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# ANALYSIS OF WATER QUALITY FOR SELECTED PARAMETERS AT DIFFERENT LOCATIONS IN PANDHARPUR TOWN, SOLAPUR DISTRICT, MAHARASHTRA

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## ABSTRACT

The necessity of clean drinking water appears in all forms of life and is a right of all life forms. A majority of epidemics are a direct or indirect result of contaminated forms of drinking water. Deterioration of water quality could be due to various reasons, like open defecation, bathing in or near to water sources and other reasons. But safe drinking water is a right of life. The quality of drinking water can be tested for its Physical-Chemical characteristics. Pandharpur is a town in the Solapur district of Maharashtra and experiences huge mass gatherings during pilgrimage occasions popularly known as '*Wari'* at least three times annually. In this respect assessment of water quality analysis was done for select parameters in the study area for the lockdown period, for which, water samples were collected from different water supply zones, bore wells, and different locations along the river stretch. The present research paper shows spatial assessment of water quality for select parameters at different locations from the study area.

**Keywords: Assessment, Water Quality, Selected Parameters, physical-chemical**

## INTRODUCTION:

Today, most countries are experiencing unprecedented demand for fresh water supplies. The worldwide population is rapidly increasing, and present practices are expected to result in a 40% deficit between predicted demand and available supply of water by 2030 (The

World Bank 2020). Feeding 9 billion people by 2050 will necessitate a 60% increase in agricultural production and a 15% rise in water demands. Aside from the rising demand, the resource is already in short supply in many regions of the world. According to estimates, 40 percent of the world's population lives in water-scarce areas, and close to a quarter of the world's GDP is vulnerable to this dilemma.According to the WHO, there are 2.5 million fatalities and 4 million instances of diarrheal illnesses, including dysentery, with water-borne pathogens being key causes. There are still an estimated 12.5 million cases of salmonella typhoid each year, and many underdeveloped nations have endemic waterborne infections.

India has 18% of the world's population and around 4% of the world's water resources. The majority of rain in India falls during the monsoon season (June to September). India has around 20 river basins; however, due to increased demand for household, industrial, and agricultural purposes, the majority of river basins are water stressed. The Deccan plateau region receives 50 to 100 centimetres of rain each year on average.

Pandharpur is a popular pilgrimage destination in Maharashtra. It is situated on the banks of the Bhima River, commonly known as the Chandrabhaga. Huge people converge at Pandharpur as a visual symbol of the god 'Vithoba's' trust. Thousands of devotees visit here every day, and the number grows on Ekadashi and full moon days (Poornima) of each month. As a result, basic amenities like as sanitation, accommodation, and, most importantly, water is required during pilgrimage. As a result, it was decided to investigate the quality of water supplied to the town by the Municipal Council.

The purpose of this study is to conduct an examination to determine the quality of drinking water. The basis for judging the safety of drinking water is based on national standards and international norms. The primary goal is to avert a future health disaster induced by the intake of contaminated drinking water in the face of rising urbanisation, water shortages, and climate change (Table 1).Sufficiently meeting the needs of this changing population during Wari and Tithi is becoming increasingly challenging as they place additional strain on an already stressed system of basic resources available to the local people. Solutions to the challenges would need basic data on the quality of water at various points across the Town.

**MATERIALS AND METHODS:**

Data source is divided into primary

and secondary data. Primary data collected during the Field Visit, Data gathering pertaining to water supply service and collection of water samples. Questionnaire filled from Pilgrims, Government Offices, and Local people.

Secondary data collected from different sources, i.e. Survey of India toposheets 47 O/6 and 47 O/6 NW, scales 1:50000 and 1:25000, Google Image- from Google Earth, Demographic information from the year 1991, 2001, and 2011 Primary Census Abstracts Census of India, Directorate of Census Operations.Basic Utility Services data collected from Pandharpur Municipal Council.

To achieve numerous goals, the current research project has used a rigorous and methodical technique. It primarily consists of a literature review, data collection, sampling, testing, findings, base maps, discussion, analysis, and conclusion.

Eleven water samples were obtained from several Elevated water tanks across the town, four from different bore wells, and three from River Chandrabhaga **(Figure 1)**. These water samples were then evaluated using three separate methods, namely bacterial testing, Minerals testing, and pH testing. After result tabulation have used Arc GIS, maps are constructed based on each parameter, displaying the results of each ward (Mapping). The results were then analysed, discussed, and concluded using GIS mapping through all parameters of drinking water **(Table 2)**.

**Observations and Result:**

There are 18 water samples analysed using the following parameters: Bacterial Plate Counts (BPCs), Turbidity, pH, Electric Conductance (EC), Total Dissolved Solids (TDS), Hardness as CaCO3, Calcium (Ca-), Magnesium (mg+), Sodium (Na+), Chloride (Cl-), Sulfate (SO4-), and Alkalinity as $CaCO_3$, and (Table 2). This provides us with the whole data set of water parameters analysed from the 18 samples collected in Pandharpur. **Table 3** shown the results

**Bacterial Plate Counts (BPCs):-**

The result shows that the Bacterial Plate Counts is highest i.e. 280cfu/ml of Elevated Water Tank (EWT) present in Padmavati Nagar, provides drinking water to maximum area of ward no. 19 and 33. Bacterial Plate Counts (lowest) of Elevated Water Tanks present in Ambika Nagar (Ward No.25,28,29,30,31,32), Ganesh Nagar (Ward No.24), and Mahavir Nagar (Ward No.12,13) is 49cfu/ml, 46cfu/ml, and 52cfu/ml respectively **(Figure 2)**. The most common allowable bacterial numbers used by health departments, water-supply agencies and local authorities vary from 100ml to 500ml of colony forming units.

**Turbidity:-**

Turbidity is clear of Elevated Water Tanks present in Chhatrapati Shivaji Maharaj Chauk(Ward No.15,16,17,18,26 and 27), Isbavi(Ward No.9 and 10), Manisha Naga(Ward No. 01,11,20,21 and 23), Ganesh Nagar (Ward No.24), Karad Road(Ward No.22), Anil Nagar (Ward No.2,5,6,7 and 8), Mahavir Nagar (Ward No.12 and 13), and Ambedkar Nagar (Ward No.25,28,29,30,31 and 32). Turbidity of Elevated Water Tanks present in Padmavati Nagar (Ward No.19 and 33), and Ambedkar Nagar (Ward No.3,4 and 14) is slightly Turbid **(Figure 3)**.

Turbidity is a measure of the degree to which the water loses it's transparency due to the presence of suspended particulates. The more total suspended solids in the water, the murkier it seems and the higher the turbidity.

**pH:-**

pH is highest in Elevated Water Tanks present in Padmavati Nagar (Ward No.19 and 33), Mahavir Nagar (Ward No.12 and 13), Shivaji Chauk (Ward No.15,16,17,18,26 and 27), Manisha Nagar (Ward No.1,11,20,21 and 23) and Karad Road (Ward No.22) are 7.98, 7.97, 7.96, 7.96 and 7.92 respectively. pH is lower of Elevated Water Tanks present in Isbavi (Ward No.9 and 10) and Ambika Nagar (Ward No.3,4 and 14) i.e. 7.63 and 7.66 respectively **(Figure 4)**. The pH of most drinking water lies within the range between 6.5-8.5.

**Electric Conductivity:-**

Electric Conductivity is higher in Ganesh Nagar (Ward No.24) and lower in Manisha Nagar's (Ward No.1,11,20, 21 and 23) Elevated Water Tanks i.e. 1.45mS/cm and 1.33mS/cm respectively **(Figure 5)**. The Electric Conductivity of water is important because it can tell you how much dissolve substance Chemicals and Minerals are present in water, higher amount of these impurities will leads to a higher conductivity.

**Total Dissolved Solids:-**

TDS is higher i.e. 815mg/l and 794mg/l in Ganesh Nagar (Ward No. 24) and Karad Road's(Ward No.22) Elevated Water Tanks respectively, which provides drinking water to them.And the lower TDS level i.e. 726mg/l and 735mg/l present in Mahavir Nagar (Ward No.12 and 13) and Manisha Nagar's (Ward No.1,11, 20, 21, and 23) Elevated Water Tanks **(Figure 6)**. The TDS level up to 500mg/l is considered as the most suitable and acceptable and more than this is poor and unacceptable for drinking purpose.

**Hardness as CaCO3:-**

The result shows that the Total Hardness is higher i.e.369mg/l in the Ganesh Nagar's Elevated Water Tank

provide drinking water to ward no.24 and 350mg/l in Karad Road's Elevated Water Tank provide drinking water to ward no.22 and the lower Total Hardness i.e. 315 mg/l and 321mg/l is in the Anil Nagar's Elevated Water Tank (Ward No.2,5,6,7&8) and Chhatrapati Shivaji Maharaj Chauk Elevated Water Tank(Ward No. 15,16,17, 18, 26 and 27) respectively **(Figure 7)**. Total Hardness is the sum of the calcium and magnesium concentrations, both expressed as calcium carbonate. The acceptable normal limits of Total Hardness are less than 300mg/l, more than this the water test becomes harder.

**Calcium:-**

Calcium contain is higher i.e.85mg/l and 80mg/l in Ganesh Nagar's(Ward No.24)Elevated Water Tank and Karad Road's (Ward No.22) Elevated Water Tanks respectively.And the lower in Anil Nagar's(Ward No.2,5, 6, 7 and 8), Mahavir Nagar's(12 and 13), Shivaji Chauk (Ward No.15,16, 17, 18, 26 and 27), and Manish Nagar's(Ward No.1,11, 20, 21 andWard No.23) Elevated Water Tanks i.e. 72 mg/l, 73mg/l, 74mg/l and 74mg/l respectively **(Figure 8)**. The normal limit of calcium contain in drinking water is 75 mg/l.

**Magnesium:-**

The result shows higher magnesium contains i.e. 37 mg/l, 37mg/l, and 36mg/l in the Ganesh Nagar (Ward No.24), Karad Road (Ward No.22), and Padmavati Nagar's (Ward No.19&33) Elevated Water Tanks respectively. And the lower magnesium contain is in Ambika Nagar (Ward No.3,4 and 14) and Ambedkar Nagar's(Ward No.25,28, 29, 30, 31 and 32) Elevated Water Tanks i.e. 31mg/l and 32mg/l respectively **(Figure 9)**. The normal limit of magnesium contain in drinking water is 30mg/l.

**Sodium:-**

Sodium contain is higher in Karad Road (Ward No.22) and Ambedkar Nagar's(Ward No.25,28, 29, 30, 31, and 32) Elevated Water Tanks i.e. 145mg/l and 134mg/l respectively **(Figure 10)**. And the lower sodium contain i.e. 116mg/l is in the Padmavati Nagar's Elevated Water Tank provide drinking water to ward no.19 and 33. The normal limit of sodium contain in drinking water is 200 mg/l, more than this it is unacceptable.

**Alkalinity as $CaCO_3$:-**

The Alkalinity is higher in the Karad Road (Ward No.22) and Mahavir Nagar's (Ward No.12&13) Elevated Water Tanks i.e. 330mg/l and 308mg/l respectively. And the lower Alkalinity i.e. 277mg/l and 278mg/l is in the Padmavati Nagar (Ward No.19&33) and Chhatrapati Shivaji Maharaj Chauk's(Ward No.15,16,

17, 18, 26 and 27) Elevated Water Tanks respectively (Figure 11). The normal limit

**Chlorides:-**

The result shows that the higher chloride contain i.e. 252 mg/l is in the Ganesh Nagar's Elevated Water Tank provides drinking water to the ward no.24.And the lower chloride contain i.e.211mg/l is in the Mahavir Nagar's Elevated Water Tank provides drinking water to the ward no.12 and 13 (Figure 12).The normal limit of Chloride contain in drinking water is 250mg/l, more than this the quality of drinking water becomes poor.

**Sulphate:-**

higher Sulphate contain i.e. 97mg/l present in the Anil Nagar's Elevated Water Tank provides drinking water to the ward no.2,5, 6, 7 and 8. And the lower Sulphate containsi.e 73mg/l present in the Karad Road's Elevated Water Tank provides drinking water to the ward no.22 **(Figure 13)**. The normal limit of Sulphate contain in the drinking water is 200mg/l, more than this the quality of water becomes poor.

We can clearly observe that the of Alkalinity as $CaCO_3$ in drinking water is 200mg/l.

Drinking Water provided to Padmavti Nagar, Takali Road, Ambika Nagar, Anil Nagar and Chhatrapati Shivaji Maharaj Chauk shows high Bacterial Contain, these regions are densely populated in the city. Turbidity in Padmavti Nagar, Takali Road and Ambika Nagar is Slightly Turbidthat means there is chance to mixing of outsides bad quality water in the drinking water which provides to the people in the city.

In the Ganesh Nagar and Karad Road's drinking water the contains of minerals like Calcium, Magnesium, Sodium, Chlorides is high with respect to other areas, therefore Hardness and Total Dissolved Solids (TDS) also shows High. These two region are away from the main city area, that could be one of the reason of high minerals contain. Anil Nagar and Ambika Nagar's drinking water shows high sulphate ($SO_4$) contain with respect to other areas, in the map we can see that, these two areas are very close to each other and also close to river Chandrabhaga. Also these areas are densely populated.

| Table 1: Medical disorder during Wari period in 2018 | | |
|---|---|---|
| **Medical Disorder** | **Number of Cases** | **Percentage (n=2365)** |
| **Diarrhea** | **397** | **16.8** |
| **Constipation** | **195** | **8.2** |
| **URTI** | **460** | **19.4** |
| **LRTI** | **121** | **5.1** |
| **Asthma (aggravation)** | **46** | **1.9** |
| **Knee** | **961** | **40.6** |
| **Backache** | **747** | **31.6** |
| **Foot** | **710** | **30** |
| **Whole body** | **3** | **0.1** |
| **Skin** | **249** | **10.5** |
| **Ear** | **16** | **0.7** |
| **Eye** | **99** | **4.1** |
| **CLW** | **116** | **4.9** |
| **Fracture** | **54** | **2.3** |
| **Accident** | **12** | **0.5** |
| **Gynac problem** | **14** | **0.6** |
| **Footware** | **14** | **0.6** |
| | | |

**Table 2**

| Sr.No. | Test Parameters | Normal Limits |
|---|---|---|
| 1 | Ph | 6.5-8.5 |
| 2 | Bacterial Plate Counts | 500 cfu/ml |
| 3 | TDS | 500mg/l |
| 4 | Electric Conductance | - |
| 5 | Hardness as CaCO3 | 300mg/l |
| 6 | Alkalinity as CaCO3 | 200mg/l |
| 7 | Turbidity | Clear |
| 8 | Sulphate | 200mg/l |
| 9 | Chloride | 250mg/l |
| 10 | Calcium | 75mg/l |
| 11 | Magnesium | 30mg/l |
| 12 | Sodium | 200mg/l |
| 13 | Smell | Nil |

Table 3. Water Analysis Result

| Parameters / Locations | Bacterial Plate Count | Turbidity | pH | EC | TDS | Hardness | Ca | Mg | Na | Alkalinity | Cl | So4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C. S. M. chauk | 136 | Clear | 7.96 | 1.38 | 742 | 321 | 73 | 33 | 123 | 278 | 220 | 88 |
| Isbavi | 62 | Clear | 7.63 | 1.38 | 743 | 325 | 76 | 33 | 124 | 285 | 221 | 90 |
| Manisha nagar | 128 | Clear | 7.96 | 1.33 | 735 | 320 | 74 | 34 | 132 | 296 | 220 | 81 |
| Padmavati nagar | 280 | S.Turbid | 7.98 | 1.35 | 746 | 340 | 77 | 36 | 116 | 277 | 224 | 75 |
| Ganesh nagar | 46 | Clear | 7.81 | 1.45 | 815 | 369 | 85 | 37 | 128 | 291 | 252 | 80 |
| Karad road | 57 | Clear | 7.92 | 1.43 | 794 | 350 | 80 | 37 | 145 | 330 | 237 | 73 |
| Anil nagar | 160 | Clear | 7.93 | 1.39 | 747 | 315 | 72 | 33 | 128 | 283 | 220 | 97 |
| Takali road | 220 | S.Turbid | 8 | 1.4 | 757 | 333 | 75 | 35 | 132 | 297 | 229 | 85 |
| Mahavir nagar | 52 | Clear | 7.97 | 1.37 | 726 | 325 | 74 | 35 | 131 | 308 | 211 | 77 |
| Ambika nagar | 144 | S.Turbid | 7.66 | 1.4 | 759 | 330 | 79 | 31 | 131 | 289 | 234 | 93 |
| Ambedkar nagar | 49 | Clear | 7.76 | 1.41 | 766 | 326 | 75 | 32 | 134 | 280 | 237 | 87 |
| Bore 1 | 88 | Clear | 7.54 | 8.73 | 4745 | 1795 | 426 | 178 | 727 | 706 | 1893 | 510 |
| Bore 2 | 54 | Clear | 7.87 | 1.92 | 1084 | 368 | 84 | 38 | 221 | 494 | 251 | 100 |
| Bore 3 | 39 | Clear | 7.12 | 1.61 | 905 | 483 | 119 | 45 | 90 | 326 | 249 | 91 |
| Bore 4 | 63 | Clear | 7.06 | 1.95 | 1096 | 605 | 150 | 56 | 94 | 385 | 300 | 108 |
| River US | 200 | Turbid | 8.17 | 1.44 | 801 | 353 | 79 | 38 | 129 | 288 | 252 | 83 |
| River MS | 180 | S.Turbid | 7.82 | 1.63 | 863 | 378 | 87 | 39 | 151 | 339 | 260 | 90 |
| River DS | 240 | Turbid | 8.02 | 1.54 | 857 | 343 | 78 | 36 | 162 | 321 | 265 | 95 |
| **Normal Limits** | **Max 20 cfu/ml** | **Clear** | **6.5-8.5** | **mS/cm** | **Max 500 mg/l** | **Max 200 mg/l** | **Max 75 mg/l** | **Max 30 mg/l** | **Max 200 mg/l** | **Max 200 mg/l** | **Max 250 mg/l** | **Max 200 mg/l** |

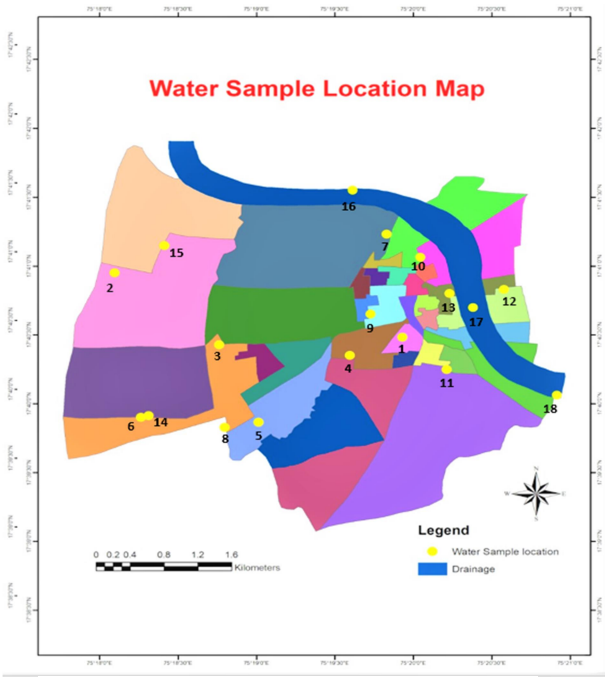



Figure 1: Water Sample Location

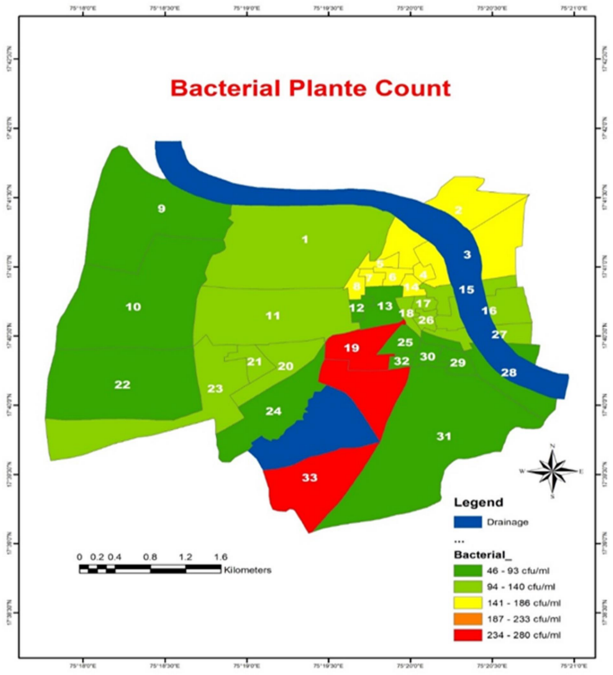



Figure 2: Bacterial Plate Count

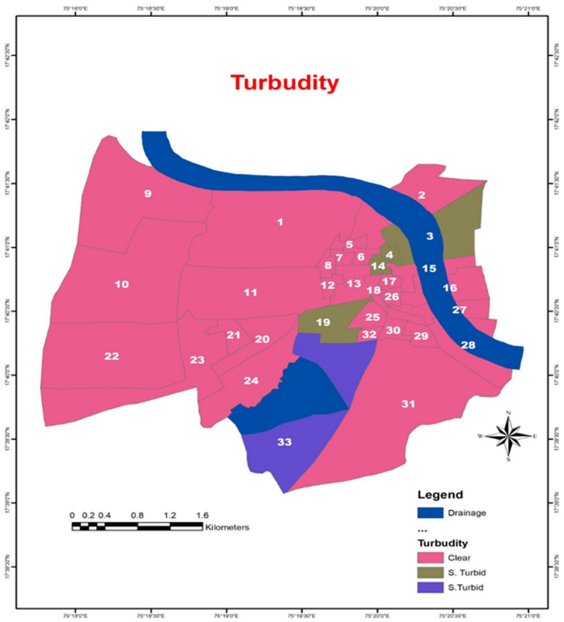



Figure 3: Turbudity

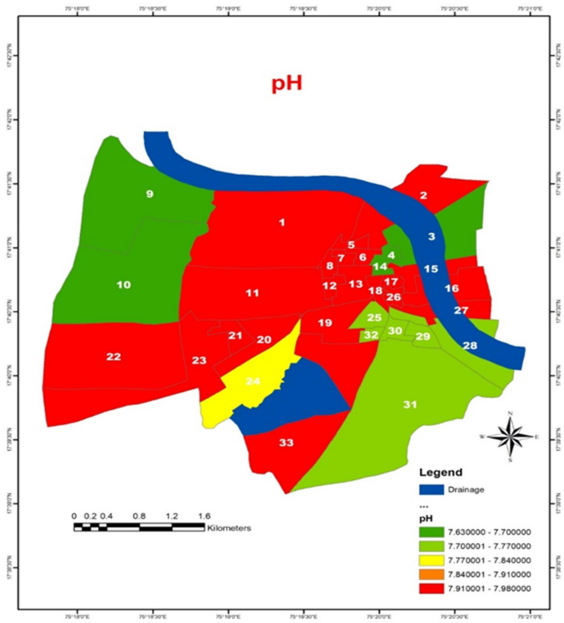



Figure 4: pH

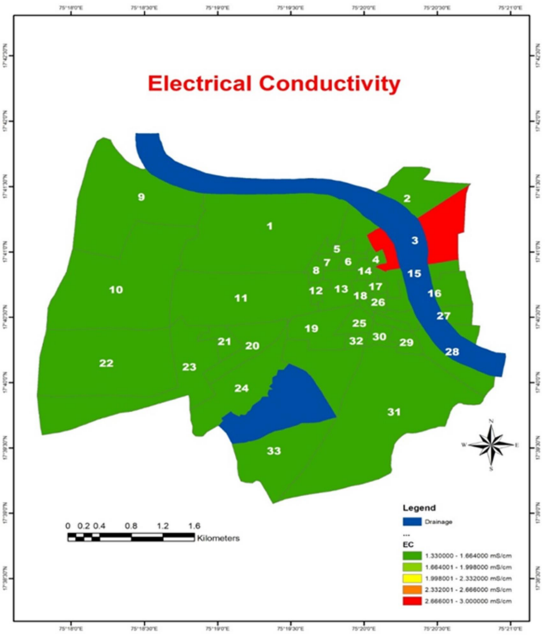



**Figure 5: Electrical Conductivity**

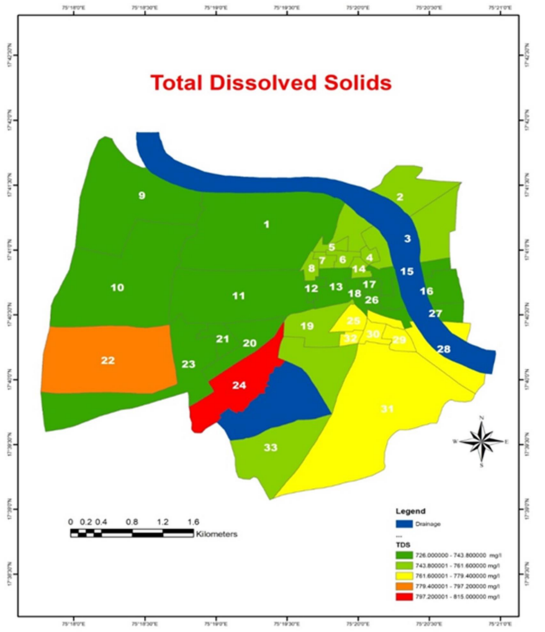



**Figure 6: Total Dissolved Solids**

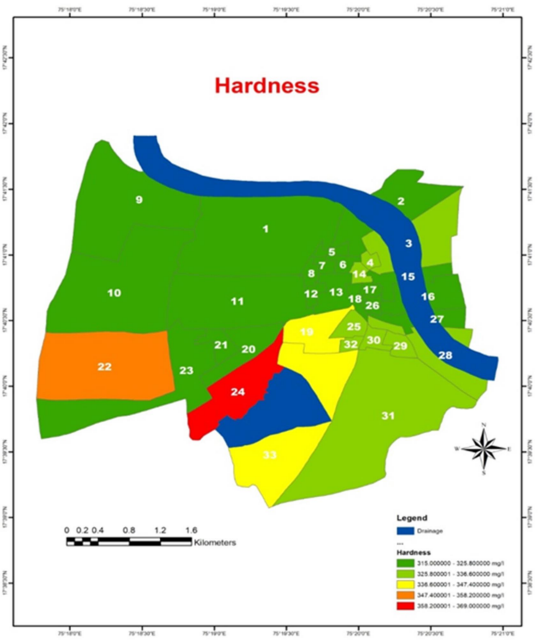



**Figure 7: Hardness**

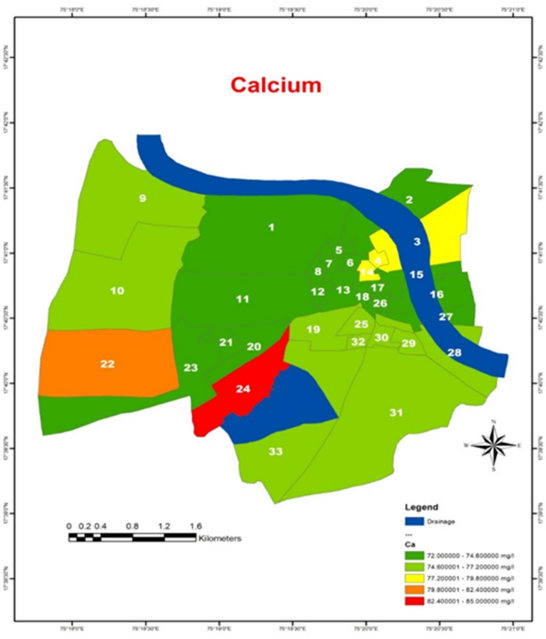



**Figure 8: Calcium**

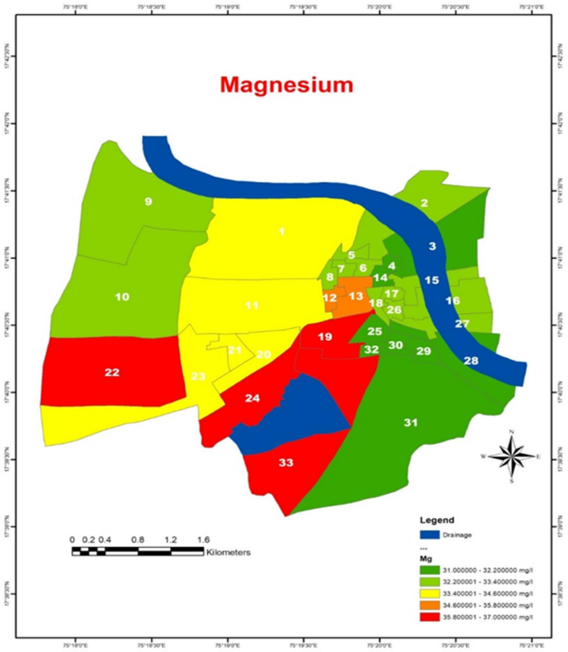



Figure 9: Magnesium

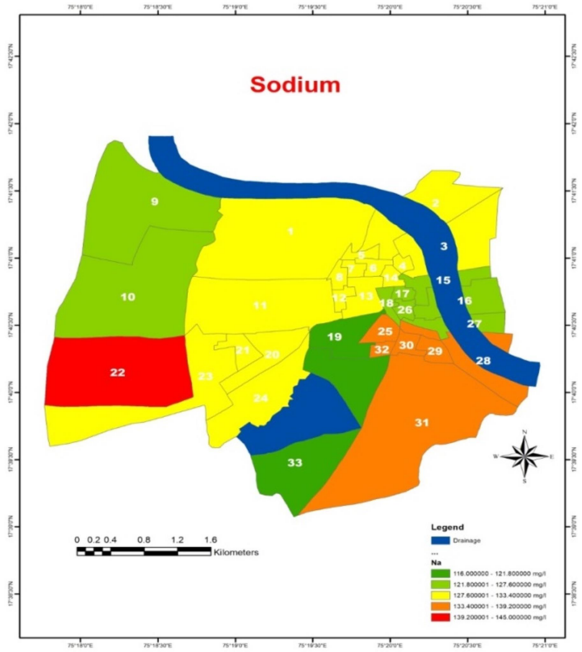



Figure 10: Sodium

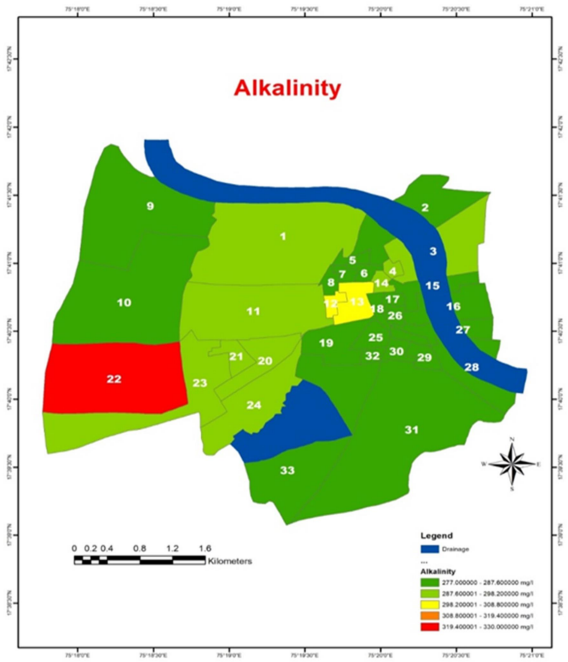



Figure 11: Alkalinity

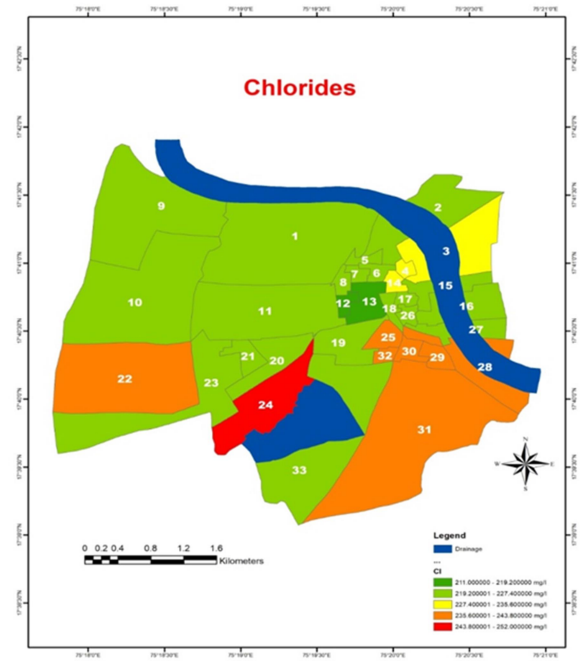



Figure 12: Chlorides

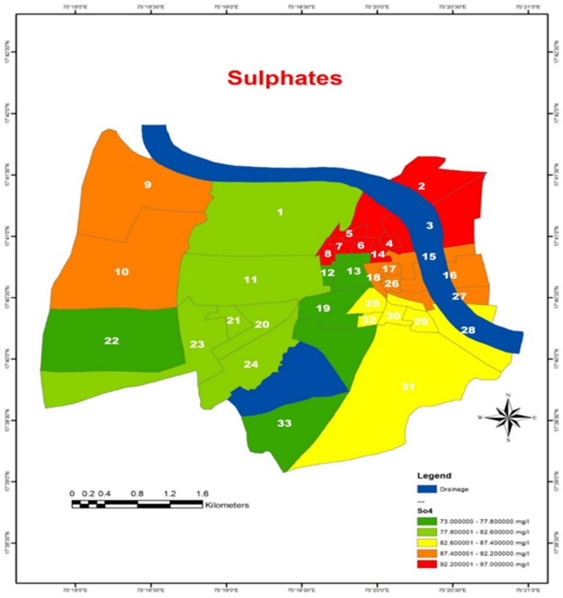


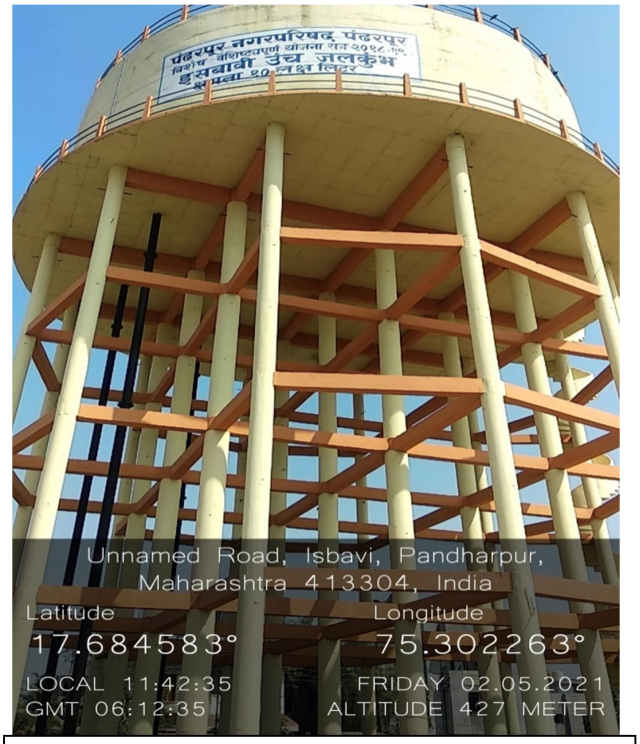

**Figure 13: Chlorides**

## Illustrations:

**Water Collection for Treatment**

**Bleaching Powder Mixing Tank**


**Water Treatment Plant Pandharpur**




**Elevated Water Tank at Isbavi, Pandharpur**

**Water Treatment Plant**

**DISCUSSION:**

The study was carried out to check the quality of drinking water provided by Municipal Council, Pandharpur. The many cases of waterborne diseases like diarrhoea, salmonella typhoid comes in front due to poor quality water provides in monsoon and during Wari and Tithis at this time millions of pilgrims from Maharashtra and from nearby states are gathers here.

This field work is carried out in February month, in this month there is no rainfall therefore water in the source is not moving and it is store in the upper stream of river Chandrabhaga, from here water lifted and treated, then this water is provided to drinking and other uses to the people through Elevated Water Tanks (EWTs).

According to the above interpretation it can be concluded that the presence of contains (parameters) like Bacterial plate Counts, Turbidity, pH, Electric Conductance, sodium and Sulphate are normal in drinking water provided through tap to the peoples of Pandharpur Town. Also, above interpretation shows some parameters like Calcium in ward no.22 and 24, Magnesium in all wards, Total Dissolved Solids in all wards, Chloride in ward no.24, Alkalinity and Hardness as $CaCO_3$ in all wards in the Town Pandharpur are crossed it's normal limits. Therefore, there is need to focus on these parameters to remain in its normal limits.

This work can become the basic data source to others, who willing to work in the times of Wari's. Using above data he/she can be relate the quality of drinking water of both the times.

**Acknowledgement:**

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