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Distribution of certain heavy metals in the nelatur lake adjacent to Sri Damodaram Sanjeevaiah (APGENCO) thermal power plant of Spsr Nellore District, AP, India

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Abstract

Coal is the only natural resource and fossil fuel available in abundance in India and is used widely as thermal energy source for thermal power plants producing electricity. Huge quantity of fly ash is produced as by product from the combustion of coal in thermal power plants and are deposited on surrounding agricultural lands and water bodies. These effluents contain the heavy metals, the most hazardous pollutants due to their speedy dissemination into biosphere and their accumulative concentrations causing serious environmental problems (Ada *et al.*, 2007). A 600 MV Sri Damodaram Sanjeevaiah (SDS) thermal power plant is situated at Nelatur Coastal Village of SPSR Nellore Dist., AP, India. Effluents from this thermal power plant adversely affect the quality of water and directly contributes to contamination of Nelatur Lake water. In the present study the distribution of four heavy metals (As, Hg, Pb & Mn) is estimated in the Nelatur Lake adjacent to the thermal power plant. The results vividly indicate that the Arsenic level is high followed by Mercury. Lead and Manganese are relatively in low level (As>Hg>Pb>Mn).

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Introduction

In recent years the global energy demand has increased with the advances in industrialization and this has been largely met by fossil fuels (Lohani *et al.*,2008). Coal meets 29.6% of global primary energy needs and its share in the worlds electricity generation is about 42% (WCA, 2012). Coal combustion from thermal power plants (TPP's) contributes to 55.32% of the total electricity generation in India (Ministry of Power, 2012). Major environmental problems associated with the use of coal as fuel in thermal power plants are the likely contamination of air, water and land environment affecting the livelihood of the local people.

The fly ash released from TPP's contain heavy metals and pollute the surface and ground water sources and affect the food chain of the ecosystem (Mukharjee *et al.*, 2006). As the concentration of heavy metals increases, inevitably enter the biochemical cycles of the flora and fauna causing mutations and disturb reactions of immune system (Sivakumar and Dutta *et al.*, 1996, Ada *et al.*, 2007, Semsettin *et al.*,2007).

Sri Damodaram Sanjeevaiah (APGENCO, TPP) is situated in Nelatur Coastal Village of Muthukur Mandal, SPSR Nellore District, AP, India and geographically located at 14.31°N and 80.10°E [Fig1].

This thermal plant is adjacent to the Nelatur Lake. This lake is very prominent in the village and one of the most precious water treasures for flora and fauna. It is the major source of water for drinking and irrigation purposes of the nelatur village people.

The effluents released from this thermal plant adversely affect the nelatur lake and its surroundings. We have made an investigation and estimated the levels of four heavy metals (As, Hg, Pb and Mn) in the Nelatur Lake to assess the important of these heavy metals released from the TPP on the pollution of the Nelatur lake.

Materials and methods

Nelatur Lake water samples were collected from 7 locations covering the entire lake. The samples were essentially taken from at a fixed time (9.00 AM).

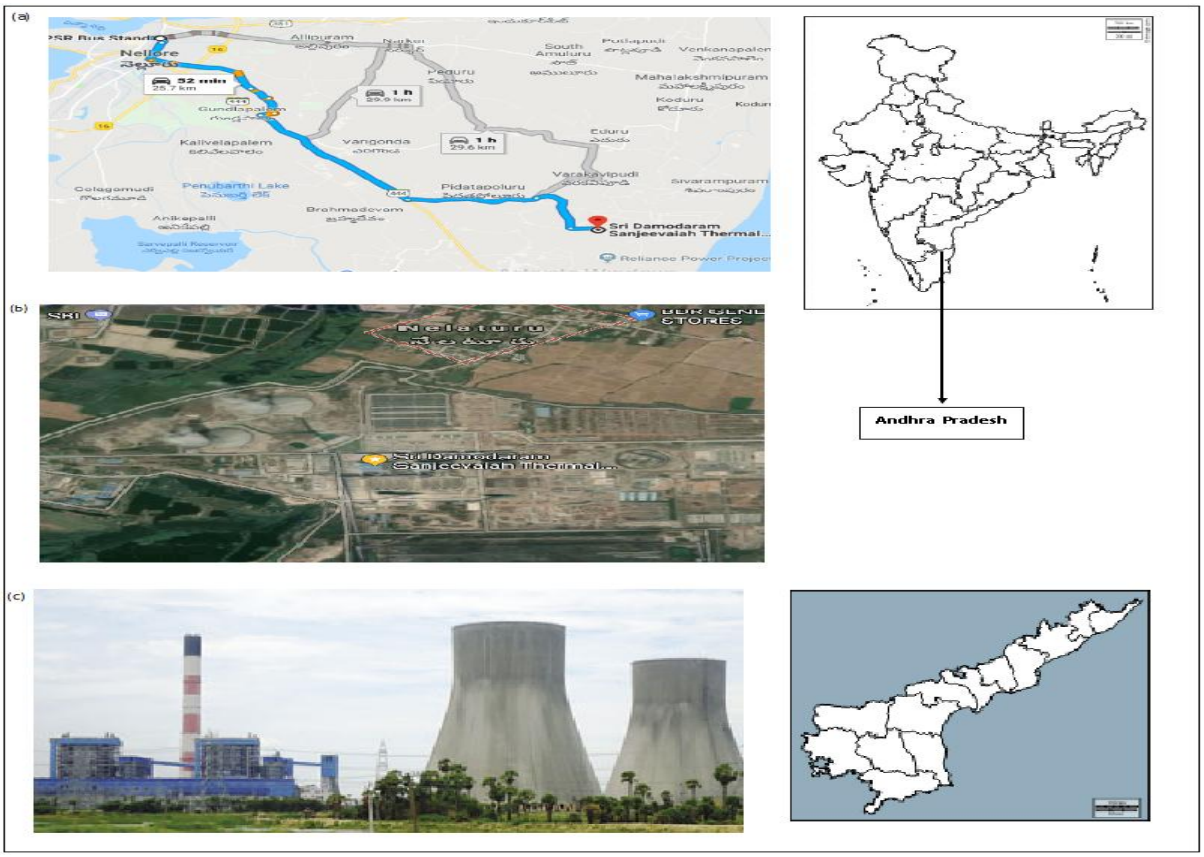
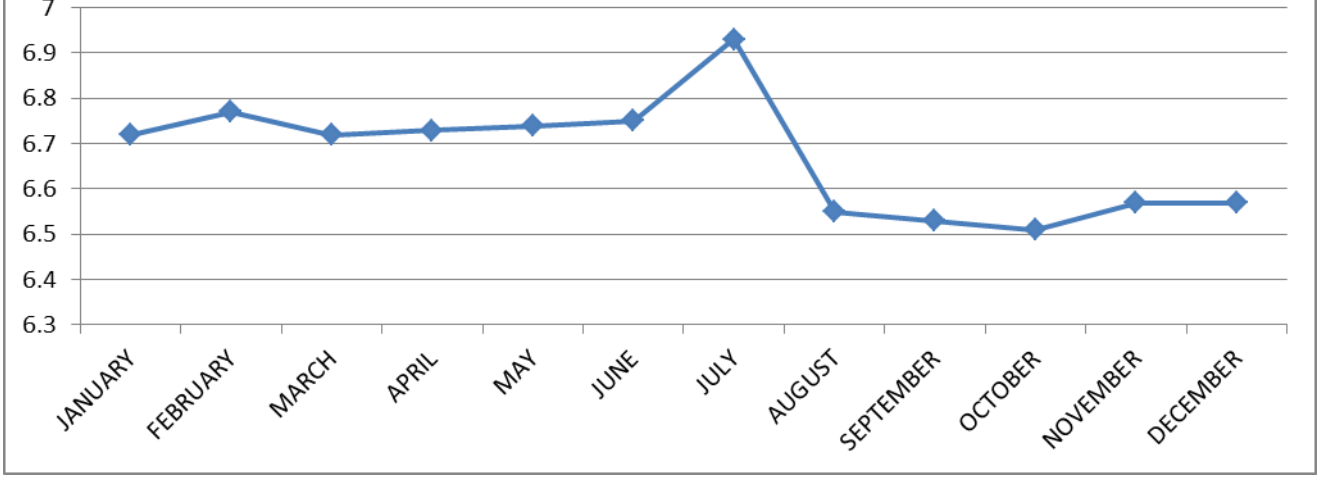


Fig. 1. Map of India showing the location of SDS thermal power plant.



and the results were presented in tables (1-4) and figures (2-5).

Results and discussion

Minimum level is observed in the month of September. The overall Arsenic concentration in Nelatur lake is within the permissible limits given by WHO (10µg/L).

Table 1. Heavy Metal Arsenic (As) content in Nelatur Lake (µg/L).

MONTH	PH	TEM	L1	L2	L3	L4	L5	L6	L7	Mean and SD Values
JANUARY	4.4	28°C	7.22	6.93	6.54	7.03	7.04	6.24	5.94	6.72+0.47
FEBRUARY	4.4	30.2°C	7.22	6.94	6.55	7.04	7.05	6.25	5.95	6.77+0.53
MARCH	4.2	31°C	7.23	6.96	6.56	7.06	7.07	6.28	5.97	6.72+0.47
APRIL	3.9	32.4°C	7.24	6.95	6.57	7.04	7.07	6.26	5.96	6.73+0.48
MAY	3.8	33°C	7.26	6.96	6.58	7.06	7.08	6.28	5.98	6.74+0.47
JUNE	3.8	32.5°C	7.25	6.97	6.59	7.07	7.09	6.29	5.99	6.75+0.47
JULY	3.9	32.7°C	7.26	6.98	7.00	7.08	7.09	7.10	6.00	6.93+0.42
AUGUST	4.5	32°C	7.21	6.9	6.51	6.13	7	6.21	5.9	6.55+0.50
SEPTEMBER	4.2	30°C	7.20	6.80	6.50	6.12	7.00	6.20	5.90	6.53+0.49
OCTOBER	4.3	28°C	7.22	6.80	6.31	6.22	6.90	6.21	5.93	6.51+0.46
NOVEMBER	4.7	27.8°C	7.20	6.92	6.52	6.13	7.01	6.22	5.92	6.57+0.48
DECEMBER	4.9	26.5°C	7.21	6.93	6.53	6.14	7.02	6.23	5.93	6.57+0.49

Table 2. Heavy Metal Mercury (Hg) content in Nelatur Lake (µg/L).

MONTH	PH	TEM	L1	L2	L3	L4	L5	L6	L7	Mean and SD Values
JANUARY	4.4	28°C	6.43	6.03	6.04	6.13	6.15	6.15	5.99	6.13+0.15
FEBRUARY	4.4	30.2°C	6.43	6.04	6.05	6.14	6.15	6.16	5.90	6.13+0.15
MARCH	3.9	31°C	6.47	6.08	6.12	6.18	6.19	6.22	6.05	6.19+0.14
APRIL	3.9	32.4°C	6.44	6.06	6.07	6.15	6.16	6.18	6.01	6.15+0.14
MAY	3.8	33°C	6.45	6.07	6.09	6.16	6.17	6.20	6.02	6.17+0.14
JUNE	3.8	32.5°C	6.46	6.08	6.10	6.18	6.18	6.22	6.03	6.18+0.14
JULY	4.2	32.7°C	6.43	6.95	6.57	6.06	6.16	6.18	5.95	6.33+0.35
AUGUST	4.3	32°C	6.42	6.00	6.02	5.90	6.00	6.20	5.82	6.05+0.20
SEPTEMBER	4.2	30°C	6.40	6.20	5.90	5.80	5.90	6.00	5.70	5.99+0.24
OCTOBER	4.5	28°C	6.40	6.01	6.00	5.92	6.11	6.12	5.96	6.07+0.16
NOVEMBER	4.7	27.8°C	6.41	6.01	6.02	5.93	6.12	6.13	5.97	6.08+0.16
DECEMBER	4.9	26.5°C	6.42	6.02	6.02	5.94	6.13	6.14	5.98	6.09+0.16

Mercury

The concentration of Mercury ranges from 5.99±0.24 to 6.19±0.14µg/L throughout the study period. Maximum level is recorded in July and Minimum in September. The concentration of Hg exceeds the permissible limits given by WHO (1.0µg/L).

Table 3. Heavy Metal Lead (Pb) content in Nelatur Lake (µg/L).

MONTH	PH	TEM	L1	L2	L3	L4	L5	L6	L7	Mean and SD Values
JANUARY	4.4	28°C	2.34	2.12	2.23	2.03	2.02	2.22	2.15	2.16+0.11
FEBRUARY	4.4	30.2°C	2.33	2.13	2.23	2.03	2.03	2.23	2.15	2.16+0.11
MARCH	4.2	31°C	2.34	2.13	2.25	2.05	2.06	2.27	2.16	2.15+0.09
APRIL	3.9	32.4°C	2.35	2.15	2.24	2.04	2.05	2.25	2.16	2.18+0.11
MAY	3.8	33°C	2.36	2.16	2.25	2.06	2.07	2.27	2.18	2.19+0.11
JUNE	3.8	32.5°C	2.37	2.18	2.27	2.08	2.08	2.28	2.19	2.21+0.11
JULY	3.9	32.7°C	2.38	2.19	2.29	2.09	2.10	2.12	2.22	2.20+0.11
AUGUST	4.3	32°C	2.31	2.11	2.20	1.92	2.21	2.11	2.13	2.14+0.12
SEPTEMBER	4.2	30°C	2.30	2.10	2.00	1.90	2.20	2.12	2.10	2.10+0.13
OCTOBER	4.5	28°C	2.32	2.10	2.21	2.00	2.02	2.20	2.12	2.14+0.11
NOVEMBER	4.7	27.8°C	2.31	2.11	2.20	2.13	2.10	2.21	2.13	2.17+0.08
DECEMBER	4.9	26.5°C	2.33	2.11	2.22	2.01	2.03	2.21	2.14	2.15+0.11

Table 4. Heavy Metal Manganese (Mn) content in Nelatur Lake (µg/L).

MONTH	PH	TEM	L1	L2	L3	L4	L5	L6	L7	Mean Values
JANUARY	4.4	28°C	0.37	0.25	0.34	0.31	0.30	0.24	0.24	0.29+0.05
FEBRUARY	4.4	30.2°C	0.38	0.26	0.34	0.32	0.31	0.25	0.24	0.30+0.05
MARCH	4.2	31°C	0.38	0.26	0.35	0.32	0.31	0.25	0.25	0.30+0.05
APRIL	3.9	32.4°C	0.39	0.28	0.36	0.33	0.32	0.25	0.26	0.31+0.05
MAY	3.8	33°C	0.42	0.29	0.37	0.34	0.33	0.27	0.28	0.33+0.05
JUNE	3.8	32.5°C	0.44	0.31	0.38	0.34	0.35	0.28	0.29	0.34+0.06
JULY	3.9	32.7°C	0.45	0.32	0.39	0.35	0.36	0.38	0.32	0.37+0.05
AUGUST	4.3	32°C	0.34	0.23	0.33	0.32	0.29	0.22	0.20	0.28+0.06
SEPTEMBER	4.2	30°C	0.33	0.24	0.32	0.34	0.28	0.21	0.20	0.27+0.06
OCTOBER	4.5	28°C	0.34	0.24	0.31	0.35	0.28	0.22	0.21	0.28+0.06
NOVEMBER	4.7	27.8°C	0.35	0.24	0.32	0.35	0.29	0.22	0.21	0.28+0.06
DECEMBER	4.9	26.5°C	0.36	0.24	0.33	0.34	0.30	0.23	0.22	0.28+0.06

Lead

The distribution of Lead varied from 2.10±0.13 to 2.21±0.11µg/L and does not exceed the permissible limit value. Maximum level is observed in the month of June and Minimum level in September. The concentration of Pb does not exceed the permissible limits given by WHO (10µg/L).

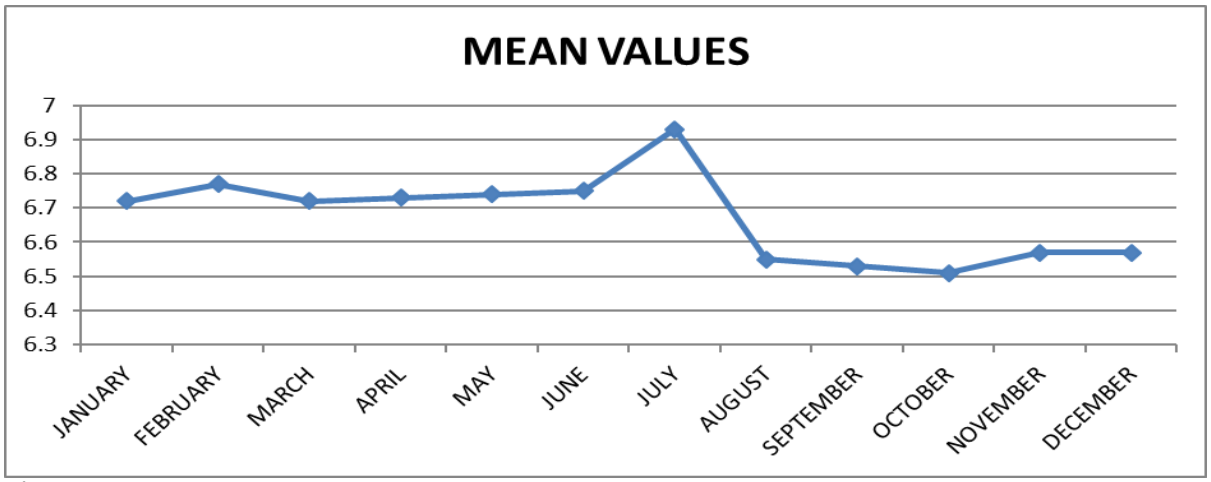


Fig. 2. Arsenic Concentration (µg/L).

Manganese

The range of concentration of Manganese in Nelatur Lake is 0.27±0.06 to 0.37±0.05 µg/L throughout the study report and the average concentration is 0.30µg/L. Maximum (0.37±0.05) level is observed in the month of July and minimum (0.27±0.06) level is observed in the month of September. Manganese concentration does not exceed the limits of WHO (500 µg/L).

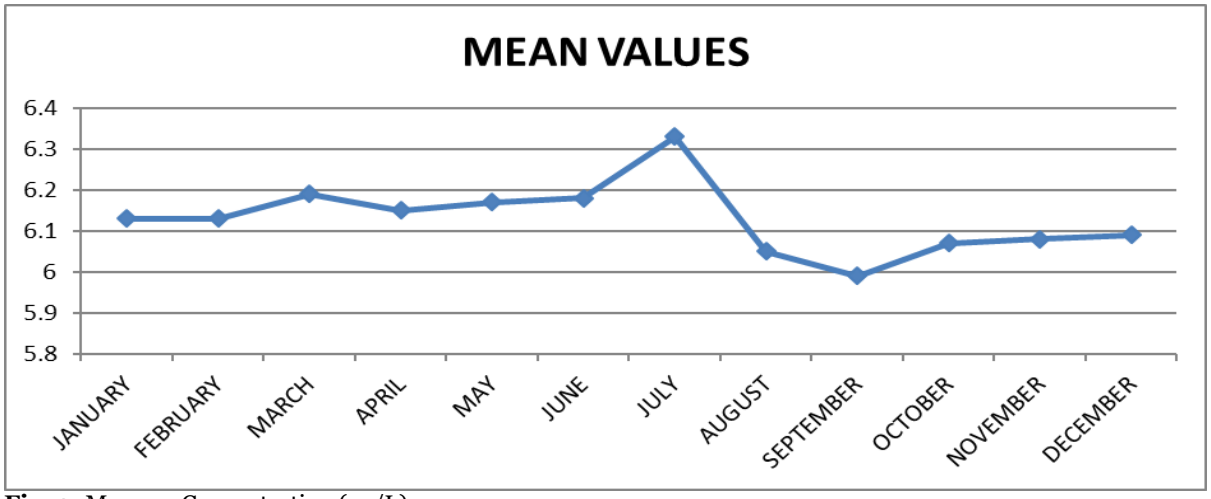


Fig. 3. Mercury Concentration (µg/L).

Discussion

Heavy metals are the most hazardous pollutants due to the speed of their dissemination in biosphere and their accumulative concentrations (WHO., 2003). Moreover, they are non-biodegradable and persist in the environment. Intensification of industrial activities affect the quality of water and directly contributes to the contamination of water reserves since, they are the collecting sources of the effluents.

Elevated levels of heavy metals in the water bodies may cause phytotoxicity and adversely affect the food chain. (Fytianos *et al.*,2001, Wang *et al.*,2005, Kar *et al.*,2008).

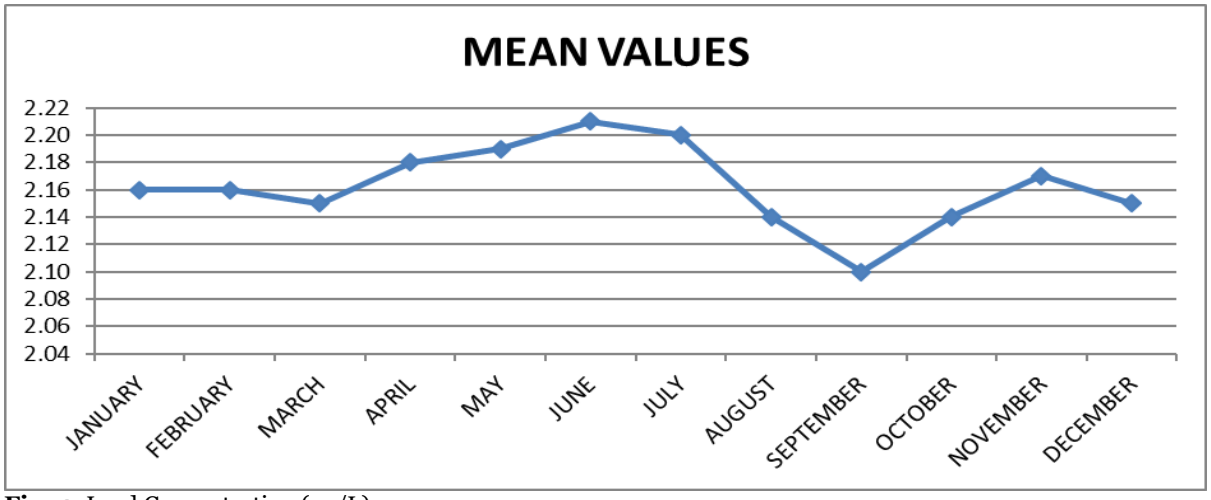


Fig. 4. Lead Concentration (µg/L).

The study has revealed the various concentration of As, Hg, Pb and Mn in the Nelatur where SDS Thermal Power Plant is located. The result shows that except Mercury, the concentration of As, Pb and Mn are within the recommended limits. Mercury level has crossed the permissible limit. It is evident that the TPP effluents are the primary cause for the increase of Mercury level in Nelatur lake and in due course the

other heavy metals will also increase and will directly contaminate the lake water thereby spoiling the flora, fauna and human health. Hence, the TPP effluents are to be pre-treated properly before they released into the surrounding environment (Jamdade and Gwande., 2017).

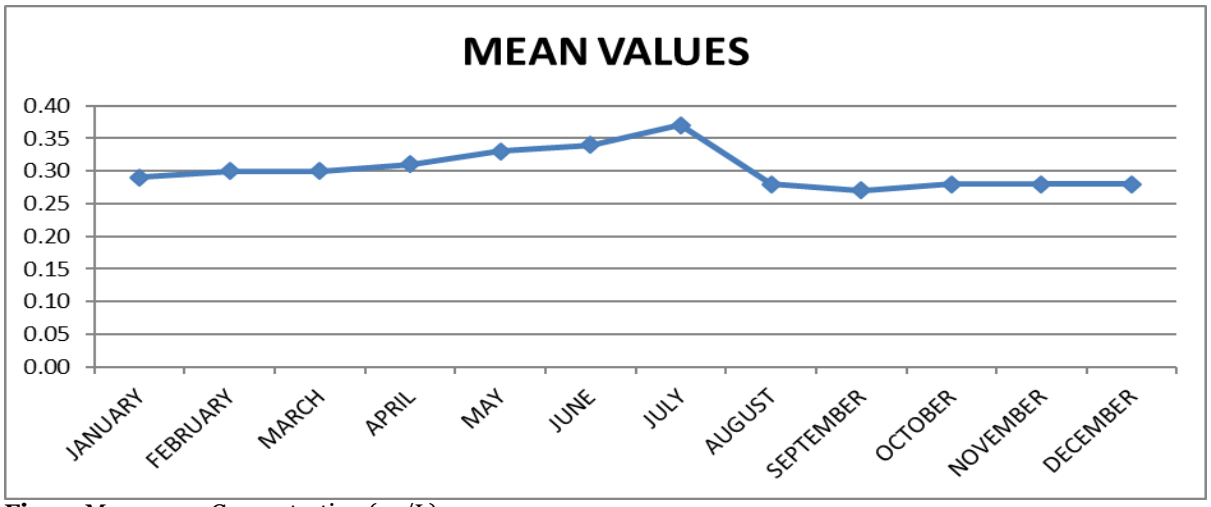


Fig. 5. Manganese Concentration (µg/L).

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