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RESEARCH ARTICLE

EFFECTS OF HEAVY METAL ON THE PHYSICAL AND CHEMICAL PARAMETERS OF KAYAMKULAM BACKWATER, ALAPPUZHA DISTRICT, KERALA

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ABSTRACT

A study was conducted on physico-chemical parameters and heavy metal contents of water from the Kayamkulam water. The study was undertaken for a period of twelve mo1nths from august 2014-July 2015.Four sites was selected for this study. The concentration of Heavy metal such as As,Cd,Cu,Pb and Hg levels are determined by using atomic absorption spectrometry. Heavy metal in water have noted the highest for cadmium and copper and all other metal followed this range Cd>Cu>Pb>As>Hg. Heavy metals in water were found in maximum concentration and showed negative correlation with DO in back water. The water parameters favored the production of brackish water fish. However, it is contaminated and therefore not suitable for human use. The present study was very preliminary for the future study, protection and management of this economically important area in Kerala.

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INTRODUCTION

Water is the most precious resource essential to sustain the life on earth. Rapid industri-alization and urbanization results in release of variety of pollutants into back water system. Heavy Metals from man –made pollution sources which are released into aquatic ecosystem pose a serious threat to biota. Heavy metals may accumulate to toxic concentrations under certain environmental conditions and cause ecological damage. The agricultural drainage water containing pesticides, fertilizers and effluents of industrial activities and Runoff, in addition to sewage wastes supply the water bodies with huge quantities of inorganic anions and heavy metals (ECDG, 2002). Natural and anthropogenic sources continuously release heavy metals into aquatic ecosystem. The heavy metals after reaching to fresh waters cause serious problem due to their long persistence, bioaccumulation, biomagnifications in the food chain and oxicity to organisms. Fish, being adominant inhibitors of aquatic environment, are considered as indicators of heavy metal pollution (Srivastav *et al*., 2013). Most environmental problems of concern today are attributed to the production and release of toxic chemicals capable of interacting with the environment and disrupting the ecosystem (Abumourad *et al*., 2013). Some heavy metals such as lead and cadmium are non-essential metals that are toxic to animals and human even at very low concentrations. However, high concentrations of some essential trace metals can become toxic at concentrations exceeded the limits, which are required (Wright and Welbourn, 2002).

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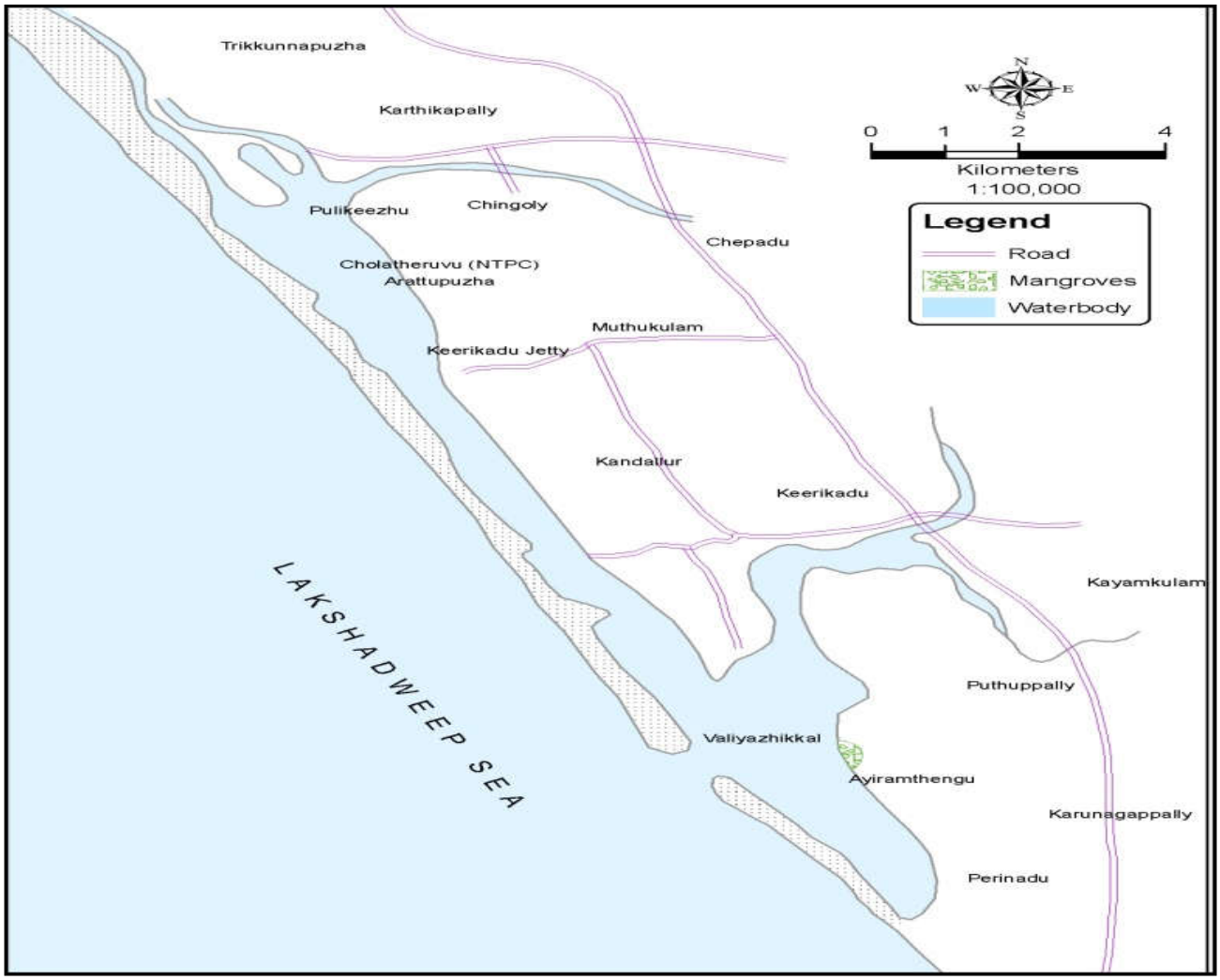
MATERIALS AND METHODS

The Kayamkulam back water is located between $9^0$07'and $9^0$16'N latitude and $76^0$20' and $76^0$28' E. The lake is 14.5 km long and 0.8 to 2.4 km wide .Four sites from the kayamkulam backwater were selected for the study. The Ist site (Ayiramthengu) is located near the Azheekal harbour, hence most of the mechanized fishing trawlers operated in the Azheekal zone is onboard in this site. Oil spillage from mechanized boat is a major source of pollution in this site. The site II valiazheekal, where the Kayamkulam lake opens to the sea, tidal influence is high in this area.Site III. Kochiyude jetty is about 6 km from station II and is almost at the middle of the lake. The site IV Choolatheruvu is on the side of thermal power plant. This site was polluted due to the discharge of waste products from the power plant.

Map showing Kayamkulam backwater

Water samples were collected early in the morning in sterilized sampling bottles and were analyzed important physicochemical parameters and trace heavy metals.



Few physicochemical parameters like Temperature (°C), pH and Dissolved Oxygen (mg/l) were performed on Spot. Other parameters like BOD,DO, Total dissolced solids Hardness,CO_2,COD were analyzed under standard laboratory conditions in accordance with APHA and Heavy metals such as As,Cd,Cu,Pb and Hg were determined by using Atomic absorption specteor photometer.

RESULTS AND DISCUSSION

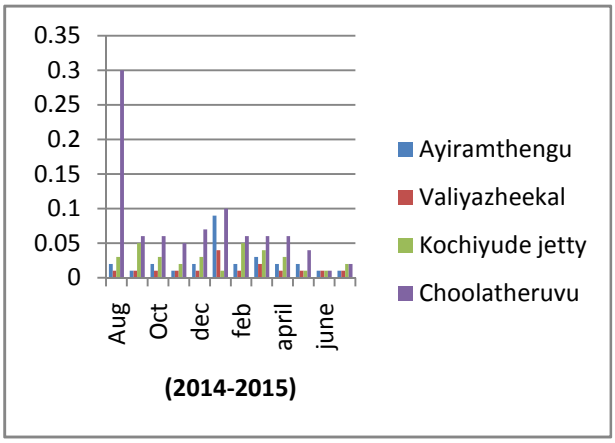
Physicochemical factors of kayamkulam back water

Table 1 recorded the average values of physicochemical characteristics of Kayamkulam Backwater. Temperature is one of the most important factors to indicate the present status of any water body. In the present study the maximum temperature was recorded at Site II (28.08 ± 1.13) and minimum at Site III (27.83 ± 1.03). Data on the Rainfall during the study period was almost same throughout the year on all sites. The highest rain was recorded in June and August. pH value was ranged from 6.90 ± 0.45 to 7.80 ± 0.38. The higher pH value noticed in Site II may be contributed to higher alkaline nature of water. The pH showed a positive relation with temperature (r= 0.583, p<0.05) and salinity (r = 0.529**, p<0.05). The alkaline pH of water might be due to the use of detergents by neighboring population. Higher the alkalinity indicated the potential susceptibility of these Water bodies for eutrophication. Water body with above 100 mg/l is considered nutritionally rich. The Do varied from 3.49 ± 0.1 to 4.51 ± 0.45. The DO was recorded mostly in low concentration throughout the year and does not noted clear trend with respect to different sites, it indicates the increasing load of pollution in the water body. DO was recorded in low values in months of summer at site IV and high in months monsoon. Low dissolved oxygen during summer might also be due to anticipated microbial activities. Do was negatively correlate with BOD(r = -0.437**, p>0.05) and COD (r = -0.500**, p>0.05). BOD values in back water ranged from 1.58 ± 0.39 to 2.62 ± 0.45. The concentration of BOD was found relatively high throughout the year. The higher BOD might be attributed to seasonal effect at high temperature. BOD also showed a negative relation with DO (r = -0.437, p>0.05) and salinity (r = -0.375**, p>0.05) recorded a positive relation with COD (r = 0.967** p<0.05). COD value ranges from (6.14 ± 0.22 to 10.67 ± 0.46). COD showed negative relation with DO (r =-0.500 , p>0.05), salinity (r = -0.362*, p>0.05) and BOD showed a positive relation (r =0.967**, p<0.05).Total hardness was recorded highest throughout the year and was maximum at site IV (249.50 ± 60.42) and lowest (188.80 ± 45.05) site II. Higher hardness may contribute to calcium and magnesium to the water body. Hardness showed a positive correlation with temperature (r = 0.681****, p<0.05). Salinity values varied from (31.12 ± 1.57) to (33.58 ± 0.70), near to similar pattern of salinity showed all the sites. Salinity noted positive relation with temperature (r = 0.493, p<0.05) and pH (r = 0.529**, p<0.05) and negative correlation with BOD (r = -0.3758**, p>0.05) and COD (r = -0.362*, p>0.05). Highest mean value of CO_2 was (0.18 ± 0.23) at site IV. The measured concentration of metals levels showed considerable difference associated with the season and month.

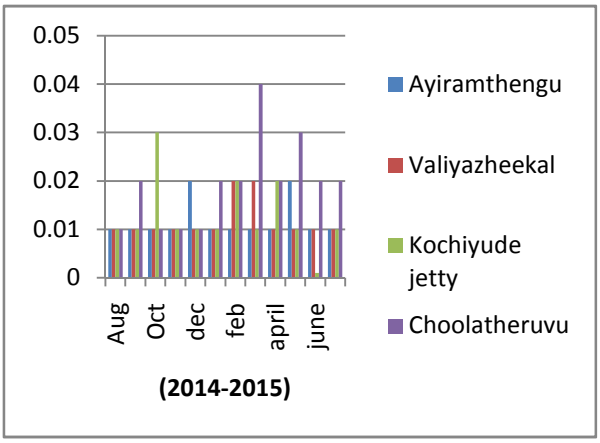
Parametres	Site I	Site II	Site III	Site IV	F value
Temperature °C	27.93 ± 1.07	28.08 ± 1.13	27.83 ± 1.03	27.87 ± 1.01	.131 **
Ph	6.90 ± 0.45	7.80 ± 0.38	7.34 ± 0.31	7.25 ± 0.40	9.76 **
Total Hardness mg/l	225.17 ± 80.36	188.80 ± 45.05	214.85 ± 82.61	249.50 ± 60.42	1.615
DO mg/l	4.51 ± 0.45	3.94 ± 0.52	4.30± 0.37	3.49 ± 0.1	13.53 **
BOD mg/l	1.58 ± 0.39	1.87 ± 0.22	1.95 ± 0.25	2.62 ± 0.45	19.934**
COD mg/l	6.14 ± 0.22	7.42 ± 0.93	7.77 ± 0.96	10.67 ± 0.46	32.46**
Salinity	32.34 ± 0.98	33.58 ± 0.70	33.20 ± 0.62	31.12 ± 1.57	13.383**
CO_2	0.14 ± 0.07	0.12 ± 0.05	0.10 ± 0.03	0.18C ± 0.23	1.009

Heavy metal concentration in Kayamkulam backwater

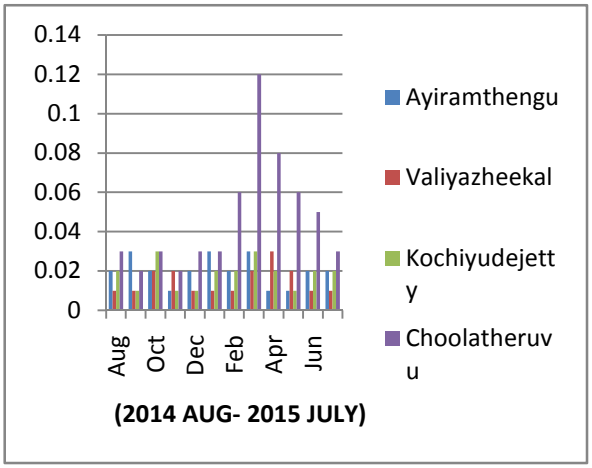
Para-meters	Site I	Site II	Site III	Site IV	F Value
Arsenic	0.02 ± 0.02	0.01 ± 0.01	0.03 ± 0.01	0.07 ± 0.07	5.531**
Cadmium	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	0.02 ± 0.01	3.796*
Copper	0.02 ± 0.01	0.02 ± 0.01	0.02 ± 0.01	0.05 ± 0.03	9.92**
Lead	0.05 ± 0.05	0.02 ± 0.01	0.02 ± 0.02	0.04 ± 0.02	2.618
Mercury	0.02 ± 0.02	0.01 ± 0.00	0.01 ± 0.00	0.22 ± 0.60	1.463



ARSENIC



CADMIUM



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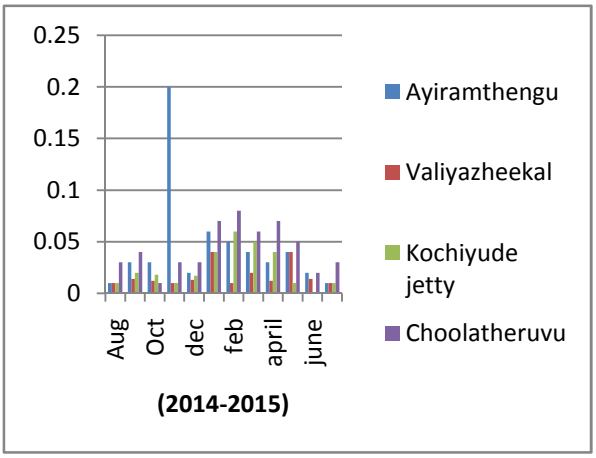
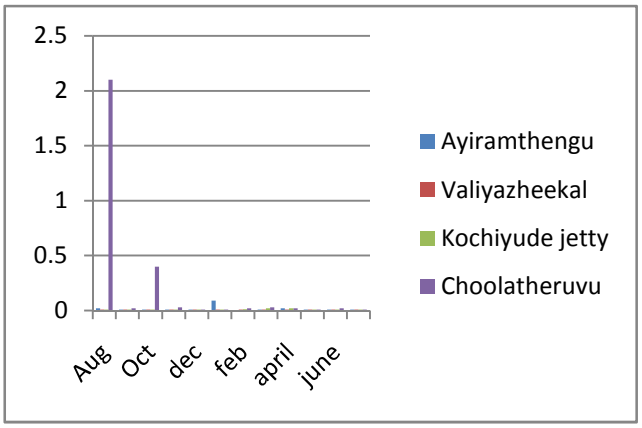


LEAD



MERCURY

Average variation of heavy metals (As, Cd, Cu, Pb, Hg) depicted in the above table. Cadmium concentration was recorded very high during the study period. The presence of cadmium and lead, which are highly toxic metals, can be attributed to industrial and agricultural discharge (Mason 2002). The lead concentration was increased and by excess released free metal ions into the water bodies from kitchen utensils and solubility of old paintwork from building during acidic wet deposition. The possible sources of cadmium in river water system are contributed by domestic wastewater released from residential area, uncontrolled use of pesticides, fertilizers and local air pollution caused by open burning. Heavy metals from industrial and wastewater treatment plant effluents can form stable complexes with inorganic and organic compounds Rivers, lakes and ponds containing excess cadmium can contaminate surrounding land, either through irrigation for agricultural purpose, dumping of grudged sediments or flooding. Mercury is a metal found naturally in the environment but human activities have greatly increased its atmospheric concentration.Anthropogenic sources of mercury in the environment includes incinerators,coal-burning facilities,industrial processes and some consmer products (Andrew and Dan Becker, 2010). The increased amount of arsenic is due to the arsenical pesticides,herbicides,crop desicants and the use of arsenic as an additive to livestock fed particularly for poultry from the sorrounding environments like aquacultural farm,fishing harbour and agricultural fields. Simple correlation coefficients (r) computed between water qualities Physicochemical properties and concentrations of different heavy metals in Kayamkulam back water was recorded in table -. Cadmium was positively correlated with temperature, hardness, BOD at p = 0.01 and COD at p =0.05 and negatively correlated with DO p= 0.05. The concentration of Hg, Cu and As were positively correlated with BOD and COD and negatively correlated with salinity. Concentration of lead was positively correlated with hardness. The relationships between the concentrations of different metals in waters indicated the state of dynamic equilibrium through which these metals that contribute directly or indirectly to ambient water in aquatic ecosystem [24, 25]. The persistence and concentrations of these trace elements in the water column and bottom sediment may reflect the concentrations found in resident aquatic organisms (through bioaccumulation), such as fish. This presents a human health concern if contaminated aquatic organisms, like fish and shellfish, are consumed.

Conclusion

In conclusion, analysis of heavy metals in water sample indicates the levels of arsenic, cadmium, copper, lead and mercury from the four sites exceeded the limits specified by the international authorities. Improper disposal of solid wastes,industrial effluents, house hold wastes causes severe contamination of the kayamkulam backwater. The concentration of heavy metals and other water quality parameters undergo seasonal and monthly changes and the values of most parameters were generally higher. This water was little much polluted and not recommended as for human consumption. There is a possibility of bioaccumulation of metals in fish. Hence, waste water should be thoroughly treated before letting them into the water body.

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