

## REVIEWER'S REPORT

Manuscript No.: IJAR-54590

**Title:** Evaluation of trace metal element levels in water, sediment and two fish species (*Clarias gariepinus* and *Oreochromis niloticus*) in ten fish farms in the Moungo Department, Littoral region, Cameroon

**Recommendation:**

Accept as it is

| Rating         | Excel. | Good | Fair | Poor |
|----------------|--------|------|------|------|
| Originality    |        | √    |      |      |
| Techn. Quality |        |      | √    |      |
| Clarity        |        | √    |      |      |
| Significance   |        | √    |      |      |

Reviewer Name: Dr. Manju M

Date: 31-10-2025

## Detailed Reviewer's Report

### 1. Study Objective

The study aimed to evaluate trace metal element (TME) contamination in water, sediment, and fish from ten integrated agro-fish farms in the Moungo Department, Littoral Region, Cameroon. It sought to determine contamination levels, spatial variability, metal transfer pathways, and potential health and ecological risks.

### 2. Study Area Description

Conducted across ten geo-referenced aquaculture farms located within a major agricultural-aquaculture hub. The region's hydrology, farming intensity, and soil geochemistry contribute to potential metal exposure from both natural and anthropogenic sources.

### 3. Sampling Design and Period

Sampling occurred between July 22–27, 2025, during the great rainy season—a period maximizing runoff and pollutant mobility. Each farm was sampled once, ensuring uniformity in temporal coverage under peak hydrological conditions.

### 4. Sample Matrices and Target Species

Three matrices were analyzed:

- Water: surface layer (30 cm depth)
- Sediment: top 0–5 cm, composite from 5 pond sites

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- Fish: *Oreochromis niloticus* and *Clarias gariepinus* These species represent the most common and economically important fish in Cameroonian aquaculture.

### 5. Sampling and Preservation Procedures

- Water: Collected in acid-rinsed polyethylene bottles ( $\text{HNO}_3$ ), stored at 4 °C.
  - Sediment: Homogenized to 500 g per pond; oven-dried at 40–60 °C.
  - Fish: Five individuals per farm, filleted, oven-dried (60 °C), and homogenized to fine powder.
- All procedures followed contamination-free protocols to ensure analytical accuracy.

### 6. Geospatial and Environmental Mapping

Each farm's coordinates were determined via GPS, ensuring spatial representativeness across river-fed and groundwater-fed systems. Maps were produced to visualize potential contamination gradients and anthropogenic influence zones.

### 7. Analytical Instrumentation

Metal analysis used an Energy Dispersive X-ray Fluorescence (EDXRF) Spectrometer-SHIMADZU EDX-7000, providing non-destructive, multi-element detection. The method allowed for simultaneous quantification of major, trace, and toxic metals in all matrices.

### 8. Elements Analyzed

- Macroelements: P, K, S, Ca
- Essential Trace Metals: Fe, Cu, Zn, Mn, Cr
- Toxic Heavy Metals: Pb, Cd, Hg, As

Detection limits:

- Solids: 0.5 mg/kg (Fe, Cu, Pb, Cd, As)
- Water: 0.05 mg/L (Fe, Cu, Zn)
- Hg detection qualitative only (~5 mg/kg d.w.) due to instrument sensitivity.

### 9. Data Analysis and Statistics

Data processed as Mean  $\pm$  SD using GraphPad Prism v8.03. Statistical comparisons made with one-way ANOVA and Duncan's post-hoc test ( $p < 0.05$ ) to identify significant differences across sites and species.

### 10. Metal Concentrations in Water

- Fe: 20.94–65.94 mg/L (max at F3, F9)
- Cu: 30.83–34.72 mg/L (relatively uniform) Both exceeded WHO guidelines (Fe = 0.3 mg/L; Cu = 2 mg/L), reflecting both geogenic inputs and anthropogenic activities (feed, fertilizers, metal corrosion).

### 11. Sediment Metal Distribution

- Fe and Si dominated, indicating mineralogical control.

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- Ca peaked at F10; Mn, Zn, Cu were lower but spatially variable. Sediments served as metal sinks, indicating long-term accumulation of TMEs from surrounding activities.

### 12. Metal Composition in Fish

- Fe: 27–91 mg/kg (high in F6, F8, F9)
- Cu: 30–46 mg/kg (high in F1)
- K: up to 20,255 mg/kg (F8) Most essential metals occurred at nutritionally relevant concentrations, while Pb, Cd, Hg were mostly below detection.

### 13. Bioaccumulation Behavior

- Fe BAF: 0.7–3.6 (notably high at F6, F8)
- Cu BAF: 1.0–1.4 (biologically regulated)
- Ca BAF: up to 5.7 (F3) Element-specific accumulation patterns were observed, influenced by water-sediment chemistry and fish physiology.

### 14. Species and Environmental Influence

*Clarias gariepinus* (bottom-feeder) and *Oreochromis niloticus* (omnivorous) exhibited distinct uptake profiles due to feeding ecology and habitat. Spatial variations reflected local geochemistry, feed composition, and farming intensity.

### 15. Environmental and Health Implications

- Water Fe and Cu pose risks to fish health (oxidative stress, gill damage).
- Sediments function as pollutant reservoirs, slowly releasing metals back into water.
- Fish tissue metals remain mostly within international safety limits-though borderline Cu levels warrant monitoring. Recommendations:
- Continuous monitoring of water and sediment quality.
- Use of low-contaminant feed and better waste management.
- Enhanced analytical sensitivity for Hg and Cd in future work.
- Establishment of national thresholds for aquaculture metal contamination.

### 16. Overall Conclusion

This study provides the **first integrated dataset** of TME contamination in agro-fish farms of the Moungo Department. Findings reveal significant **spatial heterogeneity** in metal levels and confirm **Fe and Cu** as the dominant contaminants from mixed sources. While fish remain largely safe for consumption, proactive **environmental monitoring** and **management interventions** are crucial for sustainable aquaculture and food safety assurance.