



# Assessment of Heavy Metal Presence in Peddacheruvu Freshwater Tank, Vizianagaram: A Comprehensive Study

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## Authors' contributions

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

Environmental issues like globalization, urbanization, and industrialization are some of the key factors responsible for escalation in environmental pollution, causing extensive ecological damage and habitat destruction. Heavy metals are a distinct group of non-biodegradable, harmful elements that impose adverse effects on living organisms. These heavy metals when infiltrate aquatic ecosystems through various human activities, they further aggravate the overall environmental degradation. The present investigation deals with heavy metal pollution in water samples collected from Peddacheruvu, a freshwater reservoir situated in the heart of Vizianagaram city. The water body shows heightened pollution, primarily originating from the discharge of sewage and drainage throughout the entire municipality. Water samples were collected for a period of one-year from June

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2019 to May 2020, and subjected to quantitative testing at a private lab to identify the presence of heavy metals. Analysis of the compiled data revealed the presence of arsenic (As), cadmium (Cd), lead (Pb), and mercury (Hg) in the water samples, with lead (Pb) emerging as the most abundant heavy metal followed by It may be noted that, the identified heavy metal presence in this freshwater reservoir poses potential threat to both aquatic ecosystems and human health, thereby signifying the urgency to take steps for effective environmental management and remediation strategies.

*Keywords: Pollutants; heavy metals; arsenic; cadmium; lead; mercury.*

## 1. INTRODUCTION

Water pollution is serious threat to sources like rivers, lakes, oceans, and ground water which easily get polluted through various sources. Sources of water pollution are mainly two types. 1) Point sources and 2) non – point sources. Point sources pollution include industrial drain or a waste water treatment plant whereas agricultural runoff comes under non- point sources [1], both these sources carry a lot of pollutants viz. industrial effluents, sewage, detergents, organic matter, toxic heavy metals and dangerous chemicals like fertilizers, pesticides, fungicides and weedicides.

When elevated concentrations of metallic elements that are dangerous to living things contaminate the environment, especially the soil, water, and air, it is referred to as heavy metal pollution. While certain heavy metals, like iron, copper, and zinc, are necessary for biological activities in tiny levels, high concentrations of some of these metals can be harmful. These comprise among other things, elements including arsenic, cadmium, lead, and mercury. When these metals are present in high concentrations in aquatic systems, they can have harmful impacts on human health as well as the environment.

Heavy metals can build up in sediments, plants, and aquatic life once they enter aquatic habitats. The entire ecosystem may be severely impacted by this bioaccumulation. The metabolic functions and reproductive capacities of aquatic species can be disrupted by heavy metals, which can result in decreased population sizes and a decline in biodiversity. Additionally, the metals can spread through food chains and perhaps have an impact on human health if humans eat polluted seafood [2-6].

Heavy metals can have a broad, long-lasting effect on aquatic ecosystems. Once released into the environment, heavy metals can persist for

extended periods, leading to long-term ecological and health consequences. Furthermore, through river flow, heavy metal contamination can extend beyond nearby water bodies, impacting downstream ecosystems and perhaps contaminating supplies of drinking water.

Globally, initiatives are underway to lessen the pollution caused by heavy metals in aquatic habitats. These include encouraging sustainable farming methods, enforcing strict laws and best management practices in the industry, and treating urban runoff to remove heavy metal contamination.

## 2. MATERIALS AND METHODS

### 2.1 Study Area: Peddacheruvu

"Peddacheruvu" fresh water tank, which is situated in the heart of Vizianagaram, is the study area for this investigation. It covers about 136 acres. This tank gets contaminated through sewage pollution as the entire municipality was dumped into it. Water samples were collected from June 2019 to May 2020 and tested for the presence of heavy metals.

The amounts of heavy metals in water samples are estimated using a variety of techniques. The type of metal, the anticipated concentration, the properties of the water sample and the resources available all play a role in the method selection. A few popular techniques for determining the concentration of heavy metals in water:

### 2.2 Atomic Absorption Spectroscopy (AAS)

Principle: AAS calculates how much light is absorbed by unbound atoms in a gaseous condition. The amount of metal absorbed in the sample is directly correlated with its concentration.

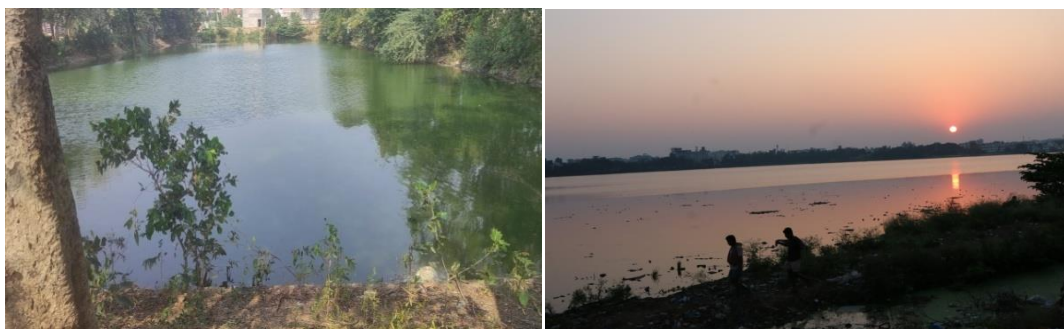
- Usage: Lead, cadmium, copper, and zinc are among the heavy metals for which AAS is frequently employed for analysis.



**Fig. 1. Peddacheruvu -Sewage Pollution**



**Fig. 2. Peddacheruvu – Domestic waste disposal**



**Fig. 3&4. Peddacheruvu located in the center of Vizianagaram city**

### **2.3 Mass Spectrometry with Inductively Coupled Plasma (ICP-MS)**

Principle: ICP-MS uses mass spectrometry with inductively coupled plasma (ICP) to determine the concentration of various elements according to their mass-to-charge ratios.

Application: The extremely sensitive ICP-MS method can analyze several heavy metals in water samples at once.

### **2.4 Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES)**

Principle: ICP-OES, like ICP-MS, measures the concentrations by atomizing and exciting elements using inductively coupled plasma. The light that is released is then measured.

- Application: A variety of metals can be analyzed in water samples using ICP-OES.

In the present investigation ICP-OES technique was used to test water samples for the detection of heavy metals [1,7-14].

## **3. RESULTS AND DISCUSSION**

The analysis of water samples indicated the presence of heavy metals like arsenic, cadmium, lead and mercury. Of the four metals, lead found to be in higher concentration when compared to other metals. The concentration of lead was followed by Arsenic, Cadmium and Mercury. Month wise analysis of the data indicated higher concentration during monsoon and winter months when compared to summer months.

**Table 1. Concentration of heavy metals in Peddacheruvu water samples recorded during the present study**

Heavy metal	Month/ Year												Standard Readings
	June 2019	July 2019	Aug 2019	Sept 2019	Oct 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	Mar 2020	Apr 2020	May 2020	
Lead (Pb)	0.0141 mg/l	0.02 mg/l	0.015 mg/l	0.016 mg/l	0.023 mg/l	0.017 mg/l	0.014 mg/l	0.021 mg/l	0.014 mg/l	0.015 mg/l	0.025 mg/l	0.017 mg/l	<0.01
Arsenic (As)	0.01 mg/l	0.01 mg/l	0.009 mg/l	0.01 mg/l	0.01 mg/l	0.01 mg/l	0.01 mg/l	0.008 mg/l	0.01 mg/l	0.009 mg/l	0.01 mg/l	0.01 mg/l	<0.05
Cadmium (Cd)	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	<0.003
Mercury(Hg)	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	0.001 mg/l	<0.001

The following information is collected from the literature -

### 3.1 Adverse Effects of Lead on Fish Health

Lead is a toxic heavy metal that can have detrimental effects on fish health when present in aquatic environments. The adverse effects of lead on fish include:

Bioaccumulation:

- Fish can absorb lead through their gills, skin, and digestive tract. Once absorbed, lead tends to accumulate in various tissues, particularly in the liver and kidneys. Over time, this bioaccumulation can result in high concentrations of lead in the fish's body [15,16].

Impaired Growth and Development:

- Lead exposure can hinder the growth and development of fish. It may affect the fish's ability to reach maturity, reproduce, and contribute to the overall population [17].

Behavioral Changes:

- Lead toxicity can lead to alterations in fish behavior. Fish may exhibit changes in swimming patterns, feeding habits, and overall activity levels. These behavioral changes can impact the fish's ability to survive and thrive in their environment.

Reproductive Impacts:

- Lead exposure can interfere with fish reproduction. It may lead to reduced egg production, lower fertilization rates, and abnormal development of embryos. This can have long-term implications for fish populations [18].

Hematological and Physiological Effects:

- Lead can affect the blood and physiological functions of fish. It may cause anemia, disrupt the synthesis of hemoglobin, and interfere with the transport of oxygen, leading to physiological stress [19,20].

Disruption of Enzyme Systems:

- Lead toxicity can interfere with various enzyme systems in fish, disrupting

essential metabolic processes. This interference can affect the fish's ability to carry out functions critical for survival [21].

Neurological Damage:

- Lead is known to have neurotoxic effects. In fish, exposure to lead can lead to damage to the central nervous system, affecting sensory perception, coordination, and responsiveness to environmental stimuli [22].

Immunotoxicity:

- Lead exposure can compromise the immune system of fish, making them more susceptible to diseases and infections. Weakened immune responses can lead to increased mortality rates and decreased overall fish health [23].

10. Impact on Aquatic Ecosystems:

- The adverse effects of lead on fish extend beyond individual organisms. As a top predator in aquatic ecosystems, fish play a crucial role in maintaining ecological balance. Lead toxicity in fish can disrupt food webs and have cascading effects on other aquatic organisms [24,25,15,17] [26-29].

## 4. CONCLUSION

Assessment of heavy metal presence in water samples were analyzed and it could be concluded that the lead concentration was identified more in monsoon and winter months but highest concentration was recorded in the month of April. All things considered, water pollution is a severe problem that needs to be addressed and resolved by businesses, governments, and individuals in order to safeguard our water supplies and guarantee a safe and healthy environment for everybody. Efforts to mitigate the impact of lead on fish health involve controlling and regulating sources of lead pollution in aquatic environments, implementing water quality management practices, and conducting regular monitoring to assess lead levels in water bodies. Additionally, the restoration of contaminated habitats and the development of strategies to reduce lead exposure are important for the conservation of fish populations and overall ecosystem health.

It should be important to do proper treatment of the effluents from various sources, before releasing into the aquatic ecosystems to diminish the damage of the living organisms. So, it is important to establish, proper treatment systems in the industries before discharging into the surroundings, to prevent damage to the aquatic flora and fauna.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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