Water quality assessment in the tsunami-affected coastal areas of Chennai

The earthquake of magnitude 9 that occurred off the coast of Sumatra on 26 December 2004 (at 00:58:50 (UTC)/06:28:50 a.m. (IST) with its epicentre at 3.29°N and 95.94°E on the shallow depths of the seabed), caused a tsunami that travelled from Indonesia to the Indian coast. In Chennai, besides sea-water intrusion and deaths of numerous people, the impact also included morphological changes along the coastline, where sea intruded in certain places and receded in others. In Adyar, the mouth of the river creek cut-off from the sea due to sandbar formation was cleared by big waves[1]. The water quality of the area is suspected to be affected due to increase in salinity and total dissolved solids along the tsunami-affected coast. In this connection, the present study was carried out in the tsunami-affected areas with respect to groundwater quality in the coastal areas of Adyar. The study area included Adyar and the surrounding areas in south Chennai that lie between latitudes 12°58′N and 13°08′N, and longitudes 80°16′E and 80°28′E.

For the present study twenty-eight sampling spots were chosen covering the sea-water intruded area (approximately around 200 m distance from sea) and also at locations that were away from sea-water intrusion during the tsunami. The sampling spots were also selected along the banks of Adyar River in the coastal area. Secondary data were obtained from various government organizations so as to understand the pre-tsunami water quality of the study area. The samples collected were analysed for basic water quality parameters, including Total Dissolved Solids (TDS) as prescribed in the *Standard Methods for Examination of Water and Wastewater*[2]. TDS values were taken as the main parameter for classification and delineation of the study area. It was done by overlaying the TDS values obtained during field tests on Adyar area onto the digitized map of Chennai.

On comparison of TDS values of some sampled areas along with the available secondary water quality data, some of the sampled locations showed no major change in TDS values after the tsunami. Though a slight increase in TDS values was seen soon after the tsunami, values of the post-tsunami water quality analysis were comparable with the pre-tsunami period of September 2004. TDS values for December 2004, i.e. prior to the tsunami were lower compared to those of September 2004, which might be because of dilution of groundwater due to rainfall experienced during monsoon, from September to November 2004. TDS values till September 2005 showed that none of the values of the post-tsunami period exceeded that of the pre-tsunami period of September 2004.

Data pertaining to daily rainfall from December 2004 to September 2005 obtained from India Meteorological Department indicated that the rainfall experienced by the district was less, which might have not be able to wash the surface contaminants and contribute to TDS of groundwater. Data also showed that the rainfall intensity was less so as to reach the aquifer and that might have contributed in the dilution of groundwater.

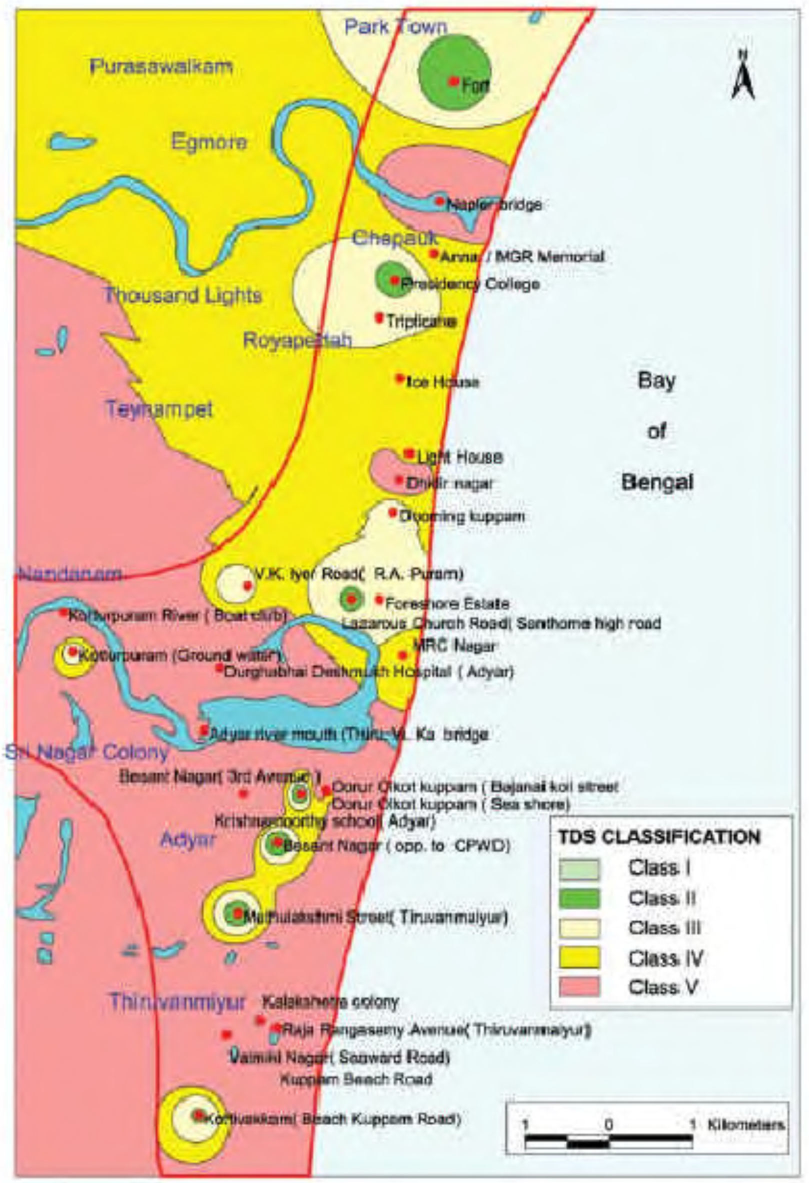

Figure 1. Classification of the study area in Chennai coastal area – Adyar, based upon TDS values of water samples.

Table 1. Criteria for classification of study areas

Class	TDS (mg/l)	Electrical conductivity (μS/cm)	Impact description
I	<1000	<1500	No detrimental effect on agriculture and acceptable as drinking water source
II	1000–2100	1500–3000	Cause for rejection as source of drinking water at TDS above 1500 mg/l. May have adverse effects on many crops
III	2100–3500	3000–5250	Unfit for drinking and has adverse effect on many crops
IV	3500–4900	5250–7500	Unfit for drinking. Salt-tolerant species may survive on permeable soils with careful management practices
V	>4900	>7500	Unfit for drinking as well as for cultivation of most crops

Source: Ref. 3.

TDS values at locations away from sea, including Kottivakkam beach, Kuppam road, Adyar Krishnamoorthy School and Triplicane showed an increase from May to September 2005. The increase may be due to insufficient rainfall in Chennai as experienced in the last six months till September.

The study area is delineated in Figure 1 based upon TDS values (Table 1)[3]. The total extent of the study area, covering the sampling points using the polygon attribute table, was found to be 34.882 sq. km.

It is suggested that the areas falling under class I with TDS < 1000 mg/l may be considered as unaffected and those falling under classes II–V may be considered as affected. Figure 1 shows that the southern part of the study area is highly contaminated compared to the northern part. This may be due to higher sea-water intrusion in the southern part (including Besant Nagar, Thiruvanmaiyur and Kottivakkam area) as a result of over-exploitation of groundwater. The coastal region in the northern part of the study area, though inundated during the tsunami showed better water quality (class IV) than the coastal regions of the southern part (class V). Locations lying on the northern part of the study area now falling under class IV were reported to fall almost under the same class during September 2004, i.e. prior to the tsunami.

Poor groundwater quality is evidenced in areas like Kottivakkam beach, Kuppam, Oorurolkot Kuppam (seashore), Raja Rangasamy Avenue (Thiruvanmaiyur), Foreshore Estate, Dhidir Nagar, Nochikuppam, Anna–MGR Memorial, which lie in close proximity to the sea and where sea water inundated during the tsunami. Apart from sea-water inundated areas, other areas showing poor water quality include R.A. Puram and Krishnamoorthy School, Adyar. TDS levels observed after the occurrence of the tsunami are within the range as observed during September 2004. Thus the recorded TDS values over time indicate that there is no major impact of the tsunami on water quality. As seepage of sea water is very less due to the short period of transgression during the tsunami, the aquifer has not been affected. Though sea water percolation into the ground through small pockets of waterlogged areas is possible, the effect would be less considering the short period of inundation of sea water during the tsunami. Thus it is clear that the groundwater quality has deteriorated due to lack of sufficient rainfall leading to sea-water intrusion that is reflected in high TDS and chloride content of the samples.

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Natural occurrence of Jatropha mosaic virus disease in India

Whitefly-transmitted geminiviruses of the genus *Begomovirus* are important pathogens of a wide range of crop ecosystems. Since the introduction of B biotype *Bemisia tabaci* in Kolar, there has been an increased incidence of begomoviruses on many vegetables and ornamental crops in the southern districts of Karnataka. Mosaic disease caused by begomovirus was one among such diseases noticed recently on Jatropha (*Jatropha curcas* L.), a drought-resistant perennial biodiesel plant in Karnataka[1]. The Jatropha Mosaic Virus (JMV) was first reported on *Jatropha gossipiifolia* from Puerto Rico and identified as begomovirus[2]. Ultrastructural studies of JMV-infected plants indicated the association of cytoplasmic inclusions such as membrane-bound bodies containing granular or fibrillar material, infection confining to phloem and virus-like particles of 15–18 nm in diameter[3]. The virus was found to be transmitted by the vector *Bemisia tabaci* Aleyrodidae in a semi-persistent manner, but not through sap inoculation and seed[4]. In this study we attempted a survey of Jatropha-growing