

Quality assessment of Physico-chemical parameters in Drinking Water at Pulicat Lake Fishermen Villages

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(Received 13 May, 2021; Accepted 30 June, 2021)

ABSTRACT

In recent trends water pollution plays a major role in human health and life threatening issues both directly and indirectly related with water utility. Present study based on the analysis of physiochemical parameters in drinking water supplies in various fishermen villages Sathankuppam, Edamani, Thoniravu, Pulicat, Goonankuppam, Arangankuppam, Vairavankuppam and Koraikuppam around fishermen villages of Pulicat lake. Physiochemical parameters like pH, total dissolved solids, total suspended solids, conductivity and turbidity were recorded from the drinking water samples. Presence of minerals and heavy metals and total bacterial count were also investigated in the water sample. Results show highest value noticed in pH (8.17) at Vairavankuppam, TDS (1589 ppm), TSS (203.1ppm) and conductivity (2788 μ s) in Goonankuppam and turbidity (2NTU) from Thoniravu and Goonankuppam. The concentration of minerals, heavy metals and bacterial contamination also monitored. Based on the water quality results it proves to be not good for the domestic usage. More knowledge and awareness are needed for the public to avoid water borne diseases.

Key words: Drinking water, Quality, Pulicat lake villages

Introduction

The quality of drinking water depends on various chemical constituents and their concentration, which are mostly derived from the geological data of particular region. Many times the industrial wastes and municipal solid waste leads to pollution of surface and groundwater (Patil *et al.*, 2012). In India it is reported that 70% water is polluted, in that source of pollution identified 84 to 92 % is sewage and waste water (Joshi *et al.*, 2009). Around the world 780 million people do not have access to clean and safe water and 2.5 billion people do not have proper sanitation as result 6-8 million people die each year due to waterborne diseases and disasters (Rahmanian *et al.*,

2015).

In India 21% all communicable diseases related to unsafe water with diarrhoea causing alone hundred thousands of death annually (Veena *et al.*, 2014). According to WHO about 600 cases of diarrhoea and 46,00,000 child deaths are reported annually due to contaminated water and improper sanitation (Khan *et al.*, 2020). In India 80% diseases related with poor water quality and unhygienic conditions (Kumar *et al.*, 2019).

Water quality monitoring and physiochemical parameters are important. Because water quality index (WQI) gets affected by atmospheric activities and heavy metals (Bhagde *et al.*, 2020). Many local and global standards are enacted as to ensure that

good water quality used for consumption, but in places where water is supplied the quality is not up to the standards (Ugwa *et al.*, 2016). More number of microorganism's such as bacteria, protozoa, algae and tiny animals rotifers present in the drinking water. Increasing population and its necessity leads to the deterioration of surface and subsurface water and ground water crisis happens due to anthropogenic activities. In this present study physiochemical parameters of drinking water were investigated in eight fishermen villages of Pulicat lake carried out with pH, TDS, TSS, conductivity, turbidity, heavy metals and total bacterial count.

Materials and Methods

Study area

Pazhaverkadu the name derived from pazham + ver + kadu the Pulicat lake located between 13°25'-13°55' N and 80°3'-80°90' (Fig. 1), it is the second largest brackish water lake after Chilika Lake in India. The average area of the water spread is 461 sq km. it is one of traditional fishing centre in Thiruvallur District, Tamil Nadu. There are 22 fishermen villages are surrounded the lake from Tamil Nadu jurisdiction.



Fig. 1. Sampling sites of study area

Methodology

Potable water Samples collected from eight different locations namely Sathankuppam, Edamani, Thoniravu, Pulicat, Goonankuppam, Arangamkuppam, Vairavankuppam and Koraikuppam. Samples were collected 1litre with sterilized container and were transferred to into the laboratory conditions for further analysis. The parameters like pH, TDS, TSS, conductivity and turbidity using Digital meter. Stock solution and standard solutions are prepared and estimated by using atomic spectrophotometer were used for minerals estimation APHA (2011).

Results

The value of Physiochemical parameters evaluated in the drinking water samples of Pulicat villages, amount of pH, TDS, TSS, conductivity, turbidity, heavy metals concentration and presence of total bacteria.

pH

High value (8.17) was detected in the Vairavankuppam, low value (6.06) noticed in Sathankuppam. The level of pH value is above the prescribed limit for these waters (Table 1 & Fig. 2). The reduced rate of photosynthetic activity and the assimilation of carbon dioxide and bicarbonate responsible for increased pH. More pH leads to eye irritation and skin disorders.

TDS, TSS, Conductivity and Turbidity

The accepted TDS value is (50-500)ppm as per WHO standard (2003) and (1200-2000)ppm is unacceptable for drinking water because of increased TDS leads to effect of central nervous system and responsible for other chronic diseases, presence of

Table 1. Shows water quality in drinking water sample

S. No.	VILLAGES	pH	TDS (ppm)	TSS (ppm)	Conductivity (µs)	Turbidity (NTU)
1	Sathankuppam	6.06	50.7	10.2	101.4	1
2	Edamani	7.99	917	184.2	1833	1
3	Thoniravu	7.92	929.6	56.8	1857	2
4	Pulicat	6.99	215	17.8	431	1
5	Goonankuppam	7.53	1589	203.1	2788	2
6	Arangamkuppam	6.44	56.8	8.35	113.5	1
7	Vairavankuppam	8.17	309	20.3	618	1
8	Koraikuppam	7.08	181	22.5	361	1

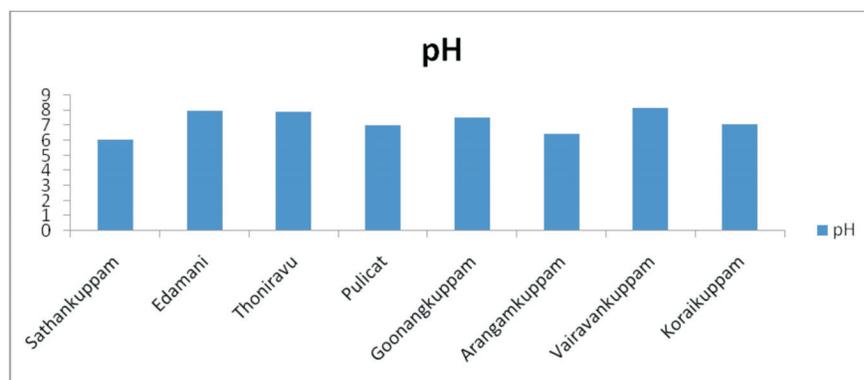


Fig. 2. Shows pH in the drinking water sample

sodium, chloride, potassium increased the TDS value and presence of heavy metals lead, arsenic cause serious health issues especially in children. High amount of TDS recorded in Goonankuppam (1589 unit) followed by Thoniravu (929.6 unit), low in Sathankuppam (50.7 Unit). High TSS noted in the Goonankuppam (203.1 unit) and low level (8.35 Unit) present in the Arangamkuppam (Fig. 3).

High conductivity was noticed in Goonankuppam (2788 μ S) followed by Thoniravu (1857 μ S), low reported in sathankuppam village (101.4 μ S). Electrical conductivity is defined as the

ionic process of solution that enables it to transmit current. As per WHO standard electrical conductivity value should not exceed 400 μ S/cm ((Meride *et al.*, 2016). Conductivity affected by the suspended impurities and ions. High Turbidity (2NTU) (NTU-Nephelometric Turbidity Unit) recorded from Thoniravu and Goonankuppam (Table 1 & Fig. 4).

Minerals

The higher values of minerals present in the drinking water samples respectively calcium (236.8ppm), magnesium (167.3 ppm), chloride (457.3ppm), po-

Table 2. Shows minerals (ppm) in drinking water sample

S. No	Villages	Ca (ppm)	Mg (ppm)	Chloride (ppm)	Nitrate (ppm)	Sulphate (ppm)	K (ppm)	P (ppm)	Na(ppm)
1	Sathankuppam	1.33	0.894	4.22	0.31	0	5.35	1.34	20.5
2	Edamani	131.6	107.3	330.8	45.9	131.3	46.3	21.9	155.9
3	Thoniravu	108.8	107.6	328.3	25.6	245.9	35.3	12.4	145.9
4	Pulicat	33.9	27.3	73.98	10.8	10.2	12.8	16.3	68.2
5	Goonankuppam	236.8	167.3	457.3	18.3	201.3	46.3	20.8	418.3
6	Arangamkuppam	10.2	0.8	5.89	2.13	1.93	0.98	2.34	20.3
7	Vairavankuppam	59.9	47.3	54.9	10.4	20.9	13.9	2.33	21.3
8	Koraikuppam	30.2	23.9	72.5	12.6	25.3	1.25	19.2	50.3

Table 3. Shows heavy metals (ppm) in the drinking water sample

S.No.	VILLAGES	Lead	Mercury	Cadmium	Selenium	Arsenic
1	Sathankuppam	<5	Absent	Absent	Absent	Absent
2	Edamani	25.3	0.5	0.25	1.70.	0.58
3	Thoniravu	25.5	0.15	0.4	0.54	<1
4	Pulicat	10.3	BDL	BDL	2.88	<5
5	Goonankuppam	27.9	0.21	0.08	1.98	0.75
6	Arangamkuppam	<2	BDL	BDL	BDL	BDL
7	Vairavankuppam	10.4	BDL	BDL	BDL	<1
8	Koraikuppam	<5	0.43	0.21	0.3	<2

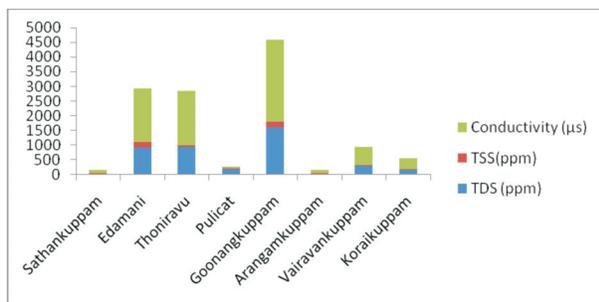


Fig. 3. Shows TDS, TSS and Conductivity of water sample

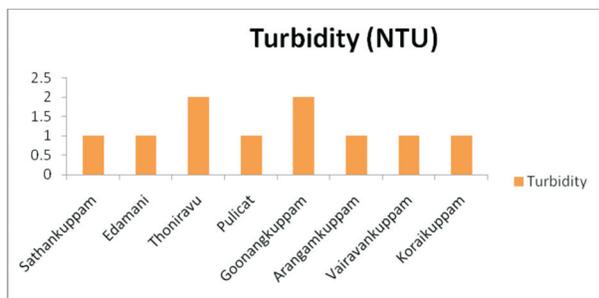


Fig. 4. Shows Turbidity in drinking water sample

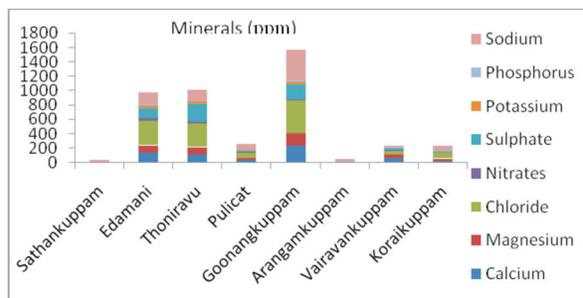


Fig. 5. Shows minerals present in the drinking water sample

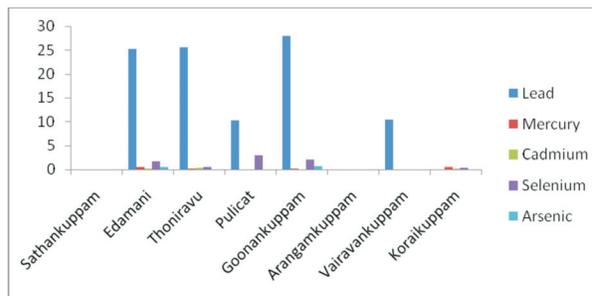


Fig. 6. Shows bacterial count in drinking water sample

tassium (46.3ppm) and sodium (418.3ppm) were recorded in the Goonankuppam. The elevated nitrate level (45.9 ppm), phosphorous (21.9 ppm) were obtained from Edamani and the sulphate level (245.9 ppm) was noticed from Thoniravu village (Table 2 & Fig. 5).

Heavy metals

Heavy metals present in the drinking water can cause serious health problems to the human. These chemical elements present in the environment and accumulated in soil and sediment of water. Heavy metals like lead, mercury, cadmium, selenium and arsenic cause numerous diseases. A trace amount of

heavy metals can poison and deteriorate mental and central nervous system function and lower energy level. Drinking water contaminated metals can cause chronic health effects involving cancer, birth disorder and loss to the immune system. They are heavy metals identified in the drinking water of eight fishermen villages in the concentration of lead (27.9ppm), arsenic (0.75 ppm) at Goonankuppam, mercury (0.43 ppm) at Koraikuppam, cadmium (0.4 ppm) in Thoniravu and selenium (2.88 ppm) at Pulicat. Absence of heavy metals and below detected levels mentioned below in Table 3 & Fig. 6.

Fig. 5 shows heavy metals present in water sample

Table 4. Shows bacterial count in the drinking water sample

S. No.	Villages	Total Bacterial Count (cfu/ml)
1	Sathankuppam	145
2	Edamani	140
3	Thoniravu	130
4	Pulicat	40
5	Goonankuppam	125
6	Arangankuppam	75
7	Vairavankuppam	120
8	Koraikuppam	110

Total bacterial count

The highest bacterial population was observed in 145 cfu/ml from Sathankuppam and lowest level was noticed 40 cfu/ml in Pulicat (Table 4 & Fig. 6)

Discussion

Present study based on the analysis of physiochemical parameters in drinking water supplies in eight fishermen villages around Pulicat lake. pH present in the water regulates the solubility and biological activities of chemical nutrients such as

phosphorous, carbon and nitrogen. The highest concentration pH 8.17 in the present study is similar to the previous record of physiochemical parameter noted by Joshi *et al.*, (2016) in Vadodara city. Anita *et al.* (2018) suggested that reason for high pH concentration is due to carbonate and bicarbonates of calcium and magnesium present in the water.

In the present study observed highest concentration of TDS is 1589 ppm in the village of Goonangkuppam. Ugwa *et al.* (2016) stated the environmental impact of total dissolved solids in water not to exceed 110% above the exceeding limits can be detrimental to the aquatic life. Raffi *et al.* (2011) observed that turbidity is cloudiness in the drinking water and it can interfere with the disinfection and provide medium for microbial growth. The study indicated that most of the drinking water measured with conductivity below 2000 μ s/cm (Adekunle *et al.*, 2007), present study in Goonangkuppam have highest concentration of (2788 μ s). Present study shows that Goonangkuppam has the high range of Ca (236.8 ppm), Mg (167.3 ppm), Chloride (457.3 ppm), K (46.3 ppm) and Na (418 ppm). High sodium is responsible for kidney damage, hypertension, headache etc. Nitrate (45.9 ppm) observed in Edamani, sulphate (245.9 ppm) in Thoniraivu and P (21.9ppm) in Edamani. Adekunle *et al.*, (2007) reported that nitrate above the concentration can cause pregnant women serious health issues and infants have methaemoglobinaemia.

The study shows high accumulation of heavy metals observed viz., lead (27.9 ppm) in Goonangkuppam, mercury (0.43 ppm) in Koraikuppam, cadmium (0.25 ppm) in Edamani, selenium (2.88 ppm) and arsenic (<5 ppm) in Pulicat respectively. Bayan (2020) recorded that high concentration of heavy metals Al-Zubair city and suggested that seasonal variation may be the result of low evaporation and decrease temperature subsequently inflow the groundwater leading to accumulation of these metals. Hasanand Jumaily (2016) mentioned that heavy metals of Arsenic permissible limit given as 10 ppb and that is specified by WHO. Highest concentration of bacteria present in the water environment indicates the possibility of sewage contamination in the potable water. Bacteriological quality and quantity of the drinking water sample for domestic sources collected from open water, tap water and tube wells. Higher level of bacterial count (145cfu/ml) in Sathankuppam and lower level (40cfu/ml) in Pulicat were noticed.

The investigation of physiochemical properties in potable water at sampling sites has maximum contamination. The results indicate that water quality polluted and it is not good for the health and domestic use. Water samples in some sites have increased heavy metals and some villages have increased TDS and TSS levels and some of them show high bacterial contamination. Concluded in this present investigation drinking water is not fit for residential purpose and required regular monitoring to avoid health issues.

Acknowledgement

The authors are thankful to authorities of Dr.Ambedkar Government Arts College (Autonomous), Vyasarjadi, Chennai for providing necessary facilities.

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