Power Grid Mapping in West Africa

11

Tommy G. D. Charles

Abstract

YouthMappers helps to map fundamental features of rural communities across the countryside of Sierra Leone as an innovative model for how to bring power to villages across West Africa. Charting location of buildings, tracing streets, and pinpointing where utility poles dot the landscape inform efforts to design and install mini-grids in places without power or with insufficient service. By understanding settlement patterns, road connectivity, and the layout of current low-voltage distribution networks, the team speeds up and scales up design for rural electrification, contributing directly to SDG 7 to bring affordable and clean energy to communities and to SDG 9 to build resilient infrastructure in ways that foster innovation for mapping and beyond.

Keywords

Energy · Sierra Leone · Power grid · Innovation · Infrastructure · Fieldwork

1 The Status of Power Access in West Africa

Limited access to information and electricity are related challenges affecting West Africans. In this chapter, we look at an innovative example from the YouthMappers chapters in Sierra Leone regarding both limitations. The lack of information, especially geospatial information, has made decision-making difficult and sometimes wrong or unreliable when they are made available. Similarly, access to electricity is also a huge challenge that affects the livelihood of West Africans, especially those in rural communities, where there is limited access to electricity when compared to urban communities and advanced communities around the world. Approximately, only 15% of the Sierra Leone's population have access to electricity that is derived from fossil fuel. The low level of access has had crippling effects on the economic growth and human capital development of the country. Women, girls, and children living in rural communities are the most affected. Economic development can be constrained in general when this industry is not

T. G. D. Charles (✉)
OpenStreetMap Sierra Leone, Freetown, Sierra Leone

P. Solís, M. Zeballos (eds.), *Open Mapping towards Sustainable Development Goals*, Sustainable Development Goals Series, https://doi.org/10.1007/978-3-031-05182-1_11

ubiquitous, and innovation is stifled. These issues directly speak to the need to address SDG 7 for clean reliable energy for all, as well as the larger development potential of West Africa represented by SDG 9, regarding industry and innovation.

2 Geospatial Solutions for Power Access

The growing need to access and use geospatial information at a more cost-effective rate and the provision of electricity across the country have led to the development of methodologies to create and utilize geospatial information that can be used in making decisions relating to the generation, supply, and distribution of electricity.

2.1 Trajectory of YouthMappers in Sierra Leone

Sierra Leone is experiencing significant growth in the use of renewable energy. There has been erection of utility poles, wiring, and construction of solar-powered stations across the country. To make the provision of electricity affordable and efficient, there must be reliable data and information such as the number of poles to be erected in the community, the approximate number of households, and the roads within the community to make rational decisions. Development partners like USAID and electricity companies realize the need to have reliable data about existing power grids in rural communities in Sierra Leone.

We were contacted by the YouthMappers director at Arizona State University (ASU) to coordinate a pilot phase of a power grid mapping project that would directly provide data for ongoing needs for information with research and development projects in the country. However, a methodology that smoothly links remote and field data had yet to be fully developed, so we worked collaboratively giving input for innovating new approaches to help speed up and improve data that is necessary for the grid system in rural communities, which goes beyond current approaches for the main national grid. This approach seeks to connect all the way to households, using artificial intelligence (AI) tools and remote and local engagement together from the start.

Before the intervention of YouthMappers in Sierra Leone, there was little or no information about electricity infrastructures in open source geospatial platforms. With the intervention of YouthMappers, utility poles are being mapped, especially in rural and suburban communities where solar grids have been erected and proposed sites across the country.

It is on this backdrop that YouthMappers embarked on extensive collection and processing of images that can be used for decision-making relating to the provision of electricity across the country. YouthMappers utilize open source geospatial tools to do the work and are receiving internal and external support.

Embarking on geospatial data collection in any form requires the appropriate skills, resources, and interests or enthusiasm. Over the years, since 2016 to be precise, the OpenStreetMap (OSM) community in Sierra Leone has been giving training to students in tertiary institutions and facilitating the establishment of YouthMappers chapters. These include five YouthMappers chapters in Sierra Leone, namely, the Students Geographical Association YouthMappers, Njala Mokonde YouthMappers, Canadian YouthMappers, and UNIMAK YouthMappers and the Eastern University YouthMappers. The first one was inaugurated at Fourah Bay College, University of Sierra Leone, where student pioneers began an influential presence for OSM Sierra Leone today. Because of being motivated to engage students in other tertiary institutions to benefit from the YouthMappers network, we made contacts with students at Njala University and the INGENAES network, and we organized our first mapping parties in 2017 where we introduced students and extension workers to OpenStreetMap and data collection tools.

2.2 Disruption of a Pandemic Drives Innovation

In 2020, in the heat of the COVID-19 pandemic, we still facilitated the establishment of the Canadian College YouthMappers, the University of Makeni YouthMappers, and the Eastern University YouthMappers chapters. These chapters include students from different fields of studies ranging from law, geography, computer science, and geology. One thing they have in common despite their diverse disciplines is the enthusiasm to create and use data for social good. Members of our chapters have been receiving and also giving data collection and visualization training and techniques over the years with the use of several open source geospatial tools. But we had to innovate given the shutdowns and disruptions of the pandemic.

To ensure that the required information for the power mapping project is acquired, YouthMappers that have the required skills were given refresher training to collect aerial and ground-level images in selected communities across the country. The captured images are processed to detect utility poles that are instantly mapped or added to the OpenStreetMap platform.

In order to get the whole methodology right, a pilot phase was implemented in five (5) communities to learn the challenges and the necessary steps or techniques we can apply to overcome them. Thereafter, we went on to map 20 more communities in rural and urban areas across the country. However, we still encountered significant challenges such as gaining authorization, liaising with community stakeholders, and logistical and technological issues. But with the right mindset and perseverance, the YouthMappers were able to overcome these challenges and implemented a successful mapping campaign.

2.3 Stitching Together Open Tools to Innovate Fieldwork

From the very beginning of the process of establishing the YouthMappers chapters, students were capacitated with mapping skills using open source geospatial tools such as OpenStreetMap, Mapillary, Pic4Review, MapRoulette, and other essential tools. This included augmented mapping using artificial intelligence (AI or GeoAI), which gave us opportunities to be a part of cutting-edge applications of science. Most students used these skills for their coursework and continuously improved on them, but they had not yet worked with GeoAI nor had we applied them in solving real-life problems within society. Therefore, the mapping of utility poles using open source geospatial and GeoAI tools was a perfect opportunity to showcase and grow our skills in addressing a national issue.

The information that was produced is already being utilized by government agencies and electricity companies to know the extent and status of electricity infrastructure. It helps them to do feasibility studies and other essential analysis that boost efficiency and service delivery and hasten and streamline their workflow. The partners at Mapillary and at Arizona State University and the YouthMappers Validation team at George Washington University (GWU) served as guides and support for the methods, validation, and linking to the partners who are implementing the data.

3 Local Fieldwork Implementation with YouthMappers

The on-site part of the power grid mapping methodology was implemented in two phases in general, a pilot phase wherein 5 communities were mapped with the help of two YouthMappers chapters and the larger implementation phase wherein 20 communities were mapped with the help of 5 YouthMappers chapters. We learned some lessons from the pilot phase and rectified them in the actual implementation phase. Together with all of the partners, we developed this portion of a robust methodology that represents innovation for youth engagement and project application in local sites.

3.1 Capacity Assessment and First-Pass Remote Mapping

At the start of the project, the capacity level of students was ascertained to better understand training needs and ensure the production of quality and reliable data on every open source geospatial platform that was used. The procedure that was developed included the strategic selection of locations where data was to be collected, most of which are rural and suburban communities across the country. The selection indirectly engaged the end-user (energy industry) needs, essentially interfacing with the national ministries and private entities involved in rural electricity access.

Thereafter, remote mapping tasks were created using the Humanitarian OpenStreetMap Team's Tasking Manager through the TeachOSM instance of the platform. Students had to remotely map and validate buildings and residential roads within the selected communities where utility poles were bound to be found or erected. This was done by YouthMappers chapters in Sierra Leone and supported by others at ASU. The validation was done by GWU students remotely.

3.2 Field Mapping and Ground Truthing

With most of the communities remotely mapped, local students went to the field to capture ground-level and aerial imageries of utility poles and other electricity infrastructures with the use of an action camera, a drone, and their mobile phones. This gave the students the opportunity to ground truth and update features on the existing maps of the locations by validating them and adding new features where necessary. Some attributes were also added. The captured images were uploaded to Mapillary, which is an open source street-level imagery platform that is available worldwide (Figs. 11.1 and 11.2).

Fig. 11.1 UNIMAK YouthMappers Ibrahim Kalokoh and Ibrahim Yusuf Jalloh capture street level images in Makali, Northern Sierra Leone

3.3 Setting Up and Deploying Mapping Teams per Location

Before going up to map each location, we set up teams consisting of one (1) supervisor and between 2 and 4 YouthMappers. These teams connected with district youth leaders through their supervisors. The supervisors are mostly graduates that have extensive mapping experiences, which made them knowledgeable enough to give mapping tutorials to beginning mappers and give them the necessary guidelines when in the field. All the supervisors are active members of the OpenStreetMap Sierra Leone community, most of which are YouthMappers alumni.

Since the YouthMappers chapters are autonomously led by local students, it was given their responsibility to select mappers that were to be part of each team for every location. This was

Fig. 11.2 Utility poles cannot be seen on satellite imagery, so street level images are important to identify the location of utility poles, and in turn, where the power grid reaches, and where are communities with and without access to electricity

mainly done through their chapter officers. They took a protocol to make the selections and submitted lists of their members with their contacts and locations they were to map. These lists were given to the supervisors who established connections with the mappers, where they usually created WhatsApp groups to liaise and determine the field mapping timelines and logistical arrangements. The lists were also sent to the USAID team for the names of students to be added to a generic letter that stated the purpose of the field mapping activities. These letters were given to each mapper as a backup for authorization purposes if the need arises to explain the activity.

After the teams were constituted and assigned departure dates, the necessary financial and technical support was given to each supervisor before they met with the YouthMappers in person. The support included but was not limited to stipends for lodging, Internet, transportation, YouthMappers styled T-shirts, selfie sticks, action cameras, power banks, and refresher training as needed. This support ensured that the teams were ready and well capacitated to map.

The number of mappers per location was determined by the sizes of the locations and their surrounding communities. Based on this, each team, including supervisors, usually consisted of 3–5 members. With the teams established with mapping timelines and a point of liaison with district youth leaders, we considered a location ready for mapping.

3.4 Authorization and Identification

The purpose or intent of fieldwork can be misinterpreted by local community members if they are not properly and thoroughly informed about the project. Our teams, therefore, had to make sure that we got in touch with community stakeholders before going to the field to capture images. The district youth leaders were focal persons of contact since we could relate well with them and they generally had the local connections. They were briefed about the project, and they willingly connected us with other community stakeholders.

Unfortunately, on one occasion during the pilot stage, a team of mappers were arrested by community stakeholders because they were not properly briefed ahead of time about the project.

Fig. 11.3 A drone image of Lunsar, Sierra Leone provides a glimpse of how the power grid does not reach everyone

Our mappers were misunderstood to be surveyors for land grabbers. However, the whole organizing group, including the network and agencies abroad, immediately responded and made the connections so that shortly the team was set free after a thorough description of the project and proper liaison with community stakeholders.

To prevent any further arrest or detention of our fieldworkers, we then got all the contacts of the elected district youth leaders through the Ministry of Youth Affairs. We introduced the Sierra Leone project leadership and the team and gave them insights about the work we do and how it would benefit their communities. In that light, supervisors had to alert the youth leaders at least a week ahead before they travelled to locations that were to be mapped.

When the mapping teams reached their designated locations, their supervisor ensured that their first point of contact was the community youth leaders who then took them to other community stakeholders for meetings to discuss the project and introduce them to locals of the community. At the end of the meeting, the teams were always assured of their safety when mapping within the communities (Fig. 11.3).

As a further backup plan, each member was provided with individually tailored letters from the USAID bearing the names and purpose of their mapping campaigns. This made the whole process safer for our mappers.

We also had to make sure that our mappers looked distinct and unique; therefore, we gave each of them YouthMappers styled T-shirts with the logo and name on the back of the shirt so they were clearly visible when the youth were riding around on the motorcycles. This made them identifiable and protected from negative community interferences.

While we anticipated a few of these measures during the original pilot work, knowing the importance of community connections and following the ethical guidelines that YouthMappers promotes, we had not fully considered the potential reactions given the innovative technology and the local context of the fear of land grabbing. But our solutions not only helped us to implement smoothly, they also ended up giving us an innovative way to connect to the elected local youth leaders and teach them about the importance of mapping for the SDGs.

3.5 Field Mapping and Monitoring

Most mappers made arrangements for accommodations before going to the mapping locations, while others do so upon arrival. It was the duty of supervisors to make sure that the YouthMappers had conducive accommodations during the whole mapping process, and once that was ensured, then they started mapping. The range of options for the open source tools was important so that the final choices supported local configurations best.

Mappers were sometimes given printed maps of the communities that they were to map. Sometimes they used applications such as Maps.me and OsmAnd. The supervisors then ensured that arrangements were made with local motorcyclists to ride the YouthMappers within the communities. The actual capturing of images commenced with each mapper in the YouthMappers regalia, seated behind their respective motorcyclist with selfie sticks and phones attached to them. The mappers gave directions to the motorcyclists to ride through the communities (Fig. 11.4).

The mappers were usually encouraged to upload the captured images as they mapped in order to create space in their phones or cameras for more images to be captured. Some mappers that had large enough storage spaces on their phones uploaded images at the end of the mapping exercise each day. The supervisors ensured that all the images were uploaded and each mapper had sufficient cellular data to do so from the resource allocation support provided.

At first, it generally took a minimum of 3 days for images to be processed and published on the Mapillary platform; however, it sometimes took over a month for them to be processed and published because the platform happened to be undergoing an important hosting transition at that very same time unrelated to our project. We directly engaged with the Mapillary team to help keep tabs on the process and receive advice and support. The latter made it a bit difficult to evaluate the extent of the mapping after the 3 days of mapping exercises. However, about 70% of the images were then normally processed and published within a week; therefore, we could tell that mapping had happened and in a correct way. At the end of each 3-day mapping exercise, our

Fig. 11.4 YouthMappers member Fatmata Kabia checks that the phone camera remains in place, snapping street view images every few seconds

teams got in touch with community stakeholders to express gratitude and say goodbyes. Finally, the supervisors facilitated the return of students to their various campuses as needed.

3.6 Second Remote Mapping

After uploading the images, the data were to be verified for the presence of utility poles and train the artificial intelligence tool to automatically detect utility poles on the images. To achieve this, Mapillary verification tasks were created, and then YouthMappers in Sierra Leone, ASU and GWU and across the world verified all the images. The utility poles verified in the images needed to be added to the OpenStreetMap platform, and the easiest way was to use a platform called Pic4Review wherein Pic4Review missions or tasks were created for all the locations and the utility poles were added to OpenStreetMap in a standard structured way, conforming in the end to the needs for downloading that data collectively for the project end-users (power industry). It was now possible for map makers and Geographic Information System experts to extract high-quality, validated, comprehensive raw data, analyze, visualize, and make use of them for the original purpose, but also from there on, for any different purposes.

3.7 Summary of Output Metrics and Mapping Outcomes

The parameters used to measure success are as follows:

Mapping of Buildings and Roads All the fifteen (15) locations across the country were fully mapped, in terms of adding buildings and roads within them. At the start of the project, some communities were not mapped with no buildings or roads on OSM. At the end of the project, 69,988 buildings were mapped and 831 km of roads were traced. This was done collectively with YouthMappers within and outside of Sierra Leone.

Streetview Imagery Collection In terms of images within the community, none of them had Mapillary images that would give remote mappers pictorial insights about the locations they were mapping remotely. However, with the power grid project, images were collected and uploaded within 7 locations across the country. These images were used to map utility poles and train the AI Platform (Figs. 11.5, 11.6, 11.7, and 11.8).

Mapping of Utility Poles Within all the locations, none had utility poles marked on OSM. This was a huge milestone as it helped enhanced electricity distribution and generation agencies to have access to information about the existing electricity infrastructures across the country (Figs. 11.9, 11.10, and 11.11).

Capacity Building and Skills Development OpenStreetMap Sierra Leone is a fairly small mapping and geospatial community that consists mostly of YouthMappers and recent graduates. Therefore, any project that enhances the capacity and skills of the membership is considered to be laudable. During the course of the power grid mapping, YouthMappers and recent graduates were introduced to new mapping tools and techniques, and the skills of others were improved. The community also had the opportunity to purchase and own a drone, camera, and other gadgets for the purpose of mapping. Members were taught how to use the equipment, which became added skills that were sought after and became a plus to the graduates. This helped to boost the community's drive to become sustainable.

Broader Inclusion The work of YouthMappers is reflective of how we want our societies to be, in terms of inclusion and equality. Students from all genders and backgrounds were encouraged to participate. Although we have a limited

Fig. 11.5 Imagery overlaid with OSM data before mapping buildings and roads in Lunsar is shown

Fig. 11.6 Imagery overlaid with OSM data after mapping buildings and roads in Lunsar is shown

number of women that have the opportunity to participate in geospatial activities in Sierra Leone, our team made sure that women were involved throughout the project. Women were involved in the planning stage and the remote mapping, and each team that captured ground-level and aerial images had at least one female member. Women benefit disproportionately as a result of receiving power access (YouthMappers 2021).

Fig. 11.7 Imagery overlaid with OSM data before mapping buildings and roads in Masiaka is shown

Exposure to Opportunities After the successful implementation of the pilot project, the community was given the assignment to map utility poles in up to 23 new locations across the country. This was considered to be a huge honor and a major boost to the YouthMappers and the OpenStreetMap community in Sierra Leone. There were interests from companies out of Sierra Leone to know about the power grid mapping project and the following blog posts, Mapillary blog (Solís et al. 2020), were published on their websites. A presentation about the project was made by the YouthMappers director (Solís 2020) during the 2020 UN Data Forum. The approach is being transferred to other countries across West Africa.

These successes of the power grid mapping are considered to be great milestones as the project was the second to be implemented by a community of mainly YouthMappers and recent graduates that were in the quest of expansion and utilizing the skills of its members for a common social good under these productivity metrics and outcomes but also for the SDGs.

4 Beyond the Map: Powerful Mapping for the SDGs

As youth, it is incumbent upon us to contribute toward achieving the Sustainable Development Goals within our countries or communities and

Fig. 11.8 Imagery overlaid with OSM data after mapping buildings and roads in Masiaka is shown

that is what YouthMappers in Sierra Leone have been doing over the years with support from both internal and external agencies. Because the power grid entailed a longer series of activities and outcomes, it is contributing to addressing some of the SDGs during the course of its implementation.

4.1 Affordable and Clean Energy

Creating affordable and clean energy is the principal goal that is being addressed by the power grid mapping, which directly relates to SDG 7. Most of the rural and suburban communities we have worked with either have installed or plans in the pipeline for solar-powered mini-grids that are in construction phases or functional. According to SDG 7, the expansion of electricity infrastructure and technology will increase the efficiency of electricity generation, distribution, and supply and improve the livelihood of communities and the environment.

One of the things that can make this goal achievable is access to reliable information from credible sources. This is what the power grid mapping project has been doing. Electricity agencies use the data that we produce to examine and get an overview of existing electricity infrastructure within our selected communities. They also use the data to study the topography, road infrastructure, and other physical features of the locations that they use as variables to assess these communities before they start constructing electricity infrastructure.

The quick and easy access to reliable information reduces the cost of implementing electricity projects. With the power grid mapping, these agencies get firsthand information about the places of interest before physically visiting them. It makes their feasibility studies much easier, efficient, and cost-effective. This reduces the

Fig. 11.9 Building and road data on OSM provides the basemap for street level imagery intake

overall cost of implementation, making access to electricity more affordable.

To be clear, the power grid mapping project was not directly involved in the construction of electricity infrastructure, but the work it did expedited the process and gave hope or increased the hopes of community members getting electricity in the near future. During the initial meetings with community stakeholders, they expressed appreciation for the initiative. They stated their ongoing plans of using electricity once generation started and, in some cases, the areas within their communities where they would want expansion. Interacting with community members gave our teams a better understanding of the latent use of electricity as they narrated their socioeconomic use of electricity when generation started. In some communities that already had partial electricity generation, they explained the socioeconomic benefits that they have been enjoying.

These socioeconomic benefits were common throughout the communities we worked. They included the use of electricity to preserve perishable goods that are sold for economic purposes and the charging of mobile phones and electronic gadgets. The most common use among children, teenagers, and youth was for studying. They stated how the presence of electricity boosts their chances of learning and how essential it is to them and the hopes of uplifting their livelihoods.

Our teams gave hope to every community we visited and gained inspiration and motivation in return. They believed that our work could improve their chances of getting electricity in communities without and renewed the hope of expansion and resolving some of the issues they faced with electricity infrastructure.

4.2 Build Resilient Infrastructure and Foster Innovation

By mapping to provide data for efforts to bring electricity to rural communities, this project contributed to SDG 9, especially in terms of contri-

Fig. 11.10 Green dots depict where street level imagery has been added by YouthMappers at a local scale

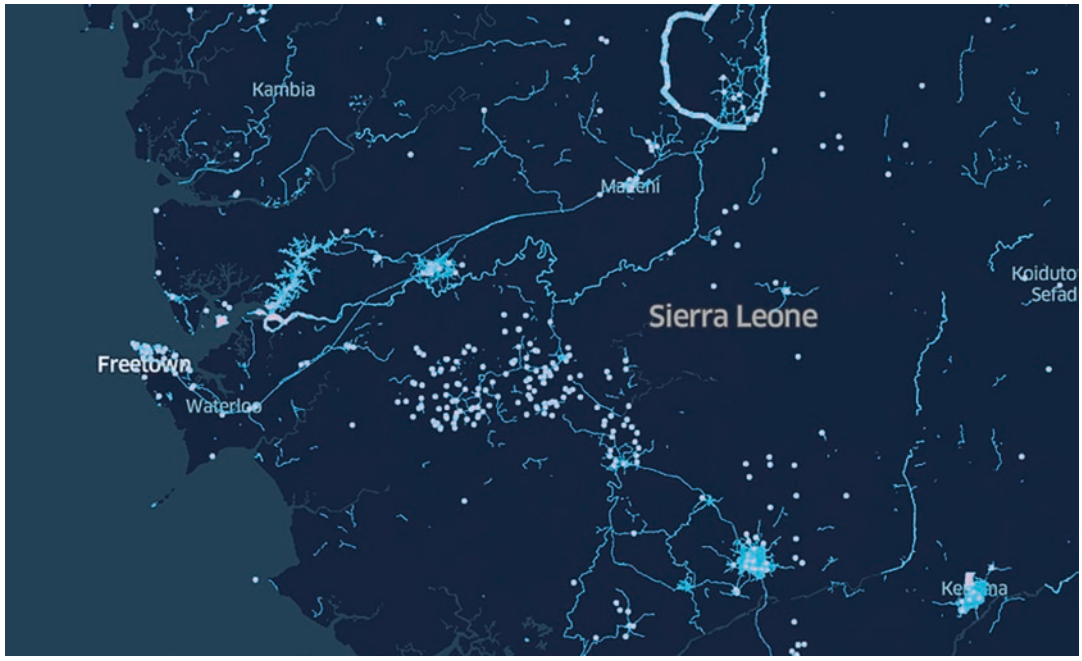

Fig. 11.11 Available open street level imagery for all of Sierra Leone has been enhanced significantly by YouthMappers in the power mapping efforts

butions to build resilient infrastructure. It is clear that clean power is not only critical for sustainability and resilience but also for development of infrastructure. The project methods themselves fostered innovation, as explained above, using cutting-edge AI tools and leveraging creative ways to collect mass imagery on motorcycles during a pandemic. That in itself would be sufficient to demonstrate these contributions, but in other long-term ways, the project also promoted resilience of students, the human infrastructure in terms of a skilled workforce, and innovation potential by peer training that passes along these abilities through the chapter network.

Our teams updated maps, and this was made possible through facilitating training for all members, from the project coordinator to the students. The skills and knowledge acquired are being used for other purposes and projects outside the power grid mapping projects. One of these instances is our members participating in Sierra Leone's midterm cartographic mapping and census.

Based on our interactions with some community members, the majority of them, especially school-going teenagers and youth, stated that their primary use of electricity was for studying. Although most of the communities had limited electricity supplies at night, students made use of the short period, usually between 6 pm and 8 pm to study and do their assignments. Very few communities had digital infrastructure ready like Internet cafes and resource centers owned and controlled by community entrepreneurs and nongovernmental organizations. These cafes utilize electricity and are learning centers for students and everyone within the communities. The power mapping work is building simultaneously this electricity infrastructure, the digital infrastructure, and the human infrastructure that will enable many kinds of economic development in the future.

Another interesting thing was that community members wanted to learn about mapping and its related skills, techniques, and technology. Our team members gave them basic yet sufficient information about mapping and how they could participate. Through this, community members learned new things and developed interests in mapping.

It is also worth noting that this innovation is inclusive toward enabling the talents of half of the nation's population: women. Our presence increased the hopes of female students and women because with electricity, there was no need to go to distant locations to study at night. Instead, they stayed at home where they mostly had conducive and safe environments to learn and do their chores.

5 Challenges and Recommendations

Although the implementation of the project would largely be considered to be successful, our team, however, experienced some challenges. These challenges are bulleted below, including some recommendations for future activities to learn from this experience:

- The mapping of features on the surface of the earth requires the use of equipment such as Global Positioning Station services, smartphones, action cameras, and Internet. In this case, most of the required equipment was unavailable and had to be imported. The procurement process was bureaucratic, and this led to the delay in starting the project. However, the delay gave us more time to do more remote mapping and better understand the selected communities.
- Access to the Internet was also a challenge; because of the COVID-19 restrictions, students or mappers were unable to meet in person for training, but this was difficult as most of the training was done online and students had limited access to the Internet, which slowly altered their participation. The unreliable Internet source made it difficult to upload collected data, and this slowed down the workflow of the project.
- One of the goals of the power grid mapping was to increase women and girls' access to electricity, and the inclusion of women in such an initiative was a must. Unfortunately, having

women and girls onboard was a critical challenge. There persists a stereotype that technical activities like mapping with the use of drones were limited to men. In order to enhance inclusion, the team decided to establish the first all-female mapping club that would specifically spearhead the recruitment and inclusion of women and girls into our mapping community.

- Some miscommunication between mappers who are not community members and actual community members occurred because to deploy across such a large area, we developed a chain of communication, but YouthMappers were not always in direct contact with community stakeholders, which created a chaotic scene in one of the communities that was being mapped.
- It was evident that rural communities not only experience lack of power but also suffer a land administration crisis. Therefore, it would be a significant opportunity if we can collaborate with them and other communities faced with similar challenges by putting the skills of YouthMappers into use and collaborating with community stakeholders on this topic as well.
- It is important that we don't just build maps; we build mappers. Our students are not just mobile "sensors" collecting data, but also innovators in the field mapping process. Knowing the full context of humanitarian mapping improves the participation of students (Solís and Delucia 2019). In order to ensure that the YouthMappers in Sierra Leone are fully engaged with the entire range of geospatial data and provide deeper insights into this innovation process, the team at ASU has offered to provide additional training on the analytical framework of how spatial data is used in later stages of the project for grid feasibility and definition to all participating local mappers.

With the plan of the government and other organizations to construct solar-powered minigrids in 94 locations across the country, there is a significant need to continue mapping buildings, roads, and utility poles. This would ensure continuous creation and availability of geospatial information that relates to electricity generation and distribution. For future continuation of these and similar efforts, we are working toward building further upon this YouthMappers infrastructure put into place. To ensure the expansion and even participation of YouthMappers in yet unmapped places, there are plans to establish more chapters in tertiary institutions across the country. This would help propagate the importance of mapping and the existence of a large pool of individuals with the required skills. In terms of inclusion, to overcome some constraints to have female and mappers with disabilities on board, we have developed a plan to set up clubs or associations that would spearhead the inclusion of underrepresented people.

In summary, one can say that the power grid mapping project represents a giant leap for the OpenStreetMap community in Sierra Leone, especially for YouthMappers. It helped to unearth the potential of all those that were involved, giving everyone insights about our intellectual capabilities and emotional growth and areas we can improve on. We also discovered numerous underlying issues affecting development and community mobilization. We contributed directly to SDG 7 toward affordable and clean energy, by mapping data that will, among other things, support local solar-powered grids and also SDG 9 for the national infrastructure that will imply not only development but also resilience. This last point underscores the innovation that came from our local youth, together with the entire global team. The skills acquired during the course of the power grid mapping are already being applied to other geospatial projects or initiatives as part of the short- and long-term endeavor of YouthMappers in Sierra Leone. These include other potential infrastructure-building campaigns like the mapping of safe spaces for girls and dumpsites and street signs and then making them easily accessible to the public. This model is also being applied in other locations in West Africa. This work would help to make communities in Sierra Leone, West Africa, and become beyond more

sustainable, thereby addressing several Sustainable Development Goals and our own ambitions.

References

Solís P (2020) Power Mapping: youth and GeoAI for augmented humanitarian action. United Nations Data Forum, October 19, Online Forum from New York, New York

Solís P, DeLucia P (2019) Exploring the impact of contextual information on student performance and interest in Open Humanitarian Mapping. Prof Geogr 71(3):523–535. https://doi.org/10.1080/00330124.2018.1559655

Solís P, Charles T, van Hove E, Beddow C (2020) Power mapping brings rapid reliable energy to rural communities. Mapillary Blog. 20 October. Available from Mapillary. http://bit.ly/2XM2qqf. Cited 2 Jan 2022

YouthMappers (2021) Everywhere She Maps, Power is Generated. Available from YouthMappers website. https://www.youthmappers.org/everywhereshemapspowerisgenerated. Cited 2 Jan 2022