# DRINKING WATER QUALITY INDEX FOR ANAND TALUKA

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***Abstract:*** This study has been undertaken to determine the Drinking Water Quality Index (WQI) of the Anand taluka which is located in Anand District, Gujarat. WQI is evaluated by Weighted mean and parameters: Alkalinity, calcium, pH, Total Hardness, Magnesium, Turbidity, Total Dissolved Solids, Fluoride, Nitrate, Chloride and Most Probable Number Test (MPN). By Spatial variation, 20 villages are used as sampling points. The water samples are taken from the borewells of the 20-selected location. The water quality analysis is done with the references as per APHA, Standard Methods for The Examination of Water and Waste Water and Gujarat Pollution Control Board Manual and the permissible limits is considered as recommended in BIS 10500 :2012. Water quality is measured for January, February and March of 2018. The overall quality of drinking water in Anand Taluka falls in the category of "Poor Water Quality" which is "GRADE – C" as per Weighted Arithmetic Water Quality Index Method.

*Index Terms* - **Water quality, Analysis, Weighted Arithmetic Water Quality Index Method, Physico-chemical analysis.**

## I. INTRODUCTION

One of the most important natural resource of any country is water. Water is remedy for all the biotic elements of life. "There is no life without water" and water is that the one in all the ordinarily used for all day to day basic activities that supports life. Water is a restricted, vulnerable, property quality on the world and depicts important aspect in the environment as it continuously and systematically cycles between the earth and the air. A water that is utilized for animals and plants breeding is likewise being imparted to the people and the marine, biological communities. Steady increment in water exploitation because of increasing development and population has brought about upsurge demand in use of table of water underground as compared to surface water which has precipitates groundwater decrease. The groundwater health is deteriorating because of mining exercises and transfer of immense modern effluents.

## II. WATER QUALITY INDEX

Water Quality Index is a mathematical expression which converts large numbers of sets of water quality data into a single form and the obtained single number displays the overall drinking water quality characteristics. WQI is a useful tool for quick and efficient estimation of any water resource and its suitability of use and enumerates the health of water.

A. Water Quality Indices are calculated in two different steps:

1. First is analysis of raw data for selected water quality parameters, having dissimilar units of measurement and are converted into unit less sub index values.
2. Next is to calculate sub-indices and then aggregation of sub-indices using some type of mathematical function to calculate a WQI value.

B. Types of Water Quality Indices in the world:

1. Oregon Water Quality Index (OWQI)
2. Weighted Arithmetic Water Quality Index Method
3. National Sanitation Foundation Water Quality Index (NSFWQI)
4. Canadian Council of Ministers of the Environment Water Quality Index (CCME WQI)

Here, Weighted Arithmetic Water Quality Index Method has been used for the study

For registering WQI three stages were taken after. In the initial step, each of the parameters has been aasigned a weight (wi) as indicated by its relative significance in the general nature of water for drinking reason. In the second step, the relative weight is registered

$$WQI=\sum WQI/\sum W_i \quad \text{.....Equation 1}$$

Where, Wi is relative weight, wi is the weight of every parameter and n is the quantity of parameter. In the third step, a quality rating scale (qi) for every parameter is appointed by dividing its concentration in each water sample by its separate standard as per the rules set around BSI and the product of result obtained into 100.

The quality rating scale (Qi) for each parameter is calculated by using below expression:

$$Qi=100[V_i-V_0/S_i-V_0]$$ ……Equation 2

$V_i$ is estimated concentration of $i^{th}$ parameter in the analysed water.
$V_0$ is the ideal value of this parameter in pure water
$V_0$= 0 (except pH =7.0 and DO = 14.6 mg/l
Si is recommended standard value of $i^{th}$ parameter.
The unit weight (Wi) for each water quality parameter is calculated by using the following formula:

$$W_i=K/S_i$$ .....*Equation 3*

K = proportionality constant and can also be calculated by using the following equation:

$$K=\frac{1}{\Sigma\left(\frac{1}{Si}\right)}$$ ……Equation 4

Table 1-Water Quality Rating as per Weight Arithmetic Water Quality Index Method

| WQI Value | Rating of Water Quality | Grading |
|---|---|---|
| 0-25 | Excellent water quality | A |
| 26-50 | Good water quality | B |
| 51-75 | Poor water quality | C |
| 76-100 | Very Poor water quality | D |
| Above 100 | Unsuitable for drinking purpose | E |

## III. AREA OF STUDY: ANAND TALUKA

1. Anand is spread over the area of 2941 $km^2$ and is located between the cities of Ahmedabad and Vadodara. Its east longitudes are 72°20' and 73°12' and north scopes 22°06' and 22°43'.
2. It is well known for "THE AMUL" Milk cooperative and also called as "MILK CITY".
3. The water of this area is under Mahi Right Bank Canal Command Area(MRBC), which has a system of channel. Population is 609,307 according to the census 2011.
4. The mean maximum temperature ranges from at 28.4°C during January to 41.8°C during May and minimum is between 11.7°C during January 27°C during June. The rainfall measured is 799.6 mm and is mostly received in the month of June and September.
5. The net region which is irrigated by Government canals is 95700 ha. The harvests are developed in every one of the three seasons. The primary kharif crops are paddy and Jowar. Wheat and pulses are the primary rabi crops. The main harvests taken amid summer are Jowar and groundnut. The two harvests, to be specific tobacco and cotton are spread over the kharif and rabi seasons. Sugarcane is the primary enduring product.
6. Most of the drinking water is delivered from the unconfined aquifers.

## IV. RESEARCH METHODOLOGY

The following steps are established for this research project

### 4.1 Selection of Parameters

Especially for the potable water analysis , the primary reason of selection of the parameters are of those elements which are essential and effects the health of the living creatures .Additionally, elements which are present in specific concentrations.
The parameters chosen for this study are experimented as per prescribed by BIS-10500: 2012.
The following tables shows the prescribed selected parameters. Method used to analyses and concentration recommended by BIS – 10500: 2012. The tests are performed as per APHA and GPCB Manual.

| Sr No. | NAME | METHOD TO BE USED | Permissible Limit as per BIS 10500:2012 |
|---|---|---|---|
| 1 | **ALKALINITY** | 2320 B- Titration Method | 200 mg/L |
| 2 | **CALCIUM AND MAGNESIUM** | EDTA Titrimetric Method | Calcium – 75 mg/L<br>Magnesium – 30 mg/L |
| 3 | **HARDNESS** | 2340 C - EDTA Titrimetric Method | 200 mg/L |
| 4 | **pH** | Electrometric Method | 6.5-7.5 |

| | | | |
|---|---|---|---|
| 5 | **TOTAL DISSOLVED SOLID (TDS)** | 2540 C-Total Dissolved Dried At 180° C | 500 mg/L |
| 6 | **TURBIDITY** | 2130 B –Nephelometric Method | 1 NTU |

| | | | |
|---|---|---|---|
| **INORGANIC NONMETALLIC CONSTITUTENTS** | | | |
| 7 | **CHLORIDE** | 4500 -Titration Method | 250 mg/L |
| 8 | **NITRATE** | 4500 B – Ultraviolet Spectrophotometric Screening Method | 45 mg/L |
| 9 | **FLOURIDE** | 4500- D SPANDS Method | 1 mg/L |

| | | | |
|---|---|---|---|
| **MICROBIOLOGICAL EXAMINATION OF WATER** | | | |
| 10 | **MOST PROBABLE NUMBER (MPN)** | Standard Total Coliform Multiple Tube | NIL COUNT |

Table 2- Parameters and Analysis Methods

**4.2 SELECTION OF LOCATIONS**

The location is selected according to the Uniform distribution of villages and Spatial variations varying from place to place in the district and the sampling points are distributed as it covers most the area of the taluka. The sampling sites are bore wells of the villages selected are as follows:

Table 3- Sampling Locations

| | | | |
|---|---|---|---|
| ADAS | HADGOOD | KUNJRAV | SUNDAN |
| AJARPURA | JITODIA | LAMBHVEL | VALASHAN |
| BEDVA | JOL | MOGAR | VASAD |
| GAMDI | KHANDHALI | SANDESAR | VAHERAKHADI |
| GANA | KHAMBHODAJ | SARSA | TRANOL |

**4.3 SAMPLING**

A. GENERAL CONSIDERATION

1. Obtaining a sample which is meets all the requirements of the sampling program and is handled in such a way that it does not get contaminated before it is tested.
2. All the sampling equipment should be clean and quality assured. Heat at $450^0$C if the glass bottles are to be used for organic experiments sampling.
3. The sample container is to be filled without pre-rinsing with sample, as this results in loss of any pre-added preservative.

B. SAFETY CONSIDERATION

1. Prohibit eating, drinking or smoking near the samples or sampling locations or the laboratory.
2. Sparks , excessive heat sources and flames are to be kept away from the sample and the locations .Label properly any sample known to be hazardous.

C. ON THE FIELD

If it is groundwater source which is flowing spring or a well equipped with a pump, the sample will be obtained at the point of discharge. The water will be allowed to flow for several minutes before sampling until it has reached constant conductivity or temperature in order to avoid any water resident in the system's piping being taken as a sample (the piping material may have contaminated the water).

Special care will be taken when sampling from springs that do not have an overflow and from shallow wells without pumps. The sampling container will be not being allowed to touch the bottom of the well or spring catchment since this would cause settled particles to become resuspended and to contaminate the sample. Sometimes, a spring catchment is higher than the surrounding ground and this permits water to be siphoned into the sample bottle. If this is done, water will be allowed to run through the hose for 2 - 3 minutes to rinse it thoroughly before the sample is collected. A ground-water sample can only be obtained as a grab sample. Water samples are usually obtained by filling a container held beneath the surface of the water – commonly referred to as a dip or **Grab sample**. A sample taken at a specific time and point which gives an indication of the water quality at that point in time.

Sampling of the samples will be done from shallow well of selected location in a polyethene bottle. The following procedures summarize the major aspects:

1) **Sample labels:** Labels are used to prevent sample misidentification as well as to identify the collected sample. Each sample bottle must be provided with an identification label.
2) **Sample seals:** Sample seals are used to detect unauthorized tampering with samples up to the time of analysis.
3) **Field log book: To** Record all information pertinent to a field survey or sampling.

D. SAMPLING BOTTLES

For Physico-chemical Paramters storage sampling storage bottle can in glass or polyethylene bottles at a low temperature (e.g. 4 °C) in the dark is recommended. Sample bottles must be clean but need not be sterile. Special preservatives may be required for some analytes. Residual chlorine, pH, and turbidity should be tested immediately after sampling as they will change during storage and transport.
For Biological examination the sample bottle should of sterilized glass bottle of 300 ml. The box used to carry samples should be cleaned and disinfected after each use to avoid contaminating the surfaces of the bottles and the sampler's hands.

## V.EXPERIMENTAL ANALYSIS RESULTS

Figure 1-Alkalinity

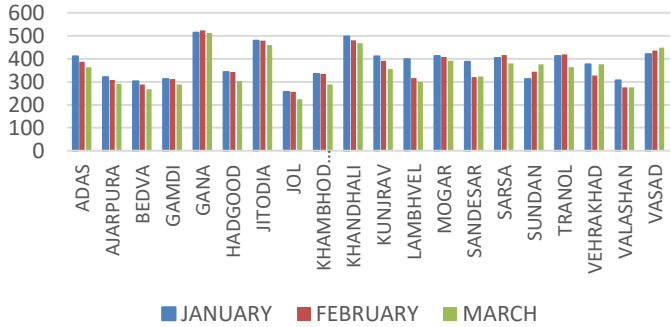



Figure 2 - pH

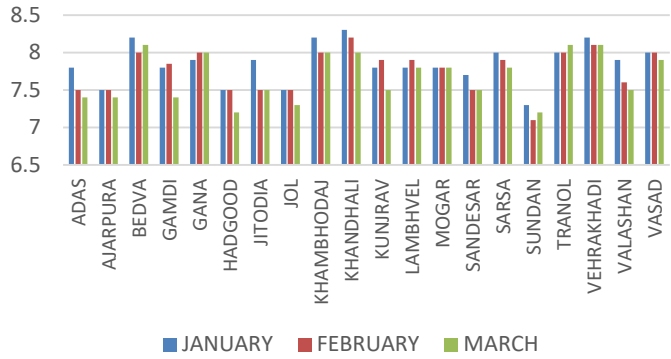



Figure 3-TDS

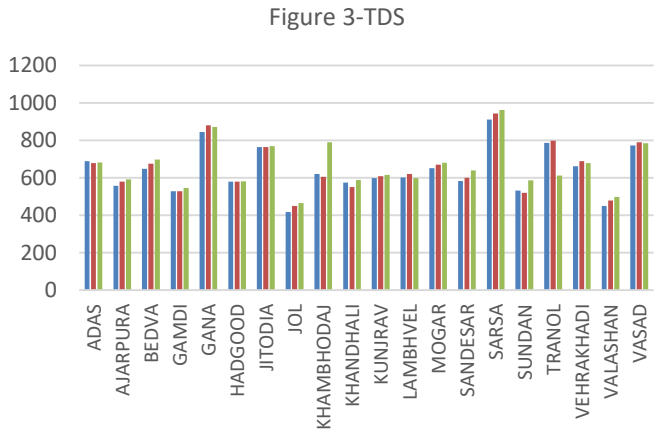



Figure 4-Turbidity

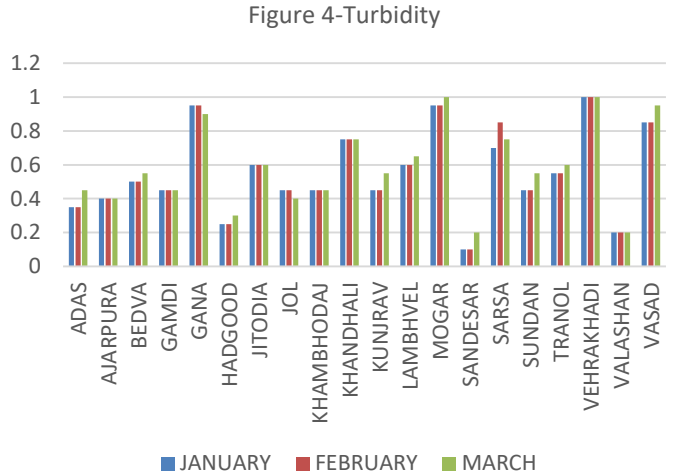



Figure 5-Hardness

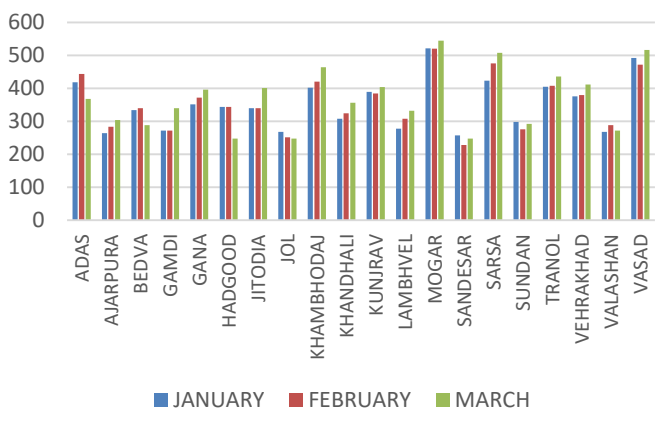



Figure 6 -Calcium

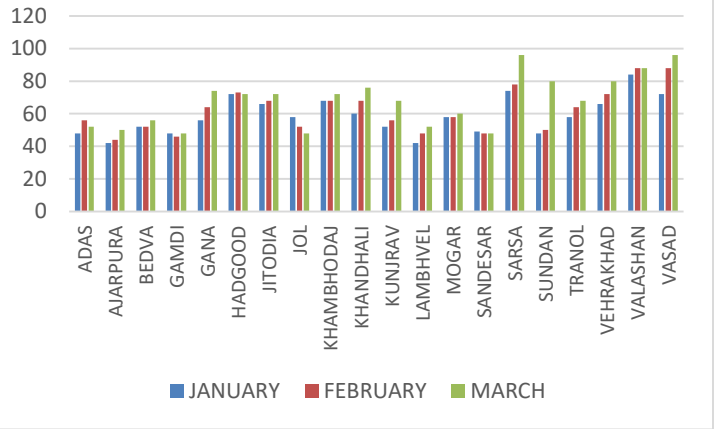


Figure 7-Flouride

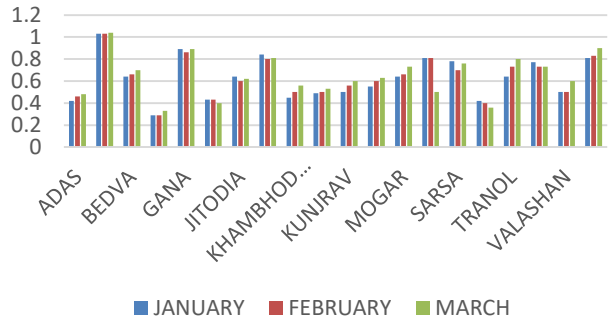



Figure 8- Chloride

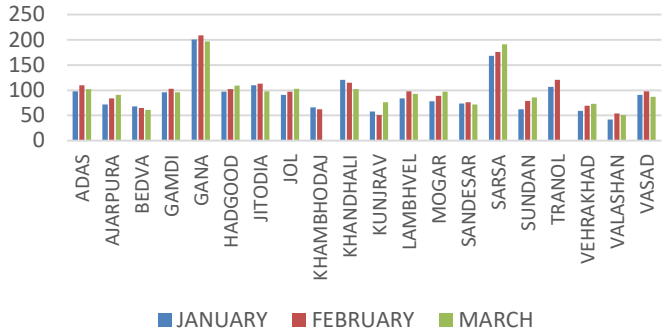



Figure 9-Nitrate

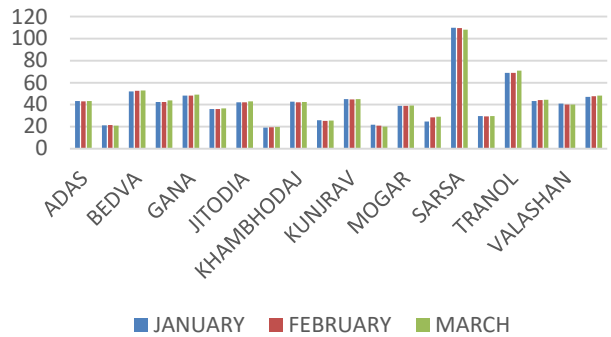
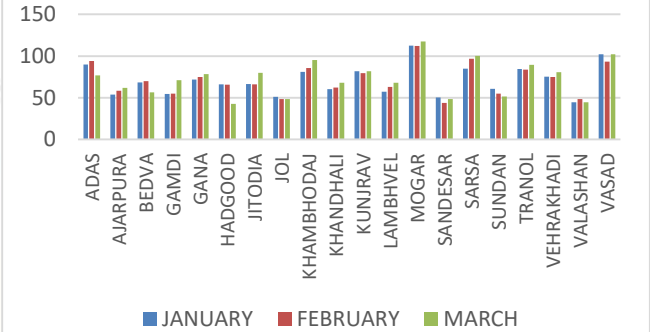



Figure 10-MAGNESIUM




MPN tests in all the areas were negative

## VI. CALCULATIONS AND OBSERVATION

- **$W_i$=K/Si**

  **K =0.454**

*Table 4- Weight for each parameter to calculate WQI*

| PARAMETER | ALKALINITY | CALCIUM | HARDNESS | pH | MPN | TOTAL DISSOLVED SOLID (TDS) | TURBIDITY | CHLORIDE | NITRATE | FLOURIDE |
|---|---|---|---|---|---|---|---|---|---|---|
| Wi | 0.00227 | 0.006053 | 0.00227 | 0.053412 | 0.0908 | 0.000908 | 0.454 | 0.001816 | 0.010089 | 0.454 |

* MPN is not included in the calculation

With the use of Equation 1, 2 ,3 and 4 The WQI of each sampling point is calculated.

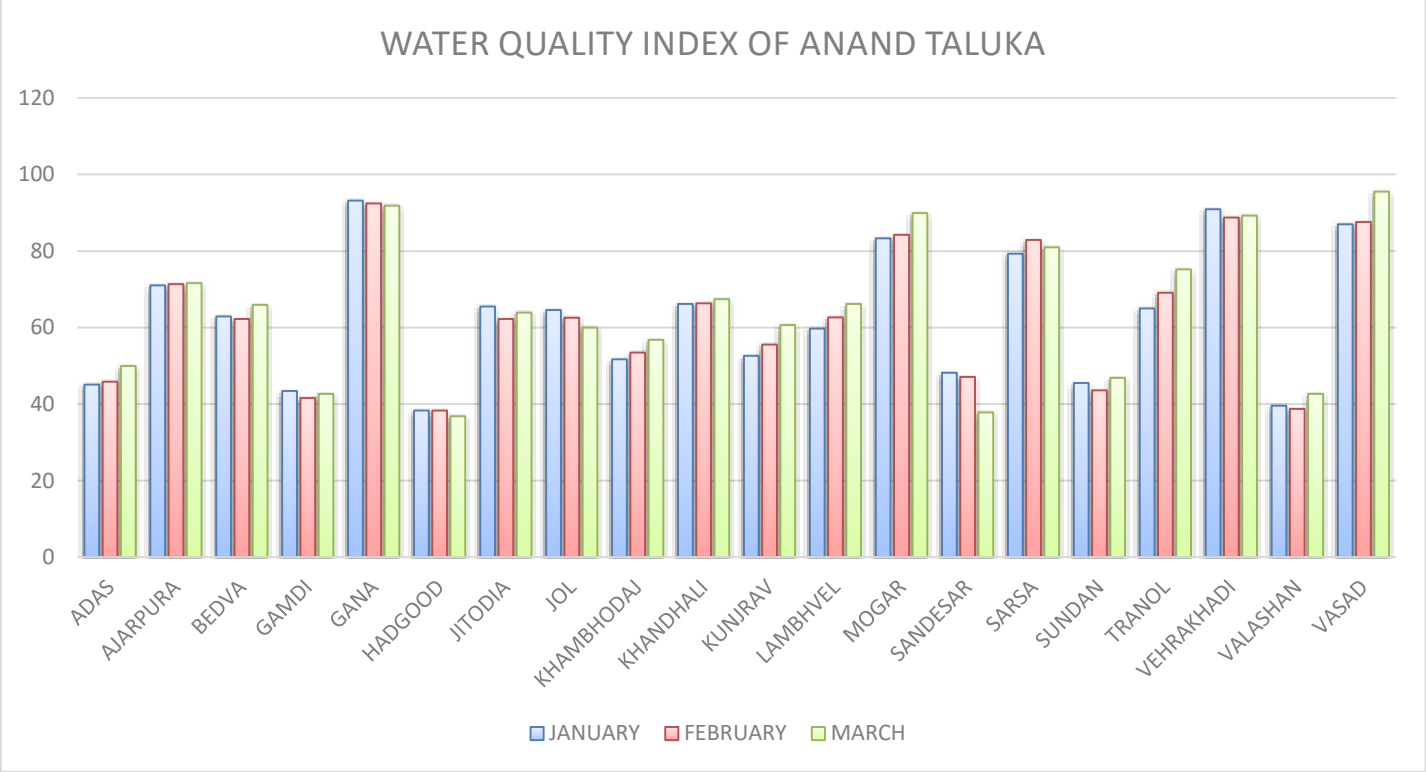



Figure 11-WATER QUALITY INDEX OF ANAND TALUKA

6.2. WQI OF OVERALL ANAND TALUKA

TOTAL WQI OF ONE MONTH = AVERAGE OF THE WQI OF 20 VILLAGES

= WQI OF ∑ (ADAS + AJARPURA+ BEDVA+ GAMDI+ GANA+ HADGOOD+ JITODIA+ JOL+ KHAMBHODAJ+ KHANDHALI+ KUNJRAV+ LAMBHVEL+ MOGAR+ SANDESAR+ SARSA+ SUNDAN+ TRANOL+ VEHRAKHAD+ VALASHAN+ VASAD)÷ 20

A. JANUARY = **62.65**
B. FEBRUARY= **62.83**
**C.** MARCH = **64.60**

**VII.CONCLUSION**

From Table 1, it is manifested that the overall drinking water of Anand Taluka falls in the category of "POOR QUALITY" of drinking water with the grade "**C"** which ranges from **62.65** in January**, 62.83** in February and **64.60** in March. The main contribution for poor quality of water is high concentration of Alkalinity which ranges from 257 - 524 mg/L, Hardness varies from 264-544 mg/L, TDS from 417-962mg/L, Magnesium from 44-112mg/L and Nitrate which is present from 18.98-110 mg/L. This all values exceeds the permissible limits in all of the selected locations for sampling. Turbidity, Calcium, pH, Fluoride are all within the limits in all the tested location. MPN in every sample is NIL.

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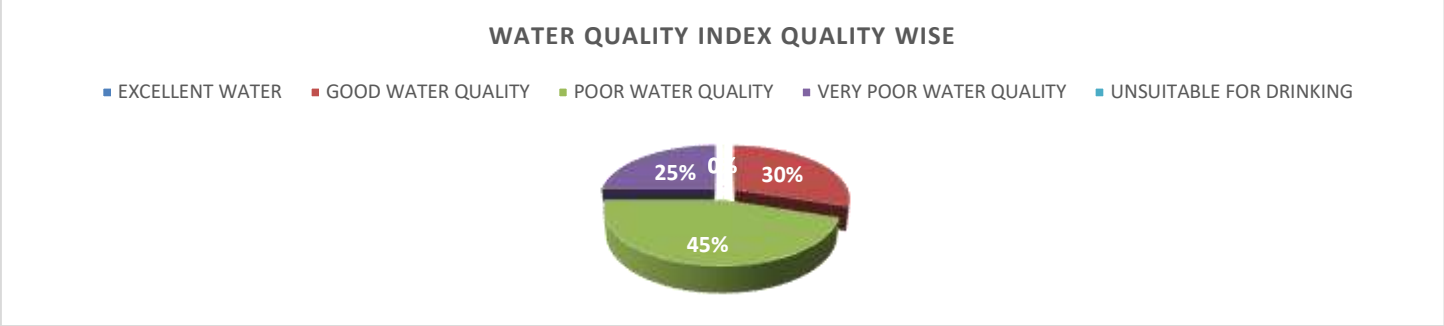


The possible reasons for this may be

A. As Anand consists of unconfined aquifer, the contaminated surface water leaches easily in the ground water.
B. The depth of the borewell is very important factor affecting the water quality in Anand. The good quality of water is present deep inside the ground, so borewells should be constructed deep to drain that water out. Less deep borewells only provides the water which is percolated through surface and is contaminated.

## V. ACKNOWLEDGMENT

I am particularly grateful for the assistance given by Prof. (Mrs) Reshma L. Patel for her valuable and priceless suggestions during the planning and development of this work. Her willingness to give her time so generously has been very much appreciated.

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