Mapping Access to Electricity in Urban and Rural Nigeria

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Abstract

YouthMappers use OpenStreetMap and IoT tools to help map where rural communities have good, poor, or no access to electricity throughout Nigeria, contributing to efforts that bring stable power across West Africa. An ongoing energy crisis is hampering other efforts to make sustainable cities and communities, so assessing and locating the reality of power access are critical not only to address SDGs related to affordable and clean energy but also as a fundamental element that serves as an engine for sustainable development. Through these efforts, we students have built our technology capacity and community networks, while also advancing practices about how to build inclusive, sustainable cities and communities in both urban and rural places where we live and study.

Keywords

Electricity · Sustainable energy · Urbanization · Rural development · Nigeria

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12.1 Interrupted, Unstable Electricity Access Across Nigeria

Electricity is unarguably one of the crucial basic amenities needed by humanity. As the population of the world grows, the need for sustainable and reliable energy significantly increases proportionally. This is true in both cities and villages.

Access to stable, affordable electricity is a major problem in developing countries like Nigeria. Many rural communities are not even connected to the national grid, while cities connected to the grid frequently experience epileptic power supply, outages, or blackouts.

The Nigerian energy supply crisis is a huge problem, evident in continuous failure of the Nigerian power sector to effectively supply and provide electricity to domestic and industrial users of electricity. Even though the nation is one of the world's largest oil-producing countries,

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with some of the world's largest deposits of coal, oil, and gas, electricity supply is still not ubiquitous, stable, and affordable. This is a very huge and massive problem for sustainability and for development.

As of 2020, only 45% of Nigeria's population is actively connected to the Nigeria energy grid. Epileptic power supply is experienced 85% of the time, where sometimes some regions have no supply of electricity for years (Aliyu et al. 2013). The power supply situation in Nigeria is so poor that several communities, even though connected to the grid, have no power supply for days, running into months and years. Coupled with flawed legislation and practices, unplanned and unscheduled power cuts are experienced regularly. This reflects the unpredictable nature of power supply in the country as a whole (Aliyu et al. 2013).

The resultant effect is a lack of access to a dependable and affordable power supply situation in Nigeria, a context that cripples various parts of the economy of the country, ranging from industrial, agricultural, educational, and more. The problem spans all sizes of communities, from urban places to rural villages. Needless to say, the current development situation impedes Nigeria's economic growth significantly.

The causes of this poor power supply situation are very complex and multifaceted, with deep roots in administrative issues, corruption, and many others (Aliyu et al. 2013). What is clear is that the energy crisis has been going on for decades. Although several power reforms and projects have been carried out by the country leadership, no tangible long-lasting solution has been proffered. The centerline of the major power reform undertaken by the country and the most promising so far is the relatively recent privatization of the power sector. This involved the sale of primary and most important assets of the Nigeria power sector to private sectors. There has, however, not been a full conversion to total privatization, as the federal government still continues to control and manage major transmission assets (Ogunleye 2017).

12.2 Geospatial Solutions for Electricity Provision and Management

Although the electricity problem is multifaceted, it is a well-understood fact that the present power facilities are under intense pressure, as a result of increasing population density. This pressure, in turn, has impacted the quality and health of such facilities resulting in the breakdown of electricity access even in places where it exists. Unfortunately, there is still little implementation of technologies such as a geospatial framework in the planning and structuring of electrical facilities in Nigeria so far. We fear that with such little to no regard concerning the implementation of geospatial solutions in planning the locations and repair of electrical facilities in this latest reform, so many communities and cities will continue to face this poor power supply problem for decades to come.

12.2.1 Trajectory of YouthMappers in Nigeria

YouthMappers is very strong in West Africa and impressively strong in Nigeria. There are no less than 23 chapters at universities in this nation (at the end of 2021). The very first chapter established in Nigeria was at the Federal University of Technology in Akure (FUTA), being named one of only 2 inaugural chapters in the country. This designation indicates that we started in the first year of the global network (2016). Our chapter has had a storied history of fellows and ambassadors serving the network and a rich set of experiences in mapping with OpenStreetMap and other geospatial tools for a large set of applied solutions.

YouthMappers at FUTA is like the others, a university-led chapter that is connected to the global YouthMappers community. YouthMappers at FUTA is made up of members with a desire to learn, evolve, and adapt to necessary technologies and skill sets needed to solve vari-

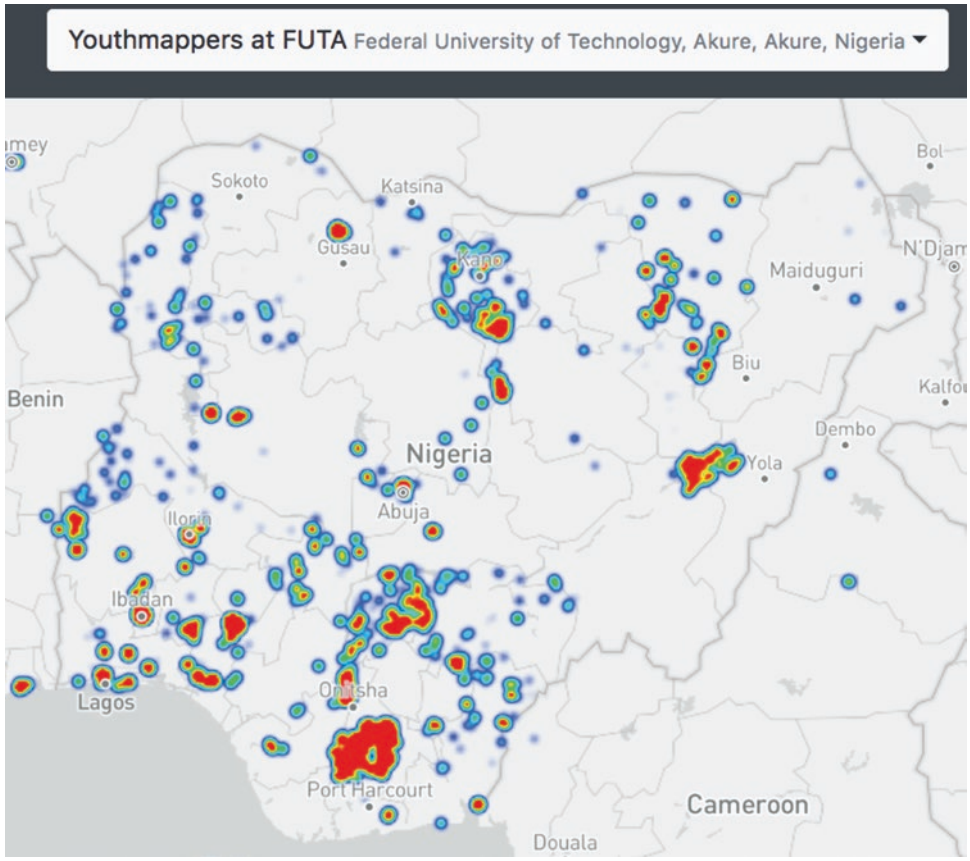

Fig. 12.1 YouthMappers at FUTA have contributed to OSM across Nigeria since establishment. (Credit: J. Anderson, 2022)

ous problems around them. The chapter is dedicated to humanitarian action and community development through open mapping, which is evident in a series of activities and projects executed in the chapter, in which members work together with open data to solve various problems around them.

The series of activities and projects carried out in the chapter has contributed to the achievement of the Sustainable Development Goals, by mapping vulnerable areas of the world to enhance effective humanitarian activities. The results of the series of activities undertaken in this chapter have significantly improved the global map data quality as members of this chapter assiduously and dexterously mapped different parts of the world, and this has also indirectly and directly improved the mapping skills of participating members and has strengthened community resilience (Fig. 12.1).

12.2.2 Disruption of Power Sparks Action Toward SDGs

YouthMappers at FUTA is domiciled in the Federal University of Technology, Akure, which faces a similar electricity supply problem ravaging the nation. Although the school campus has optimal electricity access, the communities surrounding the school campus still struggle with access to electricity. A significant proportion of students in the school live in these surrounding communities, and this creates an uneven power

situation, as students living within the school campus enjoy optimal electricity supply as a result of the unaltered access, while students living off campus struggle to enjoy electricity. This continuously affects the productivity of students in this environment.

Building on the principles of the Sustainable Development Goals (SDGs) "leaving no one behind," our chapter is composed of every willing individual with no gender or racial (tribal) discrimination. We leveraged this by building a community of students and youth who are committed to volunteering and working with a common goal in a bid to make the world a better and improved place. This principle, therefore, drives so many projects we embark on, with the majority of the projects tailored after the 2030 Agenda for Sustainable Development Goals.

Thus, one of the projects embarked on in the context of recent reforms to the power system was, of course, tailored after SDG 7, which says "ensure access to affordable, reliable, sustainable, and modern energy for all." To us this means everywhere, rural and urban, in cities and villages, and inclusive of all individuals like our chapter strives to be, too.

12.2.3 Geospatial Knowledge Needed to Understand Electricity Access

The project to map access to electricity problems was identified by YouthMappers at FUTA; however, we partnered with Energy Detectors Technologies Limited, a fast-growing startup focused on remote data collection, analysis, and visualization in the energy sectors with the use of IoT technology and advanced algorithms, to map the electricity transformers in the communities surrounding FUTA for better electricity planning, so as to bridge the gap and create a sustainable environment for all. We are also informed by other efforts in other chapters in the region and all over Africa and supported by the ambassador network and core team and by the Humanitarian OpenStreetMap Team through data internships.

12.3 Geospatial Data Implementation Projects with YouthMappers

We identified that one of the major reasons for this disparity in access to electricity is due to the huge population pressure on some electricity facilities like the transformers, and the majority of these facilities are not working optimally as a result of the pressure on them. One reason for this lack of optimization is because the areas being supplied electricity are not mapped properly, with a proper understanding of the facilities and the buildings connected to them.

12.3.1 Remote Mapping Results

YouthMappers at FUTA aimed to increase the data about access to electricity in the country embarked on several mapathons. One of those programs is Nigeria Sustainable Energy 4 All (SEA4LL) program.

When the pandemic hit, we had to adapt – and make lemonade out of lemons (Opeyemi and Jolaiya 2021). With several contingency plans from the government, as an effort to reduce the spread and impact of the virus, so many activities turned out a new leaf, as we were required to hold several meetings online rather than the normal in-person meetings we were all used to. However, we were able to adapt and also evolve in a very deciduous manner. We held different meetings to train members of the chapter as a way of refining the skill set of individual members of the group, using several teleconferencing mediums like Zoom, Microsoft Teams, and Jitsi. Workshops were also held in a virtual mode, periodically to keep members abreast about what is needed to be an effective member of YouthMappers (Figs. 12.2, 12.3, and 12.4).

In the end, the chapter massively supported the Nigeria Sustainable Energy 4 All (SE4ALL) program in remote mapathons. The progress in number (so far) is 60,183 km of electricity grid tracked. We also reached 3937 settlements remotely mapped and 3,244,605 buildings mapped.

Fig. 12.2 Mapathons by YouthMappers at FUTA typically include remote mapping training and tasks

Fig. 12.3 Officers of YouthMappers at FUTA plan the SEA4LL collaboration

12.3.2 Field Mapping Results

We also embarked on a field mapping exercise to capture locations of electrical facilities in the area, we also noted the number of buildings connected to each electrical facility, with an aim of determining the amount of load on them. Our partner – the Energy Detector Technologies Limited – provided us with IoT devices, which were installed to track and monitor if a transformer was powered on or off and the duration when it was on or off.

We collaborated with this private entity, Energy Detectors Technologies Limited, by sharing the spatial data obtained from the field. The company shared this data with the electricity distribution company responsible for managing electrical facilities and distributing electricity in the region – Benin Electricity Distribution Company (Figs. 12.5, 12.6, and 12.7).

The data obtained from the IoT devices was used in a mobile application named UPNEPA. The application notifies students/users of the current power situation within the school campus and also off campus, and this solved a great decision challenge as it prompted students automatically when electricity is supplied.

The project end goal was to improve electricity availability alerts in the mobile app developed by the E-Detectors Energy Limited.

Fig. 12.4 Students validate remote mapping for each other during the YouthMappers at FUTA events

Fig. 12.5 YouthMappers at FUTA undertake field mapping of electricity assets

Fig. 12.6 Transmission lines are important features that require field mapping or validation

12.3.3 Mapping Challenges

The project was exciting and impactful as we saw the result of our exercise in the notable increase and improved access to power supply around the school campus. However, it is noteworthy that we faced some challenges during the course of the project, one of which is the Internet connec-

Fig. 12.7 IOT devices enable mapping of attributes in electricity asset maps

tivity problem, as some of the student mappers did not have Internet data, which hindered them from participating during the course of the project.

Also, during the course of the field mapping, access to some rugged terrains was difficult, as the mappers had to walk on field visiting several locations in unsuitable weather conditions. We worked through these challenges.

Finally, there was a problem we faced, where the inhabitants of the communities being mapped were unaware of what we were doing. They were reluctant at first when they were approached about information about their residence and power supply situation where they live. We addressed these by providing the information needed for voluntary responses.

Despite the challenges faced during the course of the project, the experience cannot be compared to the tremendous impact created (Fig. 12.8).

Fig. 12.8 Skills developed through YouthMappers at FUTA projects can impact the future of student leaders

12.4 Beyond Making a Map: Mappers for the SDGs

In the course of making these projects happen, our chapter periodically embarks on exploring, teaching, and educating other members through mapping, to develop their mapping skills, contribute more to the digital world, and engage them in global funding and scholarships to attend conferences and other activities.

YouthMappers at FUTA achieved quite a lot through these experiences. Our community members Ademoyero Victor Ayomide, Olanrewaju Michael, Oke Mathew, Akintola Mercy Onaopemipo, Okikiri Favour, and Babalola Bukola participated in a data labeling contest as part of the Cloud Native Geospatial Outreach Day sponsored by Planet, Microsoft, and Azavea. Out of 231 participants from across the world, Ademoyero Victor won the 3rd Place Labeler prize award, Babalola Oluwabukola won the Top Woman Labeler Prize Award, and Akintola Mercy Onaopemipo and Olanrewaju Michael won the next 5 Top Labeler Prize Award. These outstanding participants were issued certificates for their participation at the end of the event.

Furthermore, the chapter massively supported the Nigeria Sustainable Energy 4 All (SE4ALL) program in remote mapathons, which were held five times from July through November of 2020. Two of our chapter members were awarded mapping champions thrice during the events, and we made in total over 53,000 edits on OSM. The erstwhile chapter presidents, Dennis Irorere and Emmanuel Jolaiya, were part of the program coordinators and mapathon instructors.

Moreover, we learned to adapt. Mapathons and mapping parties at first looked difficult transferring all of that to a virtual space. However, because our group consisted of youth with an adaptable mindset, we were able to quickly evolve and adjust to the virtual reality of the world made necessary by the pandemic. Remote mapping wasn't a new reality, as we as a group have been involved in this for a long time, and this was done regularly by members. But the chapter engagement had to learn to be resilient, despite obstacles like access to Internet, and ironically electricity.

In a bid to contribute to the achievement and actualization of the UN Sustainable Development Goals, the YouthMappers at FUTA decidedly contributed to SDG 7, which is to "ensure access to affordable, reliable, sustainable, and modern energy for all." The goal comprises five targets, which are to be achieved before the year 2030 and can be measured by the use of six indicators. But it goes further than this. Because electricity is a foundation for sustainable cities and villages, the contribution to this SDG also implies progress for SDG 11 made as a result of the very pertinent and persistent electricity supply problem around us.

References

Aliyu A, Ramli A, Saleh M (2013) Nigeria electricity crisis: power generation capacity expansion and environmental ramifications. Energy 61:354–367

Ogunleye EK (2017) Political economy of Nigerian power sector reform. In: Arent D, Arndt C, Miller M, Tarp F, Zinaman O (eds) The political economy of clean energy transitions, UNU-wider studies in development economics. Oxford University Press, Oxford, pp 391–409

Opeyemi N, Jolaiya E (2021) 2020: a year we made lemonade out of lemons. YouthMappers Blog, 28 January. Available from YouthMappers. https://bit.ly/3frI7am. Cited 8 Jan 2022