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Development of a Low-Cost IoT Sensor Network for Real-Time Environmental Diagnostics in Burkina Faso's Artisanal Mining Sector

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ABSTRACT

Background: Artisanal and small-scale mining (ASM) in West Africa poses significant environmental risks, including water contamination and soil degradation. Current monitoring solutions are often prohibitively expensive and technically complex for widespread deployment in remote regions, leading to a critical data gap.

Purpose and objectives: This study aimed to design, fabricate, and field-test a novel, low-cost Internet of Things (IoT) sensor network for real-time, in-situ monitoring of key environmental parameters at ASM sites.

Keywords: *Artisanal and small-scale mining, Internet of Things, environmental monitoring, sensor network, West Africa, low-cost technology*

Article Highlights

- Modular sensor node measures turbidity, pH, and particulate matter using locally available components.
- LoRaWAN gateway enables reliable long-range data transmission to a custom dashboard.
- Particulate matter downstream from crushing exceeded upstream baselines by 8–12 times during operations.
- Linear mixed-effects model accounted for site-specific random effects in environmental data analysis.

Field Validation

The network was deployed and tested over an extended period at three active artisanal mining sites in Burkina Faso, demonstrating robustness in challenging operational environments.

This study demonstrates a practical, scalable model for bridging the environmental data gap in artisanal mining regions.