FINAL REPORT

Open Cities Africa

PROGRAM OF THE GFDRR
OPEN DATA FOR RESILIENCE INITIATIVE

An initiative of

OPEN DRI Open Data for Resilience Initiative

GFDRR Global Facility for Disaster Reduction and Recovery

THE WORLD BANK IBRD • IDA | WORLD BANK GROUP

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Building Disaster Resilience in Sub-Saharan Africa

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F I N A L R E P O R T

Open Cities Africa

PROGRAM OF THE GFDRR **OPEN DATA FOR RESILIENCE INITIATIVE**

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EXECUTIVE SUMMARY

Open Cities Africa is a program of the Global Facility for Disaster Reduction and Recovery's Open Data for Resilience Initiative, in collaboration with the World Bank Africa Urban, Resilience and Land Unit, made possible by funding through the European Union's Africa Disaster Risk Financing (ADRF) program. ADRF funding supported activities carried out between June 2018 and December 2019 in the following nine cities in Sub-Saharan Africa: Accra, Ghana; Antananarivo, Madagascar; Kinshasa, Democratic Republic of Congo; Monrovia, Liberia; Ngaoundéré, Cameroon; Pointe-Noire, Republic of Congo; Saint-Louis, Senegal; Zanzibar City, Tanzania; and Mahée, Praslin and La Digue, Seychelles. Funding from various sources has supported the expanded Open Cities program in Abidjan, Cote d'Ivoire; Bamako, Mali; Brazzaville, Congo; Dar es Salaam, Tanzania; Kampala, Uganda; Niamey, Niger; and Yaoundé, Cameroon.

The program sought to take the Open Cities model that had been successful in developing critical risk information in South Asia, and update it to meet disaster risk management and digital skills needs in Africa. The purpose of Open Cities Africa was to collect, update and share geospatial data, so that it could be used by local government and community leaders to inform disaster risk decision-making. Open Cities teams engaged local stakeholders in a participatory mapping process that provided them the opportunity give feedback on the challenges in their communities. Information collected was developed into tools, data products, and geospatial databases which inform government and World Bank investments in flood risk management, urban upgrading, and other urban resilience activities. Through the process the capacity of local organizations and team members was enhanced, and a skilled cohort of African practitioners was developed.

Over the span of 18 months, Open Cities Africa mapped over 1,000,000 geographic features, 30,000 km of roads, and developed over 150 geospatial data layers. Teams attended three Regional Training Workshops and were trained on over 15 learning modules. Through the process over 500 young adults were trained in digital skills, 200 stakeholder groups were engaged, and over 1000 people gained an improved understanding of local resilience challenges.

BACKGROUND

As urban populations grow and their vulnerability increases, managing urban growth in a way that fosters cities' resilience to natural hazards and the impacts of climate change becomes an ever-greater challenge that requires detailed, up-to-date geographic data of the built environment. Addressing this challenge requires innovative, open, and dynamic data collection and mapping processes that support management of urban growth and disaster risk. Success is often contingent on: local capacities and networks to maintain and utilize risk information, enabling policy environments to support effective data management and sharing, and targeted tools that can help translate data into meaningful action.

Open Cities was first launched by the Global Facility for Disaster Reduction and Recovery's Open Data for Resilience Initiative (OpenDRI) in South Asia in 2014. The first Open Cities project was in Kathmandu, Nepal, which focused on mapping the educational institutions, health facilities, road networks, religious sites and other geographic features of Kathmandu Valley. This data proved to be invaluable for first responders when a major earthquake hit the city in 2015.

The value of this current and openly available data for disaster risk management led to a lot of momentum for both the Open Cities team and its lead implementer in Kathmandu, Kathmandu Living Labs. Over the next few years Open Cities then expanded to work on disaster risk issues in Dhaka, Bangladesh and Batticaloa, Sri Lanka. The Open Cities model was also replicated by many partner organizations of OpenDRI including USAID, American Red Cross, Inter-American Development Bank, and other organizations.

In 2017 OpenDRI received funding through the European Union's Africa Disaster Risk Financing program to take the Open Cities model and tailor it to Africa. Learning lessons from South Asia, OpenDRI sought this time to implement Open Cities Africa in more locations (8-10 cities), do it simultaneously, and in about half the time (approximately one year). The Open Cities of this round of programming would be part of a larger initiative with a harmonized cohort, that would ultimately lead to an enhanced regional network of skilled technologists able to respond to local needs for disaster risk information in the future.

ACKNOWLEDGEMENTS

The Open Cities Initiative is part of the Africa Disaster Risk Financing Program funded by the European Union, managed by the Global Facility for Disaster Reduction and Recovery (GFDRR) and implement by the WB Africa DRM team, the GFDRR Innovation Lab, and the Disaster Risk Financing and Insurance Program.

The Open Cities Africa initiative was led by Vivien Deparday, Nuala Cowan, Grace Doherty, Mira Gupta, and Robert Soden. Cristiano Giovando provided technical input on tracking OSM analytics and managing the development and tracking of city data on the initiative's website.

The Open Cities Africa team would like to thank the leadership of GFDRR including GFDRR Labs Team Lead Emma Philips Solomon, Senior Operation Officer Erika Vargas, GFDRR Brussels team Rosella Dela Monica and Hugo Wesley, current GFDRR Practice Manager Julie Dana and former GFDRR Practice Manager Francis Ghesquiere for their support in championing this initiative.

We also express special gratitude to the Africa Urban, Resilience and Land Team, led by Meskerem Brhane and Sylvie Debomy, Practice Managers and Niels Holms-Nielsen DRM Global Lead for supporting the implementation of Open Cities Africa projects throughout the region, and lending their expertise, staff, and resources to contribute to the initiative's success. We would especially like to thank the following Regional Task Team Leads and in-country consultants for supporting our work: Gyongshim An, Edward Anderson, Sokhna Ba, Yves Barthelemy, Ana Campos, Lorenzo Carrera, Laurent Corroyer, Claire Halleux, Brenden Jongman, Chris Jung, Isabelle Kane, Tamilwai Kolowa, Xiaofeng Li, Veronique Morin, Dina Ranarifidy, Gael Raserijaona, Swati Sachdeva, Su Jung Song, Deepali Tewari, Asmita Tiwari, Boris Van Zanten, Christian Vang Eghoff, Bontje Zangerling, and Yan Zhang.

We are also especially grateful to our many partners and collaborators on this project including Jess Beutler, Nate Smith and Tyler Radford from HOT, Chris Neu, Yohan Perera, Sedinam Worlayo, Jeremy Garcia from TechChange, Erica Hagen from Ground Truth Initiative, Paolo Pasquali from Ithaca, Marena Brinkhurst and Jinal Foflia at MapBox, Edoardo Neerhut at Mapillary. Andrew Wiseman from Apple, and Tim Sutton from Kartoza.

Finally, we would like to thank our implementation teams across the Open Cities Africa project cities for their enthusiasm, engagement and incredible work throughout the process.


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Approach & Methodology

1

CASE STUDY: NGAOUNDERE, CAMEROON

Multiplier Effect: Enhanced Capacity for All Involved

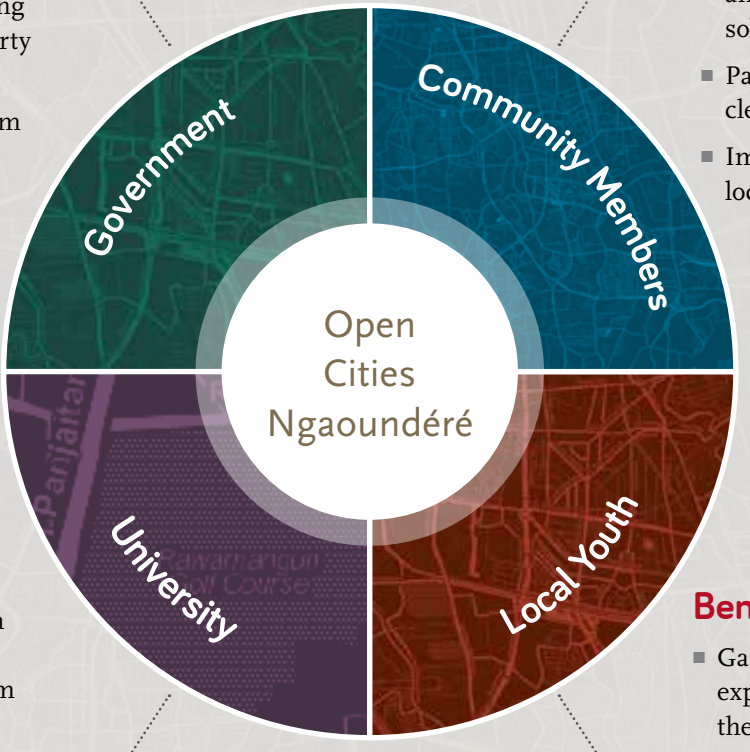
Open Cities Africa projects build the capacities of governments and local populations to understand disaster risk and implement evidence-driven urban resilience interventions.

Benefits

- Data to better plan urban growth
- City Council also using data to develop property tax system
- Received funding from MoF to develop flood zone

Benefits

- Given a voice in the process of developing and engaging in local solutions
- Participate in weekly clean up activities
- Improved relations with local government



Benefits

- Open Cities approach integrated into University curriculum
- Launched "Useful Holidays" program that allows students to map nearby cities during their vacation

Benefits

- Gained practical experience while serving their community
- Developed technical skills that led to employment upon graduation

Building on the success of the Open Cities projects in South Asia[1], the global Open Data for Resilience Initiative[2], and GFDRR's Code for Resilience[3], Open Cities Africa was carried out with ADRF funding in 9 cities in Sub-Saharan Africa:

Accra, Ghana
Antananarivo, Madagascar
Kinshasa, Democratic Republic of Congo
Monrovia, Liberia
Ngaoundéré, Cameroon
Pointe-Noire, Republic of Congo
Saint-Louis, Senegal
Zanzibar City, Tanzania
Mahé, Praslin and La Digue, Seychelles

The expanded Open Cities Africa program supports 7 more cities in Sub-Saharan Africa. Cities under the ADRF funding were selected based on risk information needs identified by World Bank Urban and Resilience teams and their government counterparts on issues such as flood risk management, resilient urban upgrading, solid waste management and others. By basing selection on existing demand, this increased the likelihood that the data products developed would be used by local government leaders and World Bank lending projects.

Teams in these cities engaged local government, civil society, and the private sector to develop the information infrastructures necessary to meet 21st century urban resilience challenges. The project was implemented through a unique partnership between GFDRR and the World Bank operational teams, city governments, and a partner community comprised of regional scientific and technology organizations, development partners,

[1] http://www.opencitiesproject.org/
[2] https://opendri.org/
[3] http://codeforresilience.org/

and technology companies to support upcoming or ongoing World Bank funded activities in the selected cities. Following a competitive application process, a small team in each selected city received funding, targeted training, technical support, and mentorship to achieve the following objectives:

1) Create and/or collate and release open spatial data about the built environment, critical infrastructure, and natural hazards;
2) Develop targeted products and/or tools (e.g., visualization tools, atlas, map series, or mobile application) to assist key stakeholders to utilize risk information towards addressing natural disaster risk in the selected city;
3) Enhance the local capacity and institutional development necessary to support the design and implementation of evidence-driven urban resilience interventions; and
4) Promote peer mentorship and build regional networks across cities.

In each participating city, Open Cities Africa projects were intended to inform decision-making or support action around a specific Problem Statement related to urban development issues such as flood resilience, urban upgrading, solid waste and others, identified by the local city government and the regional World Bank teams by achieving the following:

- Assessments conducted to understand current data, human and capacity, and institutional contexts with the regards to the Problem Statement to address;
- Participatory mapping of the target area and information completed using the global open collaborative mapping platform OpenStreetMap, and other relevant tools;
- Trainings on topics such as community mapping and data collection, data visualization and risk communication, and other related topics carried out;
- The development of local open source communities;
- The support and creation of communities of practice in Africa around urban resilience; and
- The support and creation of targeted information tools/products to support urban resilience interventions.

Open Cities Africa was designed to result in the development of new disaster risk data, with new tools/products to explore it, increased capacity among local populations, and new partnerships among diverse stakeholders. The Open Cities guide[4] is a tool for practitioners who wish to bring community mapping initiatives to their cities or regions.

[4] https://opendri.org/resource/planning-an-open-cities-mapping-project/

The Four Project Phases

Open Cities Africa was implemented in four distinct phases. A description of each phase and its associated deliverables is described below.

Phase One: Assess

In this initial phase of project implementation, Open Cities Africa teams carried out research to establish what data already exists and the condition it is in, and from there refined their Problem Statements and exact Areas of Interest. They also identified project partners and relevant stakeholders to ensure a participatory process. During this phase, teams convened for the first Regional Training Workshop where they had a chance to meet with the Open Cities Africa leadership and team from other cities, and receive technical training on several of the project components. It was at this event that they also received login credentials for the Open Cities Africa Online Learning Platform, which they could use to access project training content, submit assignments and share updates with teams from other cities.

Assess Phase Program Components:

- Developing Problem Statements
- Data Assessment
- Developing a Data Model
- Gender Analysis
- Determining Stakeholder Engagement Strategy
- Monitoring and Evaluation Framework

Phase Two: Map

In this second phase, teams used their data capture strategy and findings from the first project phase to address critical data gaps relevant to their specific Problem Statement. Using the technical skills they developed through the first Regional Training Workshop, teams began to collect geospatial data in their cities. Depending on needs, tools for data collection included smartphones or tablets, drones for the collection of high resolution imagery, or handheld GPS devices. They also focused on engaging local stakeholders in the process such as universities, the OSM community, and community members living in the project's target areas. Teams were also responsible for conducting rigorous quality assessments of data collected by local team members. As data was collected and uploaded into the OSM platform, teams conducted regular Quality Assurance/ Quality Control checks to resolve the gaps between expected and actual results. When necessary, teams retrained personnel to ensure greater data accuracy, and/or deployed an additional field survey to fill in any missing information.

Map Phase Program Components:

- Collecting Field Data
- Engaging Local Partners
- Conducting QA/QC to Validate Data

Phase Three: Design

In the third phase of the project, teams used data collected in the Map Phase to design a data tool or product to communicate the data to their stakeholders and support decision-making. Teams received hands-on training in User-Centered Design at the second Regional Training Workshop, and they also completed training module assignments through the Online Learning Platform. Team members carried out user research to better understand the needs and values of their stakeholders, and used those insights to develop simple prototypes for feedback. This collaborative process of ongoing dialogue with key stakeholders helped to ensure that the data tools and products developed would indeed be useful to their beneficiaries.

Design Phase Program Components:

- Persona Development
- Rapid Ideation
- Prototyping
- User Testing

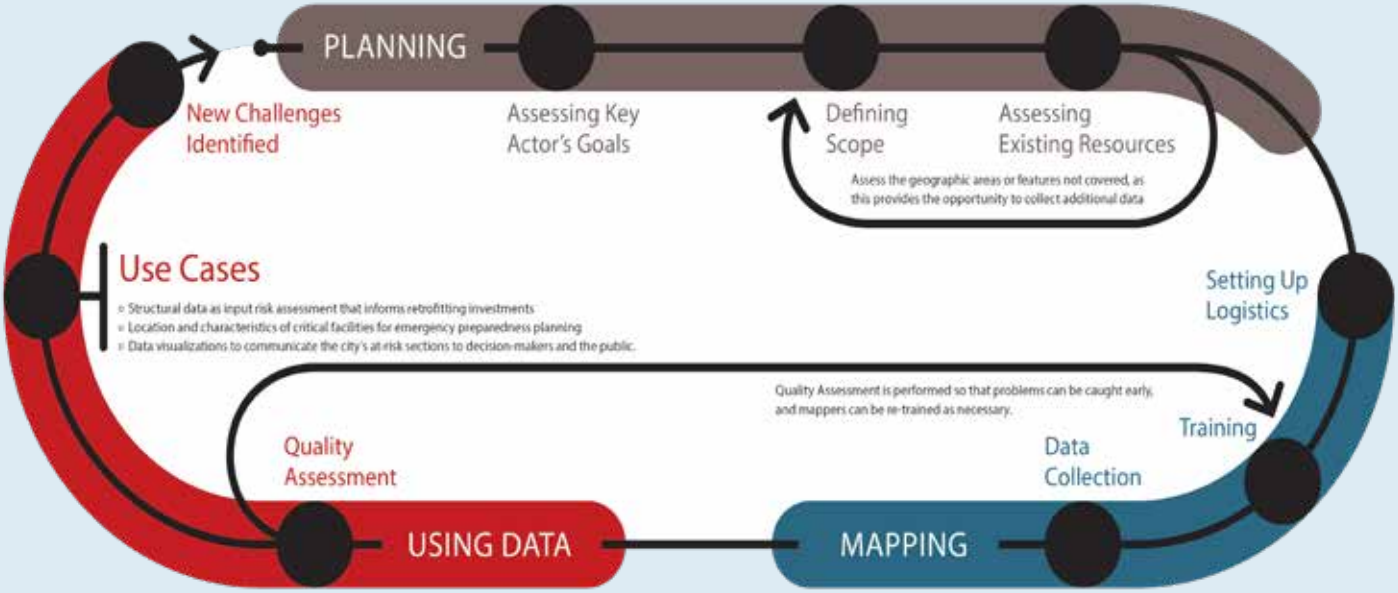
Phase Four: Develop

In this final phase of the project, teams developed their final data products based on the user feedback they received in the Design Phase. While products varied widely depending on city context, they included databases, data catalogs and visualization tool such as atlases, and web mapping applications. Teams then presented their final products to beneficiaries, sometimes in public forums or presentations. Team members also had the opportunity to learn from one another through city presentations at the third Regional Training Workshop. In addition to the focus product development, this phase of the project also emphasized the development of the Open Cities Africa cohort. Team members had the opportunity to discuss their goals for the cohort, how they could incorporate new members from future projects, and ways in which they could serve as mentors or mentees to others in the group. This allowed implementation teams to be on the receiving end of the user-centered design process, and inform the scope and structure of the cohort moving forward so that it could serve as a thriving community of practice and respond to future regional risk information needs.

Develop Phase Program Components:

- Final Data Product(s)
- Sustainability Plan
- Ignite Talks
- Cohort Development
- Mentor/Mentee Identification and Pairing

Open Cities Process Diagram



Building the Ecosystem

Each part of an Open Cities project offers opportunities for involving new participants, demonstarting the value of open data, and supporting the growth of the network organizations and individuals who can continue to update the data or champion the work after the project is complete. Finding ways to build the ecosystem of data contributors and users involved in an Open Cities project is key to long-term sustainability and impact.

Capacity Building and Knowledge Exchange 2

Open Cities Africa facilitated a comprehensive capacity building program for implementation teams and local civil servants and youth. The cohort convened at three in-person meetings hosted at regional conferences. At the desk, teams and government partners gained training via the Open Cities online learning platform course modules, webinars, and cross-country forums. Trainees used these valuable skills to bring technical knowledge to the local community via mapathons, workshops, and other training events.

Training of Trainers: Regional Workshops

To support skills development and knowledge sharing across the Open Cities cohort, city teams participated in three Regional Training Workshops. For each of these workshops, Open Cities projects sent a four-delegate team comprised of two local government representatives and two members from the implementation team.

Regional Training 1: Kampala, Uganda

June 11 – 15, 2018

City representatives (55 in total) attended the Open Cities Africa "Kick-Off Meeting" held in Kampala, Uganda from the 11-15 of June, 2018. The Kick-Off Meeting provided implementation teams and their government counterparts an opportunity to meet the Open Cities Africa management team, as well as their counterparts from the other participating cities. City teams received technical training on different forms of data collection, mapping and analysis; and developed their skills in project design, management and evaluation.

Participating groups included the local and technical organizations who are implementing the projects in each city, as well as the government counterparts with whom they work. Open Cities

offered dedicated modules on topics such as disaster risk management, open data collection tools (such as JOSM, iD, and Open Data Kit (ODK), stakeholder engagement, and gender-informed design. These modules were taught through a mix of interactive activities and presentation. All training sessions were delivered in both French and English. In a dedicated session on how to use and apply digital mapping technology, the program featured guests from the Humanitarian OpenStreetMap Team (HOT) on mapping workflow and data models; GeoGecko on drones for community mapping and acquiring and using street view imagery; and Mapillary on machine learning and computer vision applied to street view imagery.

Throughout the event, the teams had opportunities to interact and exchange ideas through presentations and brainstorming exercises. Delegates also learned of the techniques of

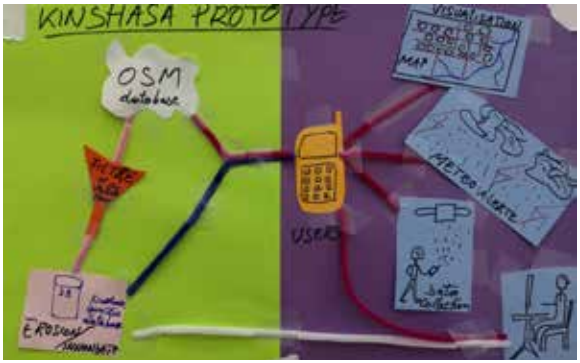
existing projects such as Tanzania Ramani Huria, Zanzibar Mapping Initiative, and Uganda Open Mapping. The diversity of attendants was a great highlight of the event. Half of the participants were francophone, and half anglophone, with many cultures, languages, and religions represented. This presented a unique opportunity for engagement and knowledge sharing. The energy and motivation of the participants was tangible; their strong commitment to open data and open collaboration for better urban planning was apparent throughout the event.

Regional Training 2: Dar es Salaam, Tanzania

August 27 – 31, 2018

In August 2018 a convention of 45 delegates joined in Dar es Salaam to mark the second regional meeting of Open Cities Africa. The consortia of local government and innovation teams from 11 cities came to participate in dedicated training for the Open Cities cohort and also attend the Free and Open Source for Geospatial (FOSS4G) and Understanding Risk Tanzania (URTZ) conferences, featuring sessions on geospatial governance, inclusion, diversity, capacity building and civic engagement.

The theme of the August meeting was user-focused data products; how can Open Cities teams learn from their stakeholders to develop information tools that are relevant, accessible, and useful for governments and vulnerable communities? In a series of intensive workshops, utilizing the principle of user-centered design, teams were tasked with designing a user-informed prototype of a risk data communication tool for their cities.



Through development of user “personas” and rapid ideation exercises, city teams emerged from the workshops with innovative new open data prototypes: from atlases of exposure and risk to city-wide early warning mobile phone applications.

The intensive week was bookended with a final workshop for developers from each of the Open Cities teams. In Zanzibar City, Mapbox hosted an extended weekend web mapping training for Open Cities Africa and the Zanzibar Mapping Initiative (ZMI).

Regional Training 3: Abidjan/Grand Bassam, Côte d'Ivoire

Nov 22 – 24, 2019

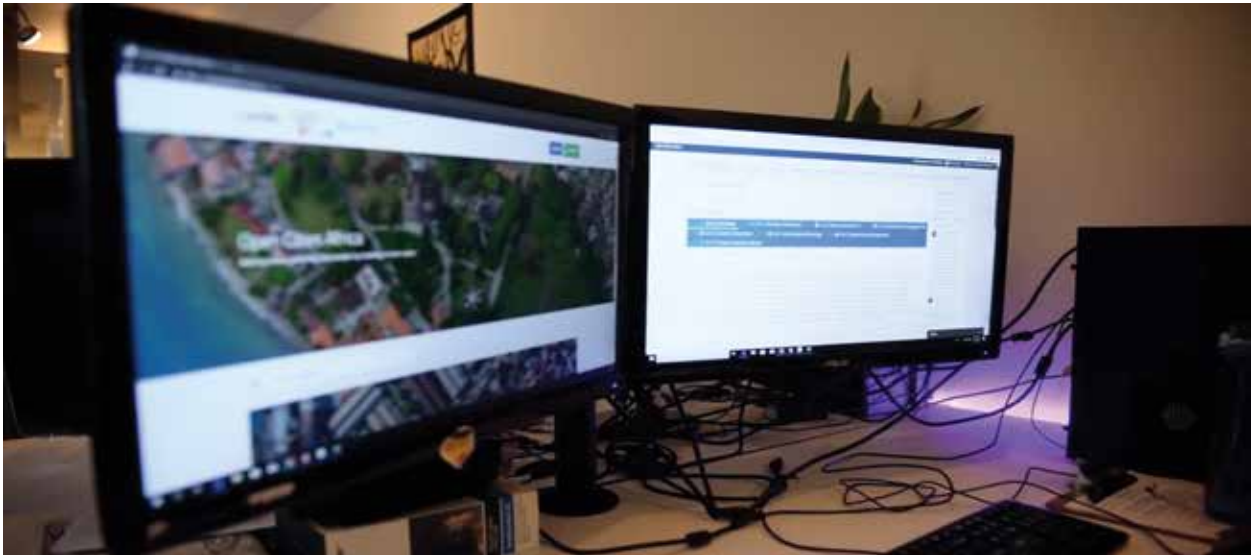
Delegates from 11 Open Cities Africa project locations gathered for the 3rd Regional Training in Abidjan and Grand-Bassam, Côte d'Ivoire in November, 2019. The training workshop coincided with the Understanding Risk West and Central Africa[5] and State of the Map Africa (SOTM Africa)[6] conferences, and provided an opportunity for participants to attend sessions at both events. Similar to the previous training workshops held in Kampala and Dar es Salaam, participants for the 3rd Regional Training were comprised of city team members from both the implementing partners and their local government counterparts. During the Understanding Risk West and Central Africa conference each team presented the work they had accomplished under the program through Ignite Talks and a dedicated poster session for conference attendees[7]. During working sessions, delegates participated in group activities to facilitate discussions around lessons learned and next steps. Special focus was placed on the future of the Open Cities Africa cohort beyond the ADRF, and how the group would continue to develop and grow. Participants were also encouraged to think about their own professional goals and how they might collaborate with others in the group either as mentors or mentees.

[5] https://understandrisk.org/event/understanding-risk-west-and-central-africa/

[6] https://2019.stateofthemap.africa/

[7] Available in the proceedings: https://understandrisk.org/understanding-risk-west-and-central-africa-proceedings/

Training of Trainers: Online Learning Platform



In addition to in-person training workshops, Open Cities Africa featured an Online Learning Platform as a way for team members to access training content, engage in discussions threads and follow the progress of other city teams. In order to standardize and harmonize efforts across cities and maintain a unified experience across the cohort, the Open Cities Africa leadership team developed a series of over 15 training modules covering topics ranging from technical skills development, to program management and reporting. The following training modules, organized by project phase, were developed in both English and French as part of Open Cities Africa:

- Problem Statement Development
- Data Assessment
- Stakeholder Engagement
- Gender Integration
- Data Capture Strategy
- Monitoring and Evaluation
- Mapping Campaign Facilitation
- Data Model Development
- Mapping with JOSM
- Survey Development
- Quality Assurance/Quality Control
- Persona Development
- Rapid Ideation
- Prototyping
- User Testing
- Sustainability

Through the Online Learning Platform, team members view training videos, participate in webinars, ask questions about the content and submit assignments. Another benefit of the online curriculum is that it gave content access to those team members who were unable to attend the Regional Training Workshops.

Local Trainings

The team members who received training in data collection, mapping and analysis, both during the regional workshops, and, as part of the online curriculum; in turn provided local training sessions for colleagues, government stakeholder staff, and local community mapping recruits. These local training events allowed for the transfer of skills, and a significant increase in OSM community numbers across the participating countries; an important aspect to program sustainability. (please see Table 1 for the number of training events, and attendees that received training for the ADRF cities).

Training revolved around a combination of remote and field data collection tools and applications. Remote Mappers typically received training on the OSM iD editor, and the HOT Tasking Manager, with advanced mappers progressing on to advanced tools such as JOSM (Java OpenStreetMap editor), and QGIS, a desktop GIS application for data management and analysis. Field Mappers received training on mobile data collection tools such as: OpenDataKit, OpenMapKit, OsmAnd, MAPS.ME and streetview imagery collection using the Mapillary app, and in some cases on traditional paper methods, including OSM Field Papers (where appropriate).

Prior to field data collection events, mappers were also trained on community interaction. This included proper introductions, and guidance on key messages and details about the project. Where data collection involved a household survey component, team members were also trained in face-to-face survey techniques.

Table 1: Training numbers for cities funded through African Disaster Risk Financing (ADRF)

City	Number of training events held	Number of people trained	Number of people participating in community mapping activities
Accra	8	329	46
Antananarivo	3	135	105
Kinshasa	17	119	130
Monrovia	8	117	34
Ngaoundéré	17	142	264
Pointe Noire	18	50	250
Saint-Louis	4	50	50
Seychelles	2	38	71
Zanzibar	30	80	22


Society
Ghana Chapter

City Projects & Results 3

The following profiles introduce the nine cities funded through the EU's Africa Disaster Risk Financing Initiative (ADRF). Each profile introduces the problem statement addressed for each city, as well as an overview of the response, with important impacts, and highlights from the project.

ACCRA GHANA

The Challenge

Greater Accra is subject to chronic flooding, the impacts of which are increasing due to climate change and population increase. About 60% of Accra's population is contained within the Odaw River basin. Severe floods in the Odaw basin frequently lead to urban flooding. In June 2015, significant flooding affected more than 50,000 people living in Greater Accra. The World Bank is supporting the Government of Ghana to provide resilient, clean, and inclusive development in the Greater Accra Region under its Greater Accra Resilience and Integrated Development (GARID) Project. The purpose of this support is to strengthen flood and solid waste management, and provision of public services in targeted low-income communities within Greater Accra Region.

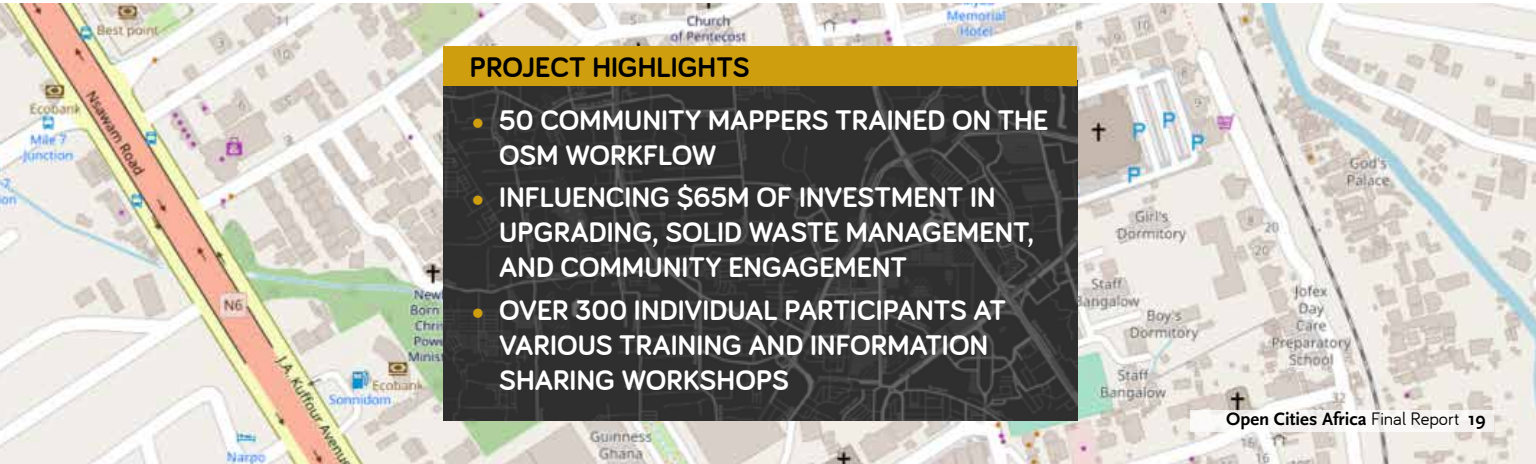
The Response

The Open Cities Accra team is a consortium of three organizations: Mobile Web Ghana (MWG), OpenStreetMap Ghana, and Humanitarian OpenStreetMap (HOT). The team worked to support GARID by creating detailed and accurate maps of the Alajo, Akweteyman, Nima and Alogboshie communities. The team also provided technical training and capacity building for the various government and community stakeholders. Stakeholder analysis identified high levels of geospatial data use among the government stakeholders, therefore the team decided to develop a web platform to share disaster risk management data with these primary stakeholders.



Impacts

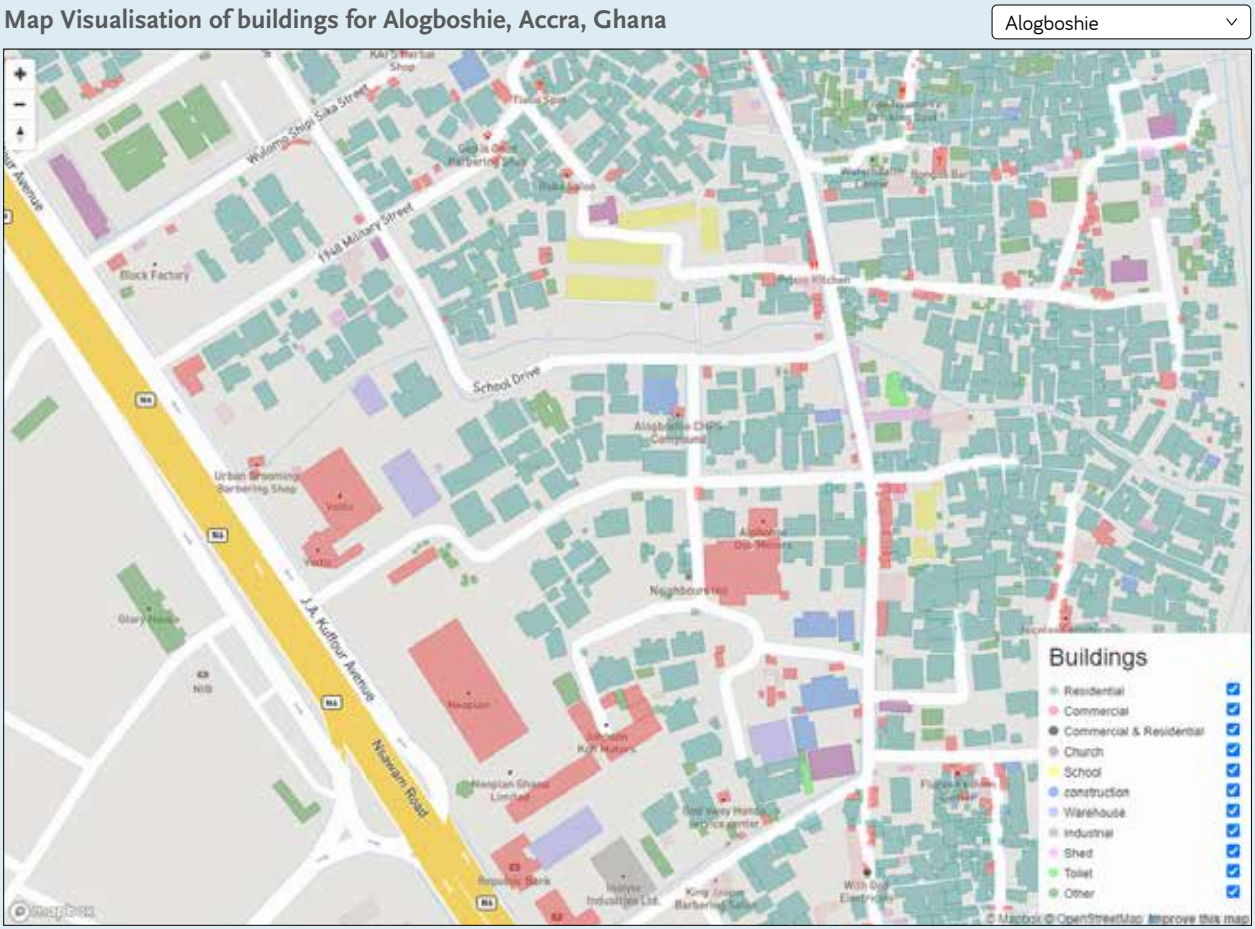
- High resolution drone imagery, as well as street level imagery, was collected for the four communities and made available online using Open Aerial Map and Mapillary.
- Map data collected included detailed building footprints, drainage networks, flood history, roads, waterways, water-points, solid waste, health facilities, educational facilities, and points of interest.
- Capacity building and community engagement was an integral aspect of this project. Mappers from the local community were recruited and trained to collect data using a variety of desktop and mobile tools. Training was provided for the Accra Metropolitan Assembly, Ghana Statistical Services, Metropolitan and Municipal District Assemblies, Ministry of Inner Cities Development and Zongos, National Disaster Management Organization.
- Gender analysis and gender integration were integral parts of this team's methodology. Gender balanced field teams ensured women from the community could work with female mappers.
- A web application was developed to allow the stakeholders to make data driven decisions, particularly for participatory upgrading and solid waste management investments under GARID.



PROJECT HIGHLIGHTS

- 50 COMMUNITY MAPPERS TRAINED ON THE OSM WORKFLOW
- INFLUENCING $65M OF INVESTMENT IN UPGRADING, SOLID WASTE MANAGEMENT, AND COMMUNITY ENGAGEMENT
- OVER 300 INDIVIDUAL PARTICIPANTS AT VARIOUS TRAINING AND INFORMATION SHARING WORKSHOPS

Map Visualisation of buildings for Alogboshie, Accra, Ghana



The digital platform visualizes building and drainage infrastructure and flood history for neighborhoods of Accra, Ghana. The platform is currently hosted on https://ocavi-app.herokuapp.com/.

ANTANANARIVO MADAGASCAR

The Challenge

Antananarivo is located in the heart of the Madagascar highlands; it is situated on 12 laterite hills and alluvial plains drained by three rivers (Ikopa, Sisoany and Mamba). The region receives an average annual rainfall of 1300mm, of which 90 percent is concentrated in the rainy season. The older parts of the city are located on the hill tops, while new growth is concentrated on the natural floodplain, which makes it particularly vulnerable to urban flooding. Greater Antananarivo (GA) was most recently hit by catastrophic flooding in January 2015, which affected an estimated 93,000 people and displaced 40,000. The country's resilience is constrained by the pre-existing vulnerability of the population and the weakness of the public infrastructure and services.

The Response

Open Cities Antananarivo, led by HABAKA, focused on low-income formal and informal communities in the center of the city. These areas are prone to significant flood risk and face extremely high levels of poverty. The Open Cities team performed detailed household surveys in addition to the base mapping activities, working closely with the primary stakeholder; CPGU (*Emergency Management and Prevention Unit*). Data collected will be integrated in the urban study under the Integrated Urban Development and Resilience (PRODUIR) project for better neighborhood planning and upgrading. Moreover, the urban project will share information on project intervention via OpenStreetMap and for local emergency plans.

Impacts

- Household surveys captured data on characteristics of the home, property access, fire hydrants, public infrastructure, householder state of health and physical fitness, access to hospitals and emergency services in each Fokontany.
- The World Bank is currently preparing a series of projects in this area including PRODUIR, focusing on drainage, flood protection and urban upgrading. The data collected under Open Cities will inform preparation and planning for these initiatives.
- Survey Teams were intentionally gender balanced to put female householders at ease.
- The final product for the project is a web mapping application that is integrated into the Madagascar GeoNode data repository, allowing data search and downloads.
- HABAKA, the NGO leading the Open Cities Antananarivo effort, used the opportunity for the promotion of entrepreneurship, technology and innovation in the city.

PROJECT HIGHLIGHTS

- 15 STAKEHOLDER GROUPS CONSULTED
- 135 PEOPLE TRAINED (GOVERNMENT, STUDENTS, AND LOCAL COMMUNITY)
- 6,426 BUILDINGS, 250KM OF ROAD AND 111KM OF DRAINAGE MAPPED

KINSHASA DEMOCRATIC REPUBLIC OF THE CONGO

The Challenge

With an estimated population of 12 million inhabitants in 2016, Kinshasa is Central Africa's largest and fastest-growing urban system. Many areas of the city are surrounded by hills, leading to rapid precipitation run-off towards low-lying plains bordering the Congo River. Failure to implement land development pushes the poorest to settle in flood and erosion prone areas, increasing their vulnerability to weather and climate related hazards. Some neighborhoods are regularly flooded and extreme precipitation can lead to loss of life and property. Both central and local governments lack the data and information necessary to better understand the magnitude and distribution of risk and to better prepare, cope and recover from these events.

The Response

The Open Cities Kinshasa project, led by OSFAC and Potentiel 3.0, complements ongoing World Bank activities through hazard and exposure mapping in selected poor neighborhoods of Kinshasa's N'Djili urban watershed.

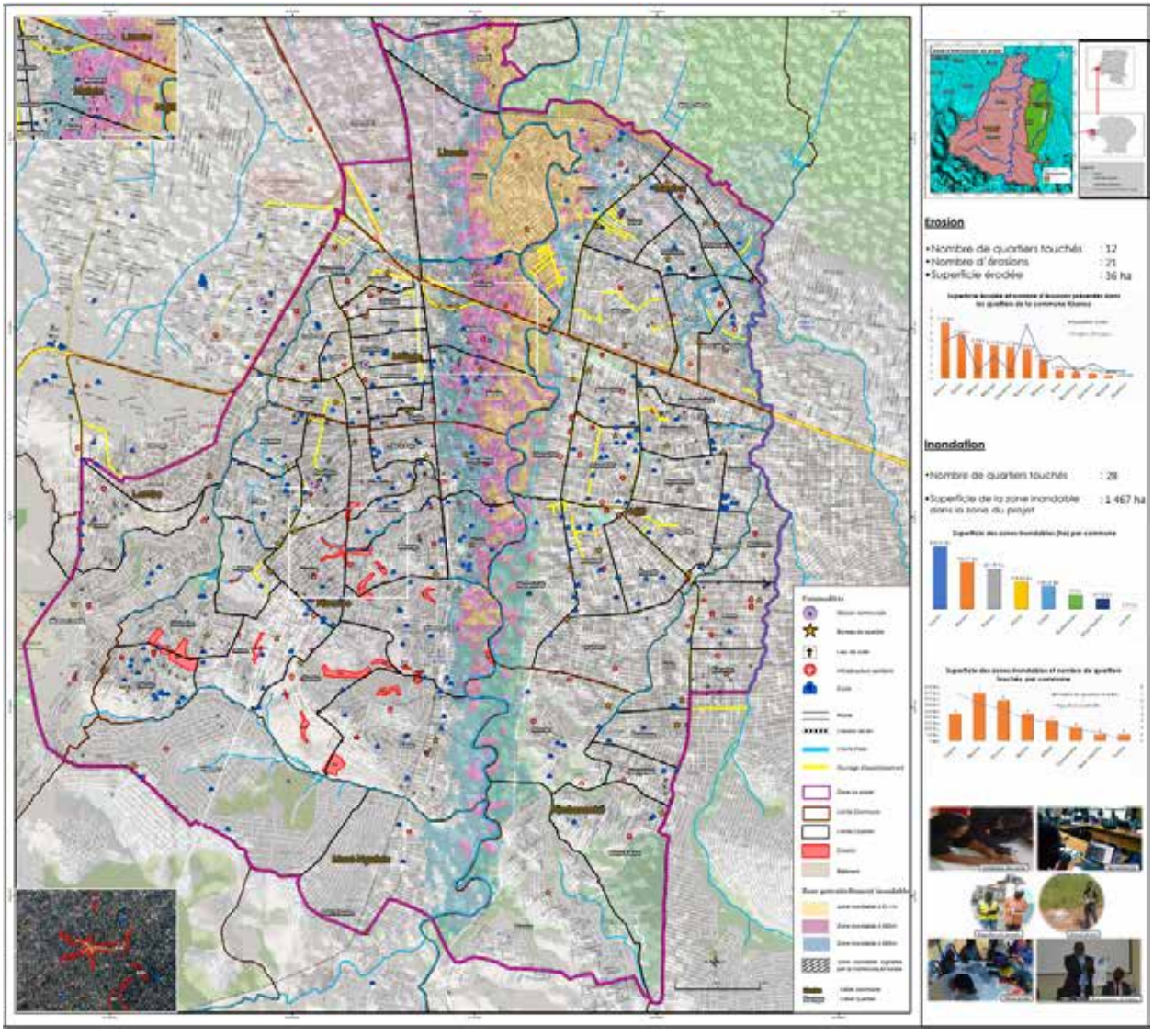
Data collection activities focused on the priority areas of Matété and Kisenso communes west of the N'Djili River. Fieldwork involved attribution of critical infrastructure and base data, followed by risk data collection (such as erosion, flood and drainage features) and finally validation of the map data with local community focus groups. The datasets will inform flood risk modeling and mitigation measures and refine soil maps for more precise exposure mapping under the Kinshasa Multisector Development and Urban Resilience Project and hydromet activities.

KINSHASA DEMOCRATIC REPUBLIC OF THE CONGO



Impacts

- The Open Cities Kinshasa team mapped 57,463 buildings, including 36 schools, 1 university, 20 hospitals, 36 churches, 1 police station, 1 gas station. 1839 roads (names, asphalt, unpaved, earthen, tunnel, one way).
- Using a user design process, stakeholders decided that a digital database, along with community atlas' were the best ways to share and disseminate the project data.
- 13 training events held, and 88 people trained on mapping technology.
- Exposure and hazard maps will inform anti-erosion works planned under the Kinshasa Multisector Development and Urban Resilience Project.



The Open Cities Kinshasa atlas contains approximately 100 maps of erosion and potentially floodable areas for 70 neighborhoods of the city. The complete atlas is accessible at https://osfac.net/opencities/atlas/OpenCitiesKinshasa_ATLAS.pdf.

MONROVIA LIBERIA

The Challenge

The city of Monrovia is a densely populated peninsular area surrounded by ocean and rivers with unplanned settlements that are prone to disasters. These settlements became densely populated during Liberia's 14 year-long civil war - a period where most rural dwellers relocated to the capital to seek employment, education, trading opportunities and security. Vulnerabilities in Monrovia's unplanned settlements are numerous, ranging from mobility, health, education, sanitation and hygiene, lack of adequate economic activities for employment, waste management among others. Upon these pre-existing conditions, cyclical flooding is turning these communities into huge disaster hubs

The Response

The Open Cities Monrovia project was led by Humanitarian OpenStreetMap Team (HOT), iLab Liberia and OSM Liberia, and provided extensive mapping in the Clara Town, River View, Struggle (Doe) and Hope communities. The team worked closely with Liberia Institute of Statistics and Geo-Information Services (LISGIS), Monrovia City Corporation (MCC) and representatives of the target communities. The project developed products (printed atlas and wall maps) using data collected from these communities to inform responders, government and local leadership on how to address flooding and flood related issues.

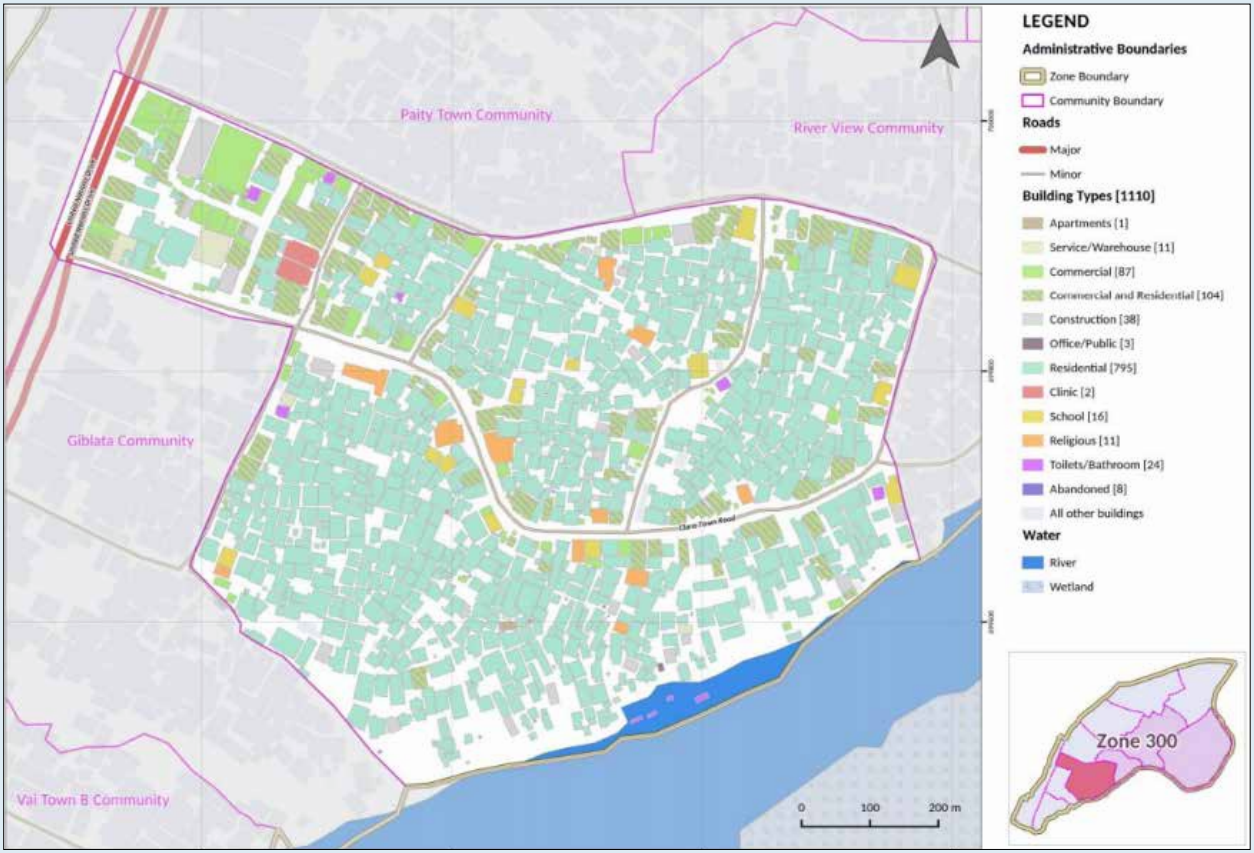
Impacts

- Flooding in Monrovia occurs during the rainy season (Apr - Oct). The team collected data during the rainy season, to capture accurate impacts of flooding and making way for interventions to occur during the dry season.
- The following features were mapped from high resolution drone imagery captured for the project: 4,126 buildings, 82 water points, 93 solid waste points, 86 economic activities, 32 education facilities, 24 health facilities, 76 drain lines, 33 drain points, and 234 historical flooding points.
- The publicly available data products will give communities and leadership a much needed insight into the challenges these communities are facing regarding flooding, and will help guide future sustainable projects.
- The success of Open Cities Monrovia has led to an expansion of city-wide mapping efforts. Following a successful drone pilot to map 20 sq km around Red Light and Douala markets, drone imagery acquisition was scaled city-wide to inform a land utilization study and built density analysis, to support the "Monrovia urban strategy ASA". A detailed 'productivity and pollution impacts' study of Duala market, was also conducted.
- Under this project, a new collaboration has formed that will see the Liberian mapping community grow, furthering community mapping activities and initiative in Liberia.

PROJECT HIGHLIGHTS

- 42 STAKEHOLDER GROUPS WERE ENGAGED, 7 WOMEN'S COMMUNITY GROUPS
- 8 OF 20 FIELD MAPPERS WERE WOMEN
- 93 PEOPLE TRAINING ON MAPPING TOOLS AND TECHNIQUES, INCLUDING 30 YOUNG PEOPLE FROM THE TARGET COMMUNITIES

Zone 300, Clara Town Community: Building type or use



The Open Cities Monrovia printed atlas was distributed to government and community leaders. Wall maps are put on display on community notice boards and youth centers for the benefit of all community residents.

NGAOUNDÉRÉ CAMEROON

The Challenge

The city of Ngaoundéré faces recurring challenges related to urban floods, which are increasing as its uncontrolled urbanization continues. Urbanization has been largely spontaneous, resulting from the increasing occupation of many flood-prone areas, wetlands and mountain slopes without adequate land management. To improve the management of its territory, the Urban Community of Ngaoundéré (CUN) must update their open access spatial data to capture built space and critical infrastructure located in areas at risk of floods and major beds of the main rivers. Such data could enable municipal and local authorities to better plan urban growth, land use, urban development and the various interventions in the event of floods and landslides.

The Response

The primary implementer, ACAGER, worked with local stakeholders to collect geospatial data in the most vulnerable communities. This included an area of 328 sq km and more than 35,000 objects such as buildings, streams and streets that were collected using a participatory approach. As maps were developed community members were consulted to validate the information. A user-centered design approach was used with government leaders to ensure the web atlas developed was tailored to their specific needs, and paper maps were also developed for local community leaders.



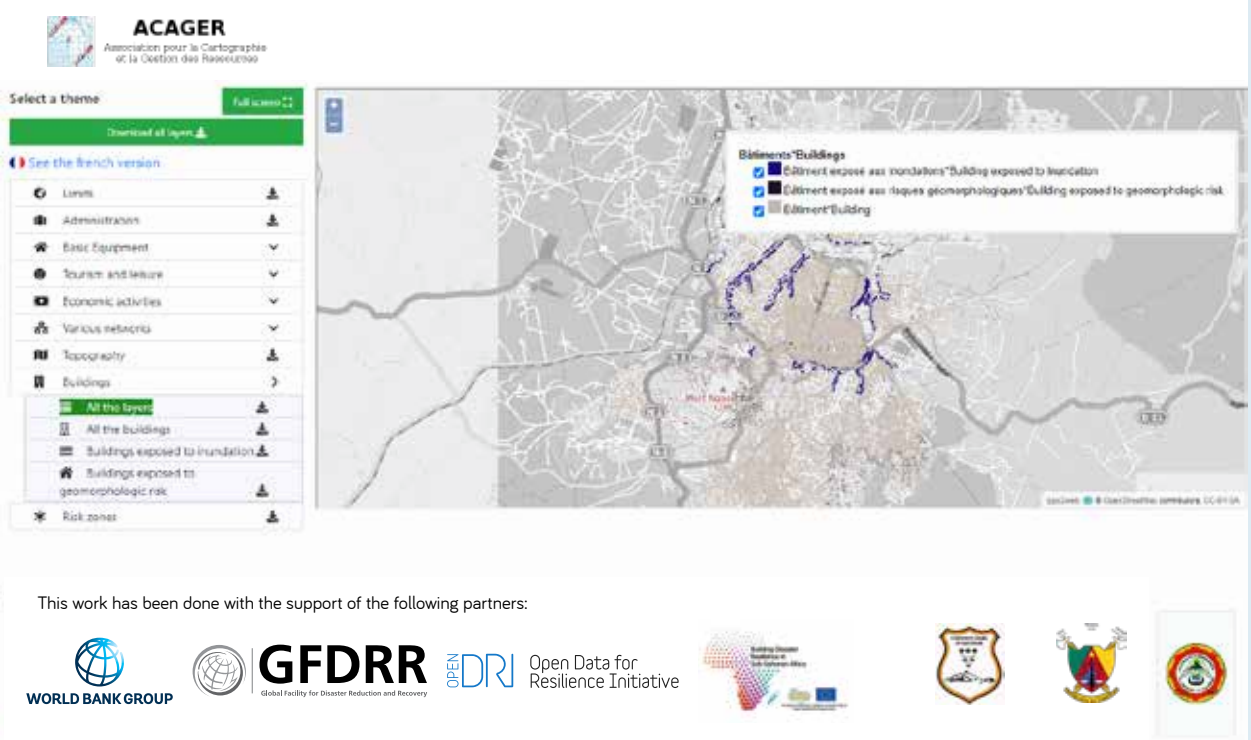
Impacts

- Data collected was used to develop a web atlas for government leaders (http://acager.org/portalgis/en/) and paper maps for local community leaders to better manage urban growth and disaster risk in their areas.
- The Ngaoundéré City Council intends to use project maps as the basis to develop an Own Source Revenue system to support the collection of taxes.
- Project training content was used to launch a spin off initiative through the local university that is mapping 4 cities in Cameroon and Chad.
- Local students who worked as mappers received excellent technical training, and one of them was recruited upon graduation to work in the National Institute of Cartography in the capital.
- The data collected is informing the design of planned neighborhood-level infrastructure (streets, water connection, street lighting, etc.) under the Inclusive and Resilient Cities Project (PDVIR).

PROJECT HIGHLIGHTS

- 33 LOCAL STAKEHOLDER GROUPS CONSULTED
- OVER 89,000 BUILDINGS EDITIED, AND OVER 1800 KM OF ROADS
- LOCAL UNIVERSITY NOW TEACHES PARTICIPATORY MAPPING COURSEWORK TO STUDENTS

Ngaoundéré maps for resilience and climate change adaptation http://acager.org/portalgis/fr/



The Open Cities Ngaoundéré database and atlas contain 93 maps depicting flood and erosion exposure for neighborhoods in and around the Mount Ngaoundéré area.

POINTE-NOIRE REPUBLIC OF THE CONGO

The Challenge

Pointe-Noire, the country's economic capital and home to a quarter of its population, faces recurring challenges as population growth pushes households into flood and erosion-prone areas. More than half of Pointe-Noire's urban space is occupied by unplanned settlements built from fragile materials. During the rainy season several of these neighborhoods become inaccessible due to flooding. Pointe-Noire has seen disease outbreak from contaminated wells and flooded latrines, and hundreds of residents have been displaced by recent flood events. The city also suffers from landslides due to deforestation and fragile soils. Efforts to reduce the population's vulnerability to climate related hazards have been inhibited by lack of effective urban planning, limited investment, and inadequate institutional capacity of key stakeholders at the national and local levels.

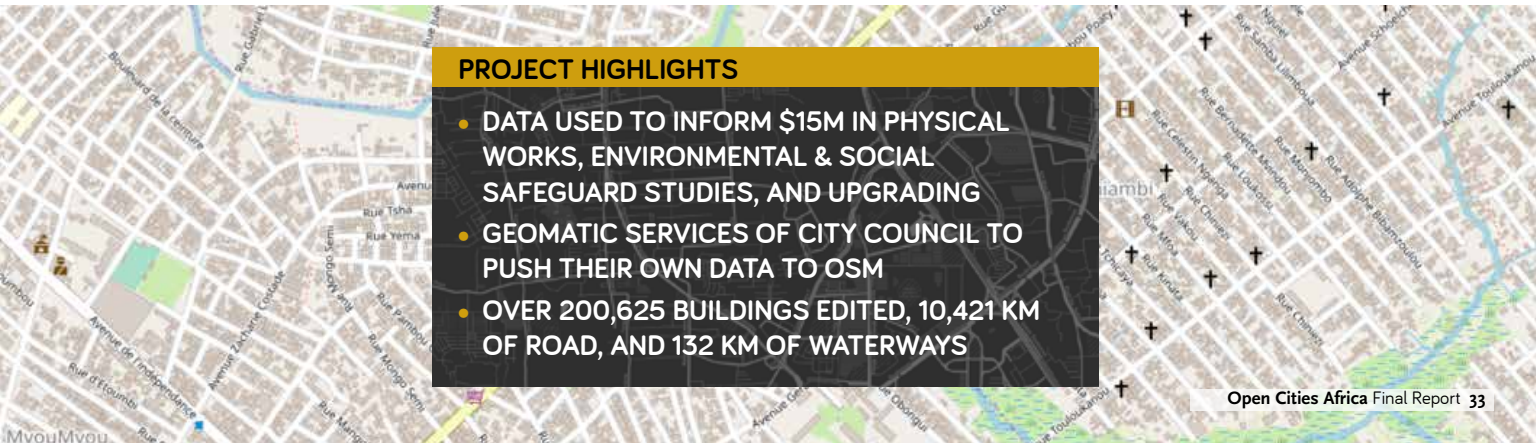
The Response

The World Bank is currently working to improve urban resilience through the Water, Electricity and Urban Development Project (PEEDU, P106975) and the Congo Urban Development and Poor Neighborhood Project (DURQuaP, P146933). The Open Cities Pointe-Noire project complements both of these efforts through tool development and capacity building activities. A consortium composed of Immergis Cameroon and the Ucac-Icam Institute of Pointe-Noire, with their local partners conducted community mapping in two flood prone neighborhoods; Quartier Mboukou and Quartier Tchiniambi.



Impacts

- High resolution imagery was acquired for Mboukou and Tchiniambi Quartiers.
- Remote mapping was conducted for "Greater Pointe Noire"—an area of 250 km², while field mapping was focused on Mboukou and Tchiniambi Quartiers 1.55 km²
- 26 local cartographers were trained to conduct the field mapping exercises, and over 300 people were trained to use the resulting data products.
- Following a user centered design process, where community and other stakeholders were consulted, a Community Atlas and wall maps were produced for Mboukou and Thciniambi. A Web GIS Platform allowing them to display, update, upload, download and share project data for the DURQUAP project is also under development (http://pointe-noire.opencitiesafrica.org/)
- City council members were provided and trained on ODK, OMK, QField, QGIS, JOSM and MapsMe. Members of the Geomatics services are now fully involved in the Open City Project in Pointe Noire, they are involved in field work and hosting the monthly mapathons in their offices.
- Results will inform physical investment and institutional strengthening activities which include physical works (roads rehabilitation,



PROJECT HIGHLIGHTS

- DATA USED TO INFORM $15M IN PHYSICAL WORKS, ENVIRONMENTAL & SOCIAL SAFEGUARD STUDIES, AND UPGRADING
- GEOMATIC SERVICES OF CITY COUNCIL TO PUSH THEIR OWN DATA TO OSM
- OVER 200,625 BUILDINGS EDITED, 10,421 KM OF ROAD, AND 132 KM OF WATERWAYS

SAINT-LOUIS SÉNÉGAL

The Challenge

The historic city of Saint-Louis, located in a coastal zone at the mouth of the Senegal River is an UNESCO World Heritage Site. Home to just over 300,000 inhabitants, Saint-Louis is exposed to multiple natural hazards, including floods, coastal erosion, and saltwater intrusion. Climate change impacts such as sea level rise and increased frequency and intensity of storm surges and gale force winds are exacerbating vulnerability to these hazards. The city is separated into three geographical areas: the thin Langue de Barbarie peninsula on the western coast; the old town on N'Dar Island on the Senegal River; and the mainland Sor on the river's eastern bank. Informal settlements are spread throughout the greater city, making up 30 percent of the urban space.

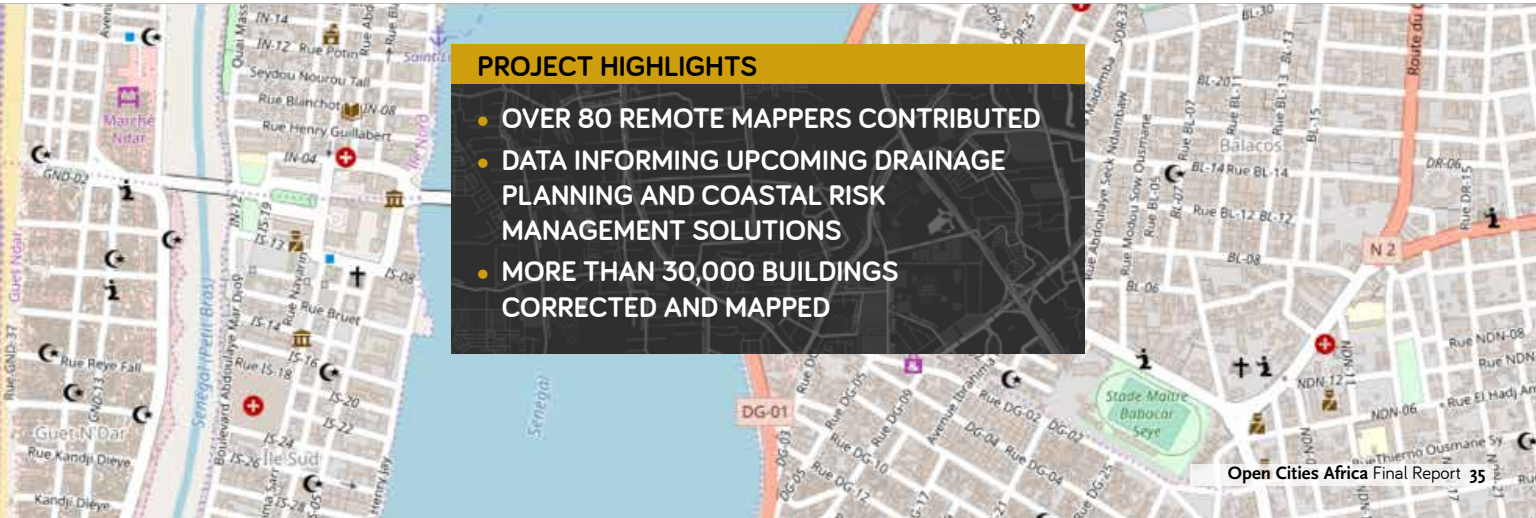
The Response

The Open Cities Saint-Louis project complements ongoing World Bank activities in the city, through capacity building and data collection. Exposure data for Saint-Louis was outdated and incomplete, and improving this database is a critical element to support effective data-driven urban planning and increase urban resilience. The implementing team led by IMMERGIS and BEST worked closely with Commune de Saint Louis, the Université Gaston Berger and OSM Senegal to collect extensive basedata for the city.

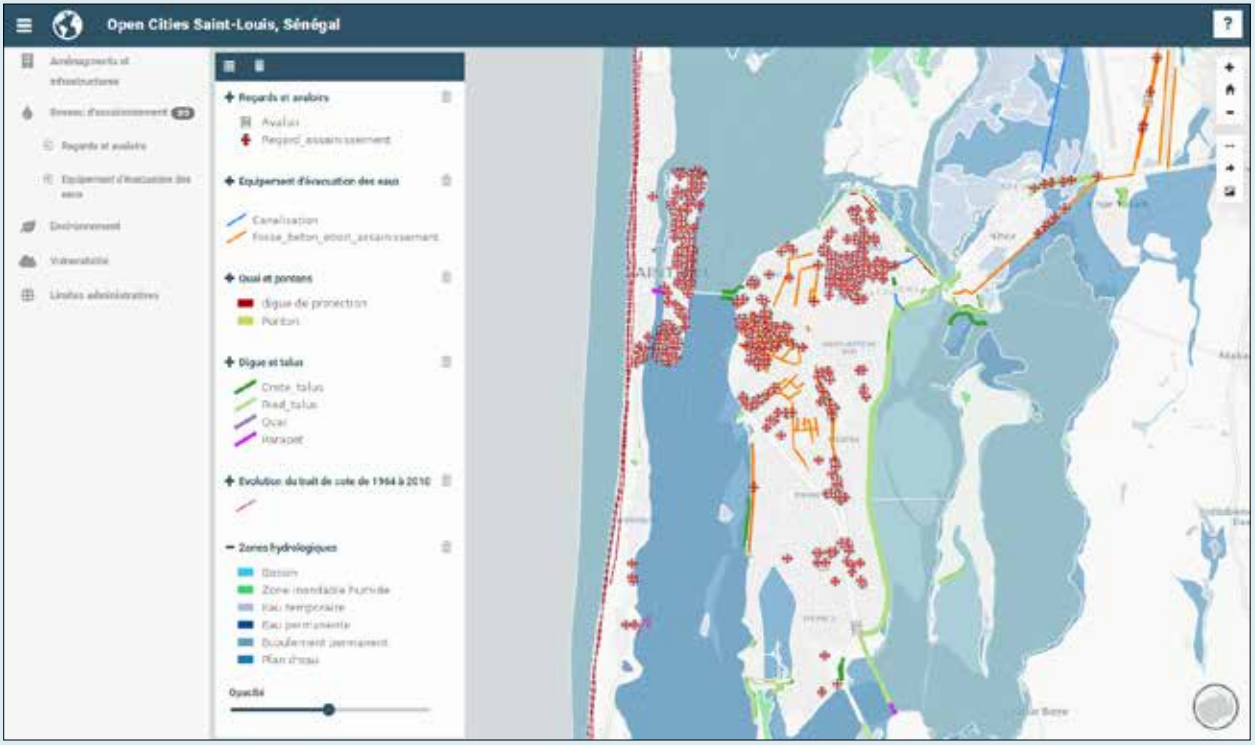


Impacts

- Data collected will directly support ongoing World Bank Projects closely coordinated with Open Cities Saint-Louis:
  - The Stormwater Management and Climate Change Adaptation Project (PROGEP).
  - The Saint-Louis Emergency Recovery Project (SERRP)
  - The West African Coastal Areas (WACA) project.
- Over 37,071 buildings, 1930 km of roads, and 79 km of drainage were created or edited
- The Open Cities data collected will be particularly useful for an upcoming flood risk study related to drainage implemented by EGIS and Deltares.
- Data collection under Open Cities was extended to include drainage and barriers in key sites of the city, including the island of Sor.
- A Web GIS Platform allowing them to display, update, upload, download and share project data is also under development (http://saint-louis.opencitiesafrica.org/).



Open Cities Saint-Louis, Sénégal http://saint-louis. opencitiesafrica.org/



The Open Cities Saint-Louis web GIS platform is displayed thematically in an easy to use format for coastal and flood management decision-making.

MAHÉ, PRASLIN & LA DIGUE SEYCHELLES

The Challenge

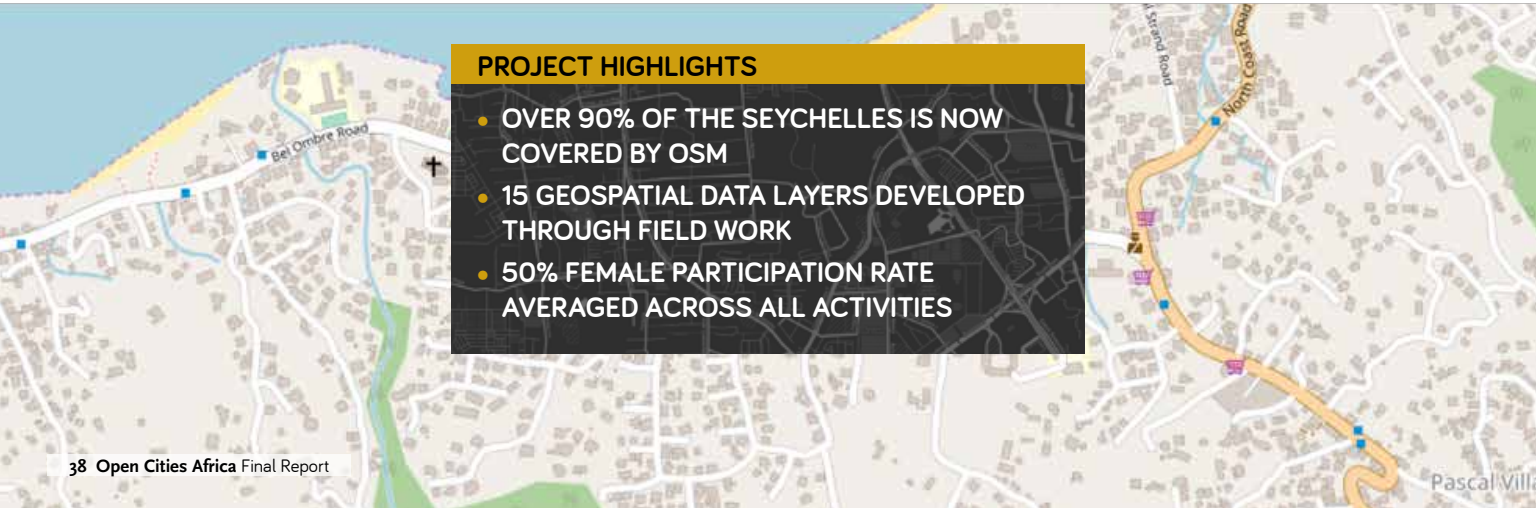
The majority of the Seychelles population is spread across three islands (Mahé, Praslin and La Digue). Due to the topography of the islands (i.e. flat coastal strips and/or plateaus rising into steep mountains towards the inner part of the island) many of the residential and commercial areas are located along the coast. Victoria and the thin coastline of Mahé are the source of the majority of economic activity in the Seychelles, but are highly vulnerable to urban flooding and coastal hazards. While some geographic data exists, there are critical gaps that need to be filled to enhance the government's ability to make decisions in light of natural disaster risks, such as; coastal erosion, coastal flooding, and urban flooding.

The Response

Mapping activities sought to fill critical gaps in the availability of base data, by focusing on urban and coastal infrastructure, with a strong focus on critical tourism infrastructure. In addition, the Open Cities Seychelles looked at public institutions such as schools, orphanages, day-cares and nursing homes because of their specific vulnerability. The implementing team at All-Spatial worked with high schools, and government departments to perform data collection. To facilitate access to the data collected the Open Cities Seychelles team implemented a tool that extracts the relevant information from OSM and generates layers in GeoPackage format. These layers can be loaded in a Geographic Information System (GIS) and be used for further analysis.

Impacts

- The project team held a four-day hands-on work- shop on GIS and OSM for government stakeholders and secondary school teachers applying a train-the-trainers approach Teachers from six secondary schools and seven government organisations attended the training.
- The team ran a multi-high school mapathon - over sixty students and eleven teachers from six secondary schools participated on Mahé, Praslin and La Digue.
- The GeoPackage product is open access, therefore anyone can retrieve the data. The data is also available through a standard-compliant web service, in particular a Web Feature Service (WFS).
- Through World Bank support, a national spatial data sharing policy was developed by the national centre for GIS under the Ministry of Habitat, Infrastructure and Land Transport (MHILT) - the focal government agency for Open Cities in Seychelles)
- Open Cities Seychelles imported 32,000 building footprints into OSM, made possible through cooperation from the Centre for GIS under MHILT and the National Bureau of Statistics (NBS).



PROJECT HIGHLIGHTS

- OVER 90% OF THE SEYCHELLES IS NOW COVERED BY OSM
- 15 GEOSPATIAL DATA LAYERS DEVELOPED THROUGH FIELD WORK
- 50% FEMALE PARTICIPATION RATE AVERAGED ACROSS ALL ACTIVITIES

ZANZIBAR TANZANIA

The Challenge

Zanzibar City is a rapidly growing, densely populated urban area with significant threat of flooding. According to some estimates, between 70 and 80 percent of residents of Zanzibar City live in unplanned settlements. For the purposes of disaster risk management, the Revolutionary Government of Zanzibar (RGoZ), specifically the Commission for Lands (COLA) and the Department of Urban Planning, have noted with urgency the need to update their Zanzibar Master Plan with locations of all the built structures and flood prone areas in the City.

The Response

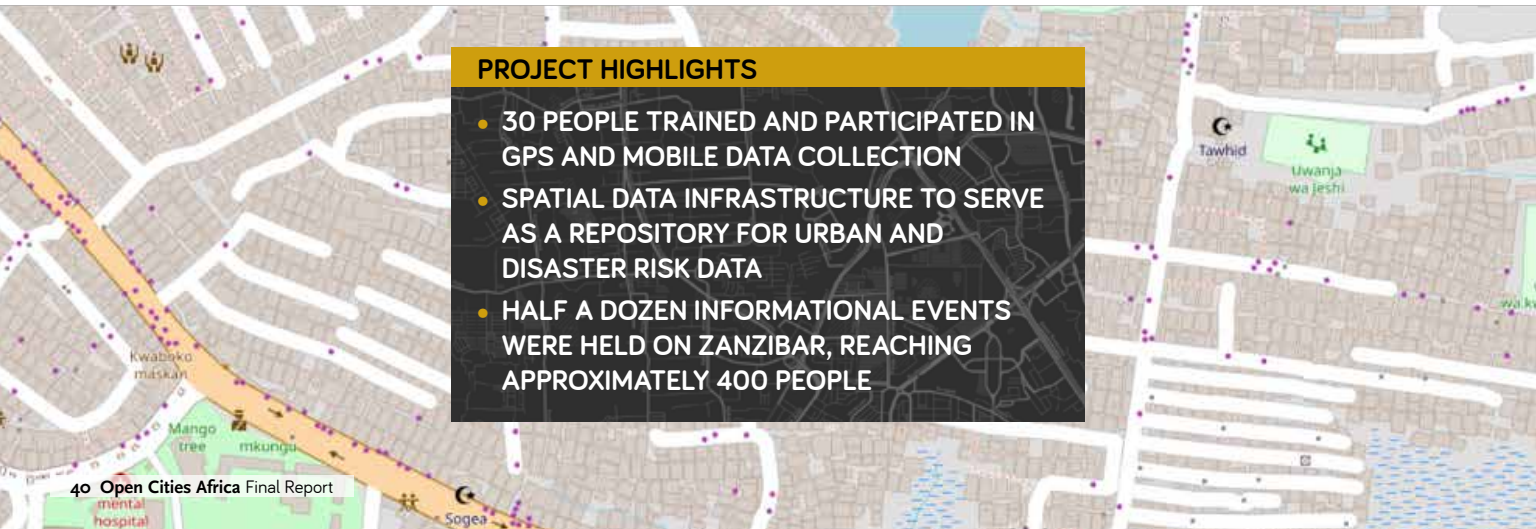
Spatial Collective, the implementing partner for the initiative, spent months on Zanzibar building capacity of the local stakeholders and coordinating various data collection activities. The goal was to generate and visualize datasets critical to disaster risk management and build local capacity in the process. Trainee participants were selected and mobilized by

the primary stakeholder; Zanzibar's Commission for Lands, and the State University of Zanzibar. Training in GPS and mobile data collection was carried out by Spatial Collective, and was followed by three weeks of intensive data collection was carried out in central Zanzibar City. GPS locations of points of interest, as well as 2,100 household surveys were completed.



Impacts

- Approximately 160,000 buildings were digitized and added to the preexisting dataset of 200,000 buildings on Unguja Island, completing digitization of Zanzibar Archipelago's largest island. Approximately, 20,000 buildings on Pemba Island were digitized.
- Openly available Interactive map of the area of interest
- All drone imagery is made available to the public under a creative commons license
- The digital maps and data layers created through Open Cities Africa project, will inform the "Boosting Inclusive Growth for Zanzibar" (The BIG-Z) project which will support the establishment of a Spatial Data Infrastructure for Zanzibar. The Zanzibar SDI will inform urban management, land use and regional development, disaster risk management, and municipal financing.
- Community members, shehia administrators, and local emergency responders in at least 6 Shehia's were engaged in the process.
- 12 stakeholder groups were consulted and 6 technical staff at the Zanzibar's Commission for Lands were trained in setting up field data collection.



PROJECT HIGHLIGHTS

- 30 PEOPLE TRAINED AND PARTICIPATED IN GPS AND MOBILE DATA COLLECTION
- SPATIAL DATA INFRASTRUCTURE TO SERVE AS A REPOSITORY FOR URBAN AND DISASTER RISK DATA
- HALF A DOZEN INFORMATIONAL EVENTS WERE HELD ON ZANZIBAR, REACHING APPROXIMATELY 400 PEOPLE

OTHER OPEN CITIES PROJECTS

In parallel to the activities in the cities supported by the Africa Disaster Risk Financing Initiative, the Open Cities Africa network has been growing through collaboration with other World Bank teams and donors in the following cities.

Abidjan, Côte d'Ivoire

The World Bank backed Urban Sanitation and Resilience Project (le *Projet d'Assainissement et de Résilience Urbaine* or PARU) aims to improve resilience to flood risks and solid waste management services in vulnerable neighborhoods of the Abidjan District and targeted secondary cities. The Open Cities Abidjan team will collect critical base map information, including settlements, transport network (vehicular and pedestrian), drainage infrastructure, waste deposition areas and the location of informal economic activities. This activity was funded by the ACP-EU Natural Disaster Risk Reduction (NDRR) program managed by GFDRR.

Bamako, Mali

The World Bank is supporting the Government of Mail in taking measures to increase access to resilience data in the city. The objectives of this support is: i) the creation of an open digital platform for the city (*Digital Platform for a Resilient Bamako*), facilitating data sharing and an overall understanding of flood risk in the city; ii) raising awareness for flood risk among the city population, municipal staff and institutions, and iii) building capacity for data collection and use of flood risk data by faculty, students and government staff. The project will follow the Open Cities methodology to organize and conduct mapping campaigns to record baseline information on specific thematic (public equipment, solid waste management, flood management) in the entire district of Bamako, and detailed data for specific targeted neighborhoods. This activity was funded by the Korean Green Growth Trust Fund.

Brazzaville, Republic of the Congo

The objective of this project is to integrate urban resilience in the design and implementation of an Urban Development and Poor Neighbourhood Upgrading project (DURQuaP), and to build capacities, and develop tools for central and local governments to address disaster risks. Outputs would include a GIS-based disaster risk management system to support basic early warning system for flooding; OpenStreetMap data to enable flood risk exposure mapping and social economic vulnerability mapping; and, associated community participatory mapping tools to enable Local Governments, in very close coordination with communities, to produce a more robust municipal base maps. This activity was funded by the ACP-EU NDRR program managed by GFDRR.

Dar Es Salaam, Tanzania

Ramani Huria is a community-based mapping project, training university students and local community members to create highly accurate maps of the most flood-prone areas of the city. As the maps have taken shape, their benefits have multiplied and their potential magnified, now serving as foundational tools for development within all socio-economic spheres beyond flood resilience. Ramani Huria is managed under the Tanzania Resilience Academy and operates in collaboration with Open Cities Africa. This activity was funded by the United Kingdom Department for International Development (DFID).

Freetown, Sierra Leone

The Resilient Urban Sierra Leone Project (RUSLP) project aims to (i) improve urban management in select cities, (ii) increase access to services and resilient infrastructure in Greater Freetown, and

(iii) enhance local and national capacity for emergency preparedness and response. It will support five mutually reinforcing components. Component one focuses on disaster risk management and resilient infrastructure, and plans to incorporate the Open Cities methodology into the collection of data for community upgrading under this component. This activity was funded by the Multi-donor Trust Fund of GFDRR.

Kampala, Uganda

The Uganda Open Mapping Program aims to develop technical capacity at the local and national level in the open mapping. Ggaba parish, Kampala was identified as a priority area to be mapped. Under the supervision of the World Bank, a team of local companies (MapUganda and GeoGecko) and international entities (HOT and ITHACA) worked together to fulfil project requirements. One of the main goals of the project was to significantly increase the coverage and detail of reference cartographic data, enabling national and local authorities (e.g. UBOS and KCCA) as well as other institutions/companies to exploit such data for their mandate, such as; addressing risk management related tasks; keeping updated health and education facility inventories; supporting the census data collection and management; and, showcasing the mapping and analytical power of the data collected. This activity was funded by the program "Building Resilience through Innovation and Open Data in Sub-Saharan Africa Program" from the Belgian Development Cooperation managed by GFDRR.

Niamey, Niger

The Niger River poses a severe flood risk to the West African country of Niger during the rainy season. In the third quarter of 2017, widespread flooding claimed the lives of over 50 people and displaced nearly 200,000. Lying on the banks of the Niger River, the Nigerien capital Niamey is especially vulnerable to flood risk. Poorly planned development in the city, which has contributed to land degradation and soil erosion, has only exacerbated the risk. Many parts of Niamey lack proper drainage infrastructure. Against this backdrop, the government of Niger, in partnership with the World Bank and the Global Facility for Disaster Reduction and Recovery (GFDRR), has been stepping up its efforts to systematically gather data and information on Niamey's exposure and vulnerability to flood risk. This activity was funded by the program "Building Resilience through Innovation and Open Data in Sub-Saharan Africa Program" from the Belgian Development Cooperation managed by GFDRR and the Niger Disaster Risk Management and Urban Development Project (PGRC-DU) of the Niger Government.

Yaoundé, Cameroon

The Government of Cameroon through the Inclusive and Resilient Cities Development Project (IRCDP), is working with the World Bank to improve urban management, access to infrastructure, and resilience to natural hazards in several cities. In Yaoundé's Municipalities 5 and 7, the SOGEFI - IRD consortium will : i) design and facilitate the implementation of a risk understanding curriculum comprising several block courses in close collaboration with local universities; ii) in collaboration with the OpenStreetMap Cameroon association, ensure the collection of existing and new data on disaster risks, including exposure data; iii) produce flood risk maps based on the results of flood modelling; and iv) provide technical assistance to integrate risk information into urban land use plans and urban development projects in Yaoundé. This activity was funded by the ACP-EU NDRR program managed by GFDRR.

4 Gender Approach

Open Cities implementation teams were able to understand additional types of data to collect and include on projects maps so that they would accurately reflect the needs and interests of community members. They were also able to explore adaptations to their recruitment models and implementation strategies to remove barriers to women's participation in Open Cities Africa projects.

Open Cities Africa sought to better understand the local dynamics that i) determine how men and women are affected differently by disasters, and ii) can make it difficult for women to engage in participatory mapping projects. When projects are designed, and maps are created by disproportionately male teams, features that are important to local women such as market areas, safe spaces like shelters, or gender-specific services may not be included on the map. Similarly, roads or pathways identified may not reflect the routes that women feel safe using.

Maps provide access and power. Whoever makes the map often determines what is featured on the map; and if those features are biased towards the needs and interests of a specific group, it can ultimately skew emergency response and urban development. The lack of women engaged in digital projects such as mapping has tangible consequences and can run the risk of further exacerbating local inequalities.

Gender Analysis

The first component of the Open Cities Africa gender approach was a Gender Analysis, to better understand how men and women in each project community were affected differently by the natural hazards. Men and women often have different roles and responsibilities, different schedules, or varied access to information, and any of these aspects could influence how they are affected by disasters. Teams were encouraged to meet with local community groups to better understand these dynamics. They were also asked consider how they could engage women in the design of community maps and how data products could be developed so that they reflect the needs and priorities of both men and women. The findings of these analyses varied by city and even community. Below are several of the key themes identified by the Open Cities teams of how men and women are affected differently by natural hazards:

- **Division or Labor and Economic Activities –** Differences in the types of economic activities men and women pursue and whether their work is paid or unpaid, lead to differences in income levels that can influence the extent to which losses due to disasters are difficult to recover from.
- **Access to Information –** Differences in how men and women access information such as by television, radio or word-of-mouth inform their levels of awareness.
- **Different Skills and Capacities –** Reactions to natural hazards and their timing can be influenced by skills and capacities such as how well men and women can swim or climb to safe places.
- **Vulnerability to Violence –** Women and girls face a heightened risk of violence when they are forced to stay in temporary shelters or with other community members.
- **Low Financial Resilience –** Depending on their sources of income and whether or not they are available, men and women may have different levels of financial resilience. For example, if their income is generated by selling crops, they may have a difficult time recovering financially if their plots of land are ruined.
- **Vulnerability to Diseases –** Men and women may have different levels of exposure to diseases

based on the amount of time they spend at home during or following a natural hazard, their degree of contact with family members and their levels of access to clean water.

Understanding these differences helped teams determine what features would be most important to include on project maps. In Pointe-Noire the Open Cities team carried out separate focus groups with male and female community members to ensure that everyone felt comfortable sharing their perspectives on the challenges they face as a result of urban floods. Men focused on the destruction water damage caused to their homes and threats of job termination as a result of absenteeism, while women shared that they struggle to find safe drinking water and protect their families from the increased risk of contracting diseases. Open Cities Africa teams were able to use this type of community feedback to make sure that their data products accurately reflected local needs so that government leaders could better understand and manage these communities.

Men's and women's focus group discussions that informed to Gender Analysis findings in Pointe-Noire.

One Female Mapper's Open Cities Africa Experience

Pascalina Awelana Abadum worked on the data collection team of the Open Cities Accra project. As part of the Open Cities work, she was selected to attend the Third Regional Meeting in Côte d'Ivoire and the 2019 State of the Map Africa conference, where she was inspired by many of the women presenters. Through her Open Cities mentors she began working with Soko Aerial, which helped her to continue to grow her expertise in GIS data collection and UAVs. Through this work she was able to attend the Africa Drone Forum in Rwanda in 2020 where she met even more young leaders working on geospatial mapping and further developed her professional. Today Pascalina works on Data Quality for the Humanitarian OpenStreetMap Team and credits Open Cities Africa for helping he identify her passion and launching her career.

Barriers to Entry

The second component was for teams to identify potential barriers to women's participation in Open Cities Africa activities, and select some of those barriers to the address through their projects. In many of the Open Cities Africa communities, women are underrepresented in Science and Technology, the two technical areas of the initiative's work. While it was anticipated that some teams might have challenges recruiting female participants, this was also an opportunity for those with technical expertise to understand the reasons for this and to adjust their approach to learn how small steps taken could strengthen gender equality. Teams were asked to consider the influence of mapmakers, and that whomever creates the map often determines the features captured on the map. Such influence can be problematic if only men are creating the maps that are used by local government leaders to inform urban management decisions. The most common barriers to entry identified included:

- **Disparities in Levels of Education –** In many of our project locations men had more educational opportunities than women. Gaps in literacy levels and knowledge of technology make it difficult for some women to engage.
- **Socialization –** Women are often guided toward domestic responsibilities, while men are encouraged to explore their surrounding and learn how things work. One project community noted that technology is a man's domain and that women are taught not to do men's work.
- **Lack of Decision-Making Authority –** Women in our project locations are often under more strict supervision by their parents or spouses. They have less freedom of movement and need to obtain permission to participate in extracurricular activities.
- **Responsibilities at Home –** There are expectations that women need to spend the majority of their time on household chores such as cooking, cleaning and caring for children. They are often prohibited from engaging in activities that would compromise their ability to complete these tasks.
- **Security Concerns –** Women face higher risks working in informal settlement areas at certain hours or when they are working alone.

Open Cities Africa teams developed innovative approaches to address the barriers to women's participation identified in their project communities. They all addressed the education barrier by providing comprehensive training to all participants so that recruitment could be based on interest rather than previous experience. In Ngaoundéré, the project leadership team met with heads of households in the local communities to introduce the project and explain the benefits of involving women and girls in this work. In several project cities, data collectors were granted flexible schedules, which allowed women to participate at times when they were available without hindering their ability to carry out household responsibilities. In Antananarivo, teams traveled through local communities in pairs to ensure the security of the female participants. And in Accra and Kinshasa, team strategically selected women to lead community outreach efforts, to provide role models to women interested in data collection and mapping.

As a result of this work local technologists learned how to create innovation solutions to support women's participation, and the women recruited on Open Cities Africa projects served as examples in their local communities of how women can engage in digital projects.

Impact 5

Work carried out through the projects of the Open Cities Africa initiative resulted in numerous outputs that quantified results around geospatial data collected and/or produced, the number of people trained, and increased awareness of local resilience challenges. Intermediate outcomes were also collected to measure the impact of the work of various project stakeholders long term and the ways in which Open Cities Africa contributed to national strategies and best practices around disaster risk management.

Initiative Outputs

In addition to the city-level impacts highlighted earlier in the City Projects and Results section of this report, there were a number of aggregate outputs that demonstrate the value of the Open Cities approach across the Africa region:

- Over **1,000,000** geographic features mapped;
- Over **30,000 km** of roads mapped;
- Over **150** geospatial layers developed relevant to local resilience challenges;
- Over **600** mappers contributing to OSM;
- Over **500** young adults in Africa trained in digital cartography;
- Over **950** community members engaged in the participatory mapping process;
- Over **1,000** people gained an improved understanding of local resilience challenges;
- An average of **20** stakeholder groups were engaged per city;
- Over **100** training events held.
- Over **900** people trained to use risk information products; and
- Over **65** square kilometers of drone imagery captured.

Intermediate Outcomes

While the specifics varied slightly by city based on local context and specific stakeholders, several intermediate outcomes were consistent across many of the Open Cities Africa sites:

High quality, up-to-date, accessible data

- Local government leaders have better data on building footprints, population density, service distribution and communities at higher risk to support urban planning and disaster risk management
- Communities have updated data to lobby for better access to public services and hold the government accountable for service delivery
- Emerging technology communities can use data to build applications for the public good
- Humanitarian sector benefits from better access to current data
- Additional government offices (Ministry of Finance, Ministry of Tourism, etc.)
- benefit from updated data and knowledge of property locations and risk zones.

Institutional capacity developed

- Universities, NGOs, and local firms now have capacity to undertake mapping activities in the future and are positioned to continue to serve local authorities as resources through the connections established
- Greater knowledge and awareness of the benefits of open data among government leaders

Digital skills enhanced

- Hundreds of young people across Africa learned QGIS, JOSM, OSM and mobile data collection methods
- Knowledge and experience gained through Open Cities Africa increased human capital and positioned those involved well to find employment in a variety of sectors
- Africa's representation in the global network of mappers was expanded
- Stakeholder relations strengthened

- Relationships were formed between new stakeholder groups, enabling greater collaboration between the government and local actors
- Local organizations and community members given a voice in the disaster risk management process and their feedback has been received by the government

Regional Community of Practice established

- A regional cohort with representation from the implementers and local government leaders from every Open Cities Africa location was established and strengthened through online discussions and Regional Training Workshops
- Cohort members are seeking each other out to serve as mentors and mentees, creating a sustainable source of professional development

Due to the success of the work piloted through Open Cities Africa, several projects have been integrated into the work of World Bank Operational Teams to expand mapping efforts into additional neighborhoods. For example, in Accra, the World Bank's Greater Accra Resilience and Integrated Development project will support mapping in two communities to facilitate planning around solid waste management and community upgrading; while in Monrovia, the World Bank will support the mapping of two market areas to better understand issues of congestion and solid waste management and improve local infrastructure and facilitate flood modeling. In Niamey, Niger and in Yaoundé, Cameroon, similar initiatives were carried out through other funding source in parallel to the work described in this report. The Open Cities leadership team has received requests from Operational Teams to implement new projects in a number of African cities.

Open Cities Data Integrated into World Bank Operations

Accra, Ghana
Kinshasa, DRC
Monrovia, Liberia
Kampala, Uganda
Zanzibar City, Tanzania
Saint-Louis, Senegal
Pointe-Noire, RoC

New Requests for Open Cities Projects

Abidjan, Cote d'Ivoire
Bamako, Mali
Freetown, Sierra Leone
Harare, Zimbabwe
Ibadan, Nigeria

Local Influence

The data collected and products developed through Open Cities Africa influenced a variety of subsequent investments and other local efforts:

Over ***$150M in urban infrastructure investments,*** including:

- In **Accra** data was used to inform investment components on participatory upgrading in flood-prone low-income communities, community-based solid waste management interventions and community campaigns, and community engagement and technical services. (~$65M)
- In **Kinshasa** information was used to inform investments components for infrastructure to prevent erosion. (~$45M)
- In **Pointe-Noire** data will inform physical investment and institutional strengthening activities, including physical works such as roads, rehabilitation, and drainage activities, and studies on environmental and social safeguards and neighborhood upgrading plans. (~$15M)
- In **Saint-Louis** information will inform drainage planning, urban development planning and

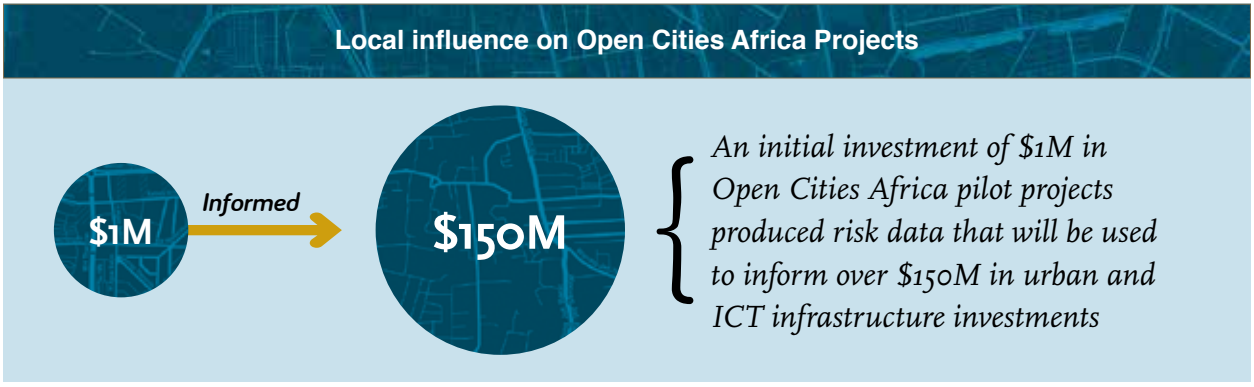
the development of a sustainable coastal risk management solution. (~$2M)

Over ***$5M in ICT infrastructure investments***, including:

- In **Niamey** additional investments were made in hardware, data, and skills training, as well as in the development of a regulatory and legal framework around the use of drone technology. (~$4M)
- In **Zanzibar** a Spatial Data Infrastructure will be established to serve as a repository for available spatial data and serve as resource for urban and disaster risk management. (~$5M)

Additional local efforts strengthened by the initiative:

- In **Monrovia** some of the data collected was integrated into a COVID-19 hotspot analysis carried out by the Liberia Water and Sewage Corporation.
- In **Ngaoundéré** community members now meet once a week to participate in neighborhood clean up activities, and the local university has integrated the Open Cities training content into its curriculum for Geography students and has launched its own participatory mapping experience for students that has led to new communities mapped in Cameroon and Chad.



Conclusions 6

Open Cities Africa has been particularly successful in building cooperation and partnerships between local government leaders, universities, nongovernmental and/or civil society organizations, and local community members, with many projects incorporating over 20 local stakeholder groups in the process. Projects were developed in alignment with the local objectives of government counterparts and World Bank operational teams, and the data produced is proving to be a valuable asset in informing infrastructure investments and disaster risk management decision-making. The initiative also fostered strong relationships across cities in the region, as implementers and their local government counterparts were able to learn from and interact with each other at the Regional Training Workshops and through the Online Learning Platform.

The following lessons have been learned through this initial round of Open Cities Africa implementation:

i. Presenting the initiative to a wide audience and **engaging members of the partner community** on an ongoing basis led to collaborations, access to data and technology, and knowledge sharing across organizations;

ii. While teams are encouraged to seek out and utilize **government databases and other pre-existing datasets**, it is important to manage expectations about how difficult these may be to obtain;

iii. **Mixing in-person and online training** provided participants with the opportunity to meet and create relationships in-person and then continue conversations through online learning in a more personable way. This combination also proved to be effective in promoting capacity building and knowledge sharing among cohort members;

iv. The addition of a **gender component** yielded valuable insights about how men and women are affected differently by disasters and guided teams to consider ways to promote women's participation in their projects;

v. The **content on user-centered design** grounded the teams' data products around the needs of their end users, local government leaders and/or community members. This helped to ensure that teams developed tools that would be valuable and relevant;

vi. Conversations and training around the **sustainability of data, skills and the mapping network** should take place at the beginning of the initiative, and continue to thread throughout the course of the project. This will encourage implementation teams to introduce sustainable practices into their early workflows (like university partnerships for training, and field mappers), while also cultivating opportunities (like local sponsorship), and partnerships (like MOU's for data exchanges) to help extend data sharing and mapping activities beyond the initial project funding cycle.

Using disaster risk management problem statements was a valuable way to anchor the projects and initiate the engagement of stakeholders. They provided teams and their associated stakeholders with a targeted goal to work toward in each project city. While there were

many benefits to the cohort of implementing the Open Cities Africa project simultaneously, due to variations in local circumstances it was difficult to coordinate so many different efforts to follow the same timeline. Ultimately, some projects moved faster than others and some finished earlier than others.

Open Cities Africa trained local team members on digital skills that could be highly useful in seeking future employment opportunities. The initiative aims to build on this momentum, and going forward will seek opportunities to work with the Resilience Academy, which is a growing network of institutions that wish to incorporate practical disaster risk management and geospatial analysis in their curriculum. Through this program, universities and their students will have access to recommended frameworks, course materials and support from other network members.

Data produced will inform many decisions and investments beyond disaster risk management, and the relationships established and methodologies learned may provide opportunities to expand local efforts to focus on additional communities or new issues areas. Several local implementation teams have been retained by World Bank operational teams to extend their work in such ways, which serves a testament to the value of the Open Cities model and the demand for these skills locally.

Finally, Open Cities Africa is intended to be a gateway initiative that encourages sustained mapping and data sharing in each of its city locations. For these efforts to have a lasting impact it is important secure local government buy-in on the value of open data. Sustained government participation in the sharing and use of open data is just as valuable of an outcome as the data produced.

Resources

Selected Videos and Guides

Open Cities Africa – Website

This website features the work of every Open Cities Africa project as well as access to their data and project reports. The website is available at https://opencitiesproject.org/

Open Cities Africa – Local Action

This video was developed to highlight how local efforts are transforming the way disaster risks are managed. The video is available at https://www.youtube.com/watch?v=IjWrni09xQY&t=20s

Open Cities Africa – Launch Video

A video provides an overview of the Open Cities Africa approach and methodology. The video is available at https://www.youtube.com/watch?v=MPwVz1B5MUg&t=243s

Open Cities Africa – UNDRR Presentation

This video highlights the work that Humanitarian OpenStreetMap Team (HOT) has carried out in Accra, Ghana and Monrovia, Liberia. The video is available at https://www.youtube.com/watch?v=A1z0472PEHU

OpenStreetMap in Africa

This video demonstrates the rate by which the African continent has been mapped in OpenStreetMap. The video is available at https://www.youtube.com/watch?v=328t90vkots

Open Cities Africa – Saint-Louis

This video features the work done under the Open Cities Africa project in Saint-Louis, Senegal. It was produced by the lead implementer in Saint-Louis, Immergis. The video is available at https://www.youtube.com/watch?v=6Sw96u00-GU

The Open Cities Guide

The guide is a resource for practitioners who wish to bring community mapping initiatives to their cities or regions. The guide documents lessons learned from past projects, and offer best practices on the design and implementation of a community mapping initiative. https://opendri.org/resourceplanning-an-open-cities-mapping-project/

Selected Blog Posts

Sustainable Cities

The rise of local mapping communities: https://blogs.worldbank.org/sustainablecities/rise-local-mapping-communities-for-resilience

Nasikiliza

Understanding Niamey's flood risk through open source mapping, drones, and modeling: https://blogs.worldbank.org/nasikiliza/understanding-niameys-flood-risk-through-open-source-mapping-drones-and-modeling

How participatory mapping can make Brazzaville's poor neighborhoods safer: https://blogs.worldbank.org/nasikiliza/how-participatory-mapping-can-make-brazzavilles-poor-neighborhoods-safer

Digital Development

How to Close the Digital Gender Gap: Lessons from Open Cities Africa https://blogs.worldbank.org/digital-development/how-close-digital-gender-gap-lessons-open-cities-africa

Towards Data Science

The Open Cities AI Challenge https://towardsdatascience.com/the-open-cities-ai-challenge-3d0b35a721cc

World of Opportunity

When community mapping meets artificial intelligence https://medium.com/world-of-opportunity/when-community-mapping-meets-artificial-intelligence-2b0282cae1b7

GFDRR

How Open Cities is changing the way African cities prepare for disaster: https://www.gfdrr.org/en/feature-story/how-open-cities-changing-way-african-cities-prepare-disaster

OpenDRI

Capturing an archipelago: Open Cities **Zanzibar**: https://opendri.org/open-cities-zanzibar/

Uganda Open Mapping for Resilience Completes Ggaba Parish Pilot: https://opendri.org/uganda-open-mapping-for-resilience-completes-ggaba-parish-pilot/

À **Saint-Louis**, **Sénégal**, open source et cartographie libre pour s'adapter à la montée des eaux: https://opendri.org/a-saint-louis-senegal-open-source-et-cartographie-libre-pour-sadapter-a-la-montee-des-eaux/

Kinshasa en lutte contre les inondations grâce aux données libres d'accès: https://opendri.org/kinshasaen-lutte-contre-les-inondations-graceaux-donnees-libres-dacces/

A **Brazzaville**, la population se met en marche pour cartographier les risques: https://opendri.org/a-brazzaville-la-population-se-met-en-marche-pour-cartographier-les-risques/

Á **Antananarivo**, la cartographie libre comme outil de gestion collective des Fokontany: https://opendri.org/a-antananarivo-la-cartographie-libre-comme-outil-de-gestion-collective-des-fokontany/

Leveraging OpenStreetMap to improve disaster risk management in the **Seychelles**: https://opendri.org/seychelles-openstreetmap-to-improve-disaster-risk-management/

Au **Cameroun**, la cartographie libre pour aider Ngaoundéré à s'adapter au changement climatique: https://opendri.org/cartographie-libre-ngaoundere-changement-climatique/

My experience as a student mapper for Open Cities **Accra**: https://opendri.org/my-experience-as-a-student-mapper-open-cities-accra/

Tackling coastal flooding in **Monrovia** slums: Understanding through partnerships, one community at a time: https://opendri.org/tackling-coastal-flooding-in-monrovia-slums/

City planning and community mapping: Gathering people and data in **Pointe Noire**, **Republic of Congo**: https://opendri.org/city-planning-community-mapping-pointe-noire-congo/

Building web maps in **Zanzibar**: https://opendri.org/building-web-maps-in-zanzibar/

Tool design for urban resilience at Open Cities Africa second regional meeting: https://opendri.org/open-cities-africa-second-regional-meeting/

Open Cities Africa Kickoff 2018: https://opendri.org/open-cities-africa-kickoff-2018/


C.A.R.
S. Sudan
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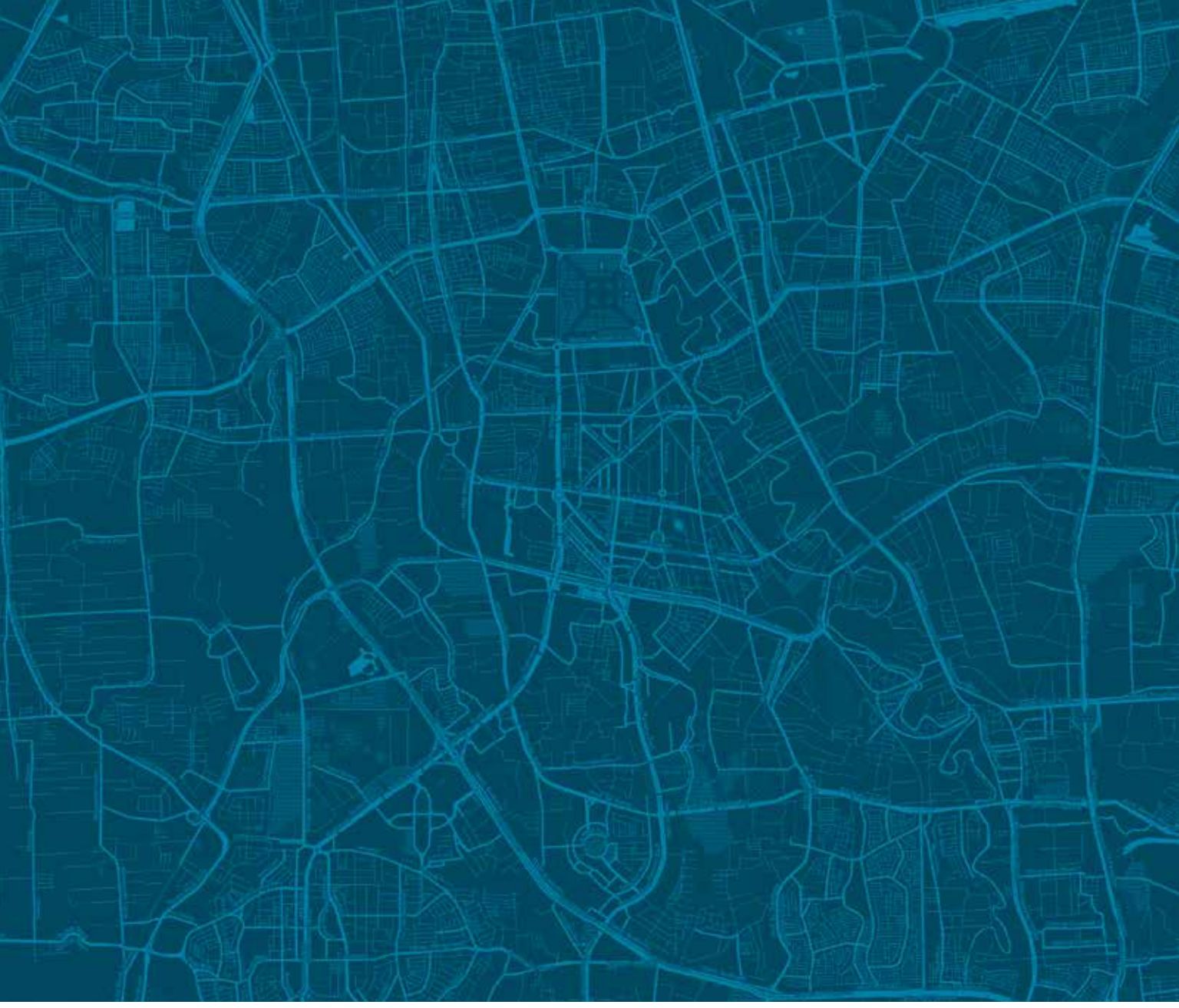

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