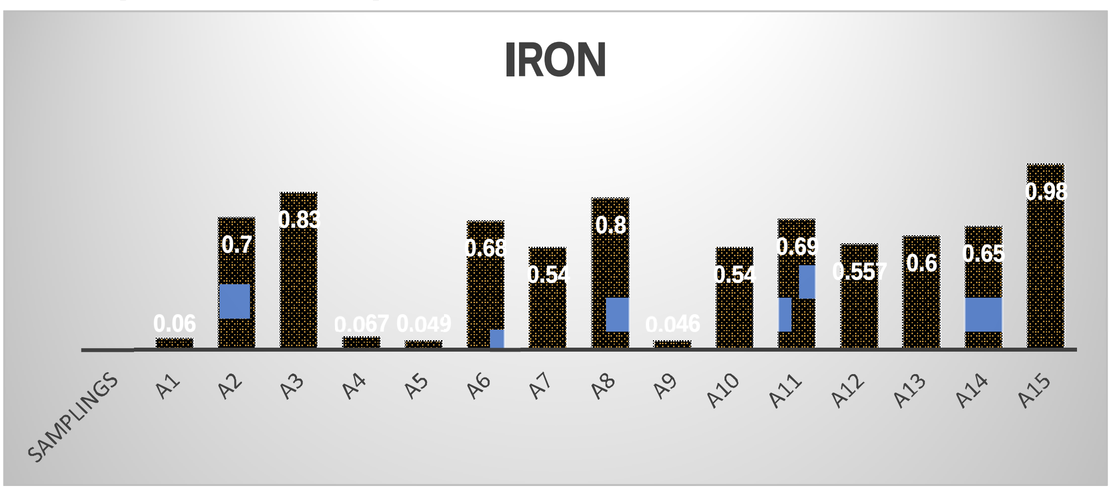
I. Sulphate

The obtained sulphate value while conducting the water quality analysis of honakere hobli was inbetween BIS standards (200-400 mg/L) hence there is no problem noticed in this parameter.



J. Iron

The obtained iron value while conducting the water quality analysis of honakere hobli was inbetween BIS standards (0.3-1 mg/L)) hence there is no problem noticed in this parameter.



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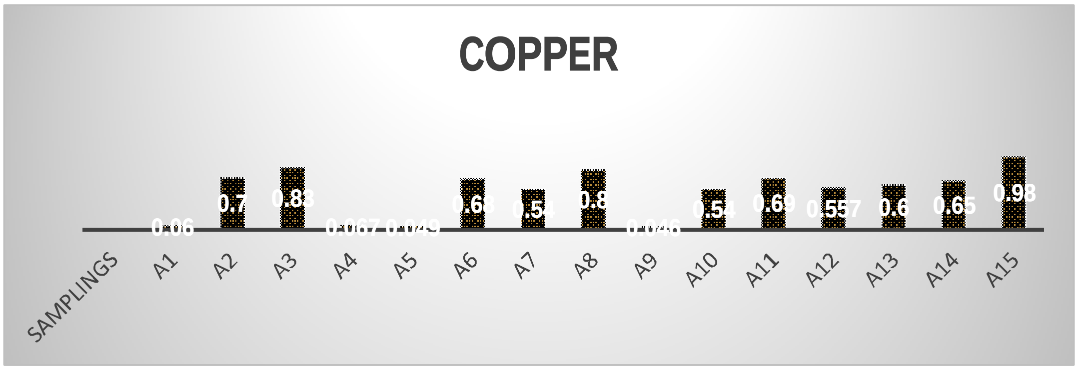
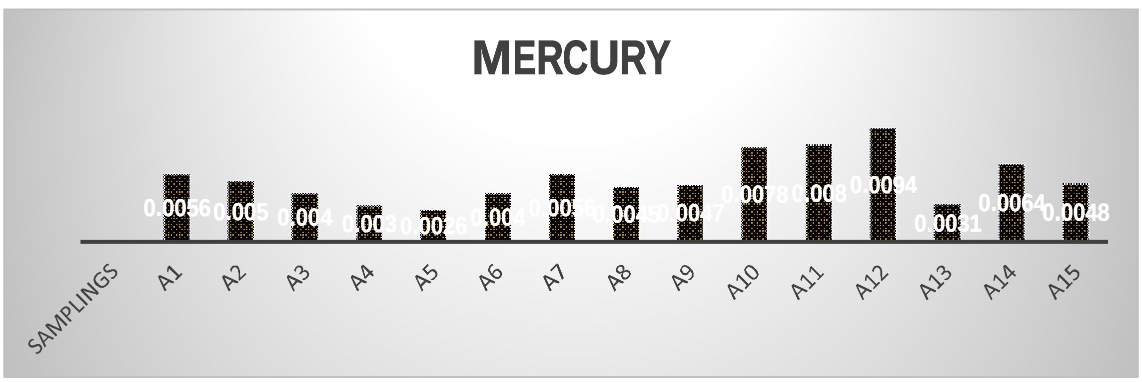
K. Copper

The obtained copper value while conducting the water quality analysis of honakere hobli was in between BIS standards (0.05-1.5 mg/L) hence there is no problem noticed in this parameter. High levels of copper may get into the environment through mining, farming, manufacturing operations, and municipal or industrial wastewater released into rivers and lakes. Copper can get into drinking water either by directly contaminating well water or through corrosion of copper pipes if your water is acidic. Consuming high levels of copper may cause nausea, vomiting, diarrhea, and stomach cramps.



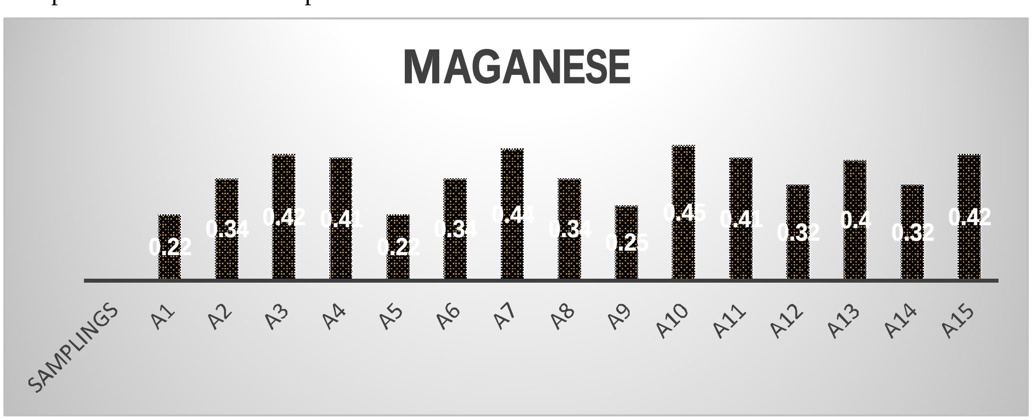
L. Mercury

The obtained mercury value while conducting the water quality analysis of honakere hobli was within the BIS standards (0.01 mg/L)) hence there is no problem noticed in this parameter.



M. Manganese

The obtained manganese value while conducting the water quality analysis of honakere hobli was in between BIS standards (0.1-0.5 mg/L)) hence there is no problem noticed in this parameter.



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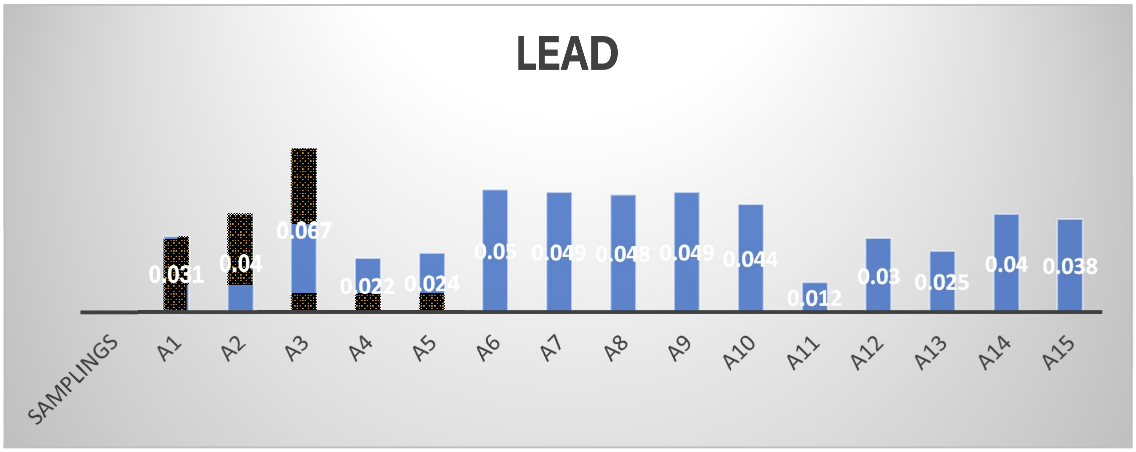
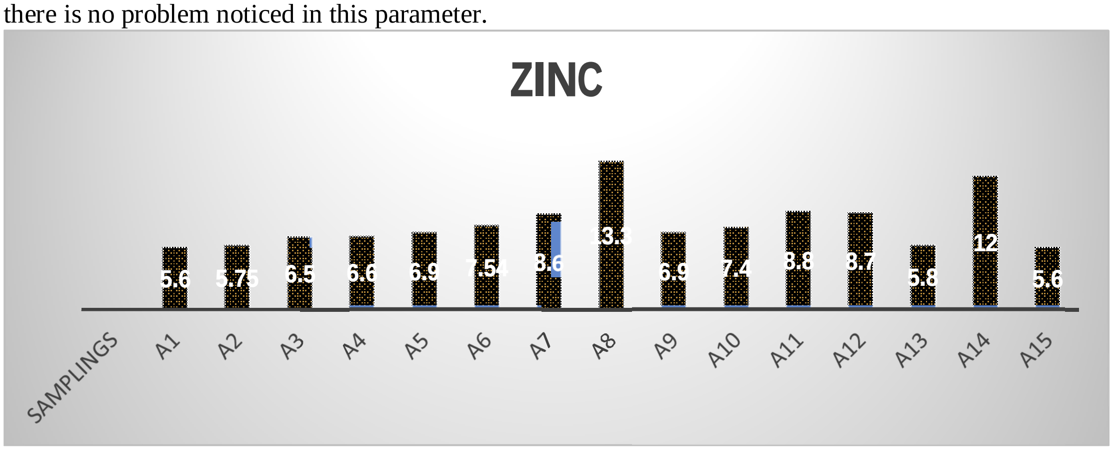
N. Lead

The obtained lead value while conducting the water quality analysis of honakere hobli was in between BIS standards (0.05 mg/L). The most common sources of lead in drinking water are lead pipes, faucets, and plumbing fixtures. Certain pipes that carry drinking water from the water source to the home may contain lead,



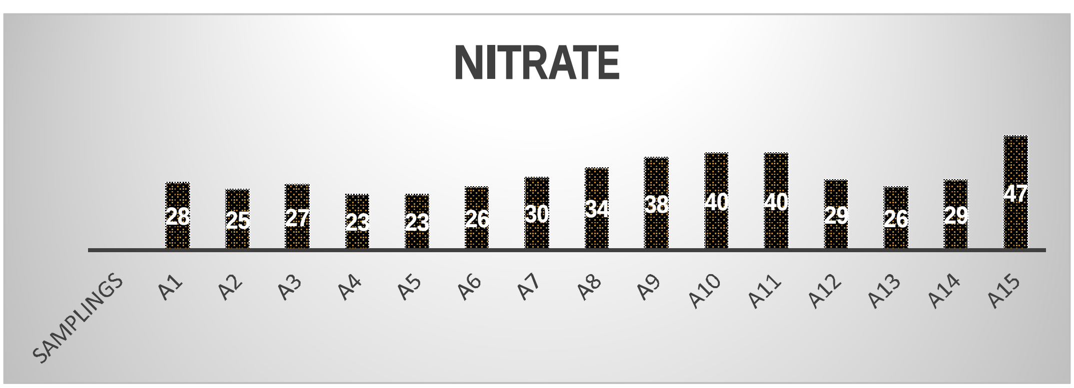
O. Zinc

The obtained manganese value while conducting the water quality analysis of honakere hobli was in between BIS standards (5-15 mg/L)) hence there is no problem noticed in this parameter.



P. Nitrate

The obtained nitrate value while conducting the water quality analysis of honakere hobli was in between BIS standards (45-100 mg/l) hence there is no problem noticed in this parameter.



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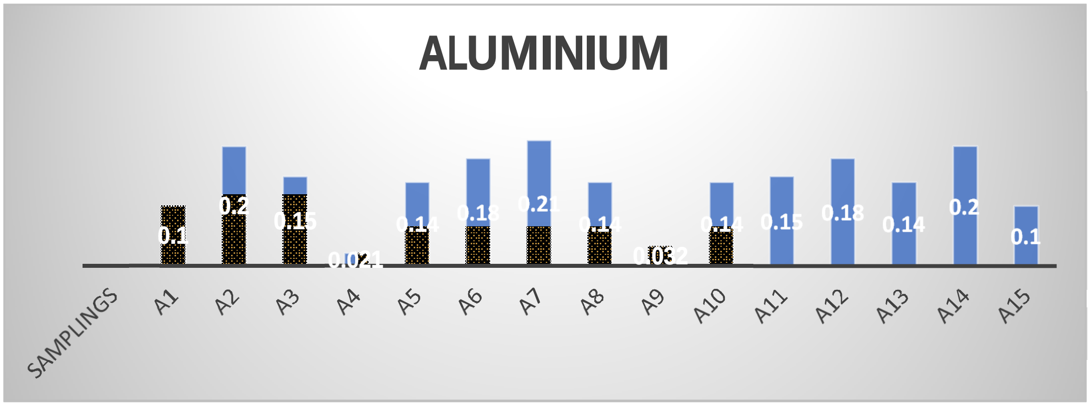
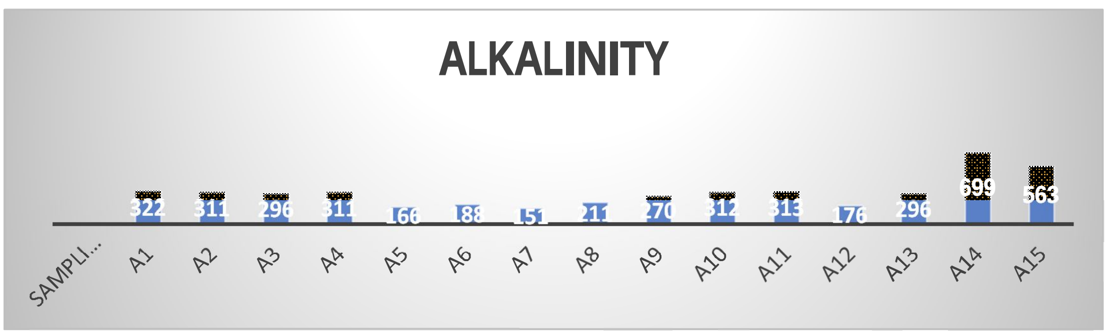
Q. Aluminum

The obtained aluminum value while conducting the water quality analysis of honakere hobli was in between BIS standards (0.03-0.2 mg/l) hence there is no problem noticed in this parameter.



R. Alkalinity

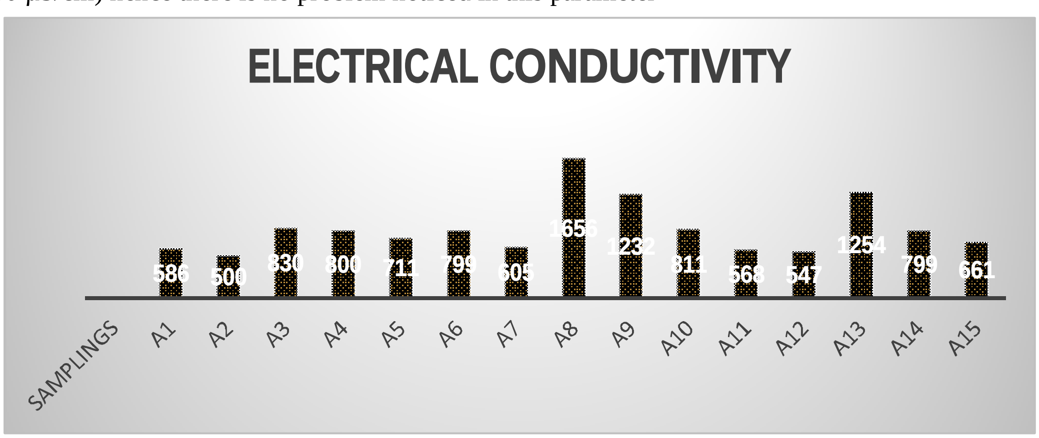
The obtained aluminum value while conducting the water quality analysis of honakere hobli wasin between BIS standards (200-600 mg/l) hence there is no problem noticed in this parameter. Alkalinity is an important factor in determining the ability of water samples to measure acidic pollution. The alkaline nature of the water could be attributed to the buffering properties of some inorganic substances



S. Electrical Conductivity

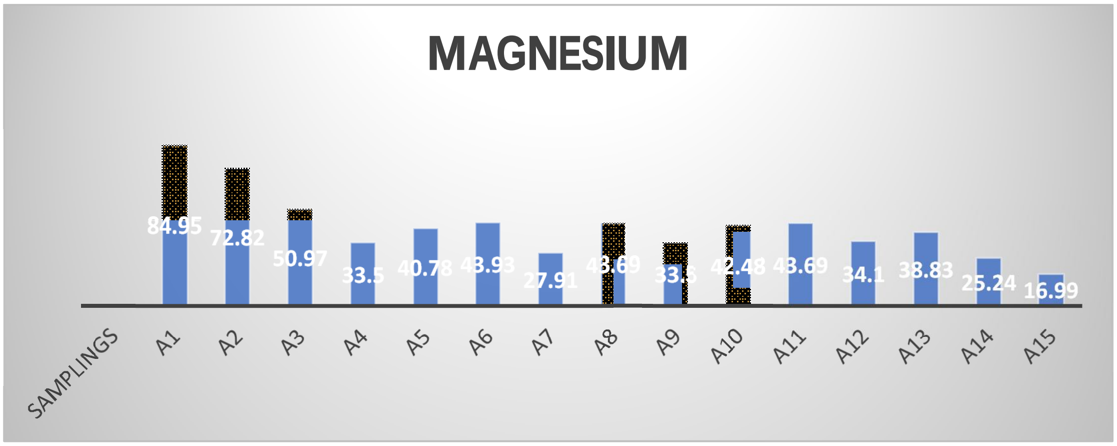
In most cases, higher temperatures will equate to higher electrical conductivity. An increase in the temperature of the water by just one degree Celsius will cause an increase of electrical conductivity by 2-3 percent, which is why it's so important to measure the electrical conductivity of your water.

The obtained electrical conductivity value while conducting the water quality analysis of honakere hobli was in between BIS standards (3000 µS/cm) hence there is no problem noticed in this parameter



T. Magnesium

The obtained magnesium value while conducting the water quality analysis of honakere hobli was in between BIS standards (30-100 mg/l)



U. Arsenic

The obtained value arsenic while conducting the water quality analysis of honakere hobli was inbetween BIS standards (0.01-0.05 µg/l) hence there is no problem noticed in this parameter.

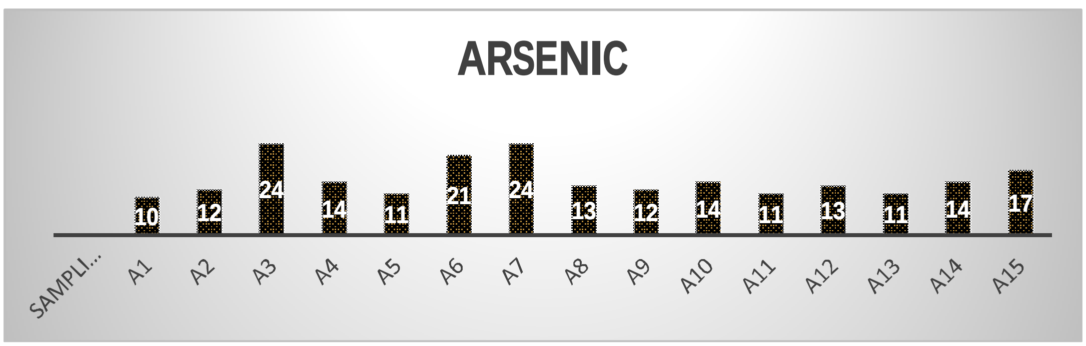


Table 5.1: Analysis results of drinking water quality parameters in the study area(Honakere)

Villages parameters	pH	Colour	EC (µS/cm)	Turbidity (NTU)	TDS (mg/l)	Hardness (mg/l)	Ca2+ (mg/l)	Mg2+ (mg/l)	Cl- (mg/l)	Mn (mg/l)	F- (mg/l)	SO42- (mg/l)	Fe (mg/l)	NO3- (mg/l)	alkalinity (mg/l)	As (µg/l)
BIS limit	6.5-8.5	05-15	3000	1-5	500-2000	200-600	75-200	30-100	200-400	0.1-0.5	0.5-1	200-400	0.3-1	45-100	200-600	0.01-0.05
A1	7.2	8.53	586	1.100	424	1000	260	84.95	79	0.22	0.56	73	0.3	28	322	10
A2	6.5	9.52	500	0.184	435	700	160	72.82	70	0.34	0.58	72	0.2	25	311	12
A3	7.7	8.42	830	0.550	508	620	164	50.97	69	0.42	0.60	67	0.2	27	296	24
A4	7.2	8.98	800	0.127	621	378	96	33.50	121	0.41	0.77	69	0.0	23	311	14
A5	7.8	10	711	0.500	610	658.0	196	40.78	112	0.22	0.50	71	0.5	23	166	11
A6	6.8	9.52	799	0.157	720	721.0	216	43.93	100	0.34	1.80	75	0.3	26	188	21
A7	7.0	10.56	605	0.220	823	375	104	27.91	102	0.44	0.98	62	0.0	30	151	24
A8	6.5	13.33	1656	0.157	723	680	200	43.69	88	0.34	0.45	63	0.1	34	211	13
A9	6.7	12	1222	0.560	624	648	204	33.50	101	0.25	0.54	254	0.3	38	270	12
A10	7.6	13.25	811	0.890	837	425	100	42.48	116	0.45	0.80	311	0.5	40	312	14
A11	6.5	8.25	568	5.820	567	460	112	43.69	89	0.41	0.78	68	0.3	40	313	11
A12	7.0	10.25	547	0.700	612	681	216	34.10	134	0.32	0.49	86	0.0	29	176	13
A13	7.5	12.25	1254	2.200	624	480	128	38.83	173	0.41	0.81	94	0.2	26	296	11
A14	6.8	9.53	799	4.550	723	458	141.6	25.24	181	0.32	0.63	90	0.0	29	699	14
A15	7.0	12.55	661	0.154	735	350	112	16.99	251	0.40	1.10	86	0.0	47	563	17

Table 5.2: Water quality index in different sampling villages of study area (Honakere hobli)

Sl.no	Name of the village	WQI	Water quality	Reason
1	Honakere	45.97	Good	Total hardness, Manganese
2	Honnahalli	73.021	Poor	Cadmium, Electrical conductivity, Aluminium,Total hardness, Total Dissolved Solids
3	Kemmanahalli	47.03	Good	Electrical Conductivity, TotalDissolved Solids
4	Kangonahalli	84.52	Very poor	Aluminium, Lead, and Turbidity
5	Siddegowdana koppalu	68.77	Poor	Total hardness, Total Dissolved Solids,
6	Jodihosuru	57.87	Poor	Turbidity, Total Dissolved Solids, totalhardness
7	Alapahalli	40.06	Good	Total Dissolved Solids, Electrical Conductivity
8	A. Shanbhoganahalli	59.94	Poor	Iron, Fluoride, and Lead
9	Guddenahalli	56.51	Poor	Aluminium & copper
10	Kavadihalli	34.32	Good	Cadmium
11	Kebbekoppalu	43.29	Good	Fluoride, alkalinity
12	Mallegowdanahalli	30.71	Poor	Total dissolved solids, Total Hardness,chloride
13	Huruligaganahalli	55.90	Poor	Fluoride, Turbidity, Total Dissolved Solids,total hardness
14	Vaderahalli	41.67	Good	alkalinity
15	Gaganahalli	51.61	Poor	Total Hardness, chloride, Fluoride,Iron, magnesium

VI. CONCLUSION

The study provides information about the water quality status of 15 villages in honakere hobli. The parameters namely pH, color, turbidity, alkalinity, nitrate, total dissolved solids, sulphate, manganese, lead, aluminum, EC, arsenic were within the permissible standard limits and satisfy the requirement for the use of drinking except for total hardness, calcium, magnesium, zinc, fluoride, iron, copper. The microbiological quality of Kemmanahalli and Huruligaganahalli water sources showed the presence of coliforms in the ground water, disinfection is required before consumption.

VII. RECOMMENDATIONS

The most common way to reduce hard water is a salt-based water softener. These units work by exchanging ions in the magnesium and calcium in your water. This activity exchanges these minerals with sodium. This is one of the most effective ways to remove water hardness, but it requires routine maintenance. You’ll need to refill your water softener with specialty bags of salt in order to maintain your soft water or the simplest method of softening hard water is by boilingit. When you boil water, the salts precipitate leaving clean, soft water. The most common water treatment devices for reducing the chloride content of drinking water are reverse osmosis. To reduce bacteriological impurities entire well will need to be disinfected using chlorine and any water will need to be boiled before being used. It is also important to inspect the well after it’s been treated to make sure any openings are properly sealed so that it doesn’t have bacteria growth again in the future.

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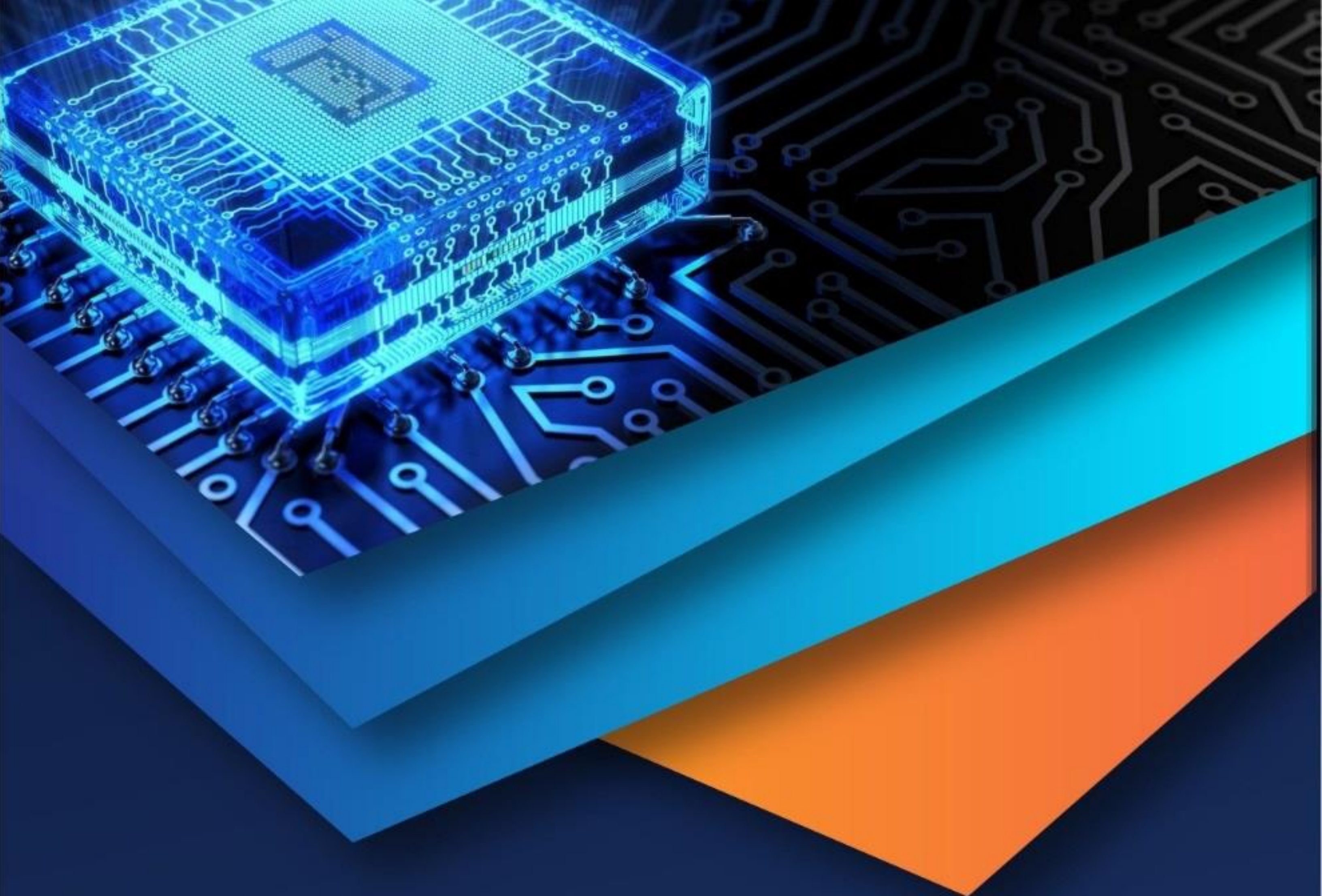
ANEXURE

parameters	Sn	1/Sn	Σ1/Sn	k=1/(Σ1/Sn)	Wn = K/Sn	(Vo)	Sn	Vn/Sn	Vn/Sn*100=Qn	WnQn
ph	7	0.14285714	283.4423201	0.003528055	0.000504008	7	7.9	1.12857143	112.8571429	0.056880881
Colour	10.56	0.09469697	283.4423201	0.003528055	0.000334096	0	15	1.42045455	142.0454545	0.04745683
Turbidity NTU	0.22	4.54545455	283.4423201	0.003528055	0.016036612	0	1.3	5.90909091	590.9090909	9.476179889
TDSmg/l	823	0.00121507	283.4423201	0.003528055	4.28682E-06	0	67	0.08140948	8.140947752	3.48988E-05
T.hardness mg/l	75	0.01333333	283.4423201	0.003528055	4.70407E-05	0	200	2.66666667	266.6666667	0.012544194
Cl-mg/l	102	0.00980392	283.4423201	0.003528055	3.45888E-05	0	250	2.45098039	245.0980392	0.00847764
Ca2+	142	0.00704225	283.4423201	0.003528055	2.48455E-05	0	75	0.52816901	52.81690141	0.00131226
F-mg/l	0.98	1.02040816	283.4423201	0.003528055	0.003600056	0	1	1.02040816	102.0408163	0.367352631
SO42-mg/l	62	0.01612903	283.4423201	0.003528055	5.69041E-05	0	200	3.22580645	322.5806452	0.018356164
Femg/l	0	0	283.4423201	0.003528055	0	0	0.3	0	0	0
Cumg/l	0.54	1.85185185	283.4423201	0.003528055	0.006533435	0	0.02	0.03703704	3.703703704	0.024197906
Hgmg/l	0.0056	178.571429	283.4423201	0.003528055	0.630009762	0	0.002	0.35714286	35.71428571	22.50034864
Mn	0.44	2.27272727	283.4423201	0.003528055	0.008018306	0	0.5	1.13636364	113.6363636	0.911171143
Pb	0.049	20.4081633	283.4423201	0.003528055	0.072001116	0	0.01	0.20408163	20.40816327	1.469410523
Zn	8.6	0.11627907	283.4423201	0.003528055	0.000410239	0	10	1.1627907	116.2790698	0.047702199
NO3-	30	0.03333333	283.4423201	0.003528055	0.000117602	0	45	1.5	150	0.017640273
Al	0.21	4.76190476	283.4423201	0.003528055	0.01680026	0	0.05	0.23809524	23.80952381	0.400006198
alkalinity	150.7	0.0066357	283.4423201	0.003528055	2.34111E-05	0	120	0.79628401	79.6284008	0.001864189



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TOGETHER WE REACH THE GOAL

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