IJASRM International Journal of Advanced Scientific Research and Management, Volume 3 Issue 11, Nov 2018
www.ijasrm.com
ISSN 2455-6378

The Effect of Dissolved Oxygen, BOD, COD, Fluoride and Nitrate-Nitrogen Contents of Tamirabarani River, Tirunelveli, Tamilnadu

O.V.Sheebha Malar[1], P.Kokila[2] and C.Isac Sobana Raj[3]

[1] Research Scholar, Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli, Tamilnadu, India. 627012.

[2] Department of Chemistry, Vivekananda College, Agasteeswaram, Kanyakumari, Tamilnadu, India. 629701.

[3] Department of Chemistry and Research, Nesamony Memorial Christian College, Marthandam, Kanyakumari, Tamilnadu, India. 629165.

Abstract

Tamirabarani is the only perennial river in south India which flows from the source to sea about 128 kilometers through Tirunelveli and Thoothukudi districts. The water samples from seven different sites of Tamirabarani river basin were examined. Parameters such as dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, fluoride and nitrate-nitrogen contents were analyzed quantitatively using standard methods. The investigations indicated that the concentration variations were recorded in site to site and in sample to sample and also season to season. The present study reveals that the water is contaminated at selected points which are not suitable for drinking. In site three the average dissolved oxygen and bio chemical oxygen demand values are not within the range of prescribed limit. The average fluorides and nitrate-nitrogen are found to be well within the permissible limit. Chemical oxygen demand of site seven was within the permissible limit. The pulp of paper mill, textile industry and temple waste and small scale industries are added to the sampling points. These are the main pollutant sources of Tamirabarani River in addition to anthropogenic activities. Tirunelveli Corporation, supplies water to towns from Tamirabarani River.

Keywords: *Tamirabarani River, dissolved oxygen, biochemical oxygen demand, fluoride and nitrate-nitrogen.*

1. Introduction

The life in the hemisphere cannot be survived without water, and it is very important to preserve the water quality. Changes in properties such as dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, fluorides and nitrate-nitrogen in particular affect the mortality of aquatic life. The characteristics of both natural weathering process and anthropogenic activities can have a significant impact on water quality. Heavy rain fall tends to dissolve and carry away minerals and contaminants found on the surface of the earth and the atmospheric gases. (Lawrence, 2010).

2. Need for present study

According to (Lawson, 2011) mixing of sewage, municipal effluents, industrial discharges and low water flow reduces the water quality. In south India the Tamirabarani is a symbol of Tamil culture and civilization. Number of peoples depends on the river for their routine activities and for satisfying their needs. Local complaints and newspaper reports on the cleanliness less of the river have made the subject a major problem to converse. Although Tirunelveli authorities have taken steps to evict encroachments near the Tamirabarani River yet the problem not has been completely solved from other areas and sewage being still let into the river. To preserve the quality of water, it is important to analyze the parameters continuously.

3. Materials and methods

This study was carried out from 2013 to 2016 and water samples were collected in the bottle after rinsing it in the same water 3 or 4 times. After the collection the bottle was tightly closed, marked and labeled. The sample of water collected from seven sites like (S_1) Vickramasingapuram, (S_2) Ambasamudram, (S_3) Cheranmahadevi, (S_4) Thirupudaimarthur, (S_5) Tirunelveli, (S_6)

IJASRM International Journal of Advanced Scientific Research and Management, Volume 3 Issue 11, Nov 2018
www.ijasrm.com
ISSN 2455-6378

Muruppanadu and (S_7) Authoor, surrounding the Tamirabarani River. The water quality parameters were analysed in the laboratory by using standard methods, (APHA, 2005).

4. Results and discussion

4.1. Dissolved oxygen

Table.1. Variation of DO in different sites at different seasons

Yr	season	S_1	S_2	S_3	S_4	S_5	S_6	S_7
2013	winter	7	7	7.3	8	6	9	7.2
	summer	8	6	7.1	8.2	6.5	8	7
	rainy	8	8	7.2	8.4	7.2	9	7
2014	winter	7.5	8	8.2	7.8	6.5	8	7.5
	summer	6.5	7	6	6.5	7.2	8	7.5
	rainy	7	6	8	8.9	7.3	8	7.5
2015	winter	6.9	7	7.5	7.6	7	7	7
	summer	6.8	7.5	6.5	7	8.5	6.8	7.2
	rainy	7	7.5	9	7	8.5	6.8	7.5
2016	winter	7.5	7.5	8	7	9	7	7.4
	summer	7	8.2	6.2	6.1	9	7	7.6
	rainy	7.2	8	8	7.2	8.5	7	7.6

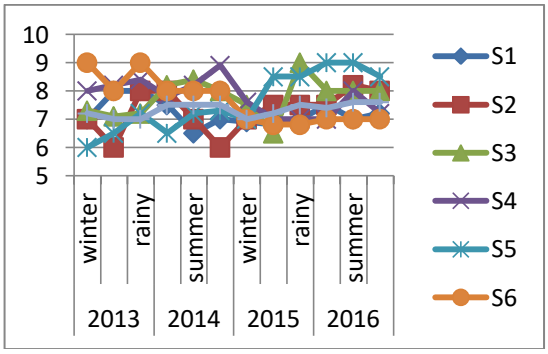

Fig .1: Variation of DO with time in different sites at different seasons

Oxygen saturation or dissolved oxygen is a relative measure of the amount of oxygen that is dissolved in water. Environmental oxygenation can be important to the sustainability of a particular ecosystem. Insufficient oxygen may occur in bodies of water such as ponds and rivers tending to suppress the presence of aerobic aquatic organisms such as fish. Deoxygenation increases the relative population of anaerobic organisms such as plants and some bacteria, resulting in fish kills and other adverse events.

Atmosphere and photosynthesis are the main sources for the formation of dissolved oxygen (Sonawane, 2009). During the study period dissolved oxygen content was ranged from 6.0 – 9.0 mg/l, whereas the prescribed limit for dissolved oxygen by world health organization is 5.0 mg/l. Minimum content (6mg/l) of dissolved oxygen was observed at site S_2 (2013 summer rainfall-111.8) (Surinder et al., 2014), S_3 (2014 summer – rainfall 8.5mm) (Surinder et al., 2016) and S_5 (2013 winter – rainfall-98.6mm). This minimum value is due to the mixing of organic pollutants waste water from industries and paper mill. Low level of dissolved oxygen indicates that the water is highly polluted and is usually associated with organic pollution (Kamal, 2007; Anisha et al., 2009). Maximum content (9mg/l) of dissolved oxygen was observed at site S_6 during rainy season (rainfall 263.8mm). This indicates that the surface run off is not polluted and also it is diluted by heavy rainfall. (Premlata et al., 2009) says that the dissolved oxygen content in water body gives direct and indirect information of bacterial activity, photosynthesis, availability of nutrients and stratification.

4.2. BOD

Table 2. Variation of BOD in different sites at different seasons

Yr	season	S_1	S_2	S_3	S_4	S_5	S_6	S_7
2013	winter	2	1.5	4.5	0.2	3.8	3	0.2
	summer	2	2	5	0.2	3.2	3	0.2
	rainy	2	1.5	4	0.2	3.2	3	0.2
2014	winter	2	2	4.8	0.1	3.1	3	0.2
	summer	3.5	2.5	4.8	0.1	3.1	3	0.2
	rainy	3.5	1.5	4.2	0.1	3.4	3	0.3
2015	winter	2	1.7	3	0.8	1.2	1.5	0.4
	summer	2	2.2	3.2	0.8	1.2	1.2	0.4
	rainy	2	1.8	1.3	0.8	1.2	1.2	0.4
2016	winter	2.9	2	2.5	0.1	2	1.3	0.4
	summer	2.5	2	3.5	0.1	2	1.2	0.4
	rainy	2.7	2	3	0.3	2	1.3	0.4

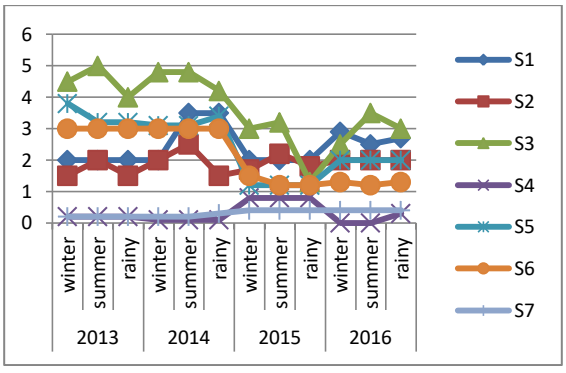

Fig .2: Variation of BOD with time in different sites at different seasons

The BOD is used as the index of organic pollution (Karthikeyani et al., 2002). BOD which is an

IJASRM International Journal of Advanced Scientific Research and Management, Volume 3 Issue 11, Nov 2018
www.ijasrm.com
ISSN 2455-6378

empirical standardized laboratory test which measures the oxygen requirement for aerobic oxidation of decomposable organic matter and certain inorganic materials present in water. The amount of dissolved oxygen needed by aerobic biological organisms is called BOD. More organic matter in water demands more of oxygen by microbes to degrade it. BOD means every living thing in water need the least minimal oxygen for respiration to live on. It is relating the stocking density of species and availability of oxygen in the water.

In the present study BOD ranges from 0.1 in site S_4 to 4.8 in site S_3 during summer in 2014. In summer the high value (4.8mg/l) of BOD was recorded in Cheranmahadevi due to the low rainfall and presence of high biodegradable materials by human activities. In 2014 February (9.6mm) and June (8.5mm) the low rainfall was recorded. Similar findings were recorded. (Ravichandran et al., 2009). High load of BOD (12.5mg/l) was due to usage of water for recreation purpose and also due to degraded algal biomass. (Panda et al., 2004). Low value (0.1mg/l) recorded in the site S_4 in rainy season 2014, due to heavy rainfall (294.2mm)

Fish and aquatic insects may die when oxygen is depleted by microbial metabolism. The BOD value is most commonly expressed in milligrams of oxygen consumed per liter of sample during 5 days of incubation at 20 °C and is often used as a rough measure of the degree of organic pollution of water. Most unpolluted streams will have a BOD below 1 mg/l and moderately polluted rivers may have a BOD value in the range of 2 to 8 mg/l.

4.3 COD

Table.3 Variation of COD in different sites at different seasons

Yr	season	S_1	S_2	S_3	S_4	S_5	S_6	S_7
2013	winter	7	10	10.6	8.9	22	9.7	2
	summer	11	12	10.6	10	20	9.5	2
	rainy	17	16	11.5	10	21	10	3
2014	winter	10	8	10.6	10	21	8.9	5
	summer	10	10	9.7	9	19	9	6
	rainy	14	17	8.9	10	19	9.5	6
2015	winter	10	6.2	12	7.1	6.2	10	2
	summer	10	6.2	10	4.4	2.6	9	2
	rainy	8	8	12	11.5	8.9	9	4
2016	winter	8	9.7	12	8	10.6	8	3
	summer	10	8	12.5	5.3	5.3	7	3
	rainy	10	8	8.9	12.4	16	7	3

In environmental chemistry, the chemical oxygen demand (COD) test is an indirect measurement of the amount of organic and inorganic compounds of bio degradable and non-biodegradable matters present in water. It is expressed in milligrams per liter (mg/l), which indicates the mass of oxygen consumed per liter of solution. (Sawyer et al., 2003).

In present study it was ranged from 2 to 21.0 mg/l. However, the prescribed limit for COD is 4 mg/l by USPHS for drinking water. Higher value recorded at site S_5 (Tirunelveli) during rainy season in 2013 due to high rainfall (263.8mm) surface runoff contains bio and non-biodegradable materials from the surroundings mixed in the river. Continuously in 2014 winter season also high COD value recorded. Human defecation along the river bank is common in Kokkarakulam area. Waste from railway station area, hospital region, and also from different streets domestic sewage are discharged into the river.

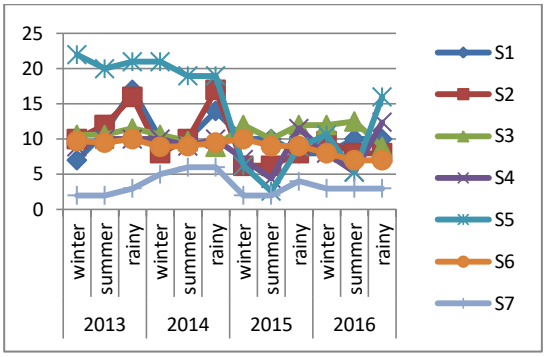

Fig .3 Variation of COD with time in different sites at different seasons

4.4. Fluoride

Table.4 Variation of FLUORIDE in different sites at different seasons

Yr	season	S_1	S_2	S_3	S_4	S_5	S_6	S_7
2013	winter	.04	.04	.05	.02	.05	.04	.01
	summer	.05	.05	.06	.01	.06	.05	.02
	rainy	.03	.03	.04	.04	.04	.03	.05
2014	winter	.05	.05	.06	.05	.06	.05	.06
	summer	.06	.06	.01	.03	.02	.06	.04
	rainy	.04	.05	.04	.05	.04	.02	.06
2015	winter	.06	.06	.05	.06	.05	.01	.01
	summer	.05	.04	.03	.01	.03	.04	.05
	rainy	.05	.06	.05	.02	.05	.05	.06
2016	winter	.07	.05	.06	.05	.06	.03	.04
	summer	.08	.06	.05	.06	.05	.05	.06
	rainy	.06	.04	.06	.04	.06	.06	.06

In most of the developing countries fluorosis is an endemic problem. Excessive amounts of fluorine are highly toxic to humans and animals when consumed in more than prescribed quantities (Miller et al., 1978). Fluorosis is known to take three forms namely skeletal fluorosis, dental fluorosis and non-skeletal fluorosis In the present study the Fluoride value of

IJASRM International Journal of Advanced Scientific Research and Management, Volume 3 Issue 11, Nov 2018
www.ijasrm.com
ISSN 2455-6378

all samples, is very less i.e. < 0.1 mg/l, whereas the (ICMR, 1975) prescribed limit is 1.5 mg/l. Enquiries with dental practitioners in the Rourkela City also testify that there are no cases of fluorosis of teeth reported from the patients. Fluoride was determined by SPADNS method (APHA, 2005). Permissible upper limit of fluoride of (BIS IS10500, 1991) is 1.5 mg/l in potable water. 0.01 to 1.28 mg/l of fluoride is seen in aquifer, tube well have 0.01 to 0.98 mg/l where as in ponds ranges from 0.01 to 0.05 mg/l.

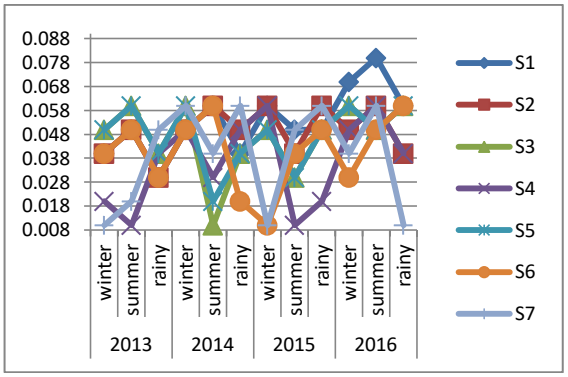

Fig .4. Variation of Fluoride with time in different sites at different seasons

Excess concentrations of fluoride ions on human body are undesirable and may cause dental carries reduction (1.0 mg/l), mottled enamel in teeth (2mg/l), oscleorosis (3-19mg/l), crippling fluorosis (20-80mg/l), kidney changes (125mg/l) and finally leads to death (2500mg/l). (Nazneen, 2012; Mehta et al., 2000)

The Crippling malady of fluorosis not only affects the bones and teeth but every tissue and organ of the body leading to death after prolonged illness. Fluoride can also damage a foetus if the pregnant woman consumes water or food with high concentration of fluorides. Ingestion of high fluoride content during breast- feeding can cause infant mortality due to calcification of blood vessels. Dust containing fluoride if inhaled causes irritation of nasal passage gastric troubles, loss of appetite, nausea, vomiting and also affect central nervous system. Excess concentration affects animal breeding and causes mottled teeth of the young animals. Higher concentration in plants prevents the accumulation of chlorophyll 'a' and 'b' and photo chlorophyll. (Nazneen, 2012).

4.5. NO_3-N

The main source of nitrate in water is the surface run-off and decomposition of organic matter. (Thilaga, 2005). Nitrate is the end product formed from the biochemical oxidation of ammonia. It affects the health of human beings. So monitoring of NO_3 quantity is important for drinking water, (Behera et al., 2010). Nitrogen occurs in natural waters in various forms, including nitrate or NO_3, Nitrite or NO_2, and ammonia or NH_3.Nitrate is usually expressed as nitrate–nitrogen or NO_3-N, which simply means nitrogen in the form of nitrate. Fertilizer is the largest contributor of anthropogenic nitrogen in the worldwide. Other major sources of nitrogen include animal and human waste, nitrogen oxide from utilities and automobiles and also leguminous crops that fix atmospheric nitrogen in their roots.

Table.5 Variation of NO_3-N in different sites at different seasons

Yr	season	S_1	S_2	S_3	S_4	S_5	S_6	S_7
2013	winter	2.5	4.5	6.9	8.2	26	3	4.2
	summer	2.5	4.5	7	8.2	25	3.6	4.9
	rainy	2.5	4.2	7.8	5.6	28	2.6	5.23
2014	winter	2.4	4.2	6.5	6.9	24	4.2	4.8
	summer	2.4	4.3	4.6	7	28	4.5	4.9
	rainy	2.3	4.4	5	6.5	29	3.2	4.9
2015	winter	4.2	3.2	12	7.4	12	5.2	4.5
	summer	4.2	3	12	7.2	12	5	4.6
	rainy	4.2	2.6	10	6.5	12.5	5.1	4.5
2016	winter	4.3	2.9	14	5.6	13	5.1	5.2
	summer	4.3	3.2	15	6.9	12	5.2	5.2
	rainy	4.1	3.1	14	7.5	9	5.2	5.3

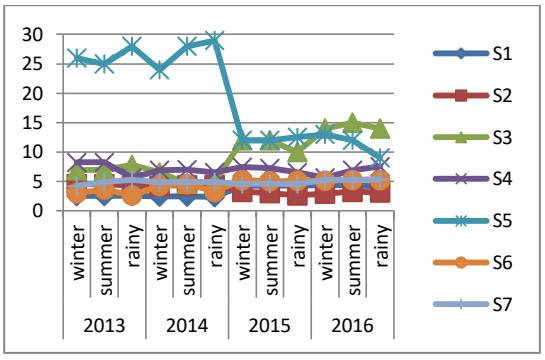

Fig .5. Variation of NO_3-N with time in different sites at different seasons

Nitrate – Nitrogen ranges from 2.3 mg/l to 29 mg/l whereas the permissible limit for Nitrate – Nitrogen is 45 mg/l. The highest Nitrate-N value of 29 mg/l was found in the river water of(S_5) Tirunelveli may be due to leaching from industrial slag as this area, is just one km away from slag dumping area. Nitrogen is important to all life. In the environment nitrogen in the atmosphere or in the soil can go through many complex chemical and biological changes. It can be combined into living and nonliving material and return back to the soil or air in a continuing cycle called the nitrogen cycle.

It is only found in small amounts in fresh domestic waste water, but in effluent of nitrifying biological treatment plants, nitrate may be found in concentrations up to 30 mg/l nitrate as nitrogen. Nitrate is a less serious environmental problem, it

can be found in relatively high concentrations, where it is relatively nontoxic to aquatic organisms.

Methemoglobinemia or blue baby syndrome is a condition caused by the inability of the blood to deliver enough oxygen to the body. It is the most well-known effect of exposure to elevated levels of nitrate in drinking water. When nitrate is ingested it is converted in to another chemical form, nitrite.

Nitrate is less stable and usually present in much lower amounts than nitrite. However, under certain conditions in the human body, nitrite can damage cells and also morph into molecules that cause cancer. The regulatory level for nitrate in drinking water supplies was determined after a survey of infant methemoglobinemia case reports in the united states indicated that no cases were observed at drinking water nitrate level < 10 mg/l nitrate-nitrogen (Walton, 1951).

5. Conclusion

Polluted water affects the human health. In the present study in site three (Cheranmahadevi) the average dissolved oxygen and bio chemical oxygen demand values are not within the range of prescribed limit. Low dissolved oxygen was due to the less rainfall and mixing of waste water from industries and paper mill present in Cheranmahadevi. The average fluorides and nitrate-nitrogen are found to be well within the permissible limit in all sites, this was due to the surface runoff from nearby agricultural field not containing nitrate and fluoride. Chemical oxygen demand of site seven (Authoor) was within the permissible limit. This indicates that there was no introduction of exotic species, over fishing and also disposal of industrial and domestic wastes from new industries. COD values are higher than BOD values, because COD includes biodegradable and non-biodegradable substances whereas BOD includes only biodegradable substances. Rapid urbanization and industrialization can post threat to sustainability of river conservation. Routine Monitoring of pollution level of river water makes younger generation happy.

References

[1] Anisha Khan B. and Satheesh Kumar P., Seasonal Variations in Physico-Chemical Parameters of Water and Sediment Characteristics of Pondicherry Mangroves, African Journal of Basic and applied Sciences, 1(1-2): 36- 43 (2009)

[2] APHA, Standard methods for the examination of water and waste water, 21stEdn, American Public Health Association, Washington, Dc., USA. (2005)

[3] Behera N.R., Mahananda R. and Mohanty B.P., physico chemical analysis of surface and ground water of Bargarh district, Orissa, India.International Journal of Research and Reviews in Applied Sciences, 2(3): 284-295 (2010)

[4] BIS, Bureau of Indian Standards. Indian standards drinking water specification IS 10500. (1991).

[5] ICMR, Special report. The Indian Council of Medical Research. New Delhi: National institute of science communication, Indian science congress. Food Nutrition and Environment security. The road ahead. Vol. Series 44. (1975)

[6] Kamal D., Bio chemical composition of some small indigenous fresh water fishes from the river Mouri, Khulna Bangladesh. Pakistan Journal of Biological Sciences, 10(5): 710-717. (2007)

[7] Karthikeyani T.P., Ramesh M and Sasi Kumar.J.M, physico-chemical, biological and bacteriological study of Kadathur canal water of Amaravathi river, TamilNadu, pollution Research, 21(1):21-23. (2002)

[8] Lawrence B., Eutrophication status of Thamirabarani River at Kuzhithurai. Journal of Basic and Applied Science, Volume 4(Issue 3). 168- 173, (2010)

[9] Lawson E.O., Physico-chemical parameters and heavy metal contents of water from the mangroves swamps of logos lagoon, logos, Nigeria, Advances in biological research, 5(1): 08-21, (2011).

[10] Mehta B.C., Das S., Das P.K., Samanta S.K. and Srivastava S.K., Fluoride hazards in ground water of Orissa, India. Indian Journal of Environmental Health, 1(1):40-46, (2000)

[11] Miller F. Benjamin and Keane B. Claire, Encyclopedia and Dictionary of Medicine, Nursing and allied health Medical dictionary. 2ndEdn. (1978)

[12] Panda S.P and Mishra C.S.K,Water quality status of 5 major temple ponds of Bhubaneswar city, Indian Journal of Environmental protection, 24(3): 199-201 (2004)

[13] Premlata and Vikal, Multivarient analysis of drinking water quality parameters of lake Pichhola in Udaipur, India, Biological form of International Journal, 1 (2): 97-102 (2009).

[14] Ravichandran C., and Jayalakshmi Suthabala S., Environmental quality of selected temple ponds in Tiruchirapalli, Indian Journal of Environmental protection, 29(5); 392-398 (2009)

[15] Sadat Nazneen, Study of Fluoride Concentration in the River (Godavari) and Ground water of Nanded City. International journal of Engineering Inventions, 1(1): 11-15, (2012).

[16] Sawyer N Clair, McCarty L.Perry and Parkin F. Gene, Chemistry for Environmental Engineering and Science, 5thEdn, New York: McGraw-Hill. ISBN 0-07-248066-1. (2003).

[17] Sonawane S.R., Hydrobiological studies of two fresh water reservoirs from Satara District, Indian Journal of Environment and Ecoplanning, 16(1); 35-40, (2009)

[18] Surinder Kaur. Dr. and Purohit. M. K., Rainfall Statistics of India-2013, Meteorological department, India, REPORT NO. ESSO/IMD/HS/R. F.REPORT/02(2014)/18, (2014).

[19] Surinder Kaur. Dr. and Purohit. M. K., Rainfall Statistics of India-2014, Meteorological department, India, REPORT NO. ESSO/IMD/HS R. F. REPORT/01(2016)/19, (2016).

[20] Thilaga A., Studies on nutrient content of the Ooty lake with reference to pollution. Nature Environment and Pollution technology, 4(2): 299-302. (2005)

[21] Walton G., Survey of literature relating to infant methemoglobinemia due to nitrate contaminated water. American Journal of Public Health 41:986-996, (1951)