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"COMPREHENSIVE ASSESSMENT OF WATER QUALITY IN DEVANAHALLI TALUK THROUGH THE WATER QUALITY INDEX (WQI) TO EVALUATE THE REGION'S ENVIRONMENTAL WELL-BEING."

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Abstract

One of the significant sources of water is Ground water and about half of the world's population makes use of it, out of it 43% is put to irrigation use. Therefore the quality of groundwater is of concern. In this project, the selected area for studies is Devanahalli taluk in Bangalore Rural District. This is important in the context of history and present congestion of Bangalore city and location of KIA (Kempegowda international airport). In this taluk, there are around 212 villages with 2 towns in addition with population touching 2,09,622 lakh. The total area of Devanahalli taluk is 446 sqkm. The task of mapping can be multi-folded by assigning bore wells which have been ascribed with the relevant latitude and longitude and ascertaining the water sample bore-chemical features of water and assessment of water quality using water quality index for the study area.

Keywords: Bore wells, Ground water, Physical and chemical parameters, Water quality index.

INTRODUCTION

Groundwater is vital for life on our planet. Water shortage can be perilous for all living organisms. There are two primary sources of water: • Surface water • Groundwater More than 1.5 billion people depend on groundwater for drinking and domestic purposes. In most parts of the world, groundwater can be the sole source of water for both rural and urban communities. The Water Quality Index (WQI) is a crucial metric to use for assessing the quality of water. It is an invaluable aid used for transmitting data on the quality of water generally. Groundwater is fresh water in the space of the soil particles and spaces between the rock, derived from precipitation or melted ice.Ground water may remain in ground for decades it might be centuries or millenniums. By ground water table it can percolate and recharge rivers lakes, ponds, wetland, and can be useful to human beings for domestic, industrial and irrigation uses. Water gets stored in pores in the rock and pores are non-permeable and water will not travel further. The phenomenon by which by which precipitation refills the ground water is referred as recharge. Because of unprecedented growth of urbanization, industrialization and the demand for water by the population is going up day by day but the amount available is the same with all this huge amount of fresh water getting contaminated by sewage water, industrial effluents, and other kinds of noxious chemicals released to environment due to human endeavors. Therefore, the quality and the supply of water should be of good value. In this way we can fulfill this we should the some parameters of water supplied these parameters are mainly of two types they are

- Physical Parameters
- Chemical Parameters

Physical parameters are 5 parameter they are taste, color, odor, temperature and Turbidity these are physical parameters of water.

Chemical parameters are Ph, Total harness, Total Alkalinity, Chloride, Calcium, Total Dissolved Solids, Nitrate, Magnesium, Ammonia, Sulphate, etc these are some the chemical parameters of water. We should make sure these parameters values should be within limits of BIS bureau of Indian Standards of drinking water. If the value of the parameters crosses the limited value then the water should be treated accordingly and then supplied. We have fetched water sample from 10 villages of Devanahalli taluk in month of March and analyzed and compared with BIS standards

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of drinking water and geo-referenced in ARC-GIS software. Devanahalli taluk is covered with four types of soils they are clayey, clayey mixed, loamy skeletal and rocky land. The surface soils of this region are medium to coarse grained texture, sub-surface soils are deep and heavily textured (S. Srinivasa Vittala et al. (2008)) In Devanahalli taluk no perennial rivers exist, there are fewer streams that originate in hills and fill the number of tanks in taluk. Therefore ground water is principal water source of this study area.

LITERATURE REVIEW

Water quality index assessment for Tumkur taluk, Karnataka state, India Ramakrishnaiah C.R et.al, (2009) purpose of the paper is Analysis of the result have to been employed to propose model for predicting water quality and the result of this paper is the quality of groundwater is not satisfactory as per BIS standards therefore treatment is essential to sustain the standards of ground water quality and ensure that it is not polluted before supplying it to consumers [3].

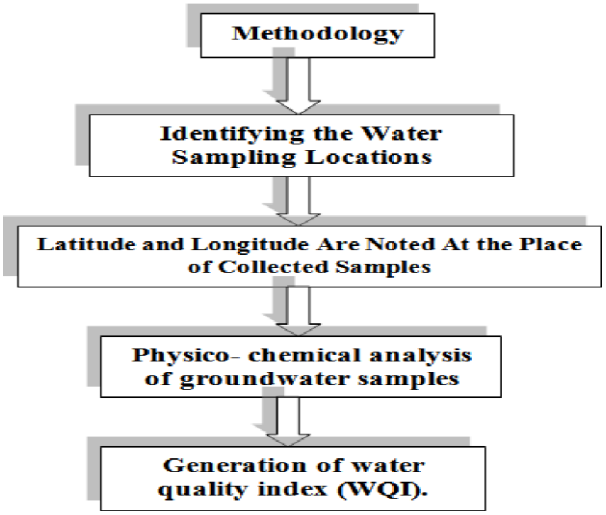
Anitha Pius et.al, (2012) aim of paper is to examine and analyze the chosen study area with the assistance of outcome of water quality parameters and comparing with outcome of water quality index results are concluded for the respective sample in case of any issue we can intelligently address it with the assistance of GIS tool and techniques. [2]Then later on the results of water quality parameters are mapped and analyzed efficiently and measures to be taken as per problem with spatial variation water quality map created with GIS tool.

Ashwani Kumar Tiwari et.al, (2014)The purpose of this study is to reflect ground water present in west bokaro coal field. Since it is coal mineing area analyst excavated 33 around the area and sample collected were tested to be compatible with drinking standards as per BIS for drinking water and WQI were created for sample test result and it was revealed that water is not compatible for drinking directly As per results 79% of water sample come under excellent quality and remaining 21% come under poor water quality index [8]. Writer has concluded the finding that we ought to treat water before it gets supplied to public for drinking intent.

Groundwater quality evaluation of Dhanbad district, Jharkhand, India[1]

The purpose of the research is to assess the ground water quality and check whether it is safe for public consumption in Dhanbad region Locations were chosen where there was heavy industries and coal mining was prevalent Approximately 79 wells were targeted which was first time supply water for drinking purpose and sample collected were analyzed was summarized by author in the following manner that it is beyond permissible total hardness value of 500 mg/l [5]. The water is also good for industrial use and can be used for industrial needs irrigation, having a low alkalinity and moderate to high salinity hazard.

METHODS AND METHODOLOGY



Initially we conducted literature review on the subject afterwards we downloaded the topographical map from Google earth pro [7]. Afterwards we chose the villages from where we have to take the water sample for studies once it gets finalized in the month of March we took 2 liters sample of sample from every location in sampling bottle and mentioned and then taken to lab for additional test and studies regarding physic chemical parameters [6]. Then we calculated Water Quality Index WQI of all the samples at last we prepared spatial representation of water quality parameters map using ARC –GIS software.

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Identifying the Water Sampling Locations

We chose study area i.e., the study area considered for physico-chemical analysis of groundwater quality. Chose the study area is Devanahalli taluk which falls under Bengaluru Rural district. Because of the rapid development of Bengaluru urban city and also the presence of KIA (Kempegowda International Airport) we should focus on this area in every aspect for the future development of Bengaluru city. Then we finalized the ten no of places in study area through Attebele, Avathi, Bullahali, Byarapanahalli Gobbarakunte, Gonuru, Kodag Urki, Kurburakunte, Venkatagiri Kote, Yelur. Latitude and Longitude Mentioned At the Location of Sampled Samples. Latitude and longitude location of bore well taken as we compiled the water sample.

TABLE- 1 Latitude and longitude details

SL NO	LOCATION	LATIUDE NORTH	LONGITUDE EAST
1	Bychapura	13.2246° N	77.7121°E
2	Doddasanne	13.2161 0N	77.6987°E
3	Kommasandra	12.8607° N	77.7410° E
4	Dharamapura	13.2417°N	77.7137°E
5	Devenahalli	13.2437° N	77.7172° E
6	Bettakote	13.1993° N	77.7414° E
7	Byrapura	13.3113° N	77.7602° E
8	Kasaba	13. 57120 N	76.42160 E.
9	Venkatapura	13.2573° N	77.5978° E
10	Varadhenahalli	13.2214° N	77.7924° E
11	Bedarahalli	13.0614°N	77.7159°E
12	Kondenahalli	13.1503° N,	77.7266° E
13	Abachikkanahalli	14.31840 N	75.79770E
14	Agalakote	13.2154° N	77.7266° E
15	Akkupet	13.2472° N	77.6808° E
16	Anighatta	13.2779° N	77.6722° E
17	Binnamangala	12.9809°N	77.6398° E
18	Boovanahalli	12.7518° N	76.1755° E
19	Budigere	13.1343°N	77.7466° E
20	BudigereAmanikee	13.1351°N	77.7495^{0}E
21	Kottigethimmanahalli	13.3099°N	77.6997°E
22	Chikkannanahosahali	13.2106° N	77.5691°E
23	Chikkasanne	13.2313° N	77.6890° E
24	Gobbarakunte	13.2916° N	77.7345° E

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25	Handrahalli	13.1211° N	77.7516° E
26	Hegganahalli	13.0064° N	77.5171° E
27	Holerahalli	13.3341° N	77.7481° E
28	Irigenahalli	13.3394° N	77.7327° E
29	Jonnahalli	13.1800° N	77.7552° E
30	Karahalli	13.3277° N	77.6901° E

Table-1 shows the latitude and longitude of the details which were recorded in the study area.

PHYSICO-CHEMICAL ANALYSIS OF GROUNDWATER SAMPLES

In this stage, physic-chemical analyses were conducted i.e., analysis of different physic- chemical parameters was conducted in environmental laboratory. That is, experimental methods were followed for getting the content of physic c-chemical parameters present in groundwater samples collected.

The permissible limit and acceptable limit of the physic-chemical parameters is referred from IS 10500:2012 (SECOND REVISION)

Physical Parameters tested were

1. Taste,
2. Color,
3. Odor,
4. Temperature
5. Turbidity.

Chemical Parameters tested were

6. Ph
7. Total harness
8. Total Alkalinity
9. Chloride
10. Calcium
11. Total Dissolved Solids
12. Nitrate
13. Magnesium
14. Ammonia,
15. Sulphate

These are the physio chemical parameters which were tested in lab and compared with BIS Standards.

GENERATION OF WATER QUALITY INDEX (WQI).

Water quality index (WQI) gives information regarding water quality in one value. There are numerous models available to compute water quality index but we have chosen CCME method for computation of water quality index. This Method was released in 2001[10] and has the guidelines for computation of water quality index. Some of the paper published based on

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this method are Al-Janabi et al., (2012), Munna et al.,(2013), Gyamfi et al.,(2013), Saleem et al.,(2015), Lamare and singh(2016).

CCME have three main elements:

- F1 (Scope)
- F2 (Frequency)
- F3 (Amplitude)

Formula's used in Calculation of WQI

Step – 1 calculating the scope Value (F1 Value)

$$F1 = \frac{\text{Number of failed Variable}}{\text{Total number of variable}} * 100$$

Step – 2 calculating the Frequency Value (F2 Value)

$$\mathbf{F2} = \frac{\text{Number of failed Test}}{\text{Total number of variable}} * 100$$

Step 3

- There are three steps in step 3 they are Used when the test parameters is not exceed the objective (Standard BIS value)

$$\mathbf{Excursion} = \frac{\text{Failed Test value} - 1}{\text{Objective}}$$

- Used when the test value falls below the objective

$$\mathbf{Excursion} = \frac{\text{Objective} - 1}{\text{Failed no of test}}$$

(Normalize Sum of Excursion)

$$\mathbf{Nse} = \frac{\text{Summation of Excursion}}{\text{Total no of Test}} \quad \mathbf{F3} = \frac{nse}{nse + 0.01}$$

Overall calculation

$$\mathbf{CCME\ WQI} = \left(\frac{\sqrt{F1 + F2 + F3}}{1.73} \right)$$

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TABLE-2 CCME WQI TABLE

CCME WQI	Ranking	Water quality Characters
95-100	Excellent	Water quality is good without or very less presence of impurities
80-94	Good	Water quality is good but has certain impurities
65-79	Fair	Certain Parameters are not in the limits
45-64	Marginal	Water should be treated well before using
0-44	Poor	Water is unfit for domestic purpose

These are the ranges given by CCME for the value of WQI.

Results & Discussion

The result of also the physio chemical parameters is obtained by various test method

TABLE-3 TEST DETAIL

SL NO	PARAMETERS	TEST ADOPTED
1	Ph	Electrometer (PH meter)
2	Alkalinity	(Titration)
3	Tds	(Titration)
4	Chloride	TDS Probe
5	Calcium	(Titration)
6	Magnesium	(Titration)
7	Nitrate	Spectrophotometer
8	Ammonia	(Titration)
9	Sulphate	(Titration)
10	Turbidity	(Titration)
11	Hardness	EDTA titration

hese are the method in table-3 adopted to test the given water sample of the study area [9]
These test results were compared with standard values

And these results are compared standard value. Various test method for different parameters are shown in table.3

BIS value table-4 of drinking water

SL NO	**PARAMETERS**	**BIS STANDANDS**
1	Colour	<5
2	Turbidity	<1
3	Taste	Agreeable
4	Odour	Agreeable

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5	Temperature	27
6	Ph	6.5-8.5
7	Hardness	200
8	Alkalinity	200
9	Chloride	250
10	Calcium	75
11	Tds	500
12	Nitrate	45
13	Magnesium	30
14	Ammonia	0.5
15	Sulphate	200

BIS STANDARDS are shown in table.4TABLE-4 BIS STANDARDS

Table-5 shows the standard value of the parameters for drinking water as per BIS The results obtained are as follows shown in table 5, 6 physical parameters

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TABLE-5 RESULT

SL NO	LOCATION	Color	Turbidity	Temp ©
1	Bychapura	2	0.9	28
2	Doddasanne	1	0.75	30
3	Kommasandra	4	0.8	27
4	Dharamapura	3	0.5	28
5	Devanahalli	3	0.45	27
6	Bettakote	2	0.7	27
7	Byrapura	2	0.9	28
8	Kasaba	3	0.85	30
9	Venkatapura	1	0.75	28
10	Varadhenahalli	4	0.7	30
11	Bedarahalli	4	0.9	30
12	Kondenahalli	3	0.7	27
13	Abachikkanahalli	2	0.9	30
14	Agalakote	1	0.5	27
16	Akkupet	4	0.5	28
17	Anighatta	3	0.75	30
18	Binnamangala	2	0.6	27

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19	Boovanahalli	1	0.45	28
20	Budigere	4	0.85	28
21	BudigereAmanikee	3	0.6	30
22	Kottigethimmanahalli	2	0.8	27
23	Chikkannanahosahali	3	0.6	27
24	Chikkasanne	3	0.75	28
25	Gobbarakunte	4	0.7	28
26	Handrahalli	4	0.8	30
27	Hegganahalli	3	0.75	30
28	Holerahalli	2	0.8	28
29	Irigenahalli	1	0.8	27
30	Jonnahalli	1	0.9	30

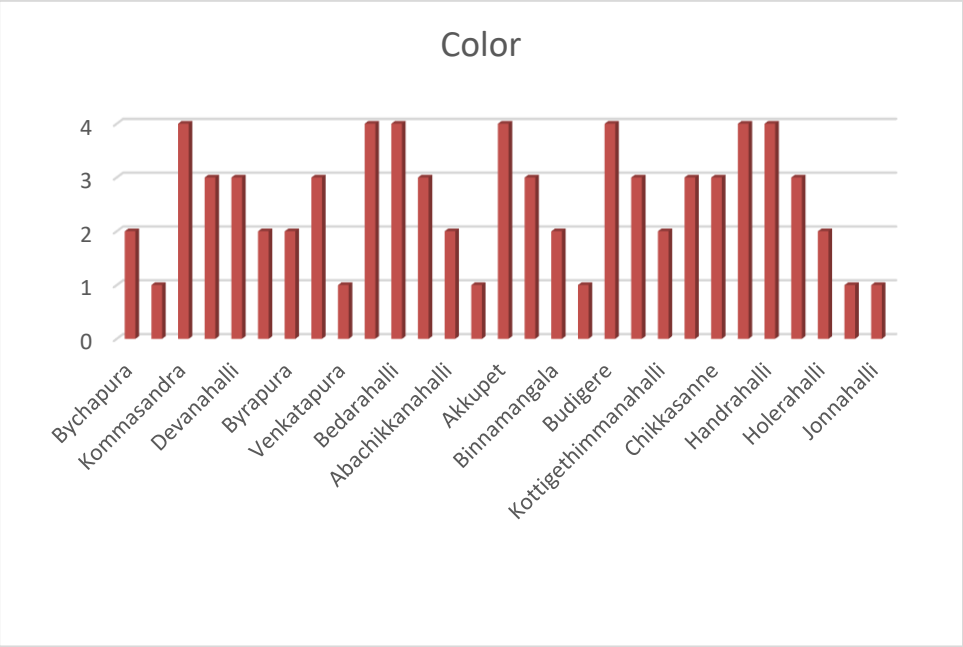

Figure 1: Represents the physical parameter color of water sample

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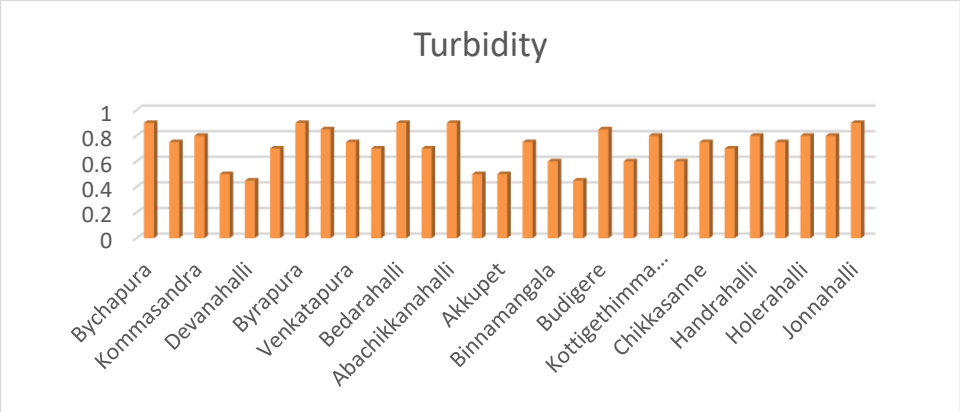

Figure 2: Represents the physical parameter turbidity of water sample

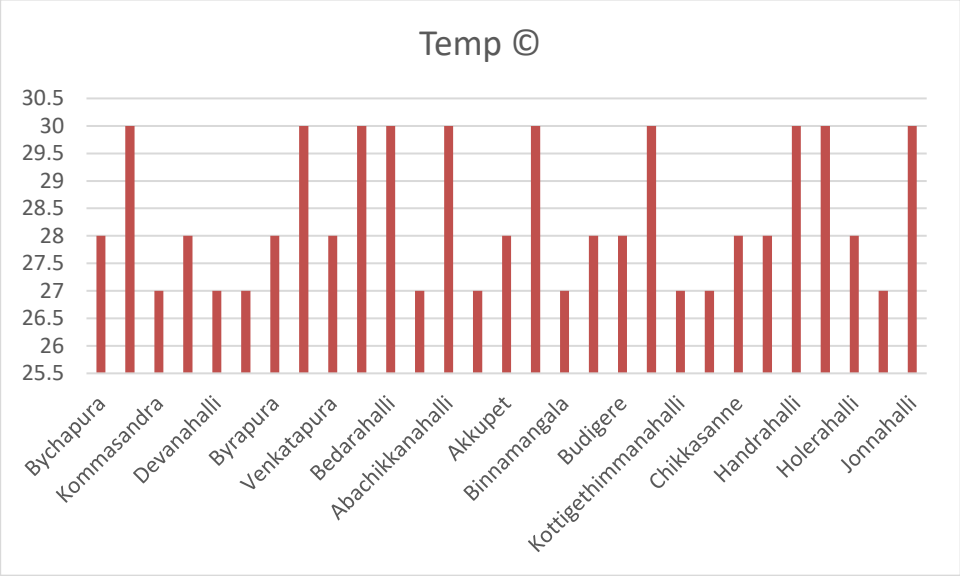

Figure 3: Represents the physical parameter temperature of water sample

TABLE-6 RESULT

SL. NO	LOCATION	Taste	Odor
1-30	All 30 Location Mentioned Above	Agreeable	Agreeable

TABLE – 7,8,9, SHOWS THE RESULTS OF CHEMICAL PARAMETERS

TABLE-7 RESULT

SL. NO	LOCATION	PH	Alkalinity	Hardness
1	Bychapura	6.51	**98**	**372**

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2	Doddasanne	6.78	**166**	**865**
3	Kommasandra	6.5	110	272
4	Dharamapura	7.81	**256**	269
5	Devanahalli	7.2	79	210
6	Bettakote	7.68	96	91.6
7	Byrapura	6.63	203	364
8	Kasaba	6.89	313	109.1
9	Venkatapura	7.08	**265**	272
10	Varadhenahalli	7.7	105	44.0
11	Bedarahalli	7.57	102	281
12	Kondenahalli	8.2	115	48
13	Abachikkanahalli	8.15	107	115.2
14	Agalakote	6.52	**202**	**370**
16	Akkupet	6.68	**311**	**849**
17	Anighatta	6.5	93.0	270
18	Binnamangala	7.7	**246**	266
19	Boovanahalli	7.1	113	208
20	Budigere	6.5	76.7	93.6
21	BudigereAmanikee	7.03	165	324
22	Kottigethimmanahalli	6.52	109	106.1
23	Chikkannanahosahali	7.52	**254**	262
24	Chikkasanne	6.52	101	54.0
25	Gobbarakunte	6.7	258	56.45
26	Handrahalli	7.6	107	107.4
27	Hegganahalli	7.8	118	278
28	Holerahalli	7.55	97	211.5
29	Irigenahalli	6.68	94	374
30	Jonnahalli	7.04	105	335

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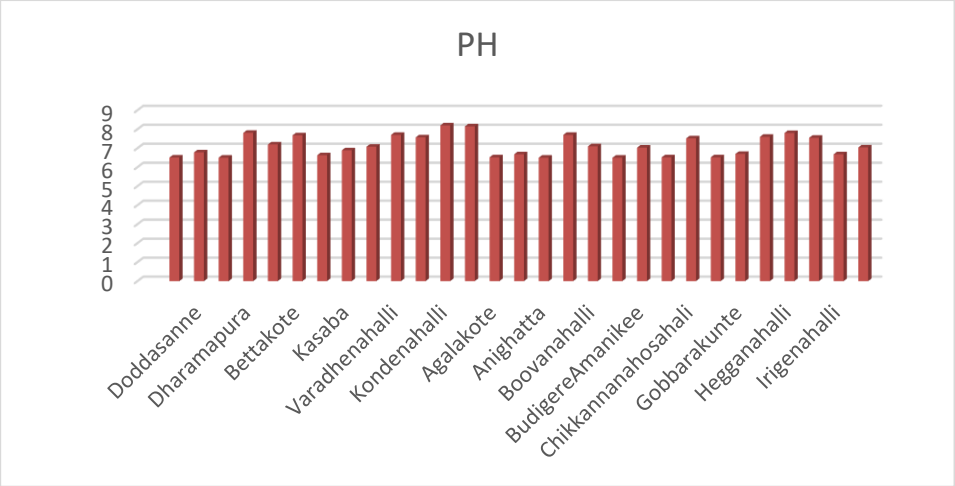

Figure 4: Represents the chemical parameter PH of water sample

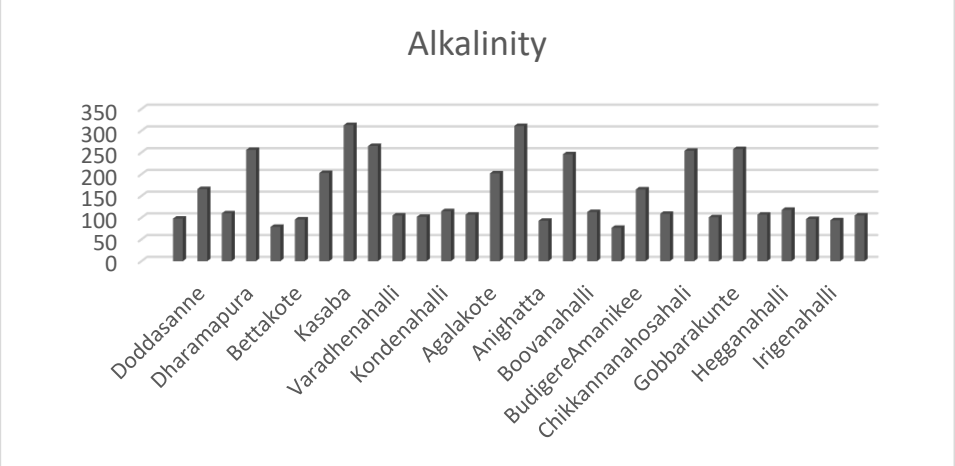

Figure 5: Represents the chemical parameter Alkalinity of water sample

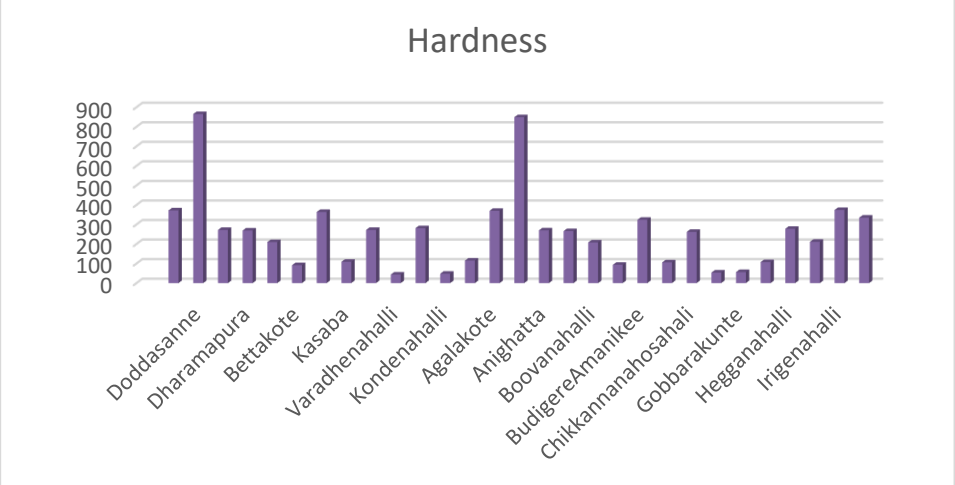

Figure 6: Represents the chemical parameter Hardness of water sample

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TABLE-8 RESULT

SL NO	LOCATION	Cl (Mg/l)	Ca (Mg/l)	TDS (Mg/l)
1	Bychapura	176	**109**	**678**
2	Doddasanne	**498**	**230**	**1649**
3	Kommasandra	159	78.3	**529**
4	Dharamapura	78.3	72.0	**548**
5	Devanahalli	162	59.0	509
6	Bettakote	77.4	24.0	289
7	Byrapura	153	**89.0**	**626**
8	Kasaba	58.8	29.0	310
9	Venkatapura	192	**88.0**	**588**
10	Varadhenahalli	38.0	19.0	219
11	Bedarahalli	78.5	24	645
12	Kondenahalli	161	49	638
13	Abachikkanahalli	174	57	789
14	Agalakote	455	119	260
16	Akkupet	161	**108**	**650**
17	Anighatta	**489**	**236**	**1640**
18	Binnamangala	158	73.3	**520**
19	Boovanahalli	74.3	70.0	**520**
20	Budigere	142	55.0	500
21	BudigereAmanikee	70.4	25.0	280
22	Kottigethimmanahalli	123	**83.0**	**620**
23	Chikkannanahosahali	50.8	25.0	210
24	Chikkasanne	112	**80.0**	**582**
25	Gobbarakunte	39.0	15.0	210
26	Handrahalli	119	118	289
27	Hegganahalli	51.9	258	646
28	Holerahalli	148	248	639
29	Irigenahalli	167	256	770
30	Jonnahalli	187	54	215

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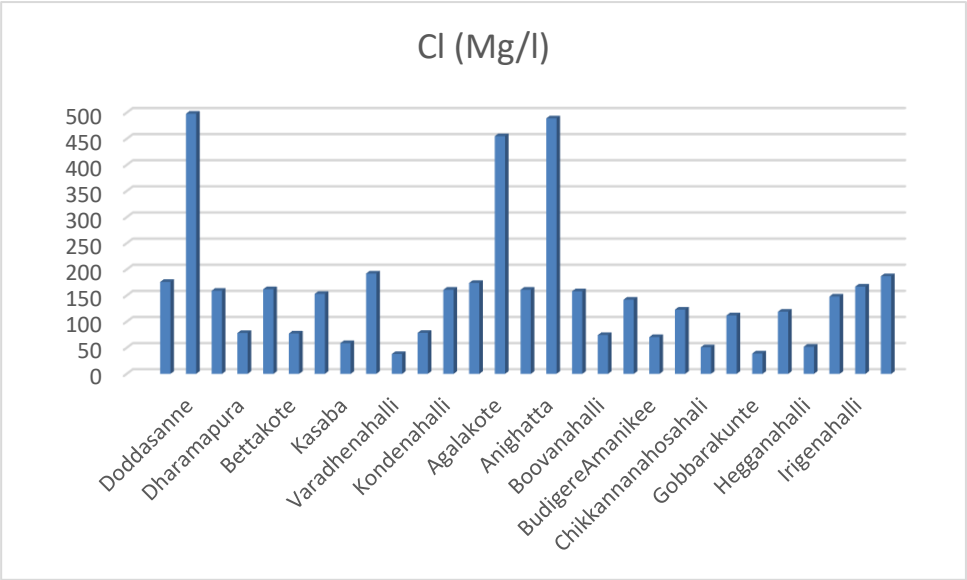

Figure 7: Represents the chemical parameter Chlorine of water sample

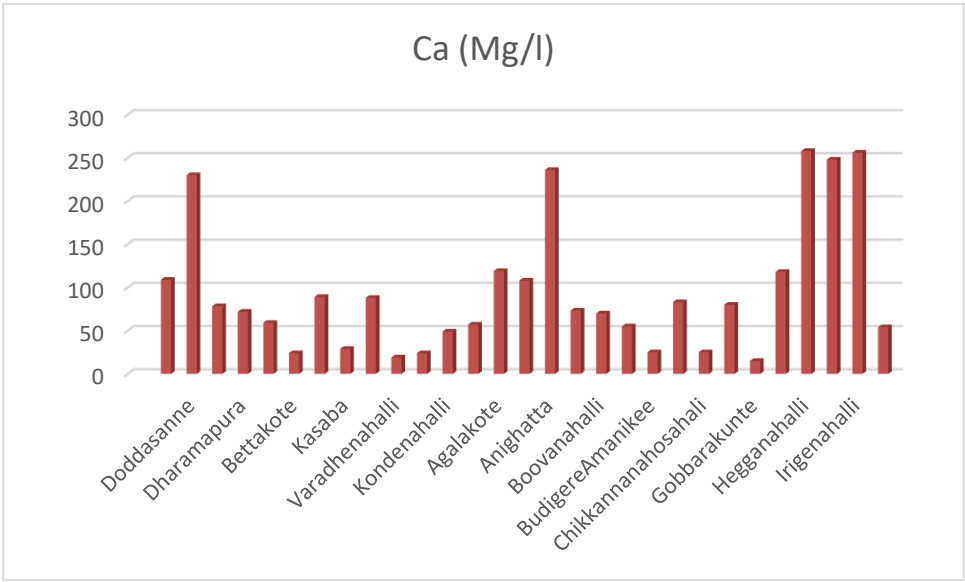

Figure 8: Represents the chemical parameter Calcium of water sample

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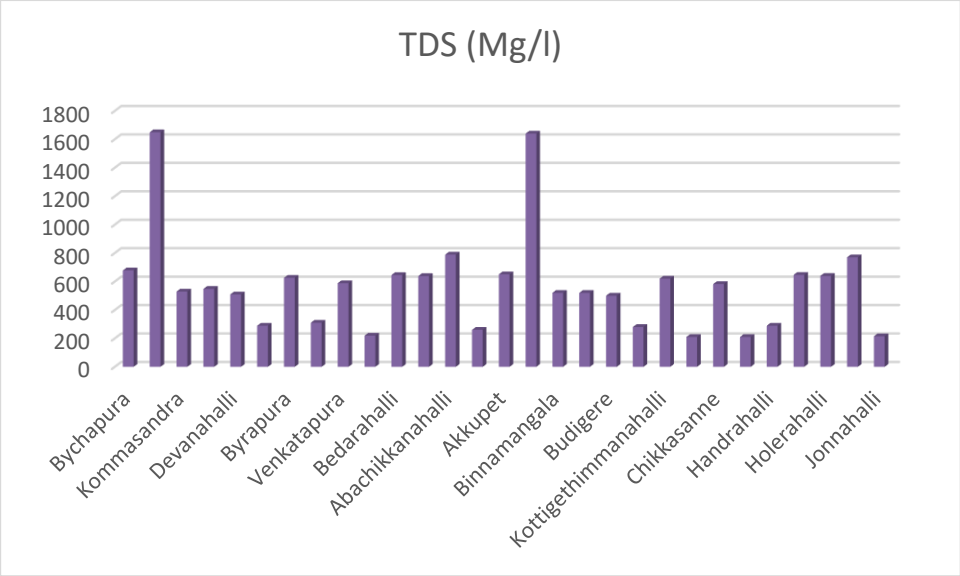

Figure 9: Represents the chemical parameter Total dissolved solids of water sample

TABLE-9 RESULT

SL NO	LOCATION	NO_3 (Mg/l)	Mg (Mg/l)	NH_4 (Mg/l)	SO_4 (Mg/l)
1	Bychapura	5.9	28.0	0.019	49.9
2	Doddasanne	2.3	19.9	0.015	6.0
3	Kommasandra	5.9	25.0	0.04	48.8
4	Dharamapura	1.7	6.0	0.08	4.0
5	Devanahalli	8.0	24.2	0.02	47.7
6	Bettakote	6.0	**62.6**	0.02	108
7	Byrapura	5.7	21.2	0.05	43.4
8	Kasaba	6.7	22.2	0.045	42.4
9	Venkatapura	4.5	17.0	0.065	6.9
10	Varadhenahalli	3.2	7.5	0.035	3.7
11	Bedarahalli	4.5	17.0	0.035	7.9
12	Kondenahalli	2.2	7.5	0.035	3.7
13	Abachikkanahalli	5.2	28.3	0.045	48.9
14	Agalakote	2.0	10.6	0.015	4.0
16	Akkupet	6.0	24.2	0.02	47.7
17	Anighatta	8.0	**62.6**	0.01	108
18	Binnamangala	4.7	21.2	0.04	42.4
19	Boovanahalli	4.7	22.2	0.035	42.4
20	Budigere	4.5	17.0	0.045	7.9

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21	BudigereAmanikee	2.2	7.5	0.025	3.7
22	Kottigethimmanahalli	5.2	28.3	0.015	48.9
23	Chikkannanahosahali	2.0	10.6	0.010	4.0
24	Chikkasanne	5.6	16.0	0.05	41.8
25	Gobbarakunte	1.4	4.0	0.09	4.0
26	Handrahalli	4.5	16.0	0.045	7.8
27	Hegganahalli	2.2	6.5	0.025	3.6
28	Holerahalli	5.2	31.3	0.015	48.7
29	Irigenahalli	2.0	10.7	0.010	4.25
30	Jonnahalli	4.5	17.25	0.045	7.84

Figure 10: Represents the chemical parameter Nitrate of water sample

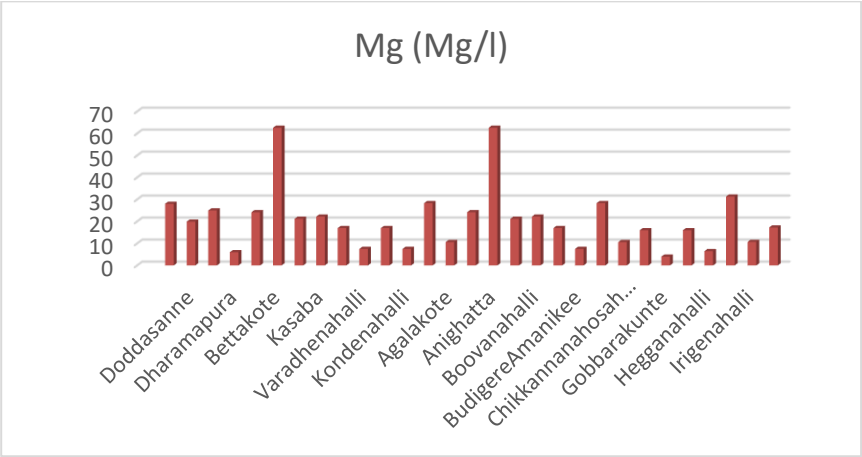

Figure 11: Represents the chemical parameter Magnesium of water sample

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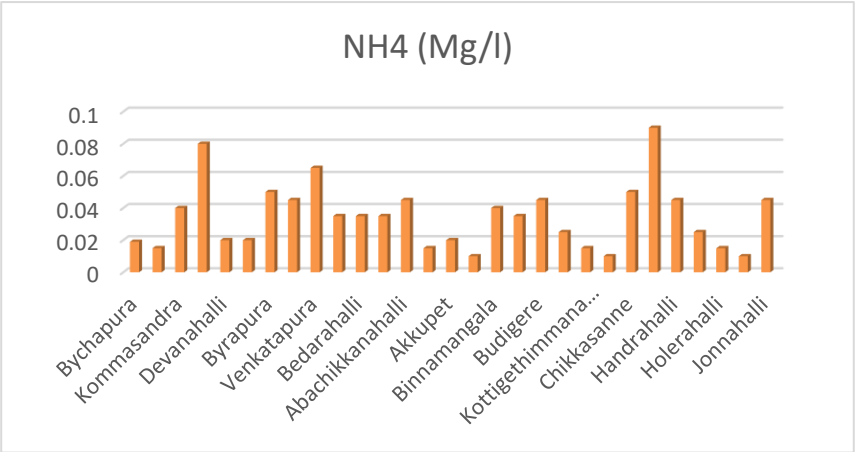

Figure 12: Represents the chemical parameter Ammonium of water sample

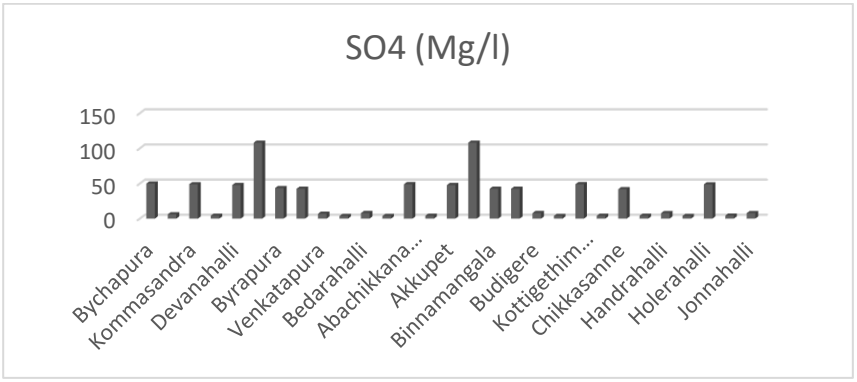

Figure 13: Represents the chemical parameter Sulphates of water sample

TABLE-10 WQI RESULTS

SL NO	LOCATION	ERQUALITY INDEX.	RANKING
1	Bychapura	95.829	Good.
2	Doddasanne	92.677	Good.
3	Kommasandra	91.407	Good.
4	Dharamapura	92.407	Good.
5	Devanahalli	100	Excellent.
6	Bettakote	100	Excellent.
7	Byrapura	96.323	Excellent.
8	Kasaba	95.542	Excellent.
9	Venkatapura	100	Excellent.
10	Varadhenahalli	94.829	Good.
11	Bedarahalli	100	Excellent.
12	Kondenahalli	94.829	Good.

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13	Abachikkanahalli	93.677	Good.
14	Agalakote	94.407	Good.
16	Akkupet	94.407	Good.
17	Anighatta	100	Excellent.
18	Binnamangala	100	Excellent.
19	Boovanahalli	96.323	Excellent.
20	Budigere	100	Excellent.
21	BudigereAmanikee	95.542	Excellent.
22	Kottigethimmanahalli	100	Excellent.
23	Chikkannanahosahali	94.829	Good.
24	Chikkasanne	93.677	Good.
25	Gobbarakunte	94.40	Good.
26	Handrahalli	94.407	Good.
27	Hegganahalli	100	Excellent.
28	Holerahalli	100	Excellent.
29	Irigenahalli	96.323	Excellent.
30	Jonnahalli	94.407	Good.

Table-10 shows the detail of water quality index found by CCME method.

The attribute database and spatial data was created for the water sample and was combined for generation of spatial variation of maps of some parameters such as PH, turbidity, sulphate etc. based on shape file obtained maps were prepared for the study area. This Water quality map aids us in knowing the condition water. In physical parameters that include taste color odor and turbidity all the 10 sample meet the requirements and are safe to drink as per BIS standards In chemical parameters test was performed on PH Alkalinity Hardness Chloride Calcium

Total dissolved solids, Nitrate Magnesium Ammonia Sulphate and the findings were as follows

PH

The pH range should be between 6.5-8.5 as per BIS for consumption. In the current study all the 10 samples meet the requirements Alkalinity

The Alkalinity level should be less than 200 mg/l as per BIS for drinking. In the current study 06 samples meet the criteria.

Total Hardness

Range of Total Hardness should be less than 300 mg/l as per BIS for drinking. In the current study 08 samples meet the requirements

Chloride

Range of Chloride should be less than 250 mg/l as per BIS for drinking. In the current study 09 samples meet the requirements

Calcium

Range of Calcium should be less than 75 mg/l as per BIS for drinking. In the current study 08 samples meet the requirements

Total Dissolved Solids

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Total Dissolved solids range should be less than 500 mg/l as per BIS for drinking. In the current study 04 samples meet the criteria Nitrate

Nitrate range should be less than 45 mg/l as per BIS for drinking. In the current study all the 10 samples meet the criteria.

Magnesium

Magnesium range should be less than 30 mg/l as per BIS for drinking.

? n the present study 09 samples satisfy the criteria Ammonia

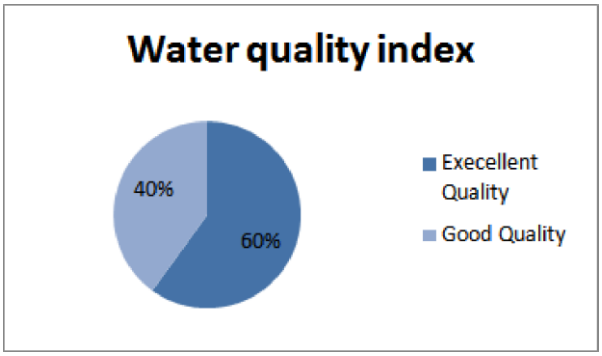
Ammonia range should be below >0.05 according to BIS for drinking. In the present study all the 10 samples satisfy the criteria Sulphate

Sulphate

Sulphate range should be below 200 mg/l according to BIS for drinking. In the present study all the 10 samples satisfy the criteria

Conclusion

- As per calculation of WQI we conclude that 40% of water sample has achieved good ranking and 60% water sample has achieved excellent ranking as per CCME WQI.
- We have noticed sample collected from some villages are having dip in WQI index hence we have to concentrate on treatment methods or plants for treatment in these villages and advice the local famers to use fertizers and pesticides judicially.
- In other villages water quality is excellent and we need to maintain the water quality index by educating the people
- As on 2021 all the 10 tested sample are suitable for drinking.
- Villages with Good quality are Attibele, Avathi, Bullahali, and Byrapanahalli. Villages with Excellent quality are Gobbarakunte, Gonuru, Kodag Urki, Kurburakunte, Venkatagiri Kote, and Yelur.



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