



Abstract

AIoT and Open Data for Environmental Justice: Smart Public Lighting as a Platform for Resilient and Sustainable Communities in Open-Pit Mining Regions [†]

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The environmental and social impacts of open-pit mining in Colombia's Caribbean region have underscored the urgency of adopting inclusive and innovative solutions for environmental risk management. The Hub Ambiental del Caribe presents an interdisciplinary strategy leveraging AIoT (Artificial Intelligence of Things) embedded in smart public lighting to transform conventional infrastructure into real-time environmental monitoring platforms that promote data openness and participatory governance.

The AIoT network comprises 90 environmental sensing nodes, strategically deployed in three mining-affected municipalities—Algarrobo (Magdalena), La Jagua de Ibirico (Cesar), and Albania (La Guajira)—with 30 AIoT nodes per municipality. These nodes capture high-frequency data on air quality (PM_{2.5}, PM₁₀), CO₂ levels, temperature, humidity, and precipitation. Data are transmitted to a centralized system and made accessible through a public digital platform with a web portal and an interactive geovisor, available at <https://hubambientaldelcaribe.co> (accessed on 20 November 2025).

In terms of community engagement, the project has reached over 1500 participants, including rural residents, youth leaders, and school communities. A key pillar of the engagement strategy is the Escuela de Ciencia Ciudadana (Citizen Science School), where technical concepts are translated into multimedia educational materials. These tools empower citizens to interpret environmental data and advocate for evidence-based decisions in their communities.

To evaluate the platform's early impact, we have tracked increased participation in local environmental councils and documented community-led alerts in response to critical air quality events. Additionally, participatory workshops have produced localized environmental maps, integrating both sensor data and community-sourced narratives. This hybrid knowledge system enhances resilience planning and fosters climate literacy at the grassroots level.

The innovation of the Hub Ambiental del Caribe lies not only in deploying AIoT and open data technologies but in repurposing public lighting poles as nodes of digital and environmental inclusion. This model offers a scalable and low-barrier solution for territories under extractive pressure, demonstrating how infrastructure can evolve into a catalyst for climate equity and technological justice.



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By merging environmental sensing, civic participation, and open data, the project advances SDG 11 (Sustainable Cities and Communities), positioning communities as co-creators in the environmental governance of their territories.

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