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Physico-chemical analysis of ground water samples of coastal areas of south Chennai in the post-Tsunami scenario

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ABSTRACT

The study of changes in ground water quality on the east coast of chennai due to the December 26, 2004 tsunami and other subsequent disturbances is a matter of great concern. The post-Tsunami has caused considerable plant, animal, material and ecological changes in the entire stretch of chennai coastal area. Being very close to sea and frequently subjected to coastal erosion, water quality has been a concern in this coastal strip, and especially after the recent tsunami this strip seems to be more vulnerable. In the present investigation, ten ground water samples were collected from various parts of south chennai coastal area. Physico-chemical parameters such as pH, temperature, Biochemical oxygen demand (BOD), Dissolved oxygen (DO), total solids; turbidity and fecal coliform were analyzed. The overall Water quality index (WQI) values for all the samples were found to be in the range of 68.81–74.38 which reveals a fact that the quality of all the samples is only medium to good and could be used for drinking and other domestic uses only after proper treatment. The long term adverse impacts of tsunami on ground water quality of coastal areas and the relationships that exist and among various parameters are carefully analyzed. Local residents and corporation authorities have been made aware of the quality of their drinking water and the methods to conserve the water bodies.

1. Introduction

About 90% of the population living in the south chennai coastal area largely depends on shallow ground water for their drinking and other domestic uses. After 2004 Tsunami, the quality of such ground water systems has become worse than ever before. The rapid growth of population, technological and industrial boom have also brought enormous problems to the aquatic environment. Over the years, the sea is steadily inching its way west so much so that the entire coastal strip has been humbled into a thin precarious ribbon of sand and alluvium. Immediately after the tsunami event many wells, ponds, lakes and other water bodies in this region turned colored and foul smelling. But, leaching of organic matter and plant nutrients, particularly soluble orthophosphates and nitrates results, in explosive cases of Eutrophication, which is characterized by drastic diurnal variation in DO, pH and alkalinity eventually leading to hypoxia and death of the water body (Padmavathy et al., 2002).

In some places of south coastal chennai, which is 12° 58' latitude and 80°13' longitude, residents use shallow open dug wells for their domestic water supply as the surrounding sandy aquifer. However, as a result of the tsunami, the coastal belt is completely flooded and the shallow ground water aquifer is contaminated with saltwater (AchuthanNair et al., 2012). The diffuse contamination of ground water and the point source contamination of wells along the affected coastal zone were aggravated by the influx of wastes from septic materials, pit latrines, chemical spills, dead bodies and surface debris. The waste and debris directly contaminate the wells or accumulated in the surface depressions and infiltrated into the aquifer for several days following the event. This study investigates the change in water quality of the highly vulnerable local sand aquifers due to tsunami and its "natural cleaning" response by precipitation over time and the effect of well cleaning and pumping water for domestic uses (Illangasekare et al., 2006).

The most important factor to take into account in most communities, the principal risk to human health derives from fecal contaminations and total solids. In some countries, there may also be hazards associated with specific chemical contaminants such as fluoride or arsenic, but the levels are unlikely to change significantly with time. Determination of quality of drinking water should be given utmost priority of any government. Local authorities and residents should also co-operate with the government to conserve natural resources. Though there are about thirty five

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Table 1
Physico-chemical and biological parameters.

Classification	Parameter
Physical	Temperature Turbidity Total solids
Chemical	Dissolved oxygen (DO) Biochemical oxygen demand (BOD) pH
Biological	Fecal Coliform

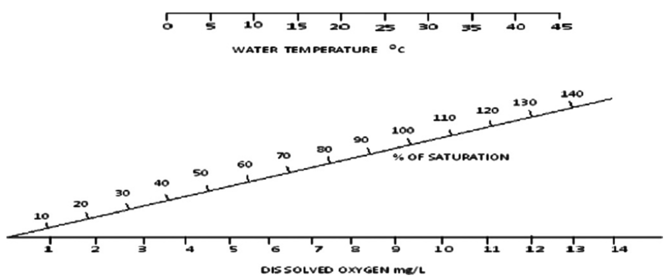

Fig. 1. % saturation chart for dissolved oxygen.

Table 2
Important rate and parameters weight – water quality index (WQI).

Parameters	Weight
Dissolved oxygen	0.17
Fecal Coliform	0.16
pH	0.11
BOD	0.11
Temp.	0.10
Turbidity	0.08
Total solids	0.07

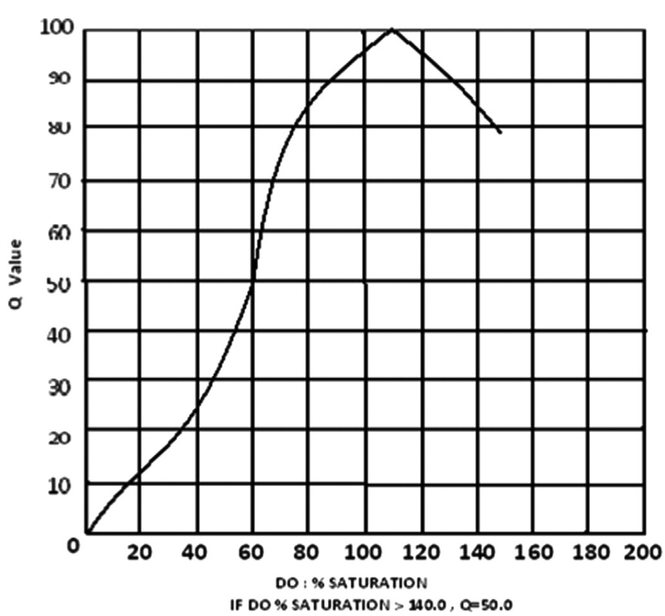

Fig. 2. DO % saturation curve (a representative graph).

Table 3
Water quality classification based on WQI values.

Range	Quality of water	Field of application
91–100	Excellent	Can be used for drinking, domestic and industrial purposes
71–90	Good	Can be used for drinking, etc.
51–70	Medium	Can be used only for irrigation and partial body contact
26–50	Bad	Cannot be used for any purpose without treatment
0–25	Very bad	Cannot be used for any purpose without treatment

parameters available, it is needless to carryout quantitative determination of all these parameters as these are interrelated in one way or other. But at the same time, one should consider the importance of each parameter and the local environment for the quantification of pollution load of any water body. National Sanitation Foundation (NSF) and Water Quality Index (WQI) have suggested only nine parameters such as Temperature, Turbidity, Total solids, Dissolved oxygen (DO), Biochemical oxygen demand (BOD), pH, Total phosphate, Total nitrate and Fecal Coliform in three categories such as physical, chemical and biological parameters for calculating Water Quality Index (Table 1). But in this present investigation, the parameters such as Total phosphate and Total nitrate have not been taken into consideration as there are no sources for these pollutants in the chosen study areas. Regular monitoring of the quality of ground water should be undertaken temporarily and spatially to identify the sources of contaminants that affect the potability of water (Illangasekare et al., 2006).

A decision is made to quantify the pollution of ground water based on the following factors: 1. Important water quality parameters 2. Priority to the parameters 3. Procedure to determine the *Q*-value for each parameter and assigning the *Q*-value. *Q* test is used for identification and rejection of outliers. This assumes normal distribution and could be used sparingly and never more than once in a data set. To apply a *Q* test for bad data, the data is arranged in order of increasing values and *Q* is calculated as defined:

$$Q = \frac{\text{gap}}{\text{range}}$$

where gap is the absolute difference between the outlier in question and the closest number to it. If $Q > Q_{\text{table}}$, where Q_{table} is a reference value corresponding to the sample size and confidence level, then reject the questionable point. Note that only one point may be rejected from a data set using a *Q* test. In an effort to develop a system to compare water quality in various parts of the country, over 100 water quality experts were called upon to help create a standard Water Quality Index (WQI). The index is basically a mathematical means of calculating a single value from multiple test results. The index result represents the level of water quality in a given water basin.

It is important to monitor water quality over a period of time in order to detect changes in the water's ecosystem. The Water Quality Index, which was developed in the early 1970s, can give an indication of the health of the watershed at various points and can be used to keep track of and analyze changes over time. The WQI can be used to monitor water quality changes in a particular water supply over time, or it can be used to compare a water supply's quality with other water supplies in the region or from around the world.

2. Experimental

Any number of water Quality measurements can serve as indications of water quality but there is no single measure that can describe the overall quality of any water system. The present study was undertaken to evaluate the quality of ground water samples