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Determination of Heavy Metal Pollution of Water in Selected Areas of Nellore Coast, SPSR Nellore District, Andhra Pradesh, India

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Abstract: ***Heavy Metals are ubiquitous in nature, their measurement is necessary in heavily industrialized areas like coastal ecosystems of Nellore district for the management of health risks associated with them. Hence toxic Heavy Metals Cadmium (Cd), Arsenic (As), Lead (Pb), and Iron (Fe) were determined in different waters such as sea water, brackish water and culture pond water of 3 stations, Station 1 (Krishna Patnam), Station 2 (Nelaturu) are of industrial importance and Station 3 (PallePalem) which receives great amount of pollution from anthropogenic origin, river runoff, nutrient loads in to the coastal water from estuary. All the water Samples were digested and Heavy Metal analysis was done using Inductively Coupled Plasma Optical Emission Spectrometer (Perkin Elmer Optima 8000 ICP-OES). In Station 1 Cadmium and Iron were reported above the background levels in all water samples (Table 1, Figure 1). Station 2 Cadmium and Iron are reported at greater concentrations in all 3 water samples. In station 3 also Iron and cadmium exceeded the desirable limits in all waters. Iron levels are low in station 3 compared with station 1 and 2 (Table1, Figure 1). Cadmium and Iron are reported in almost all samples of 3 stations the concentrations of these 4 heavy metals exceeded the normal limits specified by regulation for water pollution control official gazette 4.9.1988. Hence this study clearly proved the impact of Industrial pollution and anthropogenic pollution by the evidence of the metals Iron and Cadmium. The presence of Heavy Metals in Waters indicates the potential means for pollution transfer from this media to Food Chains.***

Keywords: ***Heavy Metals, Pollution, Food Chains, ICP-OES.***

I. INTRODUCTION

Environmental pollution is caused by a variety of pollutants in water, air and soil. One of the major concerned pollutants of living environment is “Hazardous Metals” also termed as “Trace Elements”. This term is used in geochemical and biochemical literature to refer to a group of otherwise unrelated chemical elements which are found in nature at very low concentrations. Their concentrations in different natural environments vary widely. Seawater is under the risk of high pollution because of domestic waste water, industrial waste water, sea traffic, accident potential, port services and waste water, bilge and ballast water disposals related to port services. Marine waters are identified as having the following beneficial uses: a habitat for marine organisms generally, recreational bathing beach. In recent years, contamination of sea water by heavy metals is becoming major problem for aquatic life and human health. The presence of these heavy metals in water, create a societal health risk that, which is useful for fisheries. Fish play an important role in human nutrition and therefore need to be carefully and routinely screened to ensure that there are no high levels of heavy metals being transferred to man through their consumption (Muiruri et al., 2013, p.891). Water and sediments are commonly used as indicators for the state of pollution of aquatic ecosystem

In aquatic environment, larger animals such as fish have been exposed to heavy metals as a direct consequence of biomagnifications (Ekwanyanwu et al., 2011, p.; Javed and Usmani, 2011, p.660). The Rı´a of Vigo (Vigo estuary) is one of the largest and surely the best studied of several typical estuaries on the Northwest coast of Spain. To determine heavy metal contamination, certain marine invertebrates are useful bioindicators, and sometimes the metal contamination levels in these animals are directly proportional to the available levels in the environment. Transplanted or resident bivalves and other molluscs could provide us with a good indicator of temporally and spatially average concentrations of bioavailable contaminants in aquatic ecosystems. Different limpet species have been used for aquatic biomonitoring because they are widely distributed (most rocky shores are inhabited by some type of limpet) and they concentrate heavy metals.

Heavy metals are considered a major anthropogenic contaminant in coastal and marine environments worldwide (Ruilian et al., 2008). They pose a serious threat to human health, living organisms and natural ecosystems because of their toxicity, persistence and bioaccumulation characteristics (DeForest et al., 2007).Many heavy metal ions are known to be toxic or carcinogenic to humans

(Fu and Wang, 2011). Heavy metals can contribute to degradation of marine ecosystems by reducing species diversity and abundance and through accumulation of metals in living organisms and food chains (Hosono et al., 2011). Anthropogenically, heavymetals can be introduced to coastal and marine environments through a variety of sources, including industries, waste waters and domestic effluents (Fu and Wang, 2011). Flora and fauna species in the Arabian Gulf inhabit one of the harshest marine environments due to natural stressors represented by higher levels of salinity and temperature, and reduced levels of pH (Uddinet al., 2012). Native marine organisms of the Arabian Gulf are living close to the limits of their environmental tolerance (Price et al.,1993). Despite these harsh environmental conditions, the Arabian Gulf supports a range of coastal and marine habitats such as mangrove swamps, seagrass beds, coral reefs, and mud and sand flats (Naser, 2011a). These habitats provide feeding and nursery grounds for a variety of marine organisms, including a number of valuable commercial species (Carpenter et al., 1997). There are literatures about pollution of Marmara and heavy metals in aquatic life (Bradl, 2005; Cunningham and Cunningham, 2004; Erturk and Yonsel, 2002; Oguzulgen, 1995, p.108-126; Okay *et al.*, 2011, p.55-65; Okus *et al.*, 2007, p.35-38.

II. AIMS AND OBJECTIVES

A. Determination of concentration levels of dissolved heavy metals in the selected study sites and to present a competent and practical baseline review of the concentrations of 4 heavy metals (Fe, Pb, Cd, As) in Marine, Brackish and Culture Pond waters of Nellore coast.

III. MATERIALS AND METHODS

A. Description of the Study Area

Seviour Industrialization, Shrimp farming, and adverse human activities caused several problems in the coastal belt of Nellore District. Hence major polluted areas of the coast (Krishnapatnam coast, Nelaturu coast and Pallepalem coast.) were selected for the present study. As many as 21 coal based thermal power projects were coming up close to the Krishnapatnam coast and Some has already been established. Krishnapatnam port trades Iron ore, Coal, fertilizers, edible oils, natural gas etc. Coal and iron ore may accumulate some heavy metals (Cadmium, Lead, Iron, and Manganese) in to the nearest coastal waters. Sri damodaram sanjeevaiah thermal power station is located in the Nelaturu village, near krishnapatnam within 5 km distance. Krishnapatnam port cater to the requirement of both domestic and imported coal to thermal power station. Sea water is proposed for cooling purpose, and the thermal treated water is discharged to the Nelatur coastal waters. Coolant water discharge in the adjacent coastal waters may alter the physical, chemical, and biological parameters and also increase the heavy metal loads. Thermal power stations of Nelcast, Gayatri Powertech, Genco and Reliance were located within 5 kms radius of villages in Muthukur Mandal and Krishnapatnam Port. Ash pond decant contains harmful heavy metals like B, As, Hg which have a tendency to leach out over a period of time. Due to this the ground water gets polluted and becomes unsuitable for domestic use. Due to the Ash pond of AP Genco the people of nearest villages may get affected. Because of all these reasons the nearest coastal waters and the fauna may get affected, which may also affects the coastal populations through food chains. Considering all the factors, the two near threatened areas krishnapatnam and Nelatur were become major focusing areas for the present study, and the third study area pallepalem is an estuary where fresh water mixes with Sea water, and hence it is selected for the comparision of metal contamination with higly polluted areas like Krishnapatnam and Nelaturu coast.

B. Collection of Water Samples

Three different water samples (Sea Water, Brackish water and Culture pond water) from each station were collected using 1 litre polythene cans. The samples collected were filtered with normal filter to remove any residual particulates, and then 7-8 ml of concentrated HNO3 was added to each sample at sampling station.

C. Digestion of Water Samples

1 Litre water sample was taken and the sample was filterered With Whattmann filter paper. Then the water sample was transfered into 1 Litre beaker and put on Hot Plate for evapouration at 100^{o} C after total evapouration of the sample 10 ml of 4N HNO3 is added to the precipitate of the sample and Stirr well. The Above solution was evapourated at 40^{0} C for total evapouration of the sample. Afer total evapouration the precipitate will remain at the bottom of the Beaker. The above precipitate is madeup with 1N HCL to 100 ml and was stored in plastic bottles for the analysis of Heavy metals by using Inductively Coupled Plasma Optical Emission Spectrometer (ICP- OES).

IV. RESULTS AND DISCUSSION

The concentrations of Heavy metals in waters of station 1 (krishnapatnam), station 2 (Nelatur) and station 3 (Pallepalem) of Nellore Coast were represented in Tables I, II and III. Table I and Figure1 Shows the result of Heavy Metals Lead, Cadmium, Arsenic, and Iron of different water samples of Station 1 Krishnapatnam. Arsenic is not detected in all water Medias, where Cadmium in Pond Water, sea Water, Brackish Water are 0.016, 0.013, and 0.011 mg/l respectively. Cadmium levels in all water samples of Station 1 exceeded the background levels. Lead is not detected in pond water, and the Lead concentration in Sea Water and Brackish Water are 0.004 and 0.002 mg/lit respectively. But they are below the permissible levels (0.01mg/lit). Metal concentrations of Iron in Pond Water, Sea Water, brackish Water are 4.266, 20.08, 53.43mg/lit respectively. Iron content in Station 1 is very high than the background levels. In Station 2 Heavy Metals Lead and Arsenic are not traced out in all water samples, Iron concentrations exceeded in Pond Water 1.355 mg/l Sea water 0.055mg/lit and Brackish Water 0.607 mg/l and Cadmium levels are 0.016, 0.016, 0.016 mg/l in Pond water, Sea water, brackish water respectively. Cadmium and Iron concentrations are greater than the permissible levels in station 2 i.e Nelatur (Table II and figure 2) .Table III and figure 3 represents the metal concentrations in station 3 i.e Pallepalem. Cadmium in Pond Water, 0.020 mg/l, Sea water 0.016 mg/l, Brackish Water 0.016 mg/l also Iron in Pond Water 0.128 mg/l, Sea water 0.435 mg/l and Brackish water 0.554 mg/l exceeded the permissible levels. Lead in brackish water was also reported as 0.001mg/l but it is within the normal limits.

Comparatively speaking Iron content is greater in Station 1than station 2 and 3. Cadmium concentrations are almost similar in both stations 2 and 3. Iron ore trading is the major activity of Krishnaptnam Port; hence it is evidenced in maximum concentrations in almost all the samples. Cadmium is introduced into the waters by sewage sludge, agricultural fertilizers and many industrial effluent discharges may be the reason why cadmium is reported in all the stations.

V. CONCLUSION

The results of the present study showed that the concentrations of Heavy metals Iron and Cadmium in water samples of almost all stations exceeds the permissible levels specified by regulation for water pollution control official gazette 4.9.1988. Iron and Cadmium in almost all stations were reported in Sea water, Brackish water, and culture Pond water. Iron Concentrations are maximum in Station 1 (Krishna Patnam) compared with other stations. Cadmium concentrations are higher in station 3 (PallePalem) than other stations. Arsenic and Lead are not reported in all stations. Hence it is concluded that the effect of industries is evident in the study area, As a result constant monitoring of Heavy Metals is recommended along the Nellore Coast.

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Table: I. Mean Metal concentrations of Station 1 (krishnapatnam) water samples (mg/lit)

S.NO	PARAMETER	LEAD	CADMIUM	ARSENIC	IRON
1	POND WATER	0	0.016	0	4.266
2	SEA WATER	0.004	0.013	0	20.08
3	BRACKISH WATER	0.002	0.011	0	53.43

Table: II. Mean Metal concentrations of Station 2 (Nelaturu) water samples (mg/lit)

S. NO	PARAMETER	LEAD	CADMIUM	ARSENIC	IRON
1	POND WATER	0	0.016	0	1.355
2	SEA WATER	0	0.016	0	0.055
3	BRACKISH WATER	0	0.016	0	0.607

Table: III. Mean Metal concentrations of Station 3(pallepalem) water samples (mg/lit)

S.NO	PARAMETER	LEAD	CADMIUM	ARSENIC	IRON
1	POND WATER	0	0.020	0.012	0.128
2	SEA WATER	0	0.016	0	0.435
3	BRACKISH WATER	0.001	0.016	0	0.554

Fig. 1: Comparision of Heavy Metal Concentrations of different Water Samples of Station 1 (Krishnapatnam)

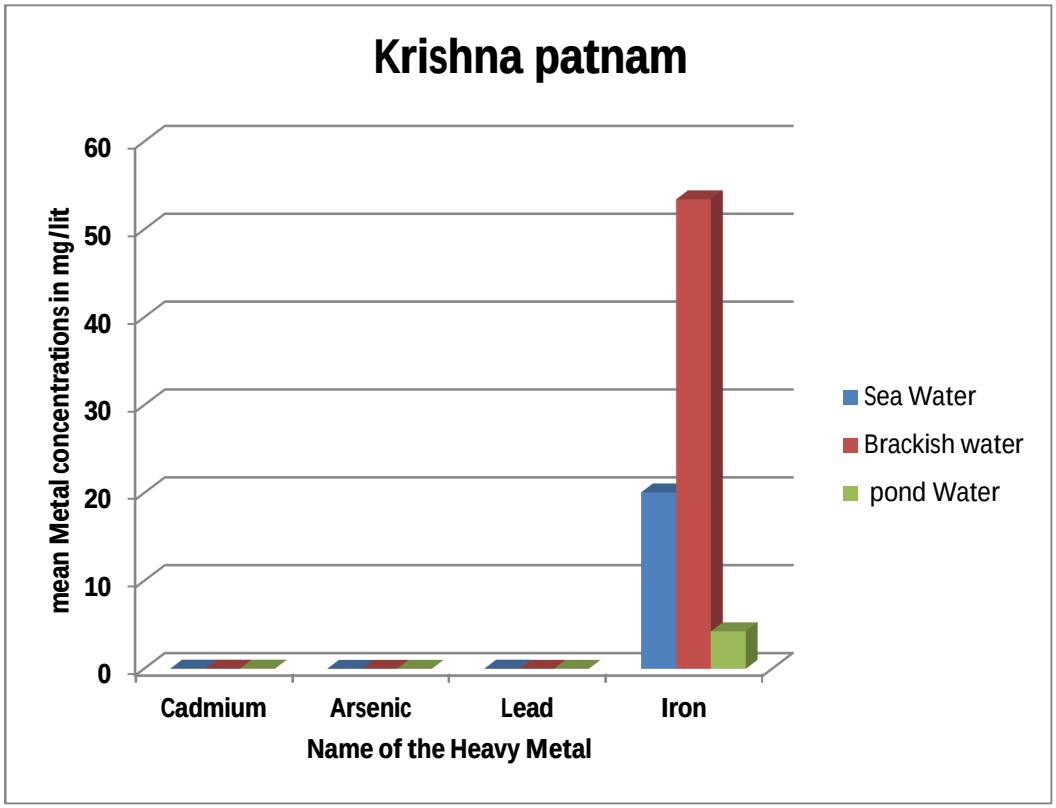


Fig. 2: Comparision of Heavy Metal Concentrations of different Water Samples of Station 2 (Nelaturu)

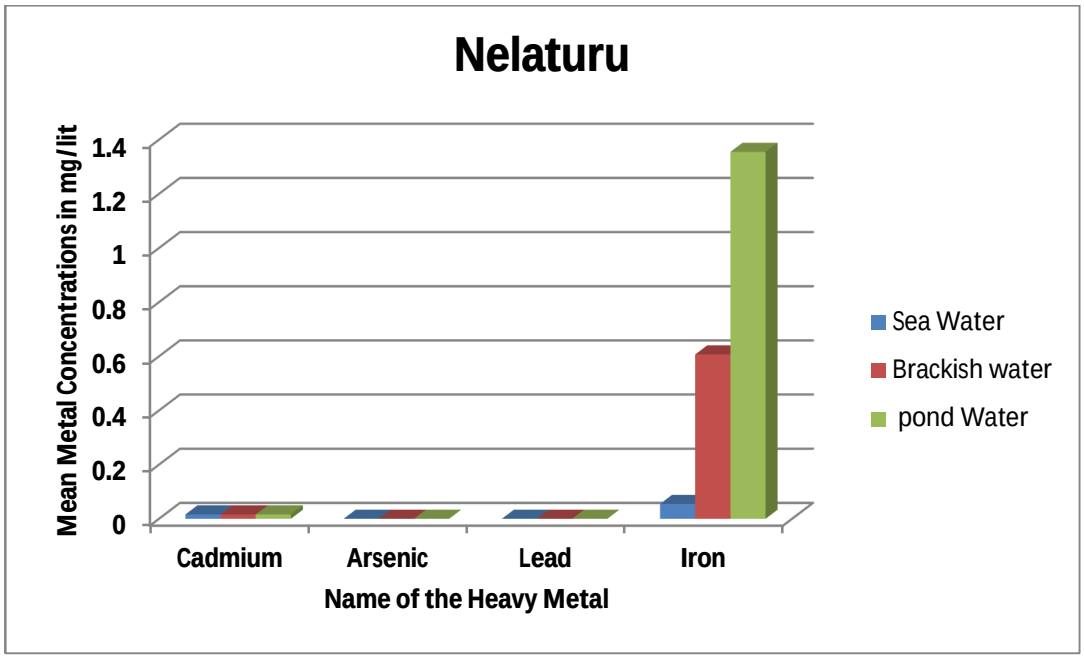
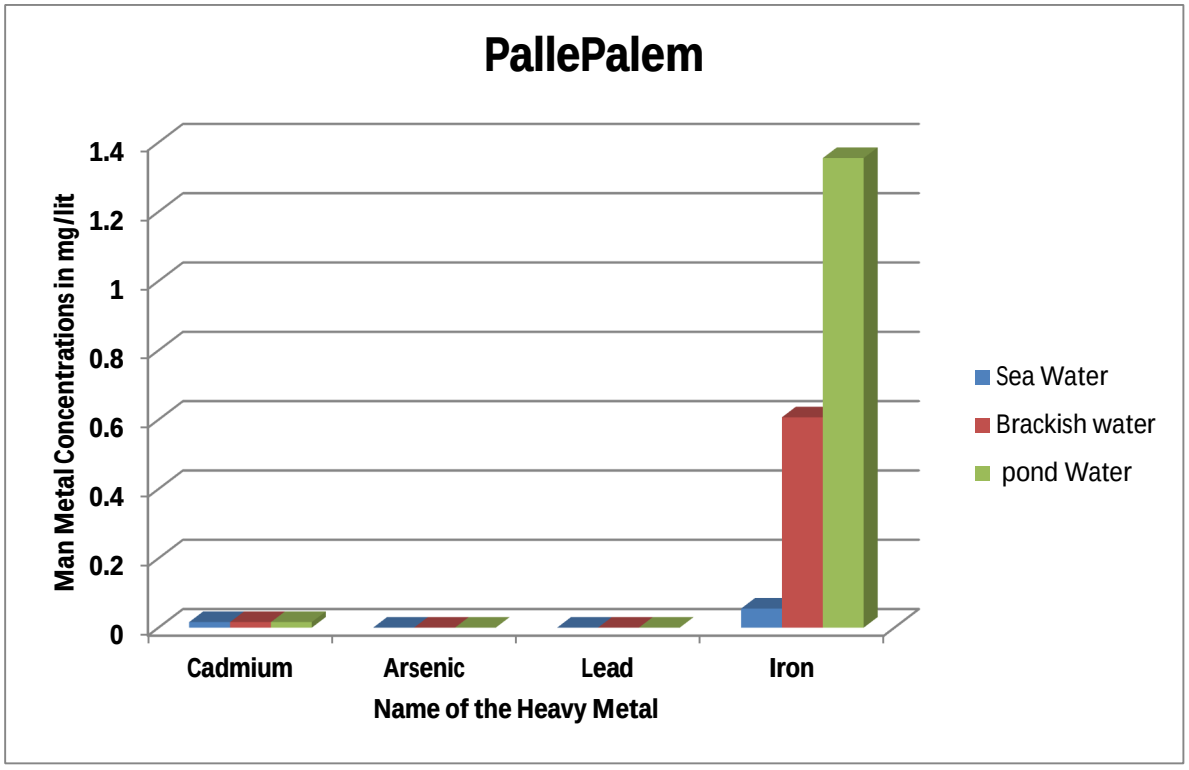
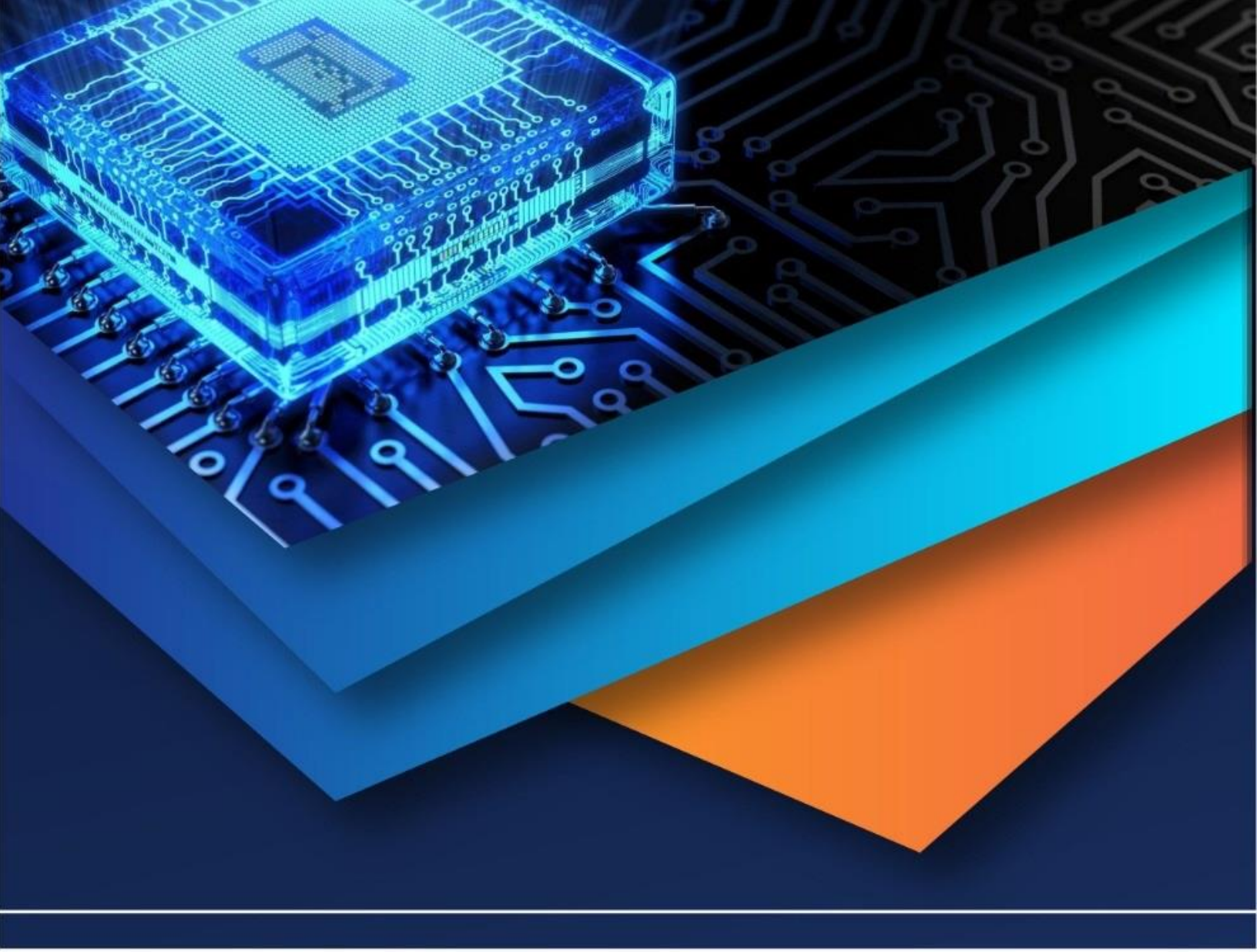


Fig. 3: Comparision of Heavy Metal Concentrations of different Water Samples of Station 3 (PallePalem)





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