



WEHUBIT

Country
Uganda



Implemented by



Budget
342.000 €

Duration
04/2021 - 03/2023

Contributions to SDGs



Implemented by



Financed by



Learning from *the AirQo project: Scaling up a participatory and citizen-driven air pollution sensing and analysis system for urban resilience in Uganda*

Can digital social innovation strengthen the resilience of cities for sustainable and inclusive urban development, how and in which context?

PROJECT OVERVIEW

Reason

According to published evidence* from ground monitoring, **air pollution in Kampala capital city** is up to 11 times the WHO Health guidelines, also comparable to other major cities in the global south.

Urban dwellers in informal settlements are most affected by environmental health risks because they have limited options for mobility, housing, domestic energy sources and tend to be concentrated in nearby industries to access employment opportunities.

Yet, Kampala city and other urban environments in Uganda have no **systematic monitoring of environmental exposures**, leading to a **scarcity of air quality data**, both in quantity and quality. Traditional urban sensing systems tend to be expensive, complex to setup and unsuitable for the African urban contexts.

As a result, there is limited **public awareness** about the impact of pollution on health and it is difficult for citizens to engage and demand for action from duty bearers. On the other side, duty bearers and the government lack **accurate data and evidence**.

Direct and hyperlocal access to air quality information for urban dwellers and duty bearers in Kampala city is crucial to allow them to **take actions** that lead to improvement of air quality in their communities.

The AirQo digital air quality platform leverages locally built low-cost technologies and artificial intelligence approaches, to close the gaps in air quality information access and allow for active citizen engagement in air urban environmental issues.

**(characterisation of pollution in Ugandan urban areas, pollution variations during COVID-19 Lockdown, machine learning and locally developed PM sensors in Uganda)*

Digital Social Innovation

AirQo's objective is to **improve access to hyperlocal, real time, relevant and actionable air quality** information for citizens and duty bearers in Ugandan cities.

To reach this objective, AirQo has established

- **A high-resolution network of optimally deployed low-cost air quality monitoring** devices in Kampala, Fort Portal, Gulu, Jinja, Kabale, and Kira.

The project team manufactures **solar-powered air monitors** in its lab within the Makerere University – Kampala. In cities, it identifies diverse locations that best characterise the **ambient air pollution** (markets, main roads, garages, botanical gardens, etc.) and engages with the relevant **local authorities and community members** to understand their data needs and receive their insights.

- The AirQo digital air quality platform available on smartphones (download from Google Play Store and App Store) and web platform.
- Each air quality monitoring device is connected to the custom platform and streams real-time open air quality **data for storage**, further **analysis, fusion** and presentation into the **desired formats**.
- **Machine learning models**.

In the framework of the project, machine learning is used for:

- 1. Spatial temporal predictions:** forecast what the air quality will be in the next 24 hours in order to inform individual decisions to minimise exposure. The forecasts are available for all active monitoring sites on the AirQo network but machine learning is also used to predict/estimate what the air quality levels are in locations around the cities, without air quality monitors at specific times. These predictions are used to generate heatmaps that help authorities understand the spatial temporal variations across the city.
- 2. Sensor data calibration to improve data accuracy:** machine learning models have been used to calibrate data from low-cost air quality monitors to improve their accuracy, reliability and to ensure that their readings are as close as possible to the international reference standards.

In parallel to its very concrete digital innovation, AirQo has also supported the development of the **air quality community of champions** comprising: public actors, civil society organisations, community leaders, academic researchers and citizens **working towards the same objective and reinforcing each other**.

Activities include **engagement with relevant public institutions**, at national and municipal level; and **awareness activities for citizens**, in line with **local interests**, focusing on the tool and encouraging citizens to download the app.



From the perspective of the human rights-based approach (HRBA)

AirQo give **rights holders** – the citizens of several cities in Uganda, including leaders, researchers...- and duty bearers – public authorities of several cities in Uganda, including Kampala - access to relevant, timely, user-friendly data.

On the one hand, AirQo has empowered citizens to **read these data and to act based on these data**. On the other hand, it has given public authorities a **tool to analyse existing problems and implement more effective and inclusive services**.

In addition, AirQo has facilitated the **development of a network** where stakeholders collaborate and coordinate, despite their different identities and interests, towards the same objectives : air quality.

Over **150 air quality monitors** deployed in 5 cities between 2019 and 2023 had primarily been planned at the beginning of the project.

Collaboration with air quality communities and duty bearers in **8 other african cities**: Nairobi, Kisumu, Lagos, Bujumbura, Yaoundé, Dakar, Manhica, Accra.





“

We are responsible for our own actions, if we want to live in a clean and safe environment we must take action.

”

Amina, mother and environmental officer in Jinja City

“

The theme is well suited for the times we are in. It is important to me because innovation and technology have become critical to our societies and they are helping us devise mechanisms for solving societal challenges.

”

Christine Atuhaire: researcher using AirQo data to advance air quality



“

I used to stay next to a dusty road, after noticing that my child was not getting better even after frequent hospital visits, we moved to a greener environment and a few months in my child stopped coughing and we have since stopped the hospital visits. **Michael share:** “I am now an air quality advocate.

”

Michael Wanyama, a father and an air quality champion





“

As a City, we depend on data to make decisions, I am glad that AirQo has given us access to air quality data to enable us to make decisions in our city.

”

Albert Ahabwer Fort Portal City Speaker

“

I believe in the transformative power of computational technology and intelligence to tackle complex society challenges and improve people's lives.

”

Engineer Bainomugisha, AirQo coordinator

KEY MESSAGES

- ▶ AirQo has provided all relevant stakeholders (duty bearers and rights holders) with **quality, easily available and readable data on air quality**. The availability of data has led to two broad outcomes: **political decision-making** and **public awareness** leading to actions.
- ▶ The availability of data and the many functionalities of the platform (including looking for specific dates and time, friendly visualisation, and extract) have helped decision makers to show evidence of the **impact of their actions**.
- ▶ The AirQo project is an **important trigger for diverse** (different levels of actors) and **multiple** actions (different types of actions) towards air quality. The AirQo team has used data to advocate for air quality actions at all levels, which has unlocked a **snowball effect**. Many actors have used AirQo data to advocate or take actions linked to their specific interests and realities, without the direct support of the project.



With concrete and very precisely located data, political leaders could not ignore the **severity of the issue** and, on the other hand, had the evidence needed to start taking relevant and impactful actions.

Actions at political level include:

- ◆ Kampala Capital City Authority (KCCA) has developed the Kampala City clean air **action plan**, which guides KCCA in improving air quality.
- ◆ Fort Portal has made mandatory for roads buildings companies with whom they partner to include a **specific clause** on air pollution mitigation.
- ◆ Jinja City public health department included a **budget line** for air quality improvement activities in the approved budget for Financial Year 2022/2023.
- ◆ The Ministry of Finance of Uganda has included air quality in its **analysis of poverty factors** and use it to advocate for the inclusion of air quality improvement in the national and the regional budgets.
- ◆ The National Environment Management Authority (NEMA) of Uganda developed a series of regulations on air quality and played an important role in **the harmonisation of regional standards**. It uses AirQo data in the air quality chapter of the **National State of Environment Report**, which leads the planning of cities
- ◆ The ministry of works and transport used the air quality data and insights from the **targeted engagement with auto-mechanics to inform the garage regulations for the transport sector**.

Kampala Capital City Authority (KCCA) and municipalities have taken up their role and raised **awareness to influence community members** to take local action, using health as the strongest argument. **Community Health Volunteers, community leaders and young environmentalists** have played an important role as **ambassadors**.

Ambassadors and communities' actions include for example,

- ◆ Since 2020, community leaders from Jinja have used the data to identify time and location of high **peaks of air pollution linked to garbage burning**. They were able to improve solid waste management, and to target awareness to specific place/communities/issues. For example, organise extra waste collection when the market is closing and raise awareness among vendors.
- ◆ Mechanics from Makindye division convened through **auto-safety** continue to use the data to raise **awareness among their clients and partners on vehicle emissions** reduction through better maintenance.





AirQo data have also been used by education institutions and researchers within their classes and studies.

For example,

Environmental health students of Mountains of the Moon University (Fort Portal) are now using AirQo data to learn about **air quality monitoring**.

Doctors and Health teachers of the Kabale University are using AirQo **data to analyse the correlation between air pollution and health issues**.

Postgraduates' students in Kampala and beyond are investigating, among others, the **different drivers of air pollution**. This kind of research could **trigger other research, taking further the scientific, locally focused, ground regarding air quality**.

LESSONS LEARNED

Inclusion and equity

For its air quality monitors, AirQo chose **representative sites that capture the variations of the physical environment**, such as population distribution (e.g. high population density vs low population density; commercial vs residential areas), land use, upscale vs informal settlements.

AirQo adheres to **local and regional regulatory frameworks** such as the **Data protection and privacy** act of Uganda. In terms of concrete implementation for example, to preserve the privacy of individuals and institutions hosting the monitoring devices and potential misuse of devices, actual coordinates where the air quality monitor is installed are remotely adjusted so that the monitoring area is known **without revealing the exact location of the monitor**.

Stakeholders and users' responsiveness

AirQo developed a **baseline of understanding** of what different stakeholders (community leaders, public servants, environmentalists...) know about air quality - its causes, consequences – as well as **opportunities and needs** before organising awareness sessions.

AirQo engaged with community leaders living close to deployed devices to **better understand the local issues** (for example, explaining pollution pikes).

AirQo has also **animated or supported awareness activities directly for citizens, in line with local interests**, focusing on the impact of air quality and encouraging citizens to download the app.



Use of digital tools beyond project's end

From the start, AirQo has **identified mutual interests with public institutions**. It has built a strong collaboration and communication flows with key institutions such as Kampala Capital City Authority (KCCA) and The National Environment Management Authority (NEMA) of Uganda, which sees it as a **key partner**. These authorities are using **AirQo data as the main source of air quality information**.

At municipal level, AirQo chose the cities where to install monitors based on **the willingness of leaders and other key stakeholders to engage with the project** and the air quality issue. AirQo actions (devices setting and monitoring, and awareness) are in line with the cities' priorities and are integrated into bigger ambitions.

Perspectives

AirQo will, on the one side, deepen its actions in Uganda : **collaborating further with public institutions and local governments** to take air quality into account, raising evidence-informed awareness within communities, installing monitors in new places and cities. On the other side, further expand its **geographic scaling up in other African cities**. To do that, AirQo can count on the results of this project and the mobilisation of diverse actors converging towards the same objective.

Depending on the needs of the local community, **additional open data** such as weather, traffic, land use, population density... will be obtained and integrated into the platform.

AirQo will continue to develop and share with **communities of practice in Africa** to **build local capacity** for Africa-led efforts to tackle **environmental health challenges** from air pollution.

AirQo will create **robust tech-driven** air quality data collection, modelling, processing, and analysis solutions.

AirQo is actively exploring **commercial partnerships for mass production of the AirQo monitors** to meet the ever growing demand for new air quality monitoring networks in African cities. However, AirQo will continue to build its capacity for research and development to refine the monitoring technology at Makerere University, over the long-term.

This learning sheet has been developed in the framework of the Wehubit Knowledge Exchange Network

With the support of Management for Development Foundation and AirQo team

And the support of [Canopée Studio](#)

June 2023

