

Report from the Workshop on Air Pollution and Health in East Africa

Held in Nairobi, Kenya, March 29–31, 2023

Jointly organized by:



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I. About the workshop

Countries in East Africa experience high levels of air pollution as well as significant health impacts from both outdoor and household air pollution. As such, targeted interventions could play an important role in improving air quality and alleviating the associated public health impacts. As public and governmental interest in the topic is growing, there is also a greater demand for data and evidence on air pollution levels and trends as well as health effects.

A 2.5- day workshop was hosted in Nairobi, Kenya between March 29 and 31, 2023 on the topic of air pollution and health in East Africa. The workshop brought together more than 50 experts working on air pollution and health from across Kenya, Uganda, Ethiopia, South Africa, India, USA and UK (see *Appendix II for workshop participant list*). Participants included researchers, healthcare practitioners, professional societies, national and regional non-profit groups, bi- and multi-lateral organizations, federal and local government agencies, ministries, and research institutes.



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Discussions on the first two days were structured to facilitate dialogue among researchers to outline potential near- and long-term opportunities for policy-relevant research studies on the health effects of air pollution across East Africa. On the third day, a short training on health impact assessment (HIA) was conducted including an overview of the principles of HIA, an introduction to the key concepts related to the types of data required for an assessment, and a summary on how to conduct such studies and interpret results using case studies from Kenya and Ethiopia.

This workshop was organized jointly by the Health Effects Institute (USA) in partnership with the [Stockholm Environment Institute–Africa Centre \(SEI Africa\)](#), [World Resources Institute \(WRI Africa\)](#), [Eastern Africa GEO Health Hub](#) (Kenya) and [AirQo](#). The workshop planning committee included:

- Dr. Kiros Berhane, Columbia University, USA
- Dr. Eloise Marais, University College London, UK
- Dr. Caradee Wright, South African Medical Research Institute, South Africa
- Dr. Lynn Atuyambe, Makerere University, Uganda
- Mr. Gideon Lubisia, AirQo–Makerere University, Uganda
- Mr. Victor Nthusi, Health Effects Institute, USA
- Dr. Pallavi Pant, Health Effects Institute, USA

The workshop was supported by the [Clean Air Fund](#). Workshop agenda, slides, and recordings are available on the HEI [website](#).

2. Goals of the workshop

- To review the status of current data and evidence on air quality and associated health effects in the region and their interlinkage to current policy debate and actions.
- To discuss concrete strategies for collaboration and strengthening technical expertise on air pollution and health in East Africa.

3. Summary of discussions

The workshop participants were first provided with an overview of the current landscape on air quality and health in East Africa, including local evidence on air pollution and its health effects on Day 1, followed by focused discussions on advancing the science–policy interface for air quality management on Day 2 (see *Appendix I for Workshop Agenda*). Through a series of structured discussions, the group identified top priorities and opportunities for:

- Strengthening evidence on exposure to air pollution and related health outcomes as well as opportunities to leverage such data for clean air action.
- Collaboration and strengthening technical expertise on air pollution and health in East Africa.

Mr. Victor Nthusi (Health Effects Institute, USA) kicked off the workshop on March 29 and provided an overview of the objectives; he encouraged workshop participants to think creatively and to identify opportunities to study health effects of air pollution in East Africa. In his opening remarks, **Dr. Philip Osano** (SEI Africa, Kenya) highlighted three issues: (a) to promote clean air action, it is important to bridge the gap between air quality and health research and healthcare practitioners in Africa; (b) in making the case for action we'll need to quantify the economic costs of air pollution and implications for development plans such as Africa's Agenda 2063; and (c) strengthening partnerships will be key to accelerating mitigation action. **Mr. Maurice Kavai** (Nairobi City County Government, Kenya) welcomed workshop participants to the city of Nairobi and noted the progress made by the County Government on air quality monitoring and in development of city-level air quality legislation. He emphasized the multi-stakeholder approach to air quality management that the city has embraced and called for strengthened collaboration between the environment and health sectors in addressing air pollution.

Dr. Nicholas Oguge (University of Nairobi, Kenya) opened the keynote talks on “*Health effects of air pollution: context, evidence and policy applications*” by highlighting that local studies can demonstrate the impact of air pollution on respiratory and other relevant diseases. **Dr. Caradee Wright** (South African Medical Research Council, South Africa) and **Mr. Robert O’Keefe** (Health Effects Institute, USA) provided a broad context on air pollution and health in Africa and the role of impartial science in effective air quality policymaking, respectively. Whereas Dr. Wright emphasized the importance of local data, Mr. O’Keefe noted that researchers should not disregard general scientific knowledge and guidelines provided by global organizations such as the World Health Organization (WHO). Long-term commitment, evidence-based standards, source identification, and continuous monitoring are all necessary for successful air quality management. Workshop participants noted the importance of public health education in raising awareness on air pollution in the context of competing priorities, such as economic growth, infrastructure development, and food security.

Dr. Eloise Marais (University College London, UK) and **Dr. Kiros Berhane** (Columbia University, USA) opened the first session, *Air Quality in East Africa*, by highlighting the importance of research in informing policy decisions and proceeded to welcome speakers for the session.

The session included various talks:

- Drawing from the [State of Global Air Initiative \(SoGA\)](#), **Mr. Victor Nthusi** presented an overview of the state of air quality and health impacts in East Africa. He emphasized that air pollution is a significant health, environmental, and economic problem, and that household air pollution is a major contributor to the burden of disease in Africa. While highlighting the limitations of both the exposure and burden estimates, he encouraged collaboration between researchers to improve these estimates through increased ground-based monitoring and improved health data collection. He concluded by inviting participants' feedback on a new [interactive literature database](#) of published evidence on air pollution and health in East Africa.
- **Dr. George Mwaniki** (World Resources Institute Africa, Kenya) emphasized the importance of a shared understanding of air pollution sources and impacts in order to bridge the interest gap among stakeholders (e.g., decision makers and the community). He urged for stronger community engagement and open communication to foster trust and transparency in research efforts. Noting the limited funding available in Africa for air quality management, he concluded by describing the air pollution crisis as an investment gap.
- **Mr. Deo Okure** (AirQo – Makerere University, Uganda) gave an overview of AirQo's deployment of low-cost sensor networks for measurement of air quality in African cities. He highlighted the need for technical and financial capacity to sustain monitoring efforts — for instance, through partnerships with technology companies, which could help in data management, data analysis, and access to researchers and the public through simplified visualizations and mobile apps. In terms of action, Mr. Okure emphasized the need for capacity building, awareness, and community engagement to effectively address air pollution.
- **Dr. Rebecca Garland** (University of Pretoria, South Africa) shared experiences from South Africa on the use of integrated methods for air quality assessment. Despite having regulatory ambient monitoring stations, she mentioned that data scarcity is a challenge, and she drew from experiences in using emissions inventories and reduced complexity models to fill this gap and improve characterization of air pollution sources and impacts. She noted that this type of work is highly collaborative, helping to address capacity constraints, and that the most successful projects are those where the leads are local.

In summary, Dr. Marais noted that synergistic collaborations crossing sectoral divides, in particular academia and policy, are key to effective action and that action needs to be viable and cost-effective in order to meet set guidelines and standards.



Photo Credit: © [Paul Kaberere](#)

The second half of Day 1 focused on smaller group discussions on the importance of good, high quality scientific research and the advantages of working in interdisciplinary collaborative projects on air pollution and health. **Dr. Jon Samet** (Colorado School of Public Health, USA) moderated the larger group discussions, linking talks from previous sessions with the most important health-related questions in the region. The goal for large group discussion was to introduce participants to the breadth of situations where health-related questions come up in relation to air pollution, whereas small group discussions explored priorities in this context — what is already available, what can be done to

further strengthen work on air pollution, and what it might take.

Day 2 focused on advancing the science–policy dialogue for air quality management. **Dr. Alice Kaudia** (Climate and Clean Air Coalition, Kenya) opened with a keynote address on the nexus between air pollution, energy, and development. Drawing from personal experience and her work in Kenya and across Africa, she acknowledged that technological advancements and innovations are enabling transition to clean renewable energy and energy efficiency and that these are backed by global and regional commitments on research, policy, and action. She urged workshop participants to align their research with regional and national development priorities, which in turn provides a foundational accountability framework that is resilient over time despite changes in political leadership and governing philosophies.



Photo Credit: © Paul Kaberere

Dr. Andriannah Mbandi (UN Climate Change High-Level Champions, Kenya) and **Mr. Gerphas Opondo** (Environmental Compliance Institute, Kenya) opened the first session of the day. They welcomed speakers to give insights on progress made on air quality policy making in East Africa, including reflections on case studies of data-driven policymaking from India.

- **Ms. Selelah Okoth** (National Environment Management Authority, Kenya) indicated that the country has had over eight years of experience in implementing the Air Quality Regulations of 2014 (for stationary and mobile sources) and has been able to identify several gaps that will inform their revision in 2023–24. In this period NEMA was responsible for emission licensing for stationary sources (mostly industries through quarterly stack emission reporting and fugitive emission control plans) and has recently embarked on implementation of a framework for emission testing for mobile sources. Strategic partnerships have been key to successes in enforcement, however Selelah noted the need for capacity strengthening on air quality modelling, data analysis, and interpretation.
- **Ms. Jennifer Kutesakwe** (National Environment Management Authority, Uganda) indicated that the country formulated its first Air Quality Regulations in 2022 to address emissions from stationary, mobile, and fugitive sources. They provide for NEMA to develop a National Air Quality Management Plan that tracks progress on emission reduction. The regulations are currently awaiting gazette. The authority will review and refine the standards every five years while reviewing progress and identifying areas of non-attainment. As a way forward, Jennifer proposed extension of the monitoring network to cover areas outside the capital city of Kampala and use of satellite data to fill the gaps.
- **Dr. Kalpana Balakrishnan** (Sri Ramachandra Institute of Higher Education, India) provided an overview on the evolution of the use of satellite-derived air pollution estimates in India. She noted that satellite measurements of $PM_{2.5}$ have enabled a broader understanding of state level exposures for ambient and household air pollution in India. While similarities exist between Africa and South Asia, she emphasized the need to create healthy, “seamless” breathing spaces, by focusing on variations in pollution between indoor and outdoor environments, rural and urban populations, and exposures among women, children, and the working population.

Andriannah and Gerphas summarized the session by noting that clean air action is urgently needed even with scarce data, and policy action can be adapted based on local context and experiences elsewhere. Countries across the region can “learn by doing” and through integrated action on air pollution and climate change.



Photo Credit: © Paul Kaberere

Dr. Pallavi Pant (Health Effects Institute, USA) moderated the panel discussion on “Application of health evidence in policymaking.” Examples shared included: (i) regulations passed by the California Air Resources Board, USA, to limit roads within 500m of schools following a study that showed chronic effects of ozone exposure to children’s health – **Dr. Kiros Berhane**; (ii) elimination of lead in petrol globally through studies that showed detrimental effects on children’s cognitive development – **Ms. Jane Akumu** (United Nations Environment Programme, Kenya); (iii) prioritization of interventions aimed at reducing air pollution and improving related

impacts on population health across Africa is deterred by existing societal challenges such as recovery from the Covid-19 pandemic, intensifying effects of climate change, and rising energy prices – **Dr. Gabriel Okello** (African Centre for Clean Air, Uganda); and (iv) for clean air action planning and strategy development to work, the science needs to be informed by policy needs and driven by practice in implementation of said interventions. This should also include, where possible, cost/benefit analyses that translate impacts of air pollution to monetary losses – **Dr. Alex Ndyabakira** (Kampala Capital City Authority, Uganda).

The afternoon session on Day 2 focused on highlighting key initiatives in the region that have embraced collaborative research and capacity strengthening on air pollution and health – one focused on ambient air pollution (**GEOHealth Hub East Africa**) and the other on household air pollution (**CLEAN-Air Africa Project**). The GEOHealth Hub project has installed a beta attenuation monitor (BAM-1022) for PM_{2.5} measurements that is maintained and managed by hub teams at Addis Ababa University (Ethiopia), Makerere University (Uganda), University of Nairobi (Kenya), and University of Rwanda (Rwanda). **Ms. Nancy Chebichii** (Kenya Medical Research Institute, Kenya) presented the activities of the CLEAN-Air Africa Project; key among them is an upcoming Centre of Excellence on Air Quality Research that will offer training, instrument calibration, and sample analysis services across the region. A key achievement has been national health system strengthening through the adaptation and digital delivery of community health workforce training material (Module 14 on household air pollution in Kenya) that will be piloted in Uganda, Rwanda, and Cameroon.

The workshop concluded with a short training on HIA on Day 3. **Dr. Jon Samet** introduced workshop participants to key concepts including: (i) burden estimation and the underlying assumption of the *counterfactual* comparison; (ii) the type of data needed for HIA; (iii) tools for HIA for air pollution, specifically WHO’s **AirQ+** tool; (iv) uncertainties associated with HIAs and its limitations for policy purposes; and (v) how to interpret and communicate HIA results. Using Ethiopia and Kenya as case studies, **Dr. Abera Kumie** (Addis Ababa University, Ethiopia) and **Dr. Nicholas Oguge** demonstrated how **HIA was conducted for Addis Ababa** and Nairobi, respectively, and their potential use for policy analysis with regard to setting ambient air quality standards.

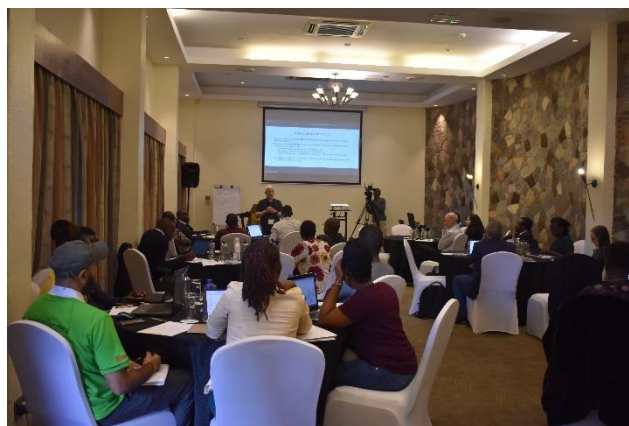


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Throughout the workshop, several crosscutting themes emerged from the presentations and discussions as summarized in the section below:

3.1 Building momentum for health studies

As depicted in the [interactive literature database](#) presented at the workshop, there is growing evidence on air pollution and health in East Africa. However, the range of health studies needs to be expanded in the region to include and assess the effects of long-term exposure to air pollution, which are typically associated with a larger health and economic burden. The existence of data gaps in the region has led to creative data integration and development of fit-for-purpose tools, especially on air quality monitoring. Cities in the region are rapidly adopting low-cost sensors (LCS) for measurement of air pollutants, thereby increasing access to air quality monitoring data. However, participants emphasized the need for harmonization and quality assurance/quality control (QA/QC) of LCS data and networks to enable data usage for research. In light of the progress made by ongoing projects (see *Appendix III*) to increase the coverage of air quality monitoring, the group recommended strategic pairing of existing air quality monitoring datasets with available health data in the near term.

This also presents an opportunity to study associations between pollution exposure and health outcomes as well as conduct health impact assessment and economic assessment.

Other recommendations included:

- **Near-term:** development of a centralized data platform or repository, preliminary data sharing among stakeholders based on agreements such as MOUs.
- **Near- to Mid-term:** development of standard operating procedures (SOPs) for air quality monitoring using LCS that can be applied across the region.
- **Mid- to Long-term:** establishment of a regional environmental public health tracking system that includes air quality data, with economic/budget impact estimates of exposure to air pollution as a motivator for action.

3.2 Capacity strengthening to promote East Africa-led studies

For high-quality, policy-relevant research to provide a strong impetus for clean air action across East Africa it is necessary that it be produced by local experts. Therefore, strengthening and expanding technical skills to conduct and lead studies on health effects of air pollution is critical. With programs such as [Eastern Africa GEOHealth Hub](#), [Clean Air Catalyst](#) and [CLEAN-Air \(Africa\)](#), there are upcoming opportunities to conduct and promote East Africa-led studies on the health effects of air pollution.

The group identified the need to focus on policymakers and other stakeholders such as journalists and faith-based leaders — who can play a key role in promoting discourse and action on air pollution through media shows, theatre, and dialogues. This will also encourage uptake of locally contextualized interventions.

Other recommendations included:

- **Near-term:** technical trainings and webinars on understanding air quality data and health effects of air pollution.
- **Near- to Mid-term:** capacity building for data analysis and management for the NEMAs.
- **Mid- to Long-term:** incorporation/review of air pollution issues into the education curricula at different levels.

3.3 Expanding public engagement and communication

It was noted throughout the workshop that there is a general misunderstanding of what air pollution is, where it comes from, and its impacts, therefore necessitating far-reaching communication strategies and community engagement. The value of open and transparent communication and building relationships with stakeholders was also stressed.

Participants emphasized the need to expand public engagement on the health effects of air pollution in communities, especially those most vulnerable to air pollution, to increase acceptability and uptake of interventions.

Other recommendations included:

- **Near-term:** communicate the health effects of air pollution to the public in a way that they can understand by leveraging evidence from successful countries; targeted sensitization of people who can drive change (e.g., parliamentarians).
- **Near- to Mid-term:** illustrative infographics for awareness (e.g., on pollution in relation to health) for different target groups.
- **Mid- to Long-term:** build good case studies across the region on best practices for packaging and sharing information with stakeholders and the public.

3.4 Opportunities for promoting integrated action

The group noted challenges that African countries face on pollution prevention in the context of competing priorities such as economic growth, infrastructure development, and food security. Tackling environmental issues, including air pollution, can result in multiple benefits, among them a healthier population (which can spur development), climate benefits from reduced warming, and improved agricultural yields.

Synergistic action should be encouraged in key sectors with an eye toward addressing air pollution and climate change. Such efforts will also reduce the investment gap towards mitigation of air pollution.

Other recommendations included:

- **Near-term:** participatory engagement of different stakeholders in tackling air quality issues.
- **Near- to Mid-term:** coalesce and create a network of all stakeholders involved in air quality management and research, encouraging multidisciplinary co-design to break silos.
- **Mid- to Long-term:** strengthening of existing networks in East Africa to integrate other strands of work beyond air pollution.

4. Timeline and next steps

April 2023	Publication of workshop summary, slides, and recordings
June 2023	Publication of workshop report and recordings
June – December 2023	Conduct a scoping review of air pollution and health evidence in East Africa
Sept – December 2023	Technical training/webinar series (topics to be communicated)
January – June 2024	Launch a funding call for pilot studies in East Africa

APPENDIX I Workshop Agenda

DAY I Air pollution and its health effects: context, evidence and research strategies

08:30 AM Registration

09:00 AM Welcome

Victor Nthusi, Health Effects Institute, USA

09:10 AM Opening Remarks

Maurice Kavai, Nairobi City County Government, Kenya

Philip Osano, Stockholm Environment Institute Africa, Kenya

09:40 AM Health effects of air pollution: context, evidence and policy applications

[Chair: Nicholas Oguge, University of Nairobi, Kenya]

- Air Pollution and Health in Africa
Caradee Wright, South Africa Medical Research Council, South Africa
- Role of impartial science in effective air quality policymaking
Robert O'Keefe, Health Effects Institute, USA

10:20 AM General Discussion

10:45 AM Tea/Coffee Break

11:15 AM Session I: Air Quality in East Africa

[Chairs: Kiros Berhane, Columbia University and Eloise Marais, University College London]

- Primer: Air quality and health in East Africa – a SoGA perspective
Victor Nthusi, Health Effects Institute, USA
- Current air quality landscape in East Africa
George Mwaniki, World Resources Institute Africa, Kenya
- Using low-cost sensors for measuring air quality: the experience from AirQo
Deo Okure, AirQo, Uganda
- Opportunities for using integrated methods for air quality assessment in Africa
Rebecca Garland, University of Pretoria, South Africa

12:45 PM Discussion

01:00 PM Lunch

02:00 PM Session II: Group Discussion

[Chairs: Jon Samet, Colorado School of Public Health, USA and Kanyiva Muindi, African Population and Health Research Centre, Kenya]

- What are the most important health-related questions that come up in various conversations?

02:30 PM *Small group discussion*

03:45 PM **Tea/Coffee break**

04:15 PM Regroup, presentations and discussion

04:50 PM Summary of discussion
Jon Samet and Kanyiva Muindi

05:00 PM Health Break

06:00 PM **Networking Dinner**

DAY 2 *Advancing the science-policy interface for air quality management*

08:30 AM **Breakfast/Networking**

09:00 AM **Welcome/Recap of Day 1**

Victor Nthusi, Health Effects Institute, USA

09:05 AM **Keynote Address**

Nexus between air pollution, energy and development
Alice Kaudia, Climate and Clean Air Coalition Senior Africa Advisor, Kenya

09:30 AM **Session III. Setting National Air Quality Policies**

[Chairs: Andriannah Mbandi, UN Climate Change High-Level Champions and Gerphas Opondo, Environmental Compliance Institute, Kenya]

- Air Quality Policymaking in East Africa
Selelah Okoth, National Environment Management Authority, Kenya
Waiswa Ayazika, National Environment Management Authority, Uganda
- The science-policy interface: case studies from around the world
 - Applications of satellite data for air quality action and research in India
Kalpna Balakrishnan, Sri Ramachandra Institute of Higher Education and Research, India

11:00 AM **Tea/Coffee Break**

- 11:30 AM** Panel Discussion: **Application of health evidence in policymaking**
[Moderator: Pallavi Pant, Health Effects Institute, USA]
- Kiros Berhane, Columbia University, USA*
Alex Ndyabakira, Kampala Capital City Authority, Uganda
Jane Akumu, UN Environment Programme, Kenya
Gabriel Okello, Africa Centre for Clean Air
- 12:30 PM** Q&A
01:00 PM Lunch
- 02:00 PM** **Session IV: From Evidence to Policy – The Roadmap for Action on Air Pollution in East Africa**
[Chairs: Pallavi Pant and Victor Nthusi, Health Effects Institute, USA]
- Collaborative research and capacity strengthening on air pollution and health: The Eastern Africa GEOHealth Hub Experience
Belay Simane, Addis Ababa University, Ethiopia
- Addressing energy and household air pollution for better public health: The CLEAN-Air (Africa) Project
James Mwitari, Kenya Medical Research Institute, Kenya
- Open Discussion**
- 03:45 PM** **Tea/Coffee Break**
- 04:15 PM** Reflections/Next Steps
04:45 PM Vote of thanks
- 05:00 PM** Meeting Adjourns

Half-Day Training Session on Health Impact Assessment of Air Pollution

About the training

Quantifying the public health impacts of exposure to air pollution is a critical input for policy decisions related to air quality. This session will provide an opportunity for researchers, professionals and/or policymakers to get an overview of principles of health impact assessments including how to conduct such studies and interpret results. The training is designed to introduce key concepts related to the types of data required for an assessment, burden of disease, etc. Using case studies from East African cities, the training will also demonstrate how an assessment might be conducted and used for policy analysis.

Goals

- Introduce key concepts related to health impact assessment of air pollution
- Equip the participants with skills necessary to efficiently make use of available air quality data for conducting health impact assessments
 - Note that we will not have the opportunity at this training for participants to conduct their own analyses.
- Gather feedback for future training needs in the region

Agenda

09:00 AM Breakfast/Networking

09:30 AM Welcome

09:40 AM Lecture: Overview of health impact assessment

Jon Samet, Colorado School of Public Health, USA

- What is a health impact assessment?
- What data are needed – air quality/health? What are the uncertainties associated with using different data?
- Using air quality data – monitoring data vs modelled estimates
- What types of results do we get?
What do the results mean (and not mean)?

10:15 AM Q&A

10:30 AM Application of health impact assessment tools in Addis Ababa, Ethiopia and Nairobi, Kenya

Nicholas Oguge, Eastern Africa GEOHealth Hub (Kenya)

Lynn Atuyambe, Eastern Africa GEOHealth Hub (Uganda)

Abera Kumie, Eastern Africa GEOHealth Hub (Ethiopia)

11:15 AM Tea/Coffee Break

11:45 AM Q&A and Discussion

01:00 PM Wrap Up and Next Steps

Lunch

APPENDIX II Workshop Participants

- 1 Maurice Kawai
Nairobi City County Government, Kenya
- 2 Margaret Kariuki
Nairobi City County Government, Kenya
- 3 Philip Osano
Stockholm Environment Institute, Africa Centre, Kenya
- 4 Nicholas Oguge
University of Nairobi, Kenya and Eastern Africa GEOHealth Hub (Kenya)
- 5 George Mwaniki
World Resources Institute Africa, Kenya
- 6 Deo Okure
AirQo – Makerere University, Uganda
- 7 Rebecca Garland
University of Pretoria, South Africa
- 8 Kanyiva Muindi
African Population and Health Research Center (APHRC), Kenya
- 9 Lynn Atuyambe
Makerere University, Uganda and Eastern Africa GEOHealth Hub (Uganda)
- 10 Ivy Murgor
World Resources Institute Africa, Kenya
- 11 Augustine Afullo
Eastern Africa GEOHealth Hub (Kenya)
- 12 Bruce Kirenga
Makerere University Lung Institute, Uganda
- 13 Sammy Simiyu
Vital Strategies, USA
- 14 Godwin Opinde
Kenyatta University, Kenya
- 15 Mackline Ninsiima
Kampala Capital City Authority, Uganda
- 16 Gideon Lubisia
AirQo – Makerere University, Uganda
- 17 Kutesakwe Jennifer
National Environment Management Authority of Uganda (NEMA Uganda), Uganda
- 18 Diana Marangu
University of Nairobi, Kenya
- 19 Alice Kaudia
Climate and Clean Air Coalition, Kenya
- 20 Andriannah Mbandi
UN Climate Change High-Level Champions, Kenya
- 21 Gerphas Opondo
Environmental Compliance Institute (ECI), Kenya
- 22 Seelah Okoth
National Environment Management Authority of Kenya (NEMA Kenya), Kenya
- 23 Alex Ndyabakira
Kampala Capital City Authority, Uganda
- 24 Gabriel Okello
University of Cambridge, UK and African Centre for Clean Air
- 25 Hadija Lelei
Ministry of Health, Kenya
- 26 Jane Akumu
UN Environment Programme
- 27 Belay Simane
Addis Ababa University, Ethiopia
- 28 Nancy Chebichii
Kenya Medical Research Institute (KEMRI), Kenya

- 29 Josephine Kanyeria
Jomo Kenyatta University of Agriculture and Technology (JKUAT), Kenya
- 30 Lydia Akinyi
Eastern Africa GEOHealth Hub (Kenya)
- 31 Paul Kaberere
Environmental Compliance Institute (ECI), Kenya
- 32 Abera Kumie
Addis Ababa University, Ethiopia
- 33 Dorothy Aanyu
National Institute of Public Health Uganda
- 34 Josephine Muramata
Kampala Capital City Authority, Uganda
- 35 Marcellah Ojiambo
National Environment Management Authority of Kenya (NEMA Kenya), Kenya
- 36 Jilani Chigulu
National Environment Management Authority of Kenya (NEMA Kenya), Kenya
- 37 Arthur Gohole
Kenya Medical Research Institute (KEMRI), Kenya
- 38 Willah Nabukwangwa
Kenya Medical Research Institute (KEMRI), Kenya
- 39 Mary Kinoti
University of Nairobi, Kenya
- 40 Raph Muli
Nairobi City County Government, Kenya
- 41 Grace Ojiayo
Nairobi City County Government, Kenya
- 42 Jacqueline Kagima
Kenyatta National Hospital, Kenya
- 43 Kiros Berhane
Columbia University, USA
- 44 Caradee Wright
South African Medical Research Council, South Africa
- 45 Jon Samet
Colorado School of Public Health, USA
- 46 Kalpana Balakrishnan
Sri Ramachandra Institute of Higher Education and Research, India
- 47 Eloise Marais
University College London, UK
- 48 Robert O'Keefe
Health Effects Institute
- 49 Pallavi Pant
Health Effects Institute
- 50 Victor Nthusi
Health Effects Institute

APPENDIX III Ongoing Projects on Air Pollution and Health in East Africa

Eastern Africa GEOHealth Hub

Contact: Dr. Nicholas Ouge, University of Nairobi, Kenya
Dr. Lynn Atuyambe, Makerere University, Uganda
Dr. Abera Kumie, Addis Ababa University, Ethiopia

Through collaborative partnership the Hub has successfully designed and implemented a multifaceted research training program that has strengthened local capacity to conduct environmental and occupational health research as well as directly supported the development and implementation of a number of research studies and translation of findings in each Hub country in Cycle I (ending 2021). Building on this success, the Hub continues to grow its research and training portfolios, expand the Hub network, and foster in-country expertise in environmental and occupational health research and policy in Cycle II (beginning 2022).

Website: <http://geohealth-hub.org/>

Clean Air Catalyst

Contact: Dr. George Mwaniki, World Resources Institute Africa, Kenya

Clean Air Catalyst is a flagship program launched by the U.S. Agency for International Development and a global partnership of organizations led by World Resources Institute and Environmental Defense Fund, Inc. We are focused on building capacity for locally tailored solutions that curb air pollution, tackle climate change and improve human health. The program is working with Nairobi City County Government, the National Environmental Management Authority, and local scientists to bolster air quality monitoring and data collection in the city's most impacted communities.

Website: <http://www.cleanaircatalyst.org/>

Supporting National Action and Planning (SNAP) to Reduce Short-Lived Climate Pollutants in Kenya

Contact: Dr. Philip Osano, Stockholm Environment Institute Africa, Kenya

In line with the purpose of the CCAC's SNAP initiative, activities under this project aim to: (i) strengthen the institutional capacity dedicated to promoting the integration of climate change and air pollution; (ii) develop an action plan for the reduction of short-lived climate pollutants (SLCPs) in Kenya; and (iii) integrate of SLCP mitigation actions into relevant national planning processes in Kenya in order to contribute towards rapid and large-scale implementation of activities to reduce short-lived climate pollutants at the national level.

Website: <http://www.sei.org/projects-and-tools/projects/snap-reduce-slcp-kenya/>

AirQo Project

Contact: Prof. Engineer Bainomugisha, Makerere University, Uganda

AirQo was founded in 2015 at Makerere University to close the gaps in air quality monitoring across Africa. Their low-cost air quality monitors are designed to suit the African infrastructure, providing locally led solutions to African air pollution challenges. They provide accurate, hyperlocal, and timely data providing evidence of the magnitude and scale of air pollution across the continent. By empowering citizens with air quality information, we hope to inspire change and action among African citizens to take effective action to reduce air pollution.

Website: <http://www.airqo.net/>

Clean-Air (Africa) Project

Contact: Dr. James Mwitari, Kenya Medical Research Institute, Kenya

CLEAN-Air (Africa) aims to provide policy-relevant evidence to raise population awareness of indoor air pollution and to support prevention through the transition to clean fuels and energy for cooking. The partnership implements research, health systems strengthening, and capacity-building activities across the five focus countries (Kenya, Cameroon, Tanzania, Rwanda, and Uganda) with the explicit objective to address the health burden from household and institutional air pollution from reliance on polluting solid fuels (e.g., wood, charcoal, coal, and biomass) and kerosene.

Website: <http://cleanairafrica.com/>

African Cities for Clean Air

Contact: Dr. Victor Indasi, C40 Cities, Kenya

The African Cities for Clean Air programme supports C40 cities in the Africa region to take action on air pollution, assisting efforts to improve air quality and public health while reducing carbon emissions. Launched in 2022, the programme aims to empower African Mayors to increase public awareness of the importance of clean air across the continent and call for policy changes that address health challenges caused by poor air quality. From 2022–2024, C40 will provide air quality technical assistance to five cities – Addis Ababa, Dakar, Durban, Johannesburg, and Lagos – on projects that will reduce harmful emissions and protect public health.

Website: <http://www.c40.org/what-we-do/scaling-up-climate-action/air-quality/african-cities-for-clean-air/>

Source Apportionment and Emissions Inventory studies

Contact: Dr. Alex Ndyabakira, Kampala Capital City Authority, Uganda
Dr. Bruce Kirenga, Makerere University Lung Institute, Uganda

KCCA has installed about 25 air quality monitors in the city to provide evidence-based information on the scale of air pollution. In collaboration with the Makerere University Lung Institute, they have recently commissioned source apportionment and emissions inventory studies to enhance air quality monitoring efforts and study pollution sources as a key step towards implementation of the Kampala Clean Air Action Plan.

Website: <http://www.kcca.go.ug/kampala-air-quality-monitoring-network>

Legislation for Clean Air in Nairobi

Contact: Mr. Maurice Kawai, Nairobi City County Government, Kenya
Ms. Grace Ojiayo, Nairobi City County Government, Kenya

The Nairobi City County Government (NCCG) and its legislative arm, the Nairobi City County Assembly (NCCA) through a consortium of partners is working to develop a suite of policy instruments for air quality management informed by scientific assessments and monitoring of air quality by researchers and stakeholders in Kenya. The county has made progress in the development of an Air Quality Action Plan, an Air Quality Policy (adopted by the county assembly as [Sessional Paper No. 2](#)), an Air Quality Bill (adopted in [2022](#)) and is now working on Air Quality Regulations that will operationalize the air quality act.

Website: <http://nairobi.go.ke>

CanAIRy Alert

Contact: Dr. George Mwaniki, World Resources Institute Africa, Kenya

CanAIRy Alert is a partnership supporting air quality managers to develop air pollution forecasting tools and better understand its sources, including representatives from Latin American and African cities sharing best practices, successful tools and management case studies from cities around the world.

Website: <http://www.wri.org/initiatives/canairy-alert>

Air Quality and Sports Governance in Africa

Contact: Dr. Philip Osano, Stockholm Environment Institute Africa, Kenya
Mr. Ngongang Danube, Stockholm Environment Institute Africa, Kenya

A partnership between UNEP, SEI and World Athletics aimed at measuring and analyzing levels of air pollution at sporting venues around the world and correlate the air quality, athletic performance and respiratory symptoms or conditions. Using sports as a unifying tool to drive climate awareness and air quality action, SEI has extended the program to World Athletics member federations in Africa.

Website: <http://www.sei.org/about-sei/press-room/air-quality-project-nairobi/>

Please note that this is not an exhaustive list. To add your project to the list, please contact Mr. Victor Nthusi (vnthusi@healtheffects.org).

APPENDIX IV Abbreviations

APHRC	African Population and Health Research Center
BAM	Beta Attenuation Monitor
CCAC	Climate and Clean Air Coalition
CHW	Community Health Workforce
ECI	Environmental Compliance Institute
HEI	Health Effects Institute
HIA	Health Impact Assessment
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KCCA	Kampala Capital City Authority
KEMRI	Kenya Medical Research Institute
LCS	Low-cost Sensors
MOU	Memorandum of Understanding
NCCG	Nairobi City County Government
NEMA	National Environment Management Authority
PM	Particulate Matter
SDGs	Sustainable Development Goals
SEI	Stockholm Environment Institute
SNAP	Supporting National Action Planning
SoGA	State of Global Air Initiative
SOP	Standard Operating Procedure
WHO	World Health Organization
WRI	World Resources Institute
UK	United Kingdom
UoN	University of Nairobi
USA	United States of America