APPRAISAL ON WATER QUALITY PARAMETERS IN THE FISHING HARBOUR OF SOUTH COAST, INDIA

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Abstract:

The heavy metals are certainly stirring elements which have natural or anthropogenic sources. The high concentration of these heavy metals causes serious health issues. In this study the physical, chemical parameters, heavy metal concentration, oil & grease content were carried out in the surface water of the Chinnamuttom fishing harbour. According to the results the distribution of heavy metals is varied spatially and seasonally. The amount of Zn, and Cr is slightly higher when related with other trace metals. The oil and grease content are within the standard limit. Statistical study like Pearson Correlation analysis was executed for the data collected to know the association among the calculated parameters. The rank order distribution of trace heavy metals in relations of their typical concentration in fishing harbour water was detected as Zn>Fe>Cr>Cu>Pb>Cd. This may be due to the anthropogenic harbour activities.

Keywords: Heavy metals, chemical, parameters, physical, Fishing Harbour

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Abbreviations: TDS - Total Dissolved Solids, EC - Electrical conductivity, Tot. Hard- Total Hardness, Temp- Temperature, Turb- Turbidity, NO3- Nitrate, Tot. Alk- Total Alkalinity, Na- Sodium, K- Potassium, Zn- Zinc, Fe- Iron, Cr- Chromium, Cu- Copper, Pb- Lead, Cd- Cadmium, pH- Power of hydrogen, EPA – Environmental Protection Agency.

1. Introduction

Water is a cherished compound present on the Earth. It is a universal solvent. Almost the world is covered with 75% of water. In which about maximum amount of the earth's water is in the ocean, and it is not fit for human usage due to its great salty nature. Remaining 2% is wrapped in polar ice covers and only 1% was found in is existing as fresh water in streams, tributaries, lagoons, pools and underground water, used for animal feasting. (Reza and Singh 2010) Due to the high usage of metal centered fertilizer in agricultural farms, there is a possibility of metal pollution in freshwater because of surface runoff. The fecal contamination of freshwater results in water-borne disease which can cause even the death of millions of people both in cities and villages (S and E 2010)

Mutually normal and human caused actions are normally accountable for contamination of trace heavy metal richness in our surroundings. Due to anthropogenic activities, a high amount of toxic heavy metals is got deposited in the aquatic surroundings. The heavy metal contamination may due to the sources like fauna and human excreta, soil enduring, waste disposal, leaching of metals from industrial waste. (Bhuyan et al. 2019)

The seawater quality was diminishing constantly due to the higher concentration of dissimilar pollutants, among which nutrient, suspended solids, total dissolved suspended solids, organic substances, and substantial reduction in dissolved oxygen. The scattering of trace metal pollutions does not have a direct effect on the optical properties of seawater. But they can influence the storage properties of water, like total dissolved solids, temperature and turbidity. Some of the pollutants (metals, biotic and nutrients) occur naturally in the location, which in shot increase the amount of pollutant around coastal areas. Commonly, ovearll result of effluent ejection from shipping events, vehicle arranging, cargo handling, container loading storage, cargo handling, municipal rainstorm water agricultural and industrialized run-off decrease the water quality. (Jahan and Strezov 2017) The evaluation of heavy metals was very essential because the difference in their concentration beyond the permitted limits leads to severe environmental threat and following welfare health issues. (Ojekunle et al. 2016)

The contamination of harbour water was caused by residual oil, rubbish water from the fishing boats, discharge of biological wastes after fish decimates, fish market surroundings runoff, trash washing and trash discarding. This will decrease the liquid superiority of the harbour. Impelling the oily water during washing boats, subsidiary oil leakage during refueling, was the main causes for pollution. The other contagion bases in a fishing harbour integrate inappropriate unloading of fish scrap and waste into water, delivery of unprocessed dirt from latrines and peep into the locations. (Niroshana et al. 2013)

The accumulation of heavy metals in the cells of living organisms can cause long-lasting illnesses and affects the human population. The developed countries have identified major environmental problems and successfully corrected the problems by monitoring and accompanying remediation programs. (Fianko et al. 2013) The chief scope of this study was to evaluate the physical, chemical and trace metal concentration of trace heavy metals for the water of Chinnamuttom fishing harbour.

Description of the study area

The Chinnamuttom fishing harbour is situated at 8.094345°N 77.561445°E, at an elevation of 200 meters. The coastal regions of the Kanyakumari District were the interval between Western Littoral Plains to the Eastern Coastal Plains. The Chinnamuttom fishing harbour is the solitary coastal zone that deceits on the Eastern Littoral Plains. Chinnamuttom is encircled via the ocean on three sides. Fig. 1 shows the study area map. The Chinnamuttom coastal area is a fishing village. They caught fish by using mechanical boats. Washing of fish using contaminated harbour water and unhygienic handling are features that subsidize for the rapid spoilage of fish and cause serious health hazards due to contamination of basin water and fish.

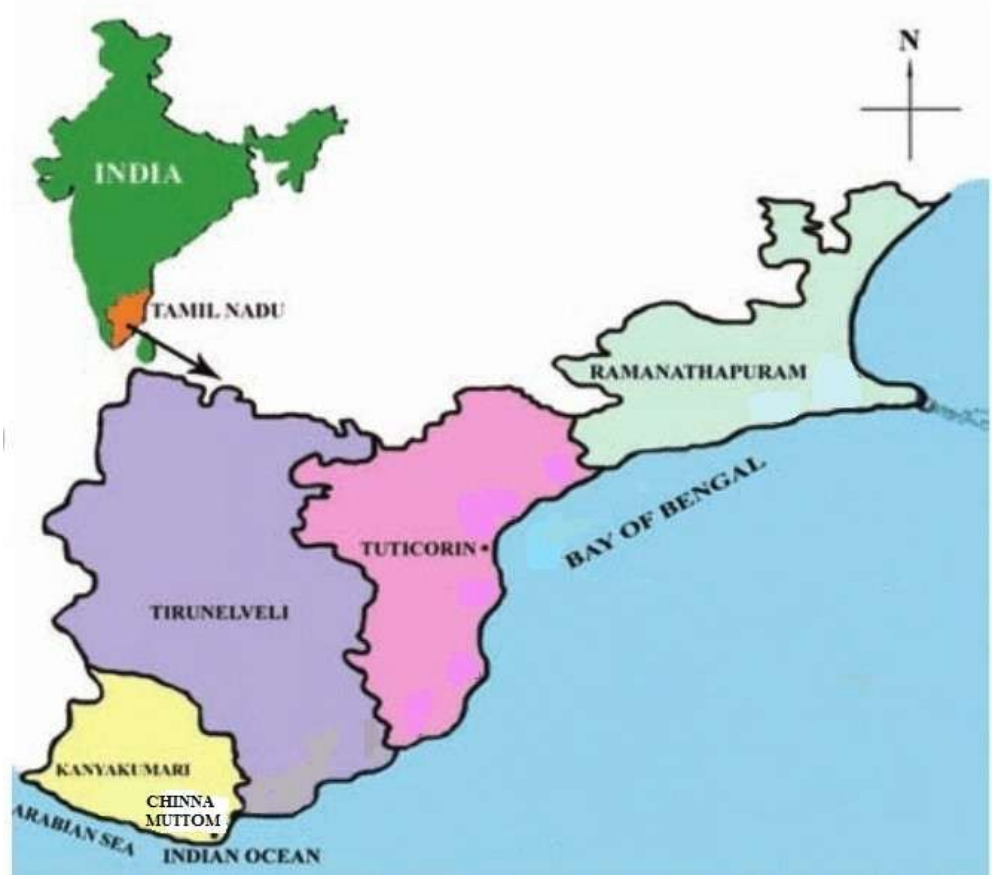

Fig. 1 Study area

Sample Collection & Analysis

The water samples were collected in poly terephthalate (PET) bottles from the study area. The present study was done in the month of May, June, July, August, and September at the Chinnamuttom Fishing harbour. Before collecting the samples, the bottles are rinsed well with water. The samples were collected at the distance of 100 m, 200 m, 300 m away from the edge of fishing harbour. So, totally three samples are taken in a month. After labelling the samples properly the samples are sent to the research laboratory for preservation followed by analysis.

Physicochemical parameters like pH, Temp, Tot. Hard, TDS, EC, Turb, NO3, Tot. Alk, K, Na, oil & grease are analyzed in this study. Using Atomic Absorption Spectroscopy, the distribution of the particular trace metals like Pb, Fe, Cr, Zn, Cd, and Cu were analyzed. By measuring the absorbed radiation by the sample, the quantities of chemical elements existing in the water samples can be identified accurately. The scope of the current study was to appraise the fishing harbour pollution by determining the physicochemical parameters and trace heavy metal gathering.

2. Results and Discussion

The life of all marine living organisms depends upon the surface water quality of coastal environment. Water quality guides are the necessary tool to outline the environmental or ecological situation of a water body and to shorten the performance of results. The physicochemical parameters of such as pH, EC, Tot. Hard, Temp, TDS, Turb, NO3, Tot. Alk, Na, K, oil & grease of water samples are analyzed.

Normally, the growth of aquatic living organisms is not directly inclined by temperature, but it may cause some secondary effects. In this study the surface water shows the average temperature between 27^0C to 30 ^{0}C (Fig.4). The pH was noted around 6.7 to 7.4 (Fig. 5). Among the important key variables, pH plays a main role. The eminence of surface water is extremely inclined by the alteration in pH. The ultimate pH for biological function is ranged 7.0 to 8.5 and below 4.0 is harmful for marine living organisms. Optimum range of pH for the aquatic life is from 6.5 to

8.5.(Shaheen Zafar et al. 2018) The turbidity is recorded around 1.8 mg/l to 3.3 mg/l. (Fig.8)

Through electrical conductivity value, we can evaluate the solvent or salt concentration in sediments, water supplies, chemical solution and in fertilizer. Based upon the conductivity value the changes occurring in the composition of water can assess. The maximum conductivity of 3749µmho/cm was noted in September and the minimum conductivity value of 1186 µmho/cm was noted in May (Fig. 6). The variations in electrical conductivity are mostly due to fluctuation in salinity and total dissolved solids. The maximum TDS is 898 mg/l recorded in the month of May and a minimum 431.7 mg/l noted in August. In the present study total hardness ranged between 134 mg/l to 286 mg/l.

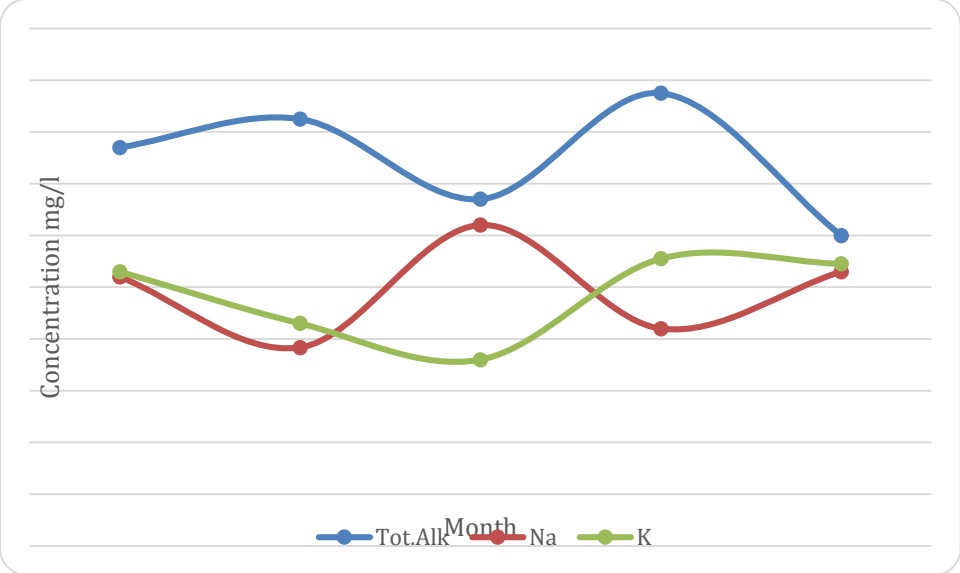

Fig. 2 The monthly variation of Tot. Alk, Na, and K in the study area.

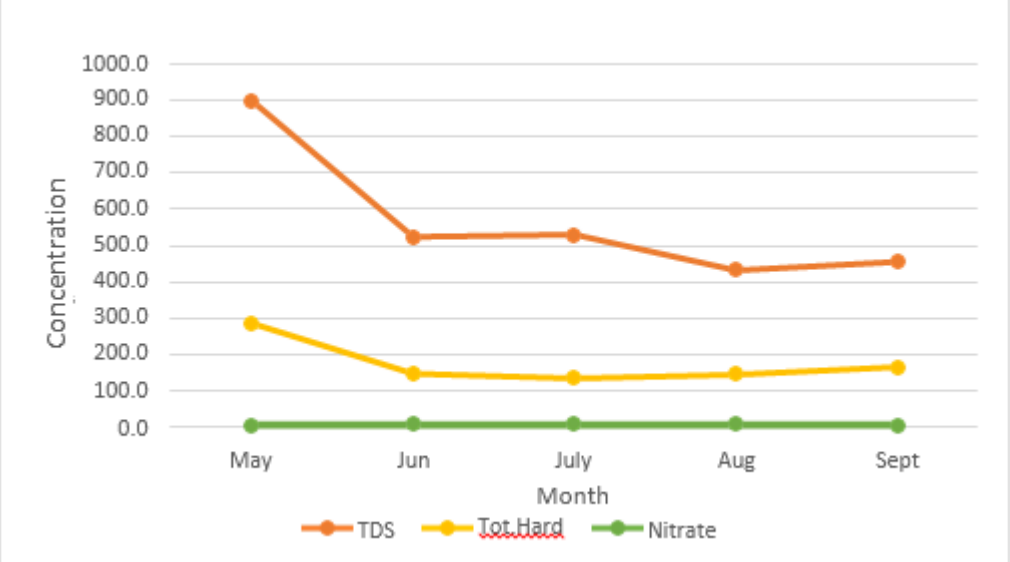

Fig. 3 The monthly variation of TDS, Tot. Hard and Nitrate in the study area.

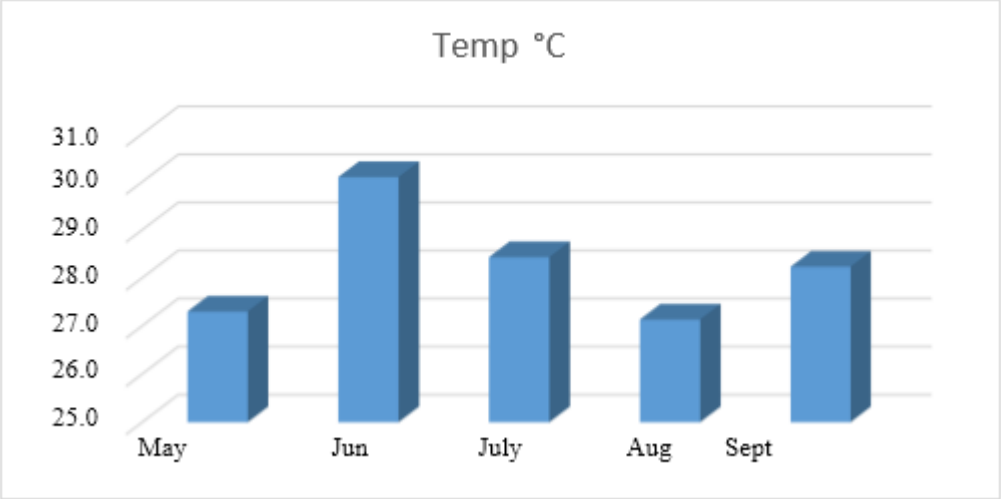

Fig. 4 The monthly variation of Temperature in the study area.

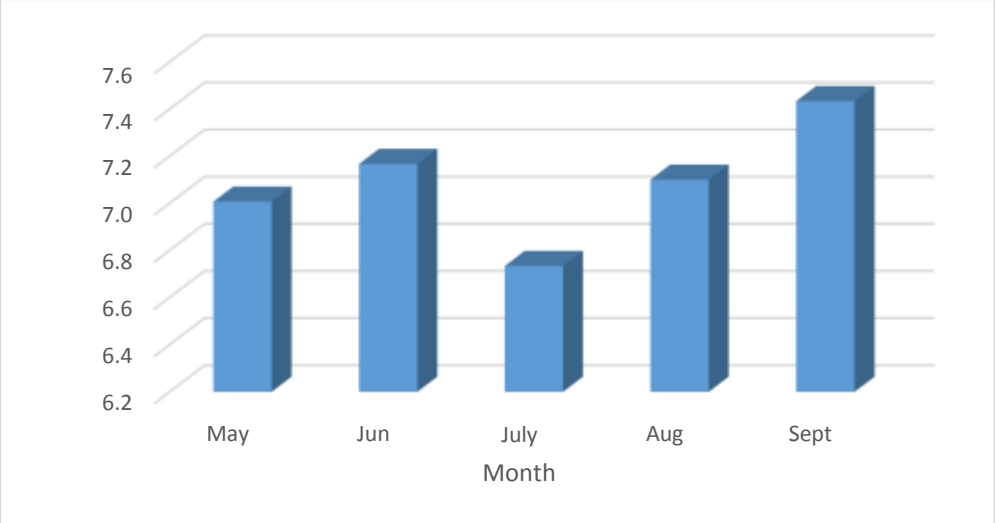

Fig. 5 The monthly variation of pH in the study area

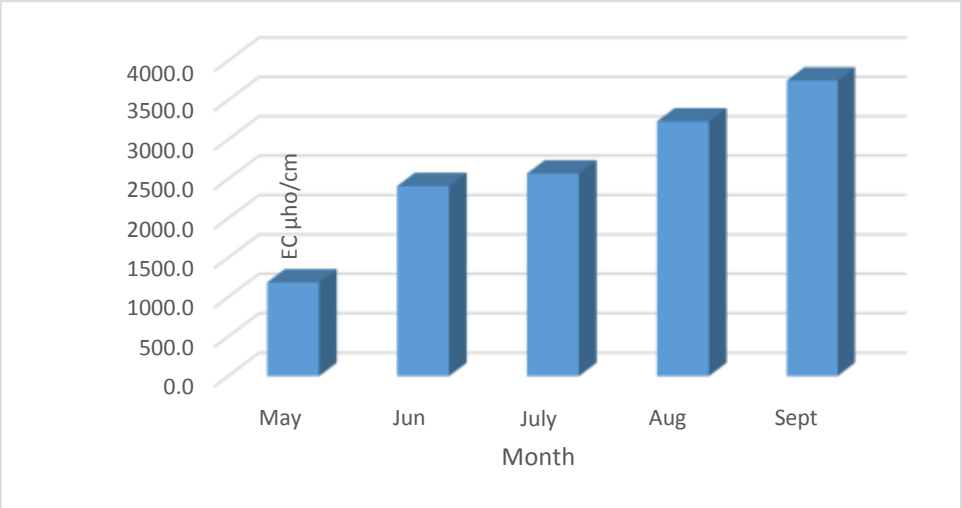

Fig.6 The monthly variation of EC in the study area

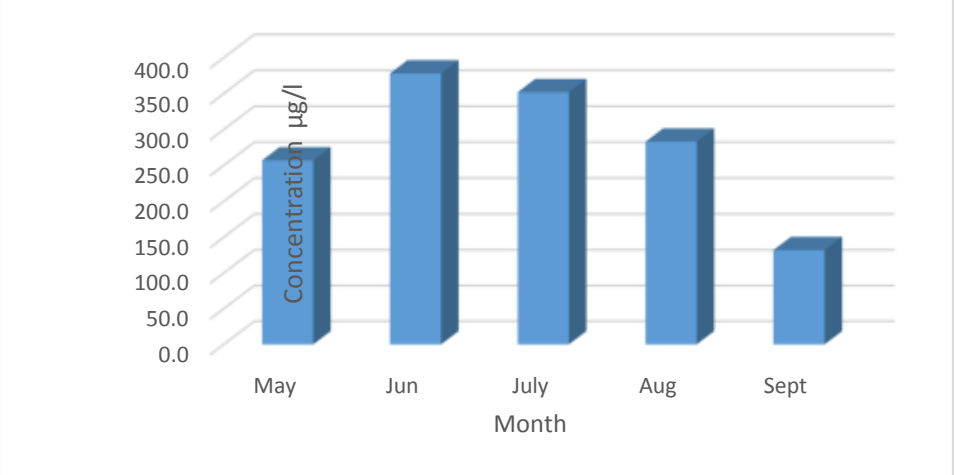

Fig.7 The monthly variation of Oil & Grease in the study area

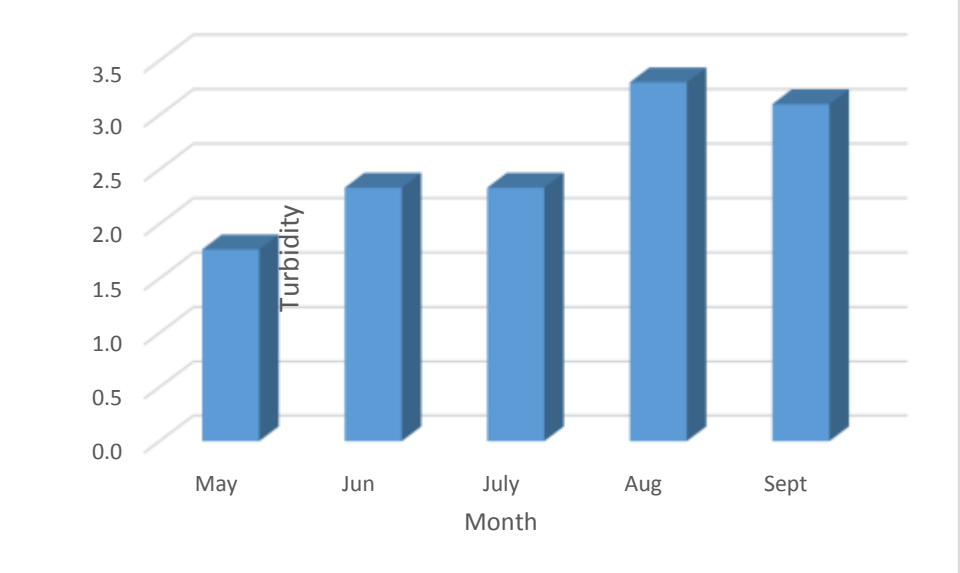

Fig.8 The monthly variation of Turbidity in the study area

The nitrate value is an outstanding parameter to evaluate organic contamination and it denotes the highest oxidized nitrogen form and a vigorous nutrient for growth, the survival of organisms and reproduction. The nitrate value is ranged from 5.3 mg/l to 8.5 mg/L in the sample water (Fig. 3). During the minimum value is recorded in September and the maximum in June. If it exceeds the permissible limit, it will decrease the ability of oxygen carrying capacity of blood in aquatic organisms.

The measure of its capability to neutralize acids is termed as the alkalinity of water. It is used as a criterion to determine the nutrient value of water. The number of contaminants can be determined by the level of hardness, alkalinity and free oxygen present in the water. The maximum value is 175 mg/l in September and the minimum value is 138 mg/l recorded in the premonsoon (Fig. 2). The total dissolved solids ranged between 431 mg/l to 898 mg/l (Fig. 3). The maximum distribution of total dissolved solids may due to the resultant surface runoff from roads, plains that have been salted in the wintertime.

Sodium is an important cation present in water and at low concentration, there is no toxic behaviour. Through enduring process potassium dissolves in surface water. Sodium and potassium are in the range of 76.7 mg/l to 124 mg/l and 72 mg/l to 110 mg/l respectively. In Chinnamuttom fishing harbour, oil and grease content ranges between 132.0 µg/l to 378 µg/l (Fig. 7). When comparing with other coastal areas the possibility of gathering oil waste was higher in harbour region. The main source of oil & grease contamination is possible in the fishing harbour due to seepages of containers pump out trash water, transferring fuel, waste oil, fuel residues and also due to oil spillages in the harbour basin. (Weerasekara et al. 2015)

Metal Determination

Based upon the inherent chemical properties the heavy metal behaviour in the aquatic environment will change. Trace heavy metal pollutions are harmful due to their potential toxicity for the environment and human beings (Sundaray, S. K et al.2011). In this study the observed distribution of heavy trace metals is in the following order: Zn>Fe>Cr>Cu>Pb>Cd in µg/l. Chromium (Cr) is a less toxic trace metal on the basis of its oversupply and essentiality. The Cr concentration increases in fishing harbour water by means of river drainage, dredging sludge and waste disposal. The concentrations of Cr ranged between 71.3 µg/l to 92 µg/l (Fig. 10). The maximum value is noted in the month of September. The chromium concentration will get increased due to the industrial effluents and municipal sewage (Nemr, A. E et al., 2006).

The copper at minimum concentration is necessary for all living beings because it maintains tissue metabolism and it plays a significant part as a factor for various enzymes. The maximum concentration of Cu is 36.3 µg/l in the month of July and a minimum value of 31.7 µg/l in the month of May (Fig. 9). The main sources of copper are anthropogenic activities, living, dead organic material, thermal and volcanic action. (Hasan et al. 2016)

Young et al. (1973) have noted that enormous concentration of zinc was released to the coastal environment and inlets lying close to highly populated areas. From many dissimilar causes of natural and human based activities Zn enters into the marine water. The Zinc concentration differs with deference to time, source, and space. (Srichandan et al. 2016) In the surface water the higher concentration of Zn is noted in as 753 µg/l in the month of September and a minimum value of 240.7 µg/l in the month of May (Fig.5). The Zn value is higher than Marine water quality standards for harbour water (Fig.9) (Zhang et al. 2015).

Lead is a highly poisonous metal for human well-being. The dispersal of Lead in water is mainly due to man actions. Its distribution in harbour was comparably high when compared to the bottom due to atmospheric
outcome (Schaule and Patterson 1981). Pb shows a higher value of 2.3 µg/l (Fig. 9) and a minimum value of 1.3 µg/l. In this study, the different distribution of metals is due to the seasonal variation. Concentrations of Cr in wet seasons were higher than in dry seasons (Al-Asadi et al.2020).

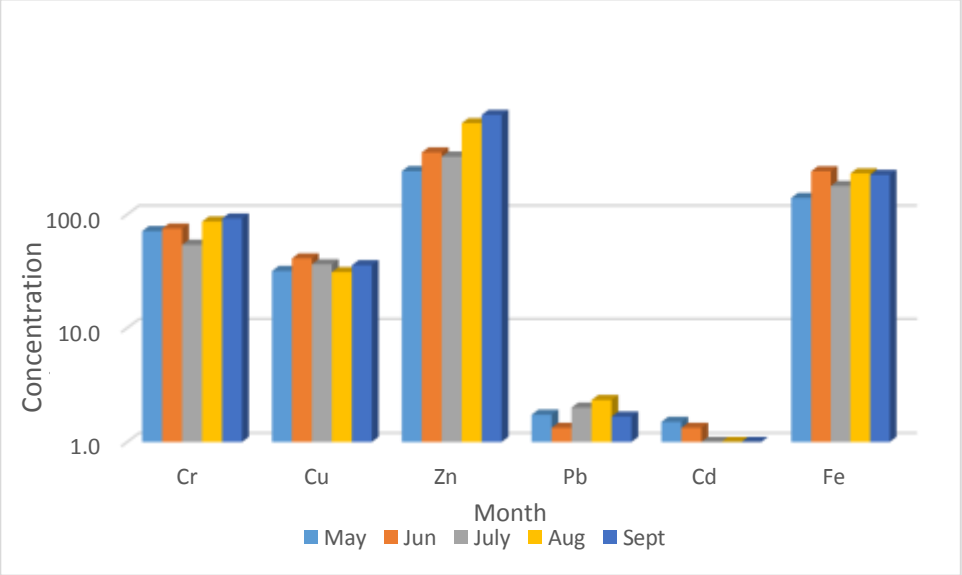

Fig. 9 The monthly variation of Cr, Cu, Zn, Pb, Cd, Fe in the study area.

Due to residual discharges from the gas dispensation plant, metallurgic actions (Shipbreaking) and other engineering activities are accountable for increasing cadmium concentration in coastal water. Even though it is at a minimum level, so far it is polluted. (Hasan et al. 2016) But in this study, the observed concentration of Cd is between 1 µg/l to 1.5 µg/l (Fig.10) it is within the permissible limit.

Generally, in the earth surface the distribution of iron is high when compared with water. The biochemical behaviour and the solubility of iron in water powerfully depend on the oxidation force inside the aquatic structure. Fe concentration is maximum of 240 µg/l in June and a minimum of 139.7 µg/l in May month.

Metal	Mean Concentration	EPA Std. USEPA2000	Marine water quality standards for harbours	WHO 2004	International Standard Aquatic Value
Cr µg/l	82.2	-	-	-	50
Cu µg/l	35.1	45	50	50	-
Zn µg/l	505.3	1180	100	-	-
Pb µg/l	1.8	28	50	100	100
Cd µg/l	1.2	71	10	-	50
Fe µg/l	209.1	-	-	3000	-
Reference	In this study	(Hasan et al. 2016)	(Zhang et al. 2017)	(Melegy et al. 2019)	(Al-Asadi et al. 2020)

Fig. 10 Comparison of Trace metals with standard values.

Abbreviation: EPA-Environmental Protection Agency, WHO-World Health Organisation

1.1 Pearson correlation coefficient

By means of Pearson's correlation, we can notice the correlation among trace heavy metals (Cr, Pd, Cu, Zn, Cd, and Fe) and the physicochemical characters like Temp, TDS, EC, Tot. hard, Oil & grease and Turb of Chinnamuttom fishing harbour (Fig. 7). A strong correlation is found between EC-Turb, TDS, Tot. Alk-TDS, EC, Tot. Hard-TDS, Cr-EC, Tot. Alk, Cu-Temp, Zn-EC, Cr). This strong association can be due to the same levels of release from the same effluence point or alike behaviour throughout their transportation. (Zhang et al. 2015). A moderate association is among Cu-TDS, Tot. Hard, K, Fe-K, O&G, T, pH, NO3. This association proposes that the trace heavy metals were from the identical chemical location or same source (Jahan and Strezov 2017)

	T	**TD**	**TDS**	**EC**	**pH**	**Tot.Alk**	**Tot.Hard**	**Na**	**K**	**NO_3**	**Cr**	**Cu**	**Zn**	**Pb**	**Cd**	**Fe**	**O & G**
Temp	1																
Turb	-0.18	1.00															
TDS	-0.28	-0.85	1.00														
EC	0.06	0.93	-0.92	1.00													
pH	0.12	0.51	-0.30	0.52	1.00												
Tot.Alk	-0.04	0.92	-0.92	0.98	0.35	1.00											
Tot.Hard	-0.44	-0.63	0.94	-0.74	-0.01	-0.78	1.00										
Na	0.59	-0.58	0.37	-0.60	-0.06	-0.69	0.21	1.00									
K	-0.49	0.71	-0.61	0.59	-0.21	0.73	-0.56	-0.71	1.00								
NO_3	0.71	0.31	-0.70	0.37	-0.05	0.37	-0.84	0.34	0.18	1.00							
Cr	-0.18	0.83	-0.78	0.91	0.27	0.96	-0.64	-0.85	0.73	0.14	1.00						
Cu	0.99	-0.17	-0.30	0.11	0.11	0.02	-0.47	0.50	-0.46	0.68	-0.10	1.00					
Zn	-0.18	0.89	-0.81	0.95	0.39	0.97	-0.63	-0.81	0.71	0.15	0.99	-0.11	1.00				
Pb	-0.76	0.46	-0.23	0.25	-0.37	0.41	-0.18	-0.64	0.91	-0.13	0.46	-0.75	0.43	1.00			
Cd	0.13	-0.81	0.85	-0.87	-0.06	-0.95	0.78	0.78	-0.84	-0.32	-0.96	0.06	-0.93	-0.56	1.00		
Fe	0.53	0.70	-0.95	0.78	0.29	0.75	-0.94	-0.06	0.39	0.87	0.56	0.53	0.60	0.00	-0.65	1.00	
O & G	0.67	0.33	-0.60	0.64	0.48	0.54	-0.58	-0.15	-0.12	0.42	0.52	0.73	0.52	-0.50	-0.43	0.64	1.00

Fig.7 Pearson Correlation of physicochemical parameters and Trace metals.

(Fig.7). A weak correlation is found between Fe-Pb, O&G-Tot. Hard, Zn-Cu, Cu-Cr. This weak association recommends that the heavy metals are not precisely related with each other, and are insignificant in circulation. (Fianko et al. 2013)

2. Conclusion

In this study the surface quality and trace heavy metal concentration of Chinnamuttom fishing harbour was assessed with the help of standard values and the results are subjected to Pearson correlation. The trace heavy metals like Cr and Zn show higher value when compared with the standard values. It may be due to the

anthropogenic and harbour activities. The trace heavy metal distribution in water may reason for the reduction in water eminence that will seriously disturb the marine organisms. Oil and grease content of the surface water are within the permitted value of fishing harbour water 10mg/l. Further the monitoring plans are suggested to safeguard a harmless fishery harbour.

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