# Assessment of Physio-Chemical Parameters of Water at Environmentally Degraded Pallikaranai Marsh Area, Chennai, India

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**ABSTRACT--** The groundwater is contaminated greatly with acidity, alkalinity, noxiousness, heavy minerals, and microorganisms throughout the world due to population growth, urbanization and industrial development. Henceforth, evaluation of water quality of groundwater and surface water is extremely important to prepare for remedial measures. The slice of research was carried out to study the ground water as well as surface water quality, and physico-chemical characteristics of Pallikaranai Marsh Area, Chennai, India. The study area is situated between latitudes 12º 55' 30" to 12º 58'30" N to longitudes 80º 12' 20" to 80º 14' 25" E and 1.362 meters above sea level. The present work has been conducted by monitoring two types of ground water i.e. ploughed well water and bore well water of 10 wards of the town. Attempts were made to study and analyze the physico-chemical characteristics of the water. Various parameters like pH, Total Dissolved Solids, Chlorides, Sulphates, Total Alkalinity, Biochemical Oxygen Demand, Chemical Oxygen Demand and the Biological Parameters like Coliform Bacteria give a picture of quality parameter in both dug well and bore well water as well as pond water of the town. By observing the result it can be concluded that the parameters which were taken for study the water quality are exceeds the pollution level for ground water which shows that the water is not safe for the use of various purposes like domestic, aquatic life, agricultural, industrial etc.

**Keywords:** Ground Water, Pallikaranai, Physio-Chemical Parameter, pH, BOD, COD, TDS

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## 1 INTRODUCTION

"Water is life". Water is quite important for living beings. Main sources of water are rain. Groundwater is an important source of water supply throughout the world. The dependency of people on groundwater has amplified in the past few decades due to tremendous increase in crop production, population and industrialization. Thus regular observing of ground water becomes very important. The natural quality of ground water inclines to be ruined by human activities [1]. Water is polluted in all the surface of earth and Pallikaranai Marsh Area [1] is no exception to this phenomenon. Standard desirable limit of water quality parameters in drinking water prescribed by different agencies is shown in Table 1.

| Parameters | ISI | WHO | ICMR | BIS |
|---|---|---|---|---|
| pH | 6.5-8.5 | 6.5-8.5 | 7.0-8.5 | 7.0-8.3 |
| TDS | 500 | ----- | 500 | 500 |
| Chloridemg/l | 250 | 250 | 250 | 250 |
| Alkalinity mg/l | 200 | 120 | ----- | 200 |
| COD mg/l | 150 | ----- | ----- | 150 |
| BOD mg/l | ----- | 6 | ----- | 30 |
| Sulphates mg/l | | 150 | | |

Groundwater quality comprises the physical, chemical and biological qualities of ground water. Temperature, turbidity, colour, taste and odour make up the list of physical water quality parameters. Since mostly ground water is colourless, odourless and without specific taste, water pollution means contamination of water by foreign matters such as micro-organisms, chemicals, and industrial or other wastes, or sewage. Contamination of drinking water supplies from industrial waste is a result of various types of industrial processes and disposal practices. Industries that use large amounts of water for processing have the potential to pollute water ways through the discharge of their waste into streams and rivers or, by run-off and seepage of stored wastes into nearby water sources.

Physio-chemical characteristics of ground water of different parts of countries have been studied by many authors [2, 3, 4]. Among the various means of pollution of ground water reservoirs, the main causes for the pollution of water are city drainage, domestic waste, industrial waste etc. All metabolic and physiological activities and life processes of aquatic organisms are generally influenced by such polluted waste and hence, it is essential to study physio-chemical characteristics of water.

Wetlands are the most important of life-supporting ecosystems that have sustained human lives and communities over the millennia. Ramsar Convention (1971) defines Wetlands as areas of marsh or fen, peat land or water, whether artificial or natural, permanent or temporary with the water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed 6 metre. This definition evolved with the perspective of conservation and restoration of degrading wetlands worldwide.

Wetland covers approximately 4 to 6 percent of Earth's land surface, expressing existence of a greater portion of different wetland ecosystem. Wetlands are a critical element of national and global ecosystems and economics. Wetlands protect the shoreline from wave action, mitigate the impact of

floods, absorb pollutants and act as habitats for flora and fauna, including a number of species that are threatened or endangered. Wetlands purify water and are a focal point for recreational activities.  It performs important functions by
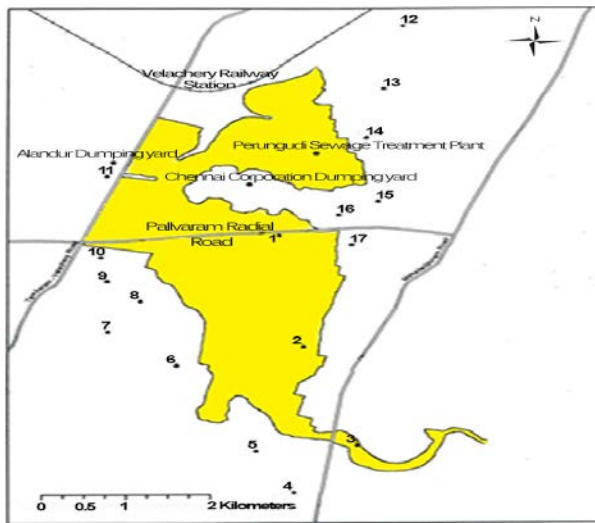


providing food and habitat to numerous species, improving water quality by intercepting surface runoff, removing or trapping sediment and nutrients, stabilizing sediments and offering protection by storing flood waters and replenishing ground water [9].

## 2  EXPERIMENTAL

### 2.1  Study Area

Pallikaranai Marshland is located at the South Eastern sub urban areas of Chennai city. It is situated adjacent to the Bay of Bengal, about 20 kilometers south of the City Centre, and has a geographical area of 80 square kilometers. Pallikaranai marshland is the only surviving wetland ecosystem of the city and is among the few and last remaining natural wetlands of South India. Pallikaranai marshland is bounded by-Velachery in north, Medavakkam in south, Kovilambakkam in west and Okkiyam Thuraipakkam in east. The Pallikaranai marsh drained about 250 sq.km, through two outlets viz the Okkiyam Madavu (channel) in Okkiyam Thuraipakkam and the Kovalam Creek.

The topography of the marshland is such that it always retains some storage, thus forming an aquatic ecosystem. Pallikaranai marsh is home to 115 species of birds, 10 species of mammals, 21 species of reptiles, 10 species of amphibians, 46 species of fishes, 9 species of molluscans, 5 species of crustaceans, and 7 species of butterflies. About 114 species of plants are found in the wetland including 29 species of grass. The region has a bird bio-diversity about 4 times that of Vedanthangal. The marsh has also had the distinction of new records of reptiles and plants being described, on a rather regular basis since 2002. Recent reports of the appearance of the White-spotted garden skink, for the first

time in Tamil Nadu and Russell's viper, the largest and the most widespread among Asian vipers, confirm its invaluable ecological status. Fish such as Dwarf gourami and Chromides that are widely bred and traded worldwide for aquaria, occur naturally in Pallikaranai.

Urban development in Chennai has historically gone hand in hand with reclaiming wetlands for waste disposal, housing and commercial and industrial purposes. Therefore, many water bodies associated with the Pallikaranai have been polluted and converted into waste water drains, resulting in a heavy loss of habitat [10].

In continuation of our earlier work (5), the water samples were collected around the Pallikaranai Marsh area at 17 locations are presented in table 2. Two litres Polyethylene bottles were used to collect the water samples for physio-chemical analysis. To prevent misidentification, the Polyethylene bottles were labelled using paper labels. The label indicates the sample location and date of sample collection. Standard methods were used for checking the water quality and all the reagents were AR grade and double distilled water was used for preparing the solutions (6, 7, 8)

TABLE 2.

| Location | Well type |
|---|---|
| Chennai Corporation Dumping Yard | Surface water |
| Mettukuppam | Well water |
| Okkiyum maduvu | Surface water |
| Tea stall, Near Sholinganallur signal | Bore well |
| Forest office, Karapakkam | Bore well |
| Adj. to Bharathi Vidyalaya Senior Secondary School, Perumbakkam | Open Well |
| Ambedkar Nagar near Chennai Corporation Primary School | Bore well |
| Narayanapuram nearby Watch tower | Open well |
| Near Variety Granites, Balaji Nagar | Open well |
| Near NIOT | Bore well |
| Near Alandur Dumpsite | Bore well |
| Backside of KG 360, Near Tharamani RS | Bore well |
| Near Hi- Style, Kandanchavadi | Bore well |
| Behind Perungudi Dumpsite | Bore well |
| Raman Nagar, Thoraipakkam | Bore well |
| Anandan Nagar, Thoraipakkam | Bore well |
| Vinayaga Nagar, Thoraipakkam | Bore well |

## 3 RESULTS AND DISCUSSIONS

The results of the physicochemical analysis of the water samples are collected from 17 places in Pallikaranai Marsh Area, Chennai are presented in Table 3.pH is considered as an vital environmental factor and provides an important factor and part of information in several kinds of geochemical equilibrium or solubility calculation. pH is an

important parameter in aquatic body since most of the aquatic organisms are adapted to an average pH. The pH values varied between 6.4 to 8.7. The pH values shows that marginally alkaline trend.

The average value of Total Dissolved Solids in the sampling points of around pallikaranai marsh area was 2954.4 mg/L. ISI prescribed the desirable limit of TDS is 500 mg/L. The maximum permissible level is 2000 mg/L. Total Dissolved Solids values observed in all sampling points were above the desirable limit. High TDS in ground water may be due to ground water pollution when waste waters from both residential and industries are discharged into pits, ponds and lagoons enabling the waste migrate down to the water table.

Chlorides are significant in perceiving the contamination of ground water by waste water. The acceptable limit of chloride in drinking water is 250 mg/L. The values of chloride observed in all sampling points were well above the standard desirable limits prescribed by WHO (1984). The presence of chloride in greater amounts in sampling points 10 and 13, may be due to natural processes such as the passage of water through natural salt formations in the earth or it may be an indication of pollution from industrial or domestic use.

The observed COD values in all the 17 sampling points are fluctuating from 4.2 to 108 mg/L. The permissible limit of COD for drinking water is 255 mg/L. Hence the observed COD values in all the 17 stations are well within the appropriate limit.

BOD is a measure of organic material contamination in water, specified in mg/L. BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic compounds and the oxidation of certain inorganic materials. According to the world health organization, sewage disposal water having BOD more than 6 mg/l is unsafe for domestic use. BOD values are observed in sampling points 1, 10,13,14,15 and 17 were above the desirable limit.

The standard desirable limit of alkalinity in drinking water is 120 mg/L. The maximum permissible level is 600 mg/L. The high content of alkalinity is shown in the Table 3. They discharge the waste waters into the soil. This may lead to increase in alkalinity of ground water in these areas. The sulphate content varies between150 to 230 mg/l and the fluoride content varies between 0.8 to 1.4 mg/l. The sulphate content values in 17 sampling points were found above the prescribed limits.

| Sampling point | pH | TDS mg/l | Chlorides mg/l | Sulphate mg/l | Total alkalinity mg/l | BOD mg/l | Coliform Bacteria MPN/100ml | COD mg/l |
|---|---|---|---|---|---|---|---|---|
| 1 | 7 | 3900 | 1589 | 8144 | 208 | 186 | 17 | 108 |
| 2 | 7.3 | 3600 | 1526 | 714 | 657 | 2.4 | <2.0 | 13 |
| 3 | 8.7 | 989 | 362 | 134 | 220 | 3.2 | 90 | 16 |
| 4 | 7.5 | 1700 | 505 | 306 | 471 | 3.6 | 21 | 21 |
| 5 | 8.1 | 4100 | 1238 | 794 | 897 | <1.0 | 17 | 4.2 |
| 6 | 7.6 | 5700 | 1685 | 686 | 242 | 2.8 | <2.0 | 12 |
| 7 | 7.3 | 1600 | 505 | 236 | 386 | <1.0 | 21 | 4.2 |
| 8 | 6.4 | 1700 | 538 | 208 | 205 | 2.6 | <2.0 | 13 |
| 9 | 7.7 | 3500 | 1411 | 506 | 412 | 3.4 | 12 | 13 |
| 10 | 7 | 7100 | 2446 | 1116 | 871 | 32 | <2.0 | 163 |
| 11 | 7.1 | 2700 | 333 | 316 | 545 | 5.4 | 33 | 29 |
| 12 | 8.3 | 1225 | 454 | 186 | 198 | 3.8 | 34 | 16 |
| 13 | 7.6 | 2000 | 5740 | 3144 | 406 | 14 | <2.0 | 64 |
| 14 | 5.3 | 911 | 352 | 174 | 20 | 16 | 34 | 84 |
| 15 | 6.7 | 2600 | 712 | 314 | 343 | 10 | 40 | 46 |
| 16 | 7.4 | 2600 | 794 | 384 | 408 | 3.4 | <2.0 | 17 |
| 17 | 7.7 | 4300 | 1654 | 688 | 733 | 32 | 160 | 168 |

## 4  CONCLUSIONS

From the results it is clearly evident that

- The high level of TDS is due to natural sources, sewage and urban runoff. Large amount of TDS makes the water body more turbid and increases its electrical conductivity which will affect the ability of the plants to uptake water for their growth.
- The high concentration of chloride indicates organic pollution and excess of chloride in water is taken as an index of pollution and considered as tracer for ground water contamination.
- The high level of BOD is due to the dumping of household garbage and improper dumping of municipal solid waste.
- The COD level in Vinayaga Nagar shows the indication of the organic contaminants in the water body.
- Pallikaranai Marsh land is under threat and immediate attention is required for the conservation in order to ensure that there is no further degradation in Pallikaranai.
- The leachates from the dumping yard are the major source for heavy metals pollution to the wetland and hence entering of leachates into the wetland should be clogged and treated properly and the treated water can be used for gardening or some other purpose.
- The entering of sludge from the sewage treatment plant should be completely stopped and the sludge can be used as manure for gardening purpose.

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