Analysis of Heavy Metals In Water Samples of Owk Reservoir, Owk, Kurnool District, Andhra Pradesh, India

Venkatararamanaiah Kolala[1], Jayaram Naik V N[2], Philip G. H[3]
[1, 2, 3] Dept of Zoology
[1, 2, 3] Sri Krishnadevaraya University, Anantapuramu, Andhra Pradesh, India.

Abstract- *Trace metals are the metals subset of trace elements, that is metals normally present in small but measurable amounts in animal and plant cells and tissues and that are a necessary part of nutrition and physiology. Many biometals are trace metals. Ingestion of, or exposure to excessive quantities of metals can be toxic. This paper deals with the analysis of trace metals concentration of like Li, Al, V, Fe, Co, Ni, Cu, Zn, As, Ag, Cd, Cs, Ba, Ti, Pb, U etc. in the water samples collected from Owk reservoir, Kurnool district AP, during the period of 2012-2014. They were measured by A Perkin Elmer SCIEX®, Model ELAN 5000 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS), is most advanced technique for the determination of trace metals concentrations up to 1 part per billion (ppb). The concentration of these metals in the study area was above desirable limits given by the Indian Standard Specification for Drinking Water IS 10500:2012.*

Keywords- Trace metals- ICP-MS- Owk- Reservoir.

I. INTRODUCTION

Trace metals are the metals subset of trace elements, that is metals normally present in small but measurable amounts in animal and plant cells and tissues and that are a necessary part of nutrition and physiology. Many biometals are trace metals. Ingestion of, or exposure to excessive quantities of metals can be toxic. By the term “heavy metals” we usually refer to any metallic element that contain a relative high density and applies to the group of metals and metalloids with atomic density greater than 4 g/cm3. There are about fifty heavy metals that are of special concern for their toxicological importance to human health and many of them, like Zn, Cu, Ni and Mn are also essential trace elements for living organisms. However, if these accumulated at high levels, or ingested in greater amounts than the required concentration, then they cause health problems (1). Aquatic ecosystem is the ultimate receipt of almost everything including heavy metals. This has long been recognized as a serious pollution problem (2).

Heavy metals enter the environment by natural and anthropogenic means. Such sources include: natural weathering of the earth’s crust, mining, soil erosion, industrial discharge, urban runoff, sewage effluents and pest or disease control agents applied to plants, air pollution fallout (3). For the past few decades the concern over the studies on different pollutants such as trace metals, pesticides, oil and fertilizers and their impacts on environmental compartments such as soil, plants and water have attained a great importance (4). In recent years, the contamination of aquatic systems has become a problem of great concern throughout the world (5). The present study is aimed to investigate the analysis of heavy metal concentration levels in water and to study the ecological status of heavy metals in Owk reservoir. Monthly variations and year wise variations of metals like Li, Al, V, Fe, Co, Ni, Cu, Zn, As, Ag, Cd, Cs, Ba, Ti, Pb, U etc., and assess the level of concentrations.

In India much research has been carried out with regards to assessment of Heavy metal concentrations in different tanks like Ureje water Reservoir (6), Hussainsagar lake water (7), River Noyyal (8), Ground water of Goa mining region (9), Drinking water contaminated with Heavy Metals (10). Andhra Pradesh has good number of Reservoirs, Ponds and Tanks. Qualitative and quantitative heavy metal investigations had been carried out in water bodies like Kolleru lake (11), water samples of Tirupathi region (12), In ground water of SPSR Nellore district (13), Surface and ground water of rural and urban areas of Kakinada, East Godavari district (14), Fish pond in around Bhimavaram, West Godavari district (15), Surface and Ground water in and around Tirupati (16).

II. METHODOLOGY

Study Area: Owk Reservoir (Sri B V Subba Reddy Sagar) is located near Owk, Kurnool District of Andhra Pradesh. It is the third largest reservoir in Kurnool District. It is located 2 km from Owk, 10 km from Belum caves and 90 km from Kurnool city. Geographical coordination of Owk reservoir is

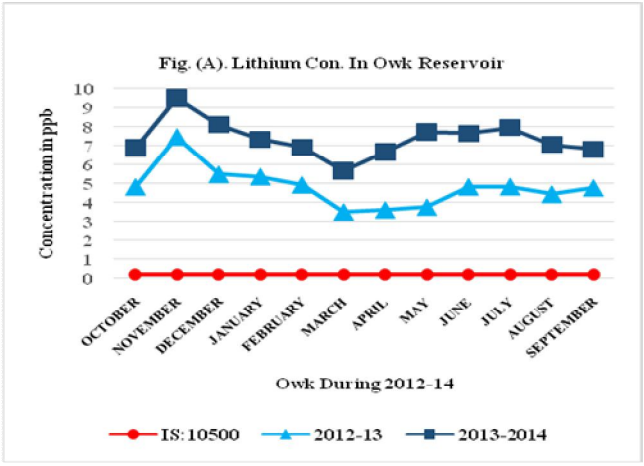
at 15°21'67" N Latitude and 78°11'67" E longitude. It has an average elevation of 194 meters (639 fts). The catchment area is 246.04 Sq km with existing ayakut 47638.74 acres. Storage capacity of this reservoir is 4.148 TMC. The source of water for this reservoir is Srisailam Right Bank Canal (SRBC) and rain.

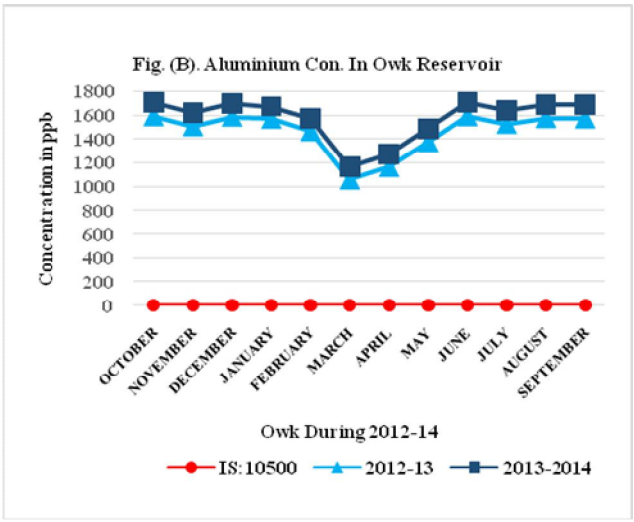
Methodology: The water samples were collected and stored in 1liter capacity clean plastic bottles. Before collection of samples, the bottles were washed with double distilled water. All the samples were filtered using Whattman 42 filter paper and were diluted to bring down the TDS 200 ppm for further analysis by ICP-MS. The trace element samples were treated with 0.6N HNO3. The elements were analyzed by Inductive Coupled Plasma-Maas Spectrophotometer (ICP-MS). A Perkin Elmer SCIEX®, Model ELAN 5000 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) (Concord, Ontario, Canada) was used throughout. Acidified water samples were directly fed into the instrument nebulizer after proper dilution and filtration. Calibration was performed using the certified reference material NIST 1640a (National Institute of Standards and Technology, USA) to minimize matrix and other associated interference effects and accuracy was better than 6% RSD. Relative standard deviation (RSD) was found to be better than 6% in the majority of the cases, which indicates that the precision of the analysis is reasonably good. Trace elements analyses were carried out at Department of Geophysics, Andhra University, Vishakapatnam, AP, India.

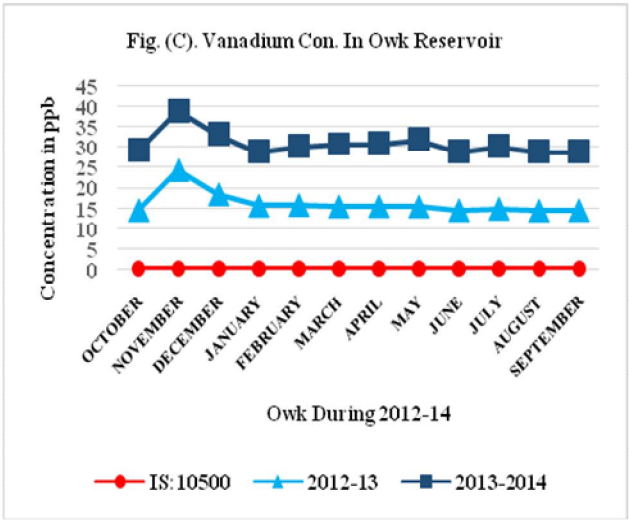
III. RESULTS AND DISCUSSION

The levels were recorded maximum 7.26 ppb in the month of November, 2012 and a minimum value 1.96 ppb in the month of January, 2014 (Fig A). The concentration of Lithium was above desirable limit i.e., 0.2 mg/L according to the Drinking water specifications IS 10500:2012. The levels of Aluminium ranged from the maximum 1593 ppb in the month of October, 2012 and the minimum 102.7 ppb in the month of January 2014 (Fig B). The concentration of Aluminium was above desirable limit i.e., 0.3 mg/L according to the Drinking water specifications IS 10500:2012. The range of Aluminium in the present study was also observed by (17) in the study of Impact of metals on Aquatic Ecosystems. The concentrations of Vanadium were ranged from 24.12 ppb in the month of November, 2012 and 14.28 ppb in the month of August 2013 (Fig C). The concentration of Vanadium was above desirable limit i.e., 0.3 mg/L according to the Drinking water specifications IS 10500:2012. Iron (Fe) is an essential metal for most living organisms and humans. It is a constituent of proteins and many enzymes, including haemoglobin and myoglobin (18, 19). The values of Iron were observed between 1678.4 ppb in the month of November, 2012 and a 136.6 ppb in the month of June, 2014 (Fig D). The concentration of Iron was above desirable limit i.e., 0.3 mg/L according to the Drinking water specifications IS 10500:2012. The high values of Fe in the monsoon season might be associated with the phenomenon of leaching due to heavy precipitation from the dumps and tailing ponds (20). Cobalt is beneficial for humans because it is a part of vitamin B12 which is essential for human health. Cobalt is used to treat anaemia with pregnant women, because it stimulates the production of red blood cells. The concentration of Cobalt the water sample ranged from 28.21 ppb in the month of November, 2012 and BDL (below detective level) in the months of June to September, 2013 (Fig E). The desirable limit of Cobalt was not mentioned according to the Drinking water specifications IS 10500:2012. In fresh waters it is generally low and higher concentrations are generally associated with industrialized or mining areas. The concentration of Nickel was found high in the month of November, 2012 (28.21 ppb) and low in the month of January, 2014 (5.32 ppb) (Fig F). The concentration of Nickel was above desirable limit i.e., 0.05 mg/L according to the Drinking water specifications IS 10500:2012. It was found maximum in rainy season. It can be deposited in the sediment by such process as precipitation, complexation and adsorption on clay particles (21). Copper is one of the earliest known metals. The range of Copper was found between 26.59 ppb in the month of September, 2013 and 10.6 ppb in the month of November 2013 (Fig G). The higher values of Cu may be attributed to the huge amounts of raw sewage, agricultural discharge in to the water bodies (22). Zinc involved in the nucleic acid synthesis and participates in a variety of metabolic processes involving carbohydrates, lipids, proteins and nucleic acid (23). The fluctuations of Zinc were observed maximum 6583 ppb in the month of March, 2013 and the minimum 1871.5 ppb in the month of March, 2014 (Fig H). The concentration of Zinc was above desirable limit i.e., 5.0 mg/L according to the Drinking water specifications IS 10500:2012. The higher values of Zn may be attributed to the huge amounts of raw sewage, agricultural discharge into the water bodies (22). The high value of Arsenic recorded in the month of November, 2012 (4.04 ppm) and the low value in the month of September, 2014 (2.16 ppb) (Fig I). The concentration of Arsenic was above desirable limit i.e., 0.05 mg/L according to the Drinking water specifications IS 10500:2012. High values of Arsenic are mainly due to discharge of effluents from industries like paints, pharmaceutical, fertilizers and pesticides. (24). The presence of minimum range of Silver in our food is very much essential for human beings, but the higher presence causes many abnormalities, especially the salts of Silver like $AgNO_3$ causing bluish or black pigmentation. The variation in the concentration of Silver was detected maximum (28.72 ppb) in the months of October, 2012 and June, 2013 and minimum

(3.2 ppb) in the month of January, 2014 (Fig J). The range of Cadmium value was noticed between 2.08 ppb in the month of May, 2014 and 0.27 ppb in the month of March, 2013 (Fig K). The concentration of Cadmium was above desirable limit i.e., 0.01 mg/L according to the Drinking water specifications IS 10500:2012. The high levels of Cd in water were known to be attributed to the agricultural discharge (25). The values of Caesium assessed more (0.09 ppb) in the month of November, 2012 and less (0.01 ppb) in the months of January, 2014 and September, 2014 (Fig L). Barium is one of the 14 abundant element found in earth's crust. The fluctuations of Barium ranged between 226.7 ppb in the month of November, 2012 and 109.5 ppb in the month of February, 2014 (Fig M). The concentration of Barium was above desirable limit i.e., 0.7 mg/L according to the Drinking water specifications IS 10500:2012. The levels of Titanium were measured between 0.3 ppb in the month of February, 2103 and BDL (below detectable level) in the months of May to September, 2013 (Fig N). The concentration of Titanium was within desirable limit i.e., 0.05 mg/L according to the Drinking water specifications IS 10500:2012. The analysis of the concentration of Lead varied from 59.2 ppb in the month of July, 2014 and 16.24 ppb in the month of March, 2013 (Fig O). The concentration of Lead was above desirable limit i.e., 0.1 mg/L according to the Drinking water specifications IS 10500:2012. The high levels of Pb in water can be attributed to the agricultural discharge (25). Uranium is the radioactive trace element occurring naturally in soil and rocks. The concentration of Uranium in water is typically very small, but varies from region to region. The variation in the concentration of Uranium was recorded maximum (3.11 ppb) in the month of October, 2012 and minimum (1.48 ppb) in the month of June, 2014 (Fig P). The concentration of Uranium was above desirable limit i.e., 0.1 mg/L according to the Drinking water specifications IS 10500:2012 in both the tanks.







VI. CONCLUSION

From all the above mentioned research findings, it is finally concluded that Sri B V Subba Reddy Sagar (Owk reservoir) water metal concentrations were beyond the permissible limits according to the Drinking water specifications IS 10500:2012. Hence, it can be said that water is good for Drinking. It can be used for Fish culture and for the purpose of Agriculture.

V. ACKNOWLEDGMENT

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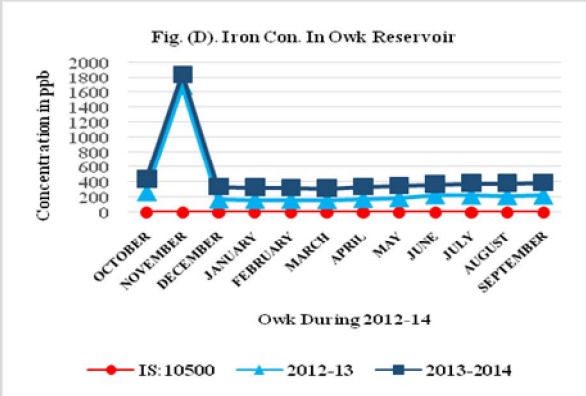


Fig. (D). Iron Con. In Owk Reservoir
Concentration in ppb
2000
1800
1600
1400
1200
1000
800
600
400
200
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Owk During 2012-14
IS:10500
2012-13
2013-2014

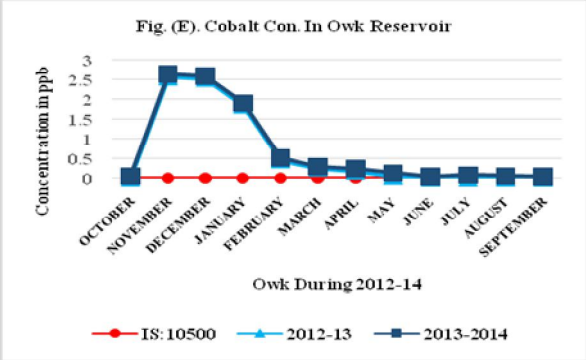


Fig. (E). Cobalt Con. In Owk Reservoir
Concentration in ppb
3
2.5
2
1.5
1
0.5
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Owk During 2012-14
IS:10500
2012-13
2013-2014

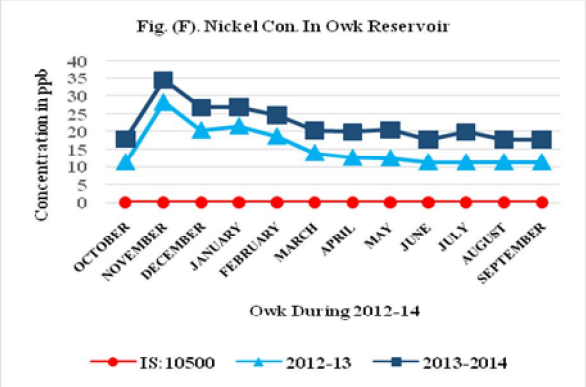


Fig. (F). Nickel Con. In Owk Reservoir
Concentration in ppb
40
35
30
25
20
15
10
5
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Owk During 2012-14
IS:10500
2012-13
2013-2014

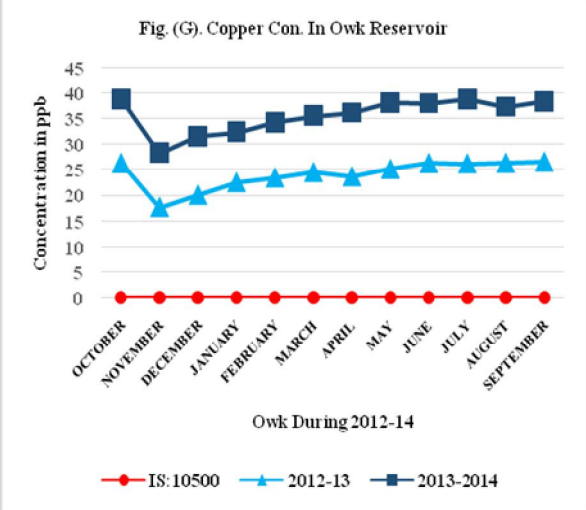


Fig. (G). Copper Con. In Owk Reservoir
Concentration in ppb
45
40
35
30
25
20
15
10
5
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Owk During 2012-14
IS:10500
2012-13
2013-2014

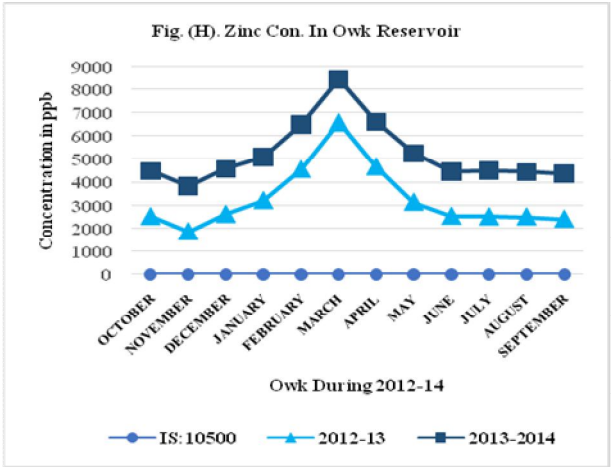


Fig. (H). Zinc Con. In Owk Reservoir
Concentration in ppb
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Owk During 2012-14
IS:10500
2012-13
2013-2014

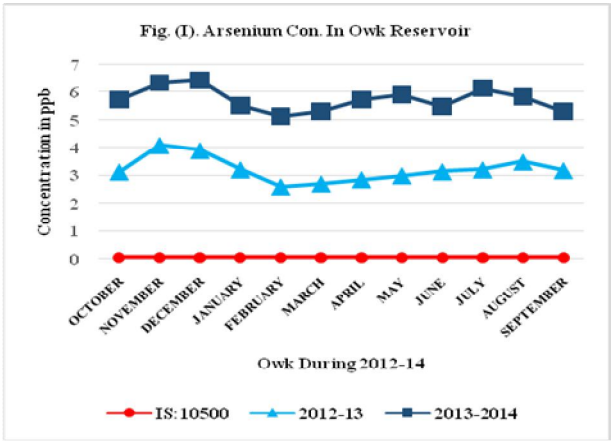


Fig. (I). Arsenium Con. In Owk Reservoir
Concentration in ppb
7
6
5
4
3
2
1
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Owk During 2012-14
IS:10500
2012-13
2013-2014

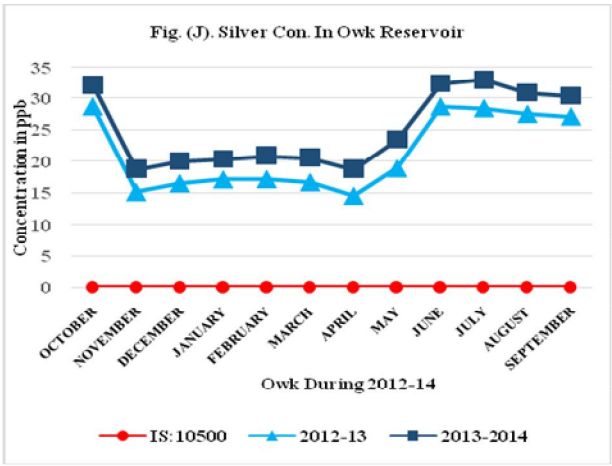
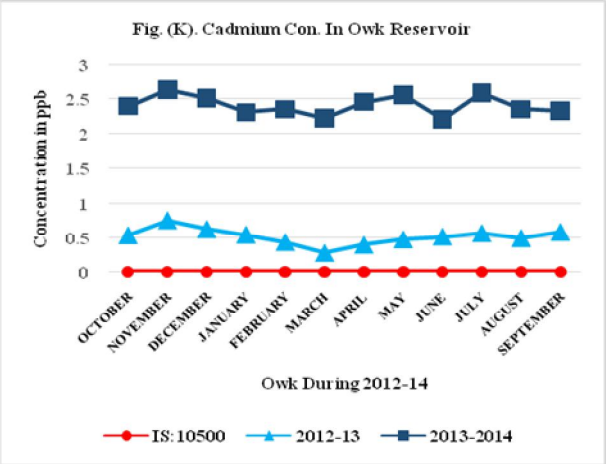
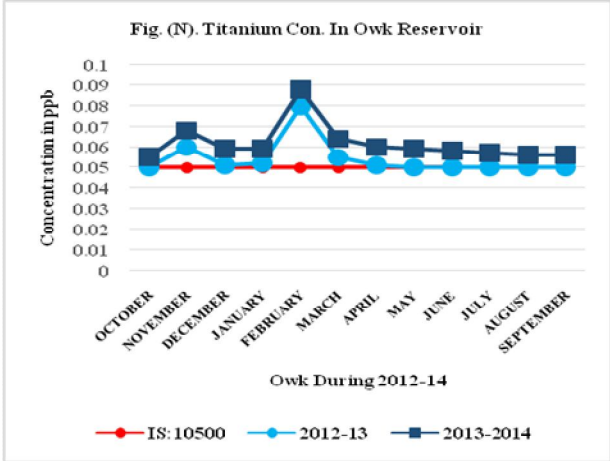
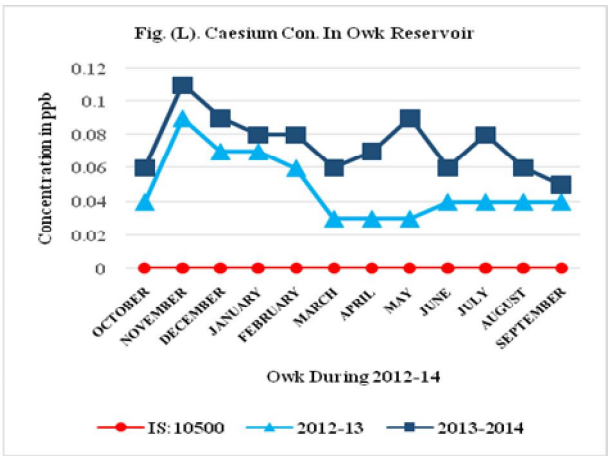
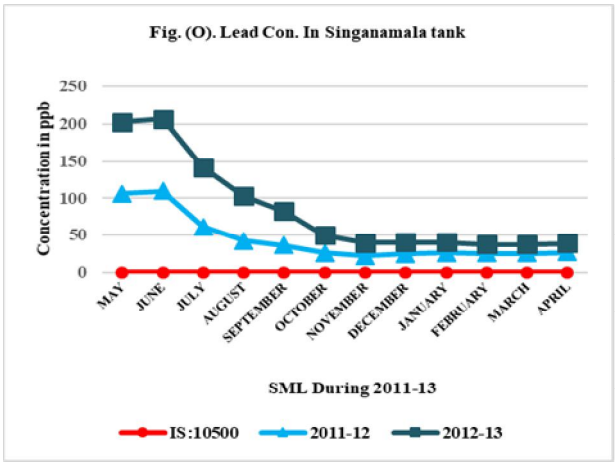


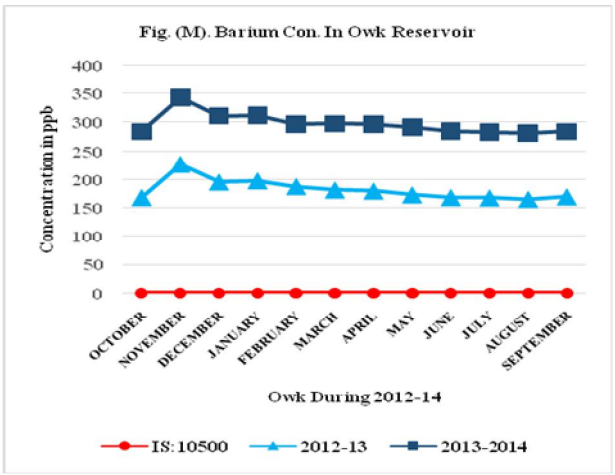
Fig. (J). Silver Con. In Owk Reservoir
Concentration in ppb
35
30
25
20
15
10
5
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Owk During 2012-14
IS:10500
2012-13
2013-2014

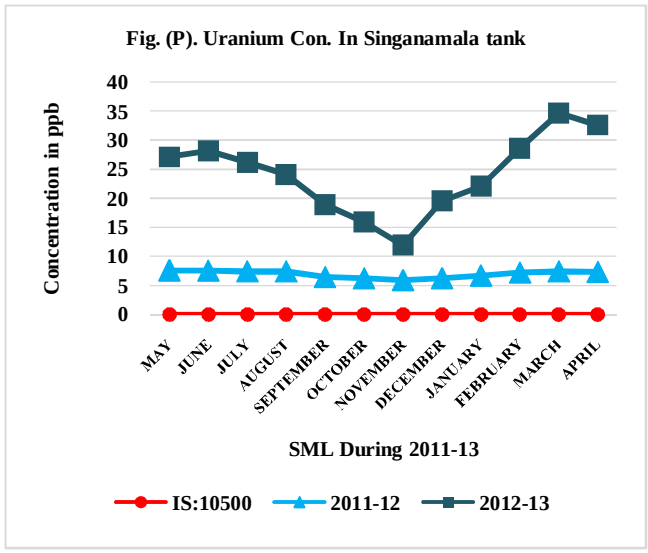












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