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ANALYSIS OF HEAVY METALS IN PLANT SAMPLES AND WATER PARAMETERS OF RANKALA LAKE

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Abstract: The aim of our work is to study of the water quality of Rankala Lake by considering different water parameters. Also to study the heavy metals present in water and aquatic plants such as Eichhornia, Hydrilla and Salvinia present in Rankala Lake. Our interest was to find whether there are any observable changes that have occurred in water quality due to removal of aquatic plant beds from the lake. The investigation about physiochemical parameters and presence of heavy metal ions in water body (Rankala Lake) are analyzed in this work .

Keywords: *Water parameters, Heavy metals, Rankala lake.*

1. Introduction:

Rankala lake:

Kolhapur is a prominent city of south western Maharashtra, in this city there is a wetland in the form of a beautiful lake called as 'Rankala' which is man made reservoir built in the end of 18^{th} century by 'HIS- Highness' of Karvir Province. The total catchments area is of 5.21 sq.Km and 94.33 million cubic feet storage capacity.

In this lake, the Eichhornia plant species was up to 2008, but in the year 2009 Eichhornia seems to be replaced by Salvinia and Hydrilla occupying whole lake which looks like a big football ground. At the end of year 2009 Kolhapur Municipal Corporation had tried to remove the aquatic plant beds. Finally they got success to remove aquatic plants completely.

At the present situation maximum surface area of the lake is free from aquatic plants. Now the citizens are enjoying the natural beauty of Rankala lake and the water source is free from hazardous pollutants

Aquatic plants are well known in accumulating & in concentrating heavy metals. In this study several physiological responses of aquatic vascular plants. Eichornia, Salvinia, Hydrilla which were elevated concentrations of various heavy metals have been investigated. The final goal of this work to examine the various heavy metals uptake using these aquatic plants from waste water.

Aquatic plants are known as accumulating metals from waste water & affect metal fluxes rough those ecosystems. Cell walls of aquatic plants contain polysaccharide & bivalent metal ion exchange with the counter ion of the polysaccharides. For example - aquatic plants contains salts of K^+, Na^+,Ca^{2+} & mg^{2+}. These ion can exchange with counter ions such as Co^{2+}, Cu^{2+}, Cd^{2+} & Zn^{2+} Resulting in the biosorptive up take of heavy metals.

The industrial waste water which contain heavy metal reduced biomass of plants by 50%. The chlorophyll a & b & biochemical activity such as protein, amylase, catalyze synthesis were also saprenced by waste water. Chlorophyll b, protein & catalyze activity were found stimulatory at 25% dilute level of waste water. The activity of amylase decreased with increases in concentration of waste water.

A. Salvinia: Salvinia is small free floating plants that grow in clusters and develops in to dense floating. Plant is a floating aquatic fern with leaves that become compressed into chain in older plants. Leaves are about 0.5 to 1.5 inches long, oval, folded and curved with arching hairs that appears like beaters on upper leaf surface. Dense salvinia colonies provide habitat for micro invertibrates but if salvinia completely covers the surface of a lake it will causes dissolved oxygen depletions and fish kills. This colonies also eliminate submerged plats by blocking sunlight penetration. Salvinia have no known direct food value to wildlife and is considered and exotic and highly undesirable species. Flowers, fruits and seeds are reproduces by tiny spores rather than flowers. It spreads by transport of plant fragment by water, human and wild life. Small floating aquatic with griping stem ,branched, bearing hairs but no true roots, a leaves in whorls of with two leaves , green, sessile, flat entire and floating. One leaf finally dissected root like and pendent. It is a sterile species. It is not known to reproduce fertile spores. Figure below shows salvinia species.

B. Eichhornia: Eichhornia Crassipes is a floating aquatic generally 0.5 meter in height. Eichhornia crassipes may form dense floating mats. Its leaves are thick, waxy, rounded and glossily and rise well above the water surface on stock. The absorption of heavy metals into biomaterials derived from plant Eichhornia crassipes was investigated. The root, stem and leaf sample of plant collected from rankala lake of Kolhapur city were analysed for metal ion concentrations using AAS. It has been observed that in a root ,stem and leaf, Pb ions get absorbed, While the extent of absorption For each element Found different in the parts analysed. In root ,the of metal ion absorption found to be Fe>Mn>Cu>Zn>Cr>Pb>Ni>Co>Cd ions. Thus it is clear that Eichhornia Crassipes absorbs heavy metal ions and can be used for minimizing the pollution taking place due to toxic metal ions in the effluents from various industries. Economic Importance – it is used in nurseries for its unusual appearance attractive flowers and ability to remove nutrients from water. The figure below is of Eichhornia species.

C. Hydrilla: It has branched and leafy stem. Leaves are in whorls, small, sessile. Fresh water submerged herbs with Fibrous, unbranched roots. Flowers and fruits are occurring in Jan-April. Submerged in aquatic water, very showy for aquarium and good food for fishes. It is located in Kagal,, Kolhapur, Radhanagari and Shiroli. Hydrilla is a fresh water herb lives ponds, rivers and reservoirs.Hydrilla plant have branched stem that grow upto 25 feet long. They have small, pointed green leaves with serrated edges, the leaves grow in groups of 4 to 8 around the stem. Hydrilla plants clog irrigation canals and water pumping stations interfere with boating and disturb the water chemistry. Hydrilla is a an aquatic plants genus usually treated as containing just one species, Hydrilla rooticiiata, though some botanist divide it into several species, synonyms include H. Asiatic, H. Japonica, H. Lithuania & H. Ovaliiolaca. It has branched & leafy stem. Leaves are in whorls, small, sessile, fresh water submersed horns with entrenched roots glowers & occurring in Jan. April submerged in aquatic looter, very showy for aquarium & good for fishes. It is located in Kagal. Kolhapur, Radhanagari and Shiroli. Figure below shows hydrilla species.

2. Materials and Methods

Materials:

I) Aquatic plants Sample collection: The sediment samples were collected at random from different areas of lake, covering all directions. Soon after, collected plant material was washed by water to remove periphyton and sediment particles. Due to this impurities dust particles were also removed. The collected plant species were placed in plastic bags and brought to laboratory. Polythene tools were used in sampling and storing collected materials to avoid metal contamination. Then in the laboratory these plant materials washed with deionized water & sorted into different pots. This sorted plant sample was dried in sunlight for 4-5 days. These dried sample fragments were sorted into minimum size. After this all fragments were dried in oven at 110^0C for about 4-5 hours. Then after it was grounded well by using mortar and pestle in laboratory till finely dry powder was formed. This dried powder was used for further chemical analysis.

II) Water sample collection: Water sample collection was done in the same lake from which a plant samples were collected. Initial water sample was collected in area 25x15 meter where plant samples had collected in the already washed cans.

III) Preparation of Eichhornia, Salvinia and Hydrilla sample for AAS

Initially dried, powdered forms of different samples of plants were taken by weighing accurately around 1 gm in separate beakers. Then 25 ml mixture of HNO_3 and $HC1O_4$ were added in the proportion 3:1. The solution was heated to dissolve all powdered samples and then evaporated all acid. Then 25 ml water was added and heated the solution to boil then clear solution was obtained. The solution was filtered and filtrate collected was diluted as 100 ml with deionized water.

Methods: The instruments used for the analysis of metals were atomic absorption spectrometer and digital Flame photometer. Also other instruments like digital pH meter and conductometer were used for the analysis of water parameters.

3. Results and discussion:

The different water quality parameters in different months in the year 2011 and 2012 are tested and the results obtained are shown in the table 1. The heavy metal contents in water sample are shown in table 2.

Table.1. Water quality parameters.

Sr.No	Parameter	Aug.2011	Sept.2011	Oct.2011	Nov.2011	Dec.2011	Jan.2012
1	pH	8.09	8.33	8.14	7.8	7.32	7.38
2	Conductivity $x10^{-3}$ mhos	0.39	0.393	0.40	0.429	0.402	0.44
3	Hardness mg/lit.	144.6	147.2	167.2	160	170	178
4	Alkalinity mg/lit.	125.2	128	136	137.2	152	156
5	Salinity mg/lit.	894.6	568	653.2	795.5	710	781
6	TDS g/lit.	170	230	300	340	330	370
7	TSS mg/lit.	0.36	0.44	0.28	0.20	0.32	0.36

8	DO mg/lit.	9.72	10.67	8.45	11.47	10.27	9.86
9	BOD mg/lit.	2.27	5.84	2.01	8.25	6.65	2.96
10	COD mg/lit.	160	220	137	140	148	154

Table 2. Amount of heavy metal contents in water sample.

Metals	Aug.2011		Sept.2011		Oct.2011		Nov.2011		Dec.2011		Jan.2012	
	Conc. mg/L	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.
Cu	0.000	0.002	0.009	0.013	0.000	0.001	0.000	0.002	0.000	0.003	0.010	0.004
Zn	0.010	0.001	0.016	0.002	0.016	0.002	0.044	0.002	0.000	0.001	0.001	0.000
Mn	0.340	0.004	0.010	0.001	0.014	0.005	0.046	0.005	0.010	0.005	0.013	0.002
Fe	0.041	0.005	0.000	0.004	0.032	0.012	0.035	0.007	0.001	0.004	0.001	0.002
Co	0.000	0.009	0.000	0.001	0.000	0.000	0.004	0.005	0.004	0.002	0.000	0.003
Ni	0.000	0.003	0.006	0.002	0.000	0.000	0.010	0.004	0.000	0.005	0.021	0.013
Cd	0.004	0.001	0.002	0.000	0.000	0.001	0.012	0.000	0.005	0.002	0.001	0.002
Ca	1.610	0.002	1.309	0.010	1.240	0.012	13.07	0.067	2.353	0.016	1.845	0.011
Mg	1.001	0.001	0.670	0.005	0.670	0.008	2.159	0.001	0.637	0.002	0.768	0.008
Pb	0.000	0.000			0.002	0.008	0.000	0.012	0.007	0.012	0.014	0.008

Table 3. Amount of heavy metal contents in Salvinia

Metals	Aug.2011		Sept.2011		Oct.2011		Nov.2011		Dec.20111		Jan.2012	
	Conc. mg/L	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.
Cu	0.743	0.007	1.840	0.002	0.574	0.009	0.224	0.006	2.17	0.016	1.32	0.008
Zn	1.148	0.004	1.033	0.004	0.283	0.004	1.035	0.002	1.240	0.004	4.773	0.052
Mn	4.652	0.018	4.307	0.034	0.507	0.007	4.722	0.020	0.781	0.002	0.221	0.002
Fe	9.420	0.032	14.45	0.036	11.03	0.080	0.229	0.003	7.660	0.045	4.733	0.005
Co	0.082	0.002	0.007	0.001	0.000	0.001	0.013	0.002	0.024	0.002	0.055	0.004
Ni	1.263	0.001	0.170	0.008	0.056	0.007	0.108	0.012	0.093	0.023	0.017	0.002
Cd	0.029	0.004	0.001	0.002	0.000	0.001	0.003	0.006	0.000	0.003	0.000	0.001
Ca	1.290	0.010	2.745	0.025	2.641	0.050	0.767	0.007	0.882	0.002	1.331	0.005
Mg	0.130	0.000	0.169	0.008	0.161	0.006	0.384	0.002	2.246	0.065	0.584	0.002
Pb	0.209	0.012	-	-	0.172	0.009	0.221	0.004	0.290	0.028	0.168	0.031

Table 4. Amount of heavy metal contents in Eichhornia

METALS	Aug. 2011		Sept 2011		Oct. 2011		Nov .2011		Dec. 2011		Jan. 2012	
	Conc. mg/L	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.
Cu	0.304	0.006	1.038	0.005	1.77	0.006	0.121	0.010	1.63	0.001	1.32	0.006
Zn	0.500	0.005	0.466	0.002	1.032	0.005	0.253	0.002	0.763	0.002	0.902	0.025
Mn	4.183	0.004	3.281	0.032	6.448	0.040	2.664	0.008	0.221	0.002	0.221	0.002
Fe	6.45	0.019	4.226	0.003	0.340	0.009	6.044	0.006	4.802	0.079	5.056	0.017
Co	0.079	0.002	0.010	0.001	0.020	0.002	0.015	0.002	0.027	0.004	0.036	0.007
Ni	0.780	0.008	0.161	0.012	0.088	0.002	0.049	0.047	0.105	0.016	0.774	0.020
Cd	0.028	0.001	0.000	0.001	0.000	0.001	0.000	0.001	0.101	0.005	0.000	0.000
Ca	1.624	0.003	4.811	0.019	1.343	0.017	1.478	0.012	3.336	0.022	2.550	0.010
Mg	0.270	0.000	0.198	0.007	0.111	0.004	0.378	0.000	0.901	0.003	0.625	0.001
Pb	0.144	0.007	-	-	0.102	0.004	0.143	0.002	0.238	0.009	0.158	0.010

Table 5. Amount of heavy metal contents in Hydrilla

METALS	Aug. 2011		Sept. 2011		Oct. 2011		Nov. 2011		Dec. 0111		Jan. 2012	
	Conc. mg/L	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.	Conc.	S.D.
Cu	0.321	0.014	1.35	0.009	0.601	0.018	0.181	0.004	2.34	0.008	0.245	0.008
Zn	0.865	0.005	0.703	0.003	0.795	0.005	0.631	0.002	0.795	0.005	0.703	0.003
Mn	6.933	0.004	1.071	0.010	0.493	0.002	0.158	0.007	2.345	0.004	1.660	0.009
Fe	1.38	0.009	7.070	0.051	8.199	0.070	0.158	0.007	7.433	0.025	6.205	0.010
Co	0.084	0.005	0.011	0.001	0.019	0.002	0.030	0.009	0.084	0.005	0.055	0.005
Ni	0.843	0.005	0.152	0.010	0.055	0.005	0.159	0.06	0.208	0.011	0.098	0.035
Cd	0.039	0.001	0.009	0.002	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Ca	4.785	0.058	1.418	0.022	7.022	0.065	2.243	0.001	3.114	0.010	2.056	0.004
Mg	0.190	0.000	0.302	0.014	0.118	0.008	0.402	0.001	0.742	0.002	0.498	0.000
Pb	0.267	0.010	0.00	0.00	0.184	0.009	0.236	0.002	0.296	0.007	0.093	0.039

Graphical Representation of Metal Contents

The graphical representation of various metal contents in water sample, Eichhornia, Salvinia and hydrilla are shown in figure 1-10.

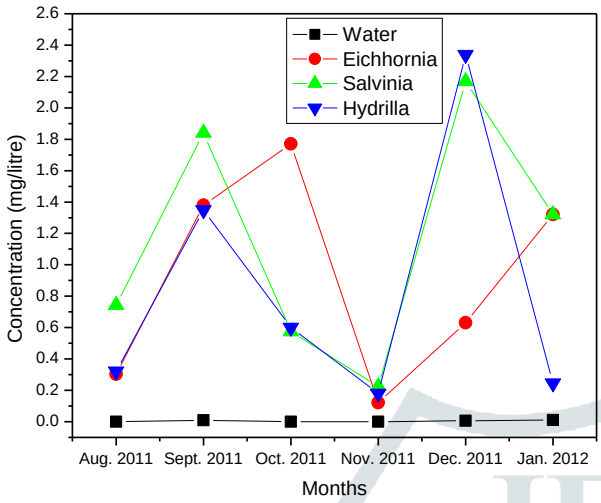

Fig.1 Concentration of Cu

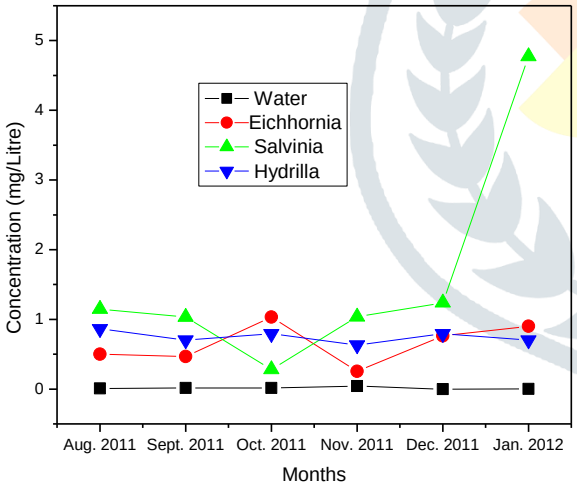

Fig.2 Concentration of Zn

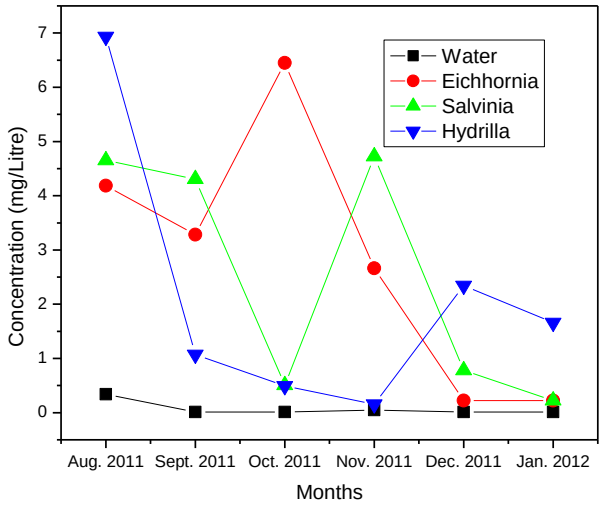

Fig.3 Concentration of Mn

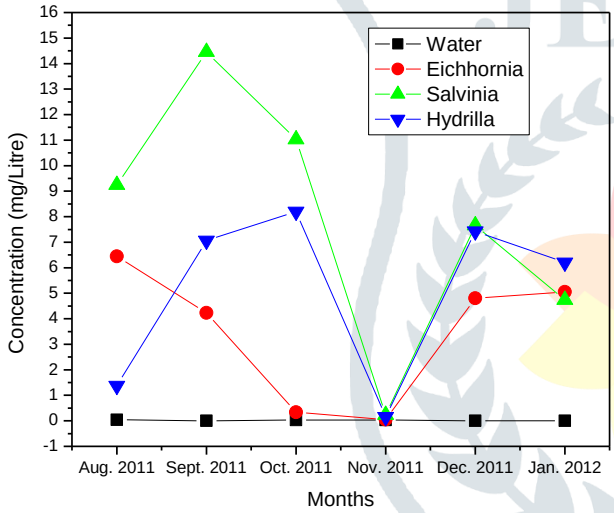

Fig.4 Concentration of Fe

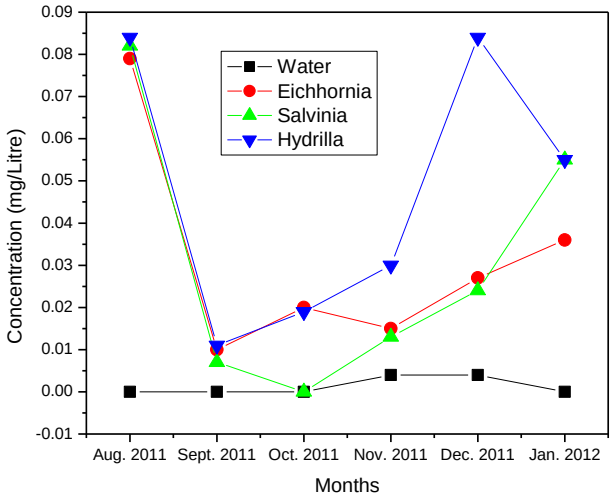

Fig.5 Concentration of Co

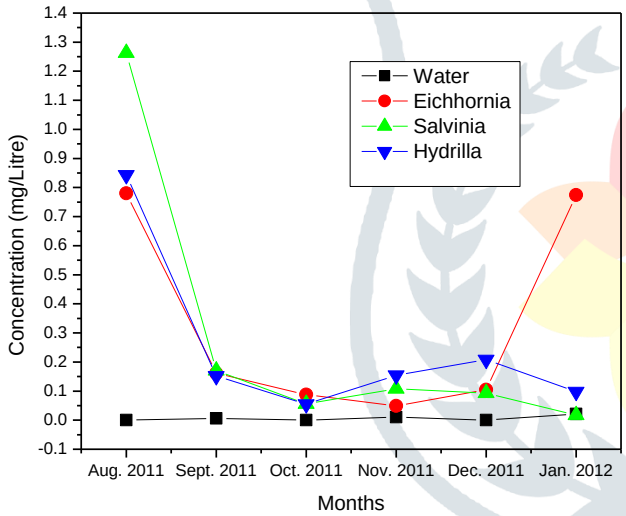

Fig.6 Concentration of Ni

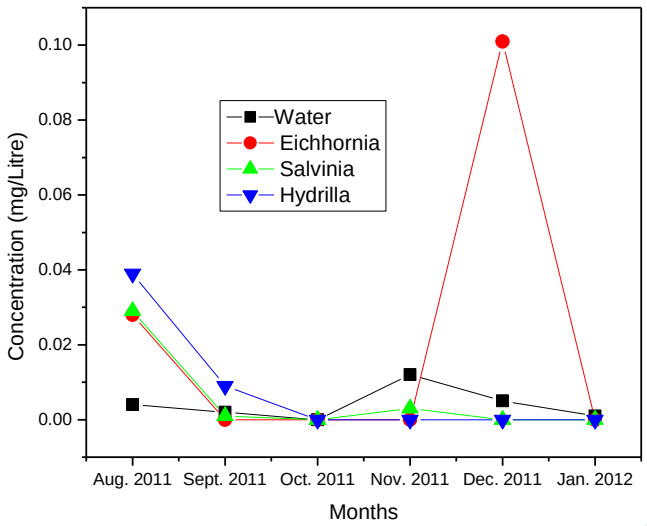

Fig.7 Concentration of Cd

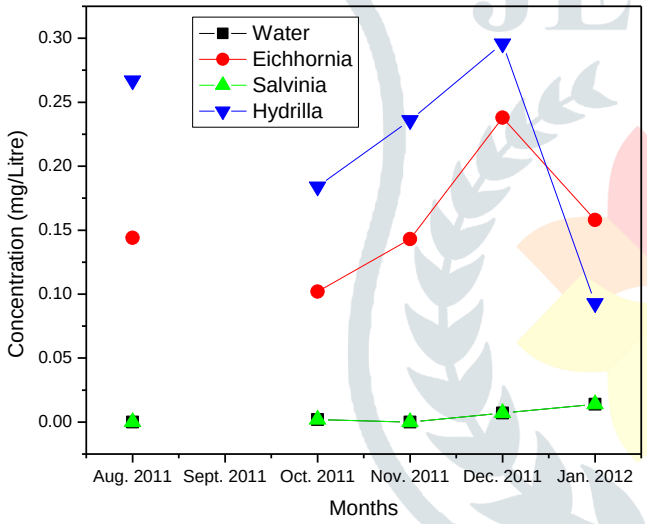

Fig.8 Concentration of Pb

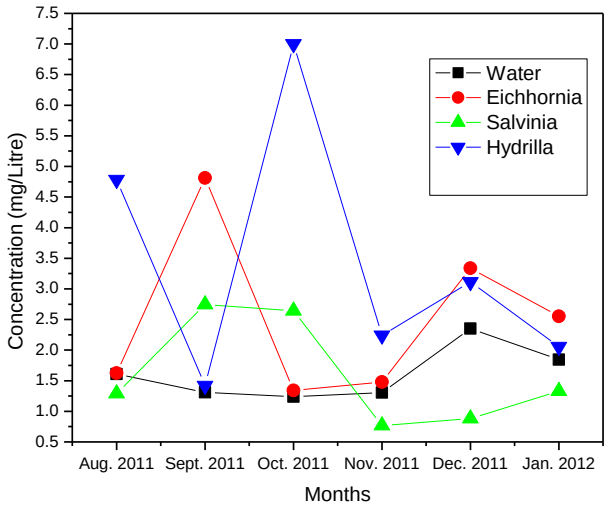

Fig.9 Concentration of Ca

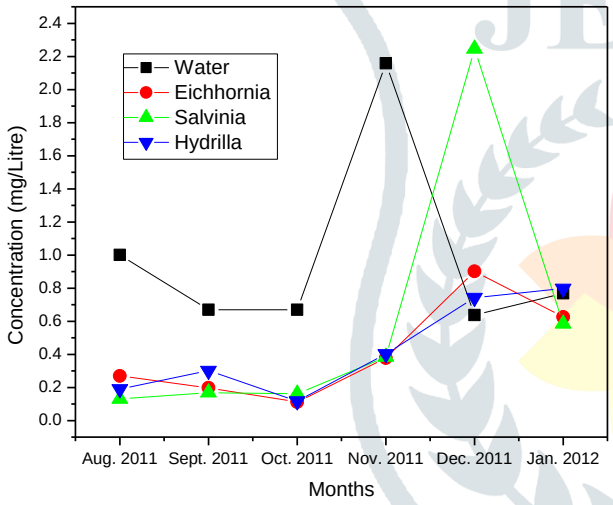

Fig.10 Concentration of Mg

Conclusion

The results indicate that the amount of heavy metals such as cadmium and lead in water was decreased up to zero due to absorption by aquatic plants such as Eichhornia, Salvinia and Hydrilla. The analysis of these plants showed that these plants contain heavy metals in higher quantities. These aquatic plants acts as pollution indicators. The heavy metal analysis of aquatic plants and water showed that aquatic plants absorb heavy metals from polluted water. From analysis of these plants and water we concluded that the water of rankala lake can now be useful for society.

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