Water Quality Assessment of Eleyele Dam, Ibadan,South-Western, Nigeria

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Abstract

Eleyele Dam water is abstracted by the Oyo State Water Corporation at Eleyele Treatment Works for treatment and supply of potable water to Ibadan's people. The dam is exposed to flooding (Adeleru, 2017) and also polluted by human and industrial activities within the metropolis. This paper assessed the quality of the water samples taken along the course of the dam. The samples were examined for physical, chemical and bacteriological parameters using standard procedures. (APHA, 2005)The result showed a high concentration of Alkalinity, Hardness, Bacteriological, and Heavy Metal Contaminants (Lead and Iron), when compared with the World Health Organisation (WHO) and the Standard Organisation of Nigeria (SON,2007) quality standards for drinking water. The high concentration of Contaminants calls for great attention because inadequate water treatment before human consumption could result in the bioaccumulation of heavy metals and result in a public health concern.The study recommends that the dam should be protected from flooding, human and industrial activities. Proper and adequate water treatment should be ensured before supply to the metropolis.

Keywords: Water Quality, Heavy Metal, Contaminants

1.0 Introduction

Water is an essential resource for human, animal and plant survival. It is a key player in the economic viability of nations; it is used in agriculture, transportation, recreation, and hydroelectric power generation.

Life cannot exist without water (Aiyelokun et. al, 2017; Agbede and Ojelabi,2017; Okoye, 2004; Okeniyi et.al., 2013; Oladejo et.al,2013).

Safe water is free from chemical and organisms that could cause illness. The quality of water determines its probable use. Human activities, improper waste disposal, urbanisation, transportation, agricultural activities and infrastructural development impact the quality of surface and groundwater resources. Agbede (1991) opined that quality should be considered in relation to hydrological, microbial and physicochemical parameters.

Dams are barriers across flowing water that creates reservoirs, lakes or impoundments (Ezugwu, 2013). The embarkment retains a large mass of water and submerges a large area of land.

Dams supply water for irrigation, human and animal consumption (Oladejo et. al, 2014), but are adversely affected by pollutants such as heavy metals and polychlorinated biphenyls (PCBs) from urban, agricultural and industrial activities.(Olayinka et. al,2017)

Water sourced from dams may be contaminated with microbes, chemicals, industrial wastes, leachates and solutes. Indiscriminate disposal of waste into water bodies is significant in the metropolis.

Omoleke(2004) identified the culture of indigenous people living in the core of the city as a major contributor to waste disposal into water bodies. Kolawole et. al (2011) opined that the pollution of the aquatic environment is a serious and growing problem, the management of water resources is of importance.

Indiscriminate waste disposal habits of city dwellers in Nigeria may compromise the quality of some of these water sources (Ukhun et.al, 2005).

Contaminated water could pose a public health problem (Agbede and Ojelabi, 2017; Okparaocha et al.,2016) and this study checked the quality of water and its suitability for human consumption, recreational, commercial use and its potential impact on the ecosystem, human and aquatic life.

Eleyele Dam provides water supply for a large percentage of Ibadan residents, while other residents source water from groundwater sources. Ibadan residents consuming untreated borehole water are potentially exposed to possible acute, sub chronic or even chronic plumbism and water borne diseases like typhoid fever, dysentery, diarrhea etc.(Olusegun,2010)

The study was necessitated by the importance of dams in municipal water supply and its public health importance on man and the environment.

1.1 The Study Area

The Eleyele Dam is situated upstream on River Ona, in the city of Ibadan within Geographical Coordinates: Latitude $7^o20'$ - $7^o25'$N, and Longitude $3^o51'$ - $3^o56'$ E. It falls within the Ido LGA of Oyo State. Eleyele waterworks is located at the close end of Waterworks road which is accessed through Eleyele roundabout on Sango-Eleiyele Road, just downstream of the confluence of River Ona and River Alapata. The Ona River on which the dam is built traverses many locations within Ibadan Metropolis and goes as far as Apata and Omi-

Adio. The reservoir is surrounded by a variable margin of woodland beyond which is urban development on all sides of the reservoir.

Eleyele reservoir is located to the north-west of the Ibadan City centre bounded by Eleyele urbanisation in the south, the areas of Apete in the east, Awotan in the north and Ologuneru in the north-west.

Eleyele reservoir is a vital resource for fishery, domestic water supply and flood control; the reservoir is fast being degraded due to various anthropogenic activities around its catchments. (Olanrewaju et. al, 2017; Bolaji, 2010)

Eleyele Dam is exposed to flooding and notable among was the flood event took place after a heavy downpour of 187.5 mm in about 4-5 hours on August 26, 2011. This flooding occasion was induced by the overflow from Eleyele reservoir causing the death of over 120 people and serious damages to infrastructure, with many bridges collapsed, roads washed away, and substantial property lost. (Adeleru, 2017)

2.0 Materials and Methods

Water samples were collected from three different points along the course of the Dam. The samples were taken and analyzed in the Laboratory for physical(Temperature, Turbidity, TDS-Total Dissolved Solids),Chemical(pH, Electrical Conductivity, Nitrates, Total Alkalinity, Total Hardness, Chloride, sulphate, Phosphate, iron and lead) and Bacteriological (Total Coliform Count, E-Coli, Bio-chemical Oxygen Demand, and Chemical oxygen demand) parameters using standard procedures (APHA, 2005).

3.0 Results and Discussions

All parameters analysed for in this study were compared with the World Health Organization (WHO,2013) and Standard Organisation of Nigeria specifications for drinking water quality (SON,2007).

3.1 Physical Parameters

The temperature of the water samples analyzed in table 1 above varied from 24.0 to 25.9^{o}C and the pH varied from 6.52 to 6.78, which falls within the permissible limit for drinking water. (WHO, 2013 and SON, 2007). The turbidity of the water samples falls within the permissible limit. From the forgoing, all the physical parameters of Eleyele dam water falls within the maximum permissible limit for drinking water.

3.2 Chemical Parameters

Total Dissolved Solid is an indicator of contamination, The TDS mean value of 19.67mg/l in this study falls within the permissible limit of 1000mg/l.

The Electrical conductivity shows the amount of materials dissolved in water and has a direct impact on the total dissolved solid. The Mean value of Electrical conductivity in this study falls below the specified limit of 1000μs .

Alkalinity Values of dam water analysed exceeded the WHO permissible limit of 100. Orowale et. al (2007) opined that excess alkalinity results to a flat ,unpleasant taste and scale formation.

Total hardness varied from 80-120mg/l, the high value was as a result of high mineral deposit in the dam.

Nitrates impact human health and a great public health concern .The nitrate concentration in the study falls within the permissible limit. Major sources of Nitrate contaminants along the course of the dam include the use of agro-chemicals, industrial activities and Decomposition of bio-degradable household wastes commonly dumped along the banks of the river (Adegbenro and Oladele, 2012).

Osibajo et. al (2011) discovered an elevated nitrate level on Alaro and Ona river in Ibadan, It was attributed to the use of Nitrogen-based fertilizers, Poultry, agricultural wastes and run-off from leachate dumpsites. Oloruntoba et.al (2013) also found an elevated nitrate level in drinking water supplies in Ibadan. Therefore, there is a need for Nitrate deposit monitoring and comprehensive treatment of the dam and other water sources in Ibadan.

The Lead and Iron Concentration of the water sample (see fig.1) were higher than the permissible limit.(WHO ,2013 and SON,2007)

Excess iron residue in water may cause taste and odour problem, It may also result in the red colouration of water (Adetunde et. al, 2011).

Previous studies reported that iron occurs in high concentration in Nigerian soils (Asaolu and Olaofe, 2004; Asaolu et. al, 1997) and this could have resulted to the pollution of water sources as a result of erosion, solute transport of contaminants and other human activities.

Chinedu et. al (2011) also discovered a high concentration of iron in water samples analyzed at Canaanland, Otta, Nigeria. This calls for the proper treatment of water before human consumption.

Moyosore et. al.(2014) while assessing selected groundwater resources in Ibadan discovered found that all the water sampled had high levels of iron concentration exceeding the WHO and SON maximum permissible limit.

Excessive concentration of iron in water cause gastrointestinal upset and adversely affects the human system and results in a condition known as haemochromatosis wherein tissues are damaged due to prolonged iron accumulation. Similarly iron deposition in the skin gives rise to a characteristic pigmentation (Raju, 2006).

Ukhun et. al (2005) opined that most Nigerians could become victims of iron poisoning over a period of time. Disease conditions associated with excess iron intake includes siderosis, primary hepatocellular carcinoma and generally enhanced malignancy in experimental animals (Klevay,1975).

Lead Contamination is toxic, the bio-accumulation of lead in body tissues has neurotoxic, nephrotoxic, fetotoxic, and teratogenic effects on man and Animals. (Asogwa, 1979; Hoekman, 2005).

Previous studies on lead contamination in Ibadan has shown a high level of lead deposit (Adelekan and Alawode,2011; Adewara and Akinlolu,2008; Olusegun,2010; Etim and Onianwa,2012; Onianwa,2001;Ayeloja et.al,2014 and Oyeleke et. al,2016).

Indiscriminate waste disposal, human and industrial activities along the river course and the metropolis is a major cause of the heavy metal deposit in the dam water samples.

3.3 Bacteriological

The total coliform count in the water samples (fig.2) below shows significant coliform bacteria contamination and the value increases downstream**.**

Indiscriminate citing of abattoirs, human activities and indiscriminate waste disposal within the metropolis are likely sources of coliform contamination.

The presence of *Escherichia coli* in the water sample is a pointer to the fact that the dam water has faecal pollution (WHO, 1997) and this is as a result of human activities in the metropolis.

The impact of E coli contamination on public health includes urinary tract infections, meningitis, diarrhoea, acute renal failure, and haemolytic anaemia (WHO, 2013).

The BOD and COD values exceeded the maximum permissible limit specified by SON and WHO and this is a sign of organic matter deposits in the dam.

Abattoirs contribute to the contamination and deposit of organic matter in surface water.

Ubwa et. al. (2013) recommended that the activities of the abattoir should be monitored closely by relevant agencies in order to prevent full-blown environmental problems and attendance health hazards.

The indiscriminate waste disposal and discharge of sewage could also increase the biological oxygen demands of a large volume of water to such a high level that all the available oxygen may be removed, thereby causing the death of all aerobic species.(Maduka,2004).

4.0 Conclusion

Dams are important infrastructures that stores water for various purposes. The flow of water often transports contaminants that pollutes, limits the performance and storage capacity of the dam.

It is evident in the study that urbanisation, human, agricultural and industrial activities are the major sources of dam water contamination.

Unregulated Industrial activities and indiscriminate discharge of industrial effluents, indiscriminate waste disposal and agro chemical usage are sources of chemical contaminants noticed in the study. Human activities also contributed greatly in the high concentration of bacteriological contaminants.

The dam water has a high lead and iron contaminants and this is a pointer to heavy metal contamination and build up within the metropolis.

In conclusion, the water quality results has shown that Eleyele dam water is polluted and its use for human consumption needs to be subjected to adequate water treatment and quality monitoring.

4.1 Recommendations

The study further recommends that human and industrial activities within the metropolis needs to be properly monitored, human activities along the course of the dam should be restricted, continuous awareness of the populace on the impact of water contamination and environmental/water management laws should be enforced.

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Table 1.0: Result of Physical, Chemical and Bacteriological analysis of water samples collected.

SAMPLE PARAMETERS	A	B	C	MEAN VALUE	WHO	SON
PH	6.52	6.64	6.78	6.64	6.5-9.5	6.5-8.5
Temperature (ºC)	24.6	25.9	24.00	24.83	Ambient	
Electrical (µs) Conductivity	32.9	32.6	32.9	32.8	1000	1000
TDS (mg/l)	19.72	19.54	19.76	19.67	1000	500
Turbidity(NTU)	3.6	3.2	3.8	**3.5**	**5**	**5**
Chlorides (mg/l)	21.99	25.99	15.99	21.32	250	250
Total Alkalinity(mg/l)	168	156	152	158.6	100	---
Total Hardness (mg/l)	88	120	84	97.3	100	150
BOD	7.2	3.1	2.50	4.26	---	----
COD	18	7.75	6.25	10.6	---	----
Nitrate(mg/l)	0.00044	ND	ND	----	50	50
Phosphate (mg/l)	ND	ND	ND	----	---	---
Sulphate(mg/l)	117.6	118.9	122.5	119.6	250	----
Iron (mg/l)	34.6	31.5	35.3	33.8	0.3	0.3
Lead(mg/l)	0.27	0.24	0.31	0.27	0.01	0.01
Total coliform Count(MPN/100ml)	180	170	90	146.6	10	10
E-coli(MPN/100ml)	160	160	50	123.3	≤1	0

NTU-Nephelometric Turbidity Unit   MPN-Most probable Number
 Cfu-Coliform unit per millimetre   ND-Not Detected   mgl-Milligram per litre
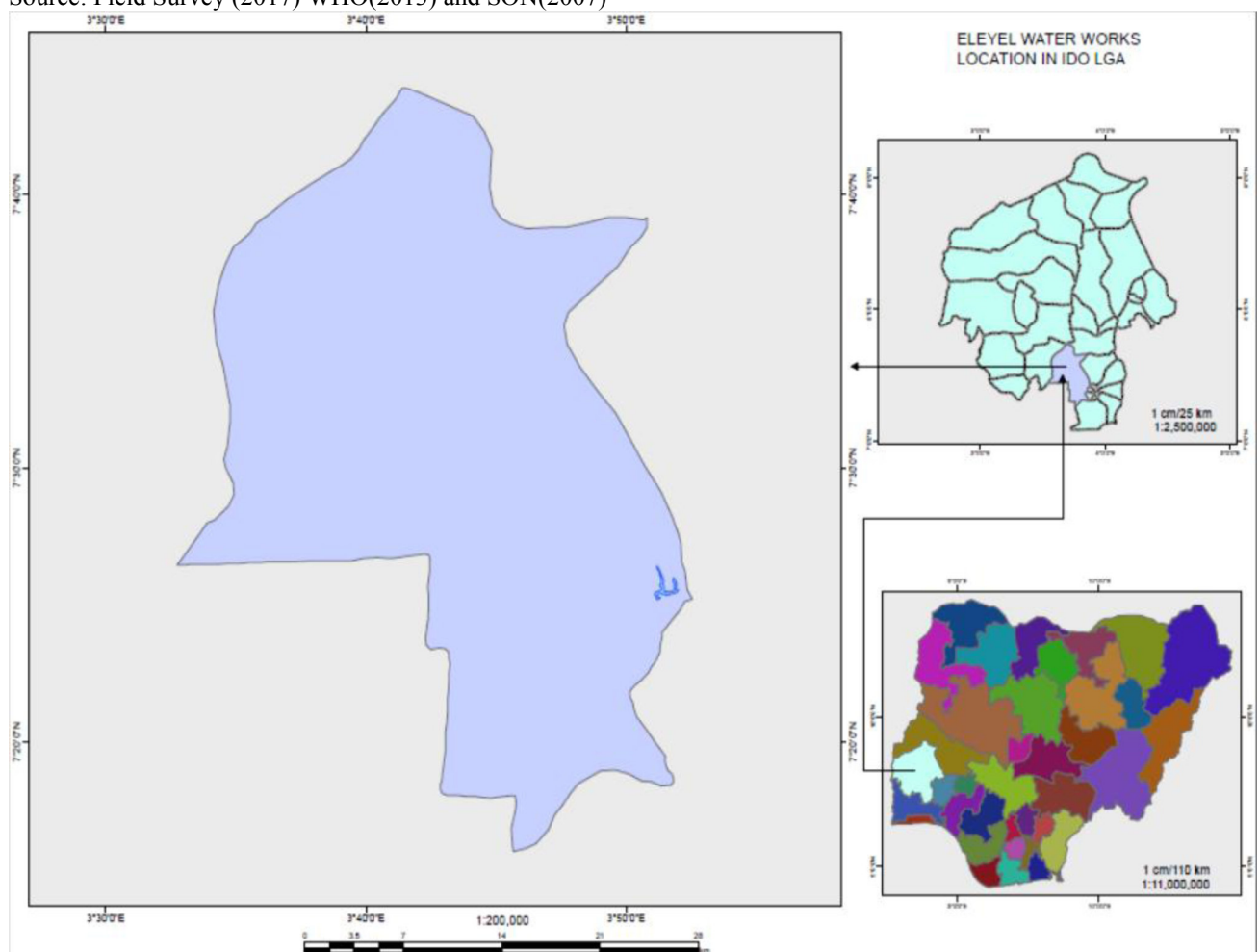Source: Field Survey (2017) WHO(2013) and SON(2007)

Figure 1 : Map of the Project Area Showing Eleyele Dam on Ona River
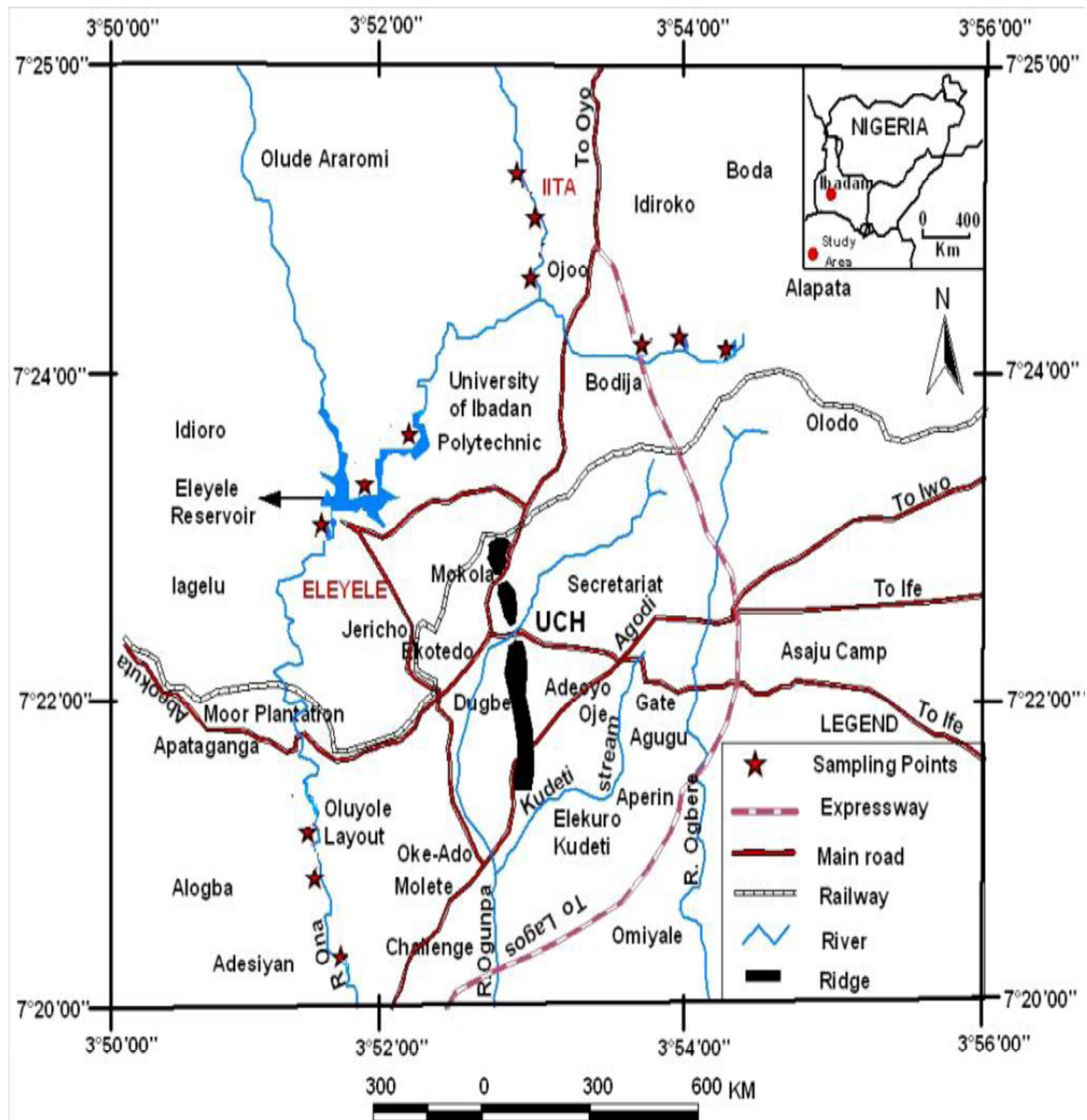*(Source: Adeleru, 2017)*

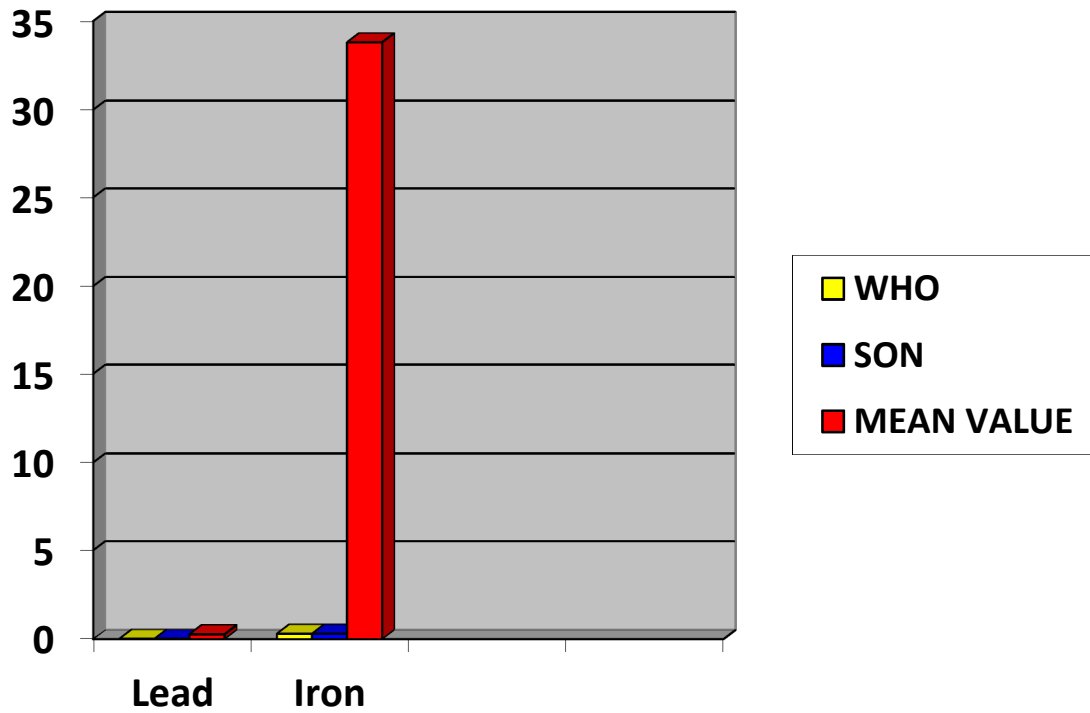Figure 2: Eleyele Catchment Areas
(Source: Adeleru, 2017)

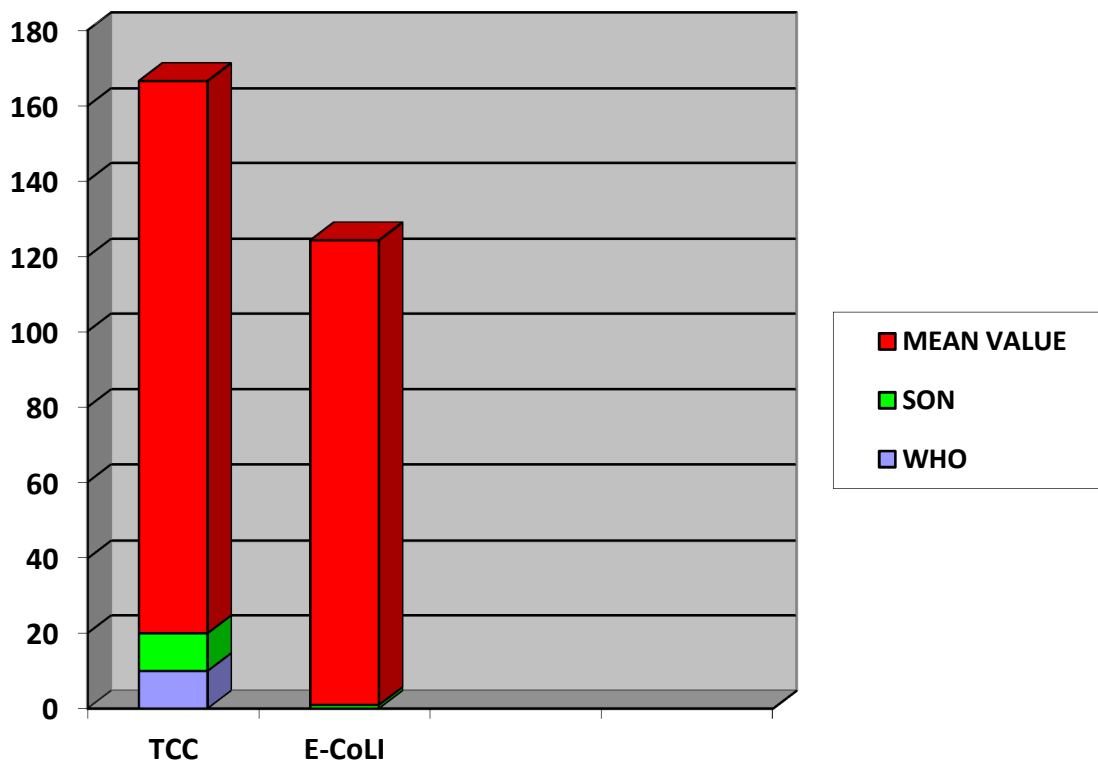Fig.3: Result of Lead and Iron Concentration of the water samples

Fig.4: Result showing the Total Coliform Count and the Escherichia coli