Physico-Chemical analysis of ground water interfaced with mobile application

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Abstract— **The ground water quality is determined in two districts (Thiruvallur and Chennai) that lays in northern parts of Tamilnadu, where from each district five ground water samples were studied for their Physico- Chemical status. In the current analysis, various quality parameters were measured which includes pH, turbidity, electrical conductivity (EC), total dissolved solids (TDS), total hardness(TH), chloride (Cl⁻), alkalinity and DO. Also all parameters were compared with ICMR standards of water quality and the results were interpreted using MIT mobile application.**

Index Terms— **Hardness, Mobile app. Physico-Chemical properties, Water quality.**

I. INTRODUCTION

Universally, requirement for freshwater will continue to rise significantly over the coming decades to meet the needs of increasing populations, growing economies, changing lifestyles and evolving consumption patterns. This will greatly amplify the pressure on limited natural resources and ecosystems. In addition, increase in urbanization, industrialization, agriculture activity and various human activities have increased the pollution of surface water & ground water [1]. It is therefore necessary that the quality of drinking water should be checked at regular time intervals because due to use of contaminated drinking water, human population suffers from a variety of water borne diseases. To be safe and potable, water is expected to be free from various contaminants like organic and inorganic pollutants, heavy metals, pesticides etc., However, the preliminary quality of water could be easily established by having an idea about the parameters like pH, Electrical Conductivity, Calcium, Magnesium, Total Hardness, Carbonate, Bicarbonate, Chloride, Total Dissolved Solid, Alkalinity, Sodium, Potassium, Nitrate and DO.

For decades, water quality monitoring and evaluation have depended on a low-resolution water quality monitoring. This approach is time-consuming and expensive and not appropriate for certain biological and chemical processes such as oxidation-reduction potential that need to be measured on-site to ensure accuracy [2]. However, as a first step to simplify the procedure at low costs, here in this paper, we interface the reports of water testing to be analysed by a mobile application. The digital results are easy to interpret, fast and precise. MIT App inventor is the tool we have used here which is an interesting and innovative beginners to app creation and programming. The app converts the complex language of text-based coding into visual, drag-and-drop building blocks. This app is being very widely used by researchers nowadays to process their data collection and analysis in a customized manner.

II. STUDY AREA

Areas under focus were districts of Thiruvallur and Chennai (Map 1 and Map 2) Five samples were collected respectively from each district viz., Thiruvallur river bank, Manavala Nagar, Veeraraghavan Temple, Sevapet and Aranyvoil from Thiruvallur and Marina, Mylapore, Mandaveli, CIET colony and Santhome from Chennai respectively.
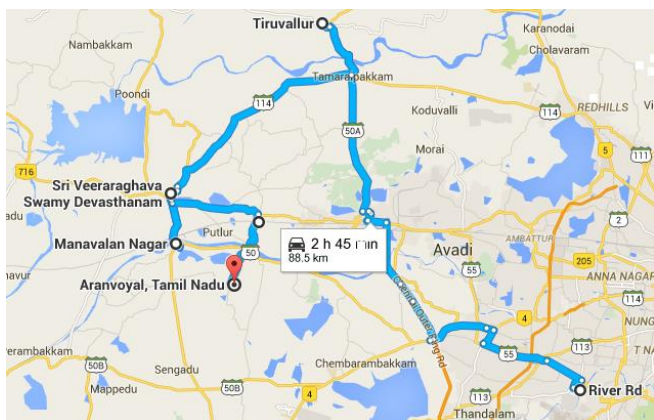
III. WATER SAMPLING

In present investigation, ten water samples were collected in polythene bottles which were cleaned with acid water, followed by rinsing twice with distilled water. The samples were labeled as T1-T5 referring to those collected from Thiruvallur district and C1-C5 to those collected from Chennai district (Table-1). The analysis of water was done using the procedure of standard methods. The water samples were also chemically analyzed [3].

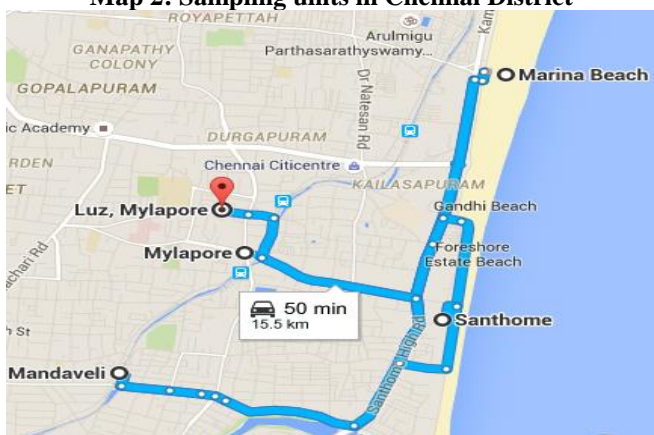| S. No	Sampled Area	Label
1	Thiruvallur River Bank	**T1**
2	Manavala Nagar	**T2**
3	Veeraraghavan Temple	**T3**
4	Sevapet	**T4**
5	Aranvoyal	**T5**
6	Marina	**C1**
7	Santhome	**C2**
8	Mandaveli	**C3**
9	Luz corner	**C4**
10	Mylapore	**C5**

Table 1: Labels of Water samples

The areas are chosen in such a way that they are not very far apart and hence the quality of water can be easily compared.

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Map 1: Sampling units in Thiruvallur District

Map 2: Sampling units in Chennai District

IV. MATERIALS AND METHODS

Parameters Such as DO, TDS, Free CO_2, Hardness, Chlorides, Alkalinity, Turbidity were determined in the laboratory by using standard methods as prescribed By APHA, AWWA [4], Trivedy and Goel [5], Kodarkar[6].

All the chemicals and solvents used in the testing procedures were of AR grade and obtained from SD Fine Chemicals Ltd. Doubly distilled water was used for all washing and dilution purposes. Electrical Conductivity and TDS measurements were made with a microprocessor water analysis kit (model no. 191). Turbidity of the samples were checked with the kit of model no. 172. All the testings were carried out within 24 hours of the sample collection.

V. RESULTS AND DISCUSSION

The samples were collected from 10 different places of Thiruvallur and Chennai district during the month of January in the year 2016 and analyzed for their Physico-Chemical parameters viz., Temperature, Hardness, Dissolved Oxygen (DO), Total Dissolved Solids (TDS), Electrical Conductivity (EC), pH, Alkalinity, Carbonate (CO_3^{2-}) and (HCO_3^-). The physical and chemical parameters analyzed for all the samples are collated in Tables 2 and 3.
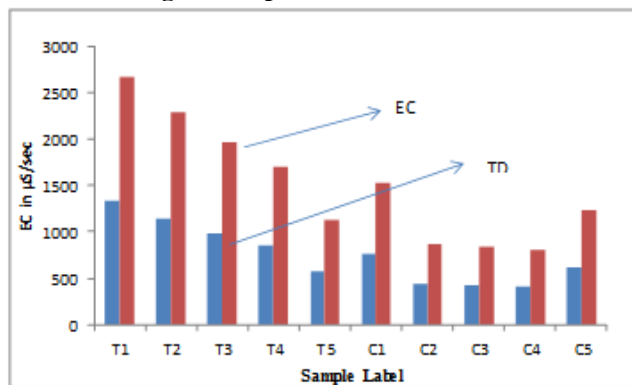
V.1. Physical parameters

By and large, the temperatures of all the ground water samples were in the range of 25 – 28 ºC which is well with in the agreeable limits for drinking purposes. The turbidity values were in the range of between 0.1 to 0.7 NTU which again indicates a good quality of the water samples for drinking purposes. The highest turbidity observed (0.7 NTU) is at Sevapet of thiruvallur district which may be due to human activities and suspended particulate matters. The Total Dissolved Solids (TDS) measured shows a substantial difference between the two districts. In case of Thiuvallur, the TDS measured are in the range of 500 to 1400 ppm, whereas in Chennai districts, the values were in a comparatively lower range viz., 400 to 800 ppm. This may be attributed to the heavy rainfall recorded in the thiruvallur district in the recent monsoon. The presence of high TDS in this area is directly correlated to the values of Electrical Conductivity of the water samples. As shown in Table 2, the samples from Chennai district recorded a lower conductivity when compared to thiruvallur district. A comparative analysis of Electrical Conductivity and TDS of all the five locations is as shown in Figure 1.

S. No	Sample	Tem perat ure (ºC)	TDS (ppm)	pH	Turbidity (NTU)	Electrical Conductivity (µS/sec)
1	**T1**	25	1336.5	8.3	0.6	2673
2	**T2**	25	1140.5	8.21	0.3	2281
3	**T3**	25	981	7.45	0.4	1963
4	**T4**	25	851	7.13	0.7	1702
5	**T5**	27	567	7.11	0.5	1133
6	**C1**	28	763	8.4	0.1	1525
7	**C2**	26	436	8.29	0.3	872.3
8	**C3**	28	420.7	7.34	0.2	841.4
9	**C4**	25	407	7.13	0.4	814.3
10	**C5**	27	617	7	0.1	1234

Table 2: Physical parameters measured for ground water sample.

Fig 1: Comparative chart of EC and TDS

As far as the pH values were considered, there was not much of a greater difference between the two districts as indicated in the Table 2.
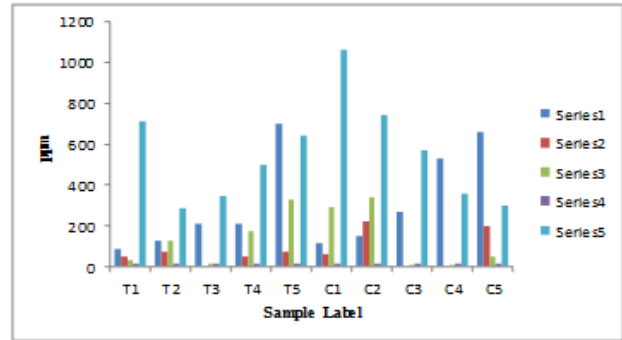
V.2. Chemical parameters:

Almost a neutral pH of the water samples observed is in good correlation with the witnessed Dissolved Oxygen (DO) values for all the samples. On an average, the DO was recorded as 13 to 14 mg/lit, which is well advocated for an active photosynthetic process for the planktons. The high temperature, long days and bright sunlight during the time of sample collection are found to be the reasons for good DO values [7]. In both the districts, total hardness of the samples were found to be in the range of 100 ppm to 700 ppm. The high values of hardness is assigned to high temperature occurring in the environment which would have led to an accelerated evoparation of the water levels. Regrettably, the chloride content measured are quite high in both the districts than the required limits. This may be due to the frequent chlorination of other sources of drinking water supplied to the localities through corporations for disinfection purposes. The washouts of the local residential areas might be a reason for the presence of excess of chloride ions present in ground water in such places. However, the values recorded are still in consistency with the relaxable limits allowed by the Bureau of Indian Standards [8]. Alkalinity of the samples due to the presence of free carbonate and bicarbonate ions were estimated independently. As expected, the samples C1 and C2, collected from marina region were found to show higher values of both kinds of alkalinity when compared to all other samples. This observation is well justified by the closer proximity of the sampling units to the coastal beach. A comparative analysis of the said parameters are graphically depicted in Fig 2.

S. No	Sample	Total Hardness (ppm)	CO_3^{2-} Alkalinity (ppm)	HCO_3^- Alkalinity (ppm)	Dissolved Oxygen (ppm)	Chloride content (ppm)
1	**T1**	87.36	50	32.75	13.68	710
2	**T2**	123.68	75	125	13.14	284
3	**T3**	206.31	0	15.5	13.03	344
4	**T4**	210	50	175	14.04	497
5	**T5**	700	75	325	13.42	639
6	**C1**	114.21	60	290	14.25	1065
7	**C2**	150	220	340	14.88	745
8	**C3**	269.47	0	5	13.28	568
9	**C4**	526.31	0	7	14.54	355
10	**C5**	657.8	200	50	15.22	295

**Table 3: Chemical parameters measured for ground water samples**

Fig 2: Comparative chart of Chemical parameters, series 1- TH , series 2 – CO_3^{2-}, series 3 – HCO_3^-, series 4- DO, series 5- Cl^-.

V.3. Mobile App Interfacing

The physical and chemical parameters determined through analysis were interfaced with a mobile application called MIT inventor. The standard values as per the guidelines prescribed by the Bureau of Indian Standards were given as the input. The list of parameters to be analysed are displayed as it appears in screen shot 1(Fig 3). Once the data for an individual sample is given as the input, the screen appears as in Fig 4.

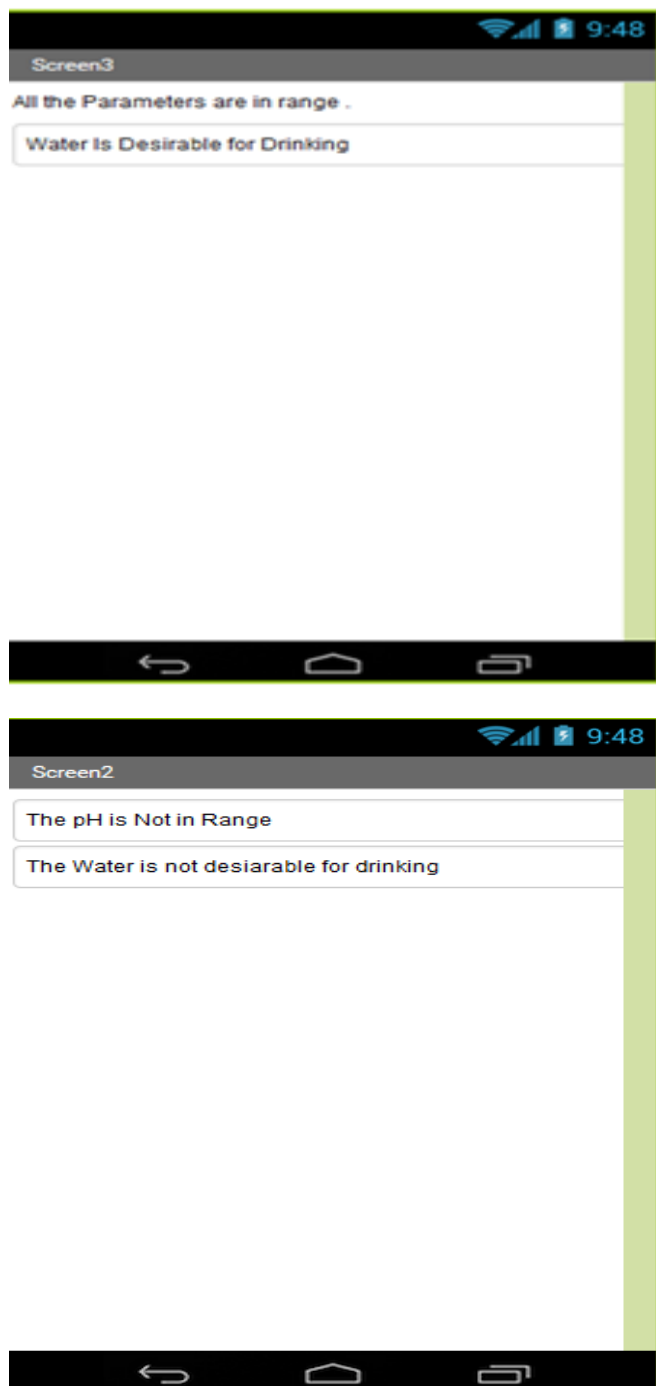**Fig 3 : List of parameters**
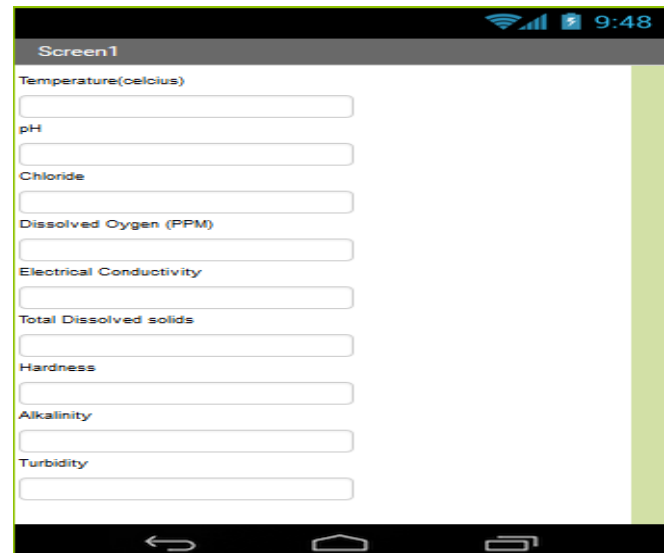
Fig 4: Display of the app after entering the data

Based on the standard values provided and comparing it with the data of the individual sample, the app does an analysis and gives the output as a declaration regarding the suitability of water for drinking purpose as shown in screen shot Fig 5.

Fig 5: Results displayed by the mobile app after analyzing the data provided

interfaced with the MIT Inventor app. The app hence can be used for the data collected at any locations and could be inferred whether the water sample under test is suitable or not suitable for drinking purposes. Thus the analysis of water samples for drinking qualities is made easy and viable even for a novice to process ones data collection and this could be further explored into a wide variety of fields right from medical to social.

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VI. CONCLUSION:

The samples collected from various places in the two districts of Tamilnadu namely Thiruvallur and Chennai were successfully analysed for their physical and chemical parameters using standardized procedures. In general, the physic-chemical nature of the samples were found to be well with in the reliable and acceptable limits for drinking purposes as per the guidelines of WHO. For easy interpretation of the results, the data were successfully