Cellular Citizenship

Invigorating Development through Mobile

MATT BERG, PRABHAS POKHAREL, ANNIKA SWEETLAND, AND VIJAY MODI

In Nigeria, hundreds of government-hired enumerators armed with GPS-enabled smartphones have systematically been visiting schools, water points, and health facilities across the country. At each location they take a photo, record a GPS point, and with the aid of a mobile data collection form, assess local capacity based on the availability of necessary human and material resources—such as basic infrastructure, staffing, furniture, and tools—to deliver a given service. For example, is a water point functional and being used? Does a clinic have adequate equipment, medicines, and staffing to deliver care? Does a school have a roof, teachers, desks, and books?

The goal of this ambitious effort by the government of Nigeria, with technical support by the Earth Institute at Columbia University, is to quickly develop a complete, accurate, and timely understanding of the issues related to access to vital services that are critical to achieving the Millennium Development Goals (MDGs), especially by the rural poor. To date, this consisted of nation-wide mapping exercises representing an inventory of over 250,000 facilities and service points. Collected in the span of only a few months, this rapid assessment has provided specific and actionable data required by policy makers and planners, both at a local and national level, to properly understand the resources required to address the identified gaps in service provision.

This data collection exercise is part of the Conditional Grants Scheme (CGS), a Nigerian development initiative introduced in 2007 by the Office of the Senior Special

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Assistant to the President on MDGs in order to enable the federal government to use debt-relief funds to provide technical and financial support to state and local governments to achieve the MDGs. The conditions attached to grants are designed to ensure greater responsibility in public expenditure by decentralizing the planning, budgeting, and implementation of MDG-related programs to Nigeria's 774 local government authorities (LGAs). The overarching goal is to enhance government accountability by improving transparency in decision-making and resource allocation, while increasing local planning capacity and ownership.

Quickly mapping Africa's most populous nation is admittedly an audacious goal, but one that is now possible with the help of the mobile phone.

Planning in the Fog

Traditional paper-based data collection is a costly and time-consuming process that involves the physical collection of surveys, manual data entry, data cleaning, and data synthesis. As a result, government data is usually out of date by the time it is released, making it impossible for policy makers to adequately plan for and allocate the necessary resources to achieve the MDGs.

Though it is possible to collate GPS coordinates with paper surveys, it is a cumbersome and error-prone process. This weakness in paper-based systems has led planning agencies to over-rely on simple metrics such as facility-to-population ratios, without taking into account proper consideration of important factors such as population density when trying to assess access to services. This is demonstrated when trying to make sense of national-level performance indicators in an LGA with a large urban center, as they usually distort or mask rural conditions. That 70 percent of the population has access to energy in an urban area provides no reliable indication of the reality facing people in neighboring rural areas. Geospatial analysis and good data, which can help disambiguate these indicators, require a trained Geographic Information System (GIS) specialist—a resource to which few district planners have access.

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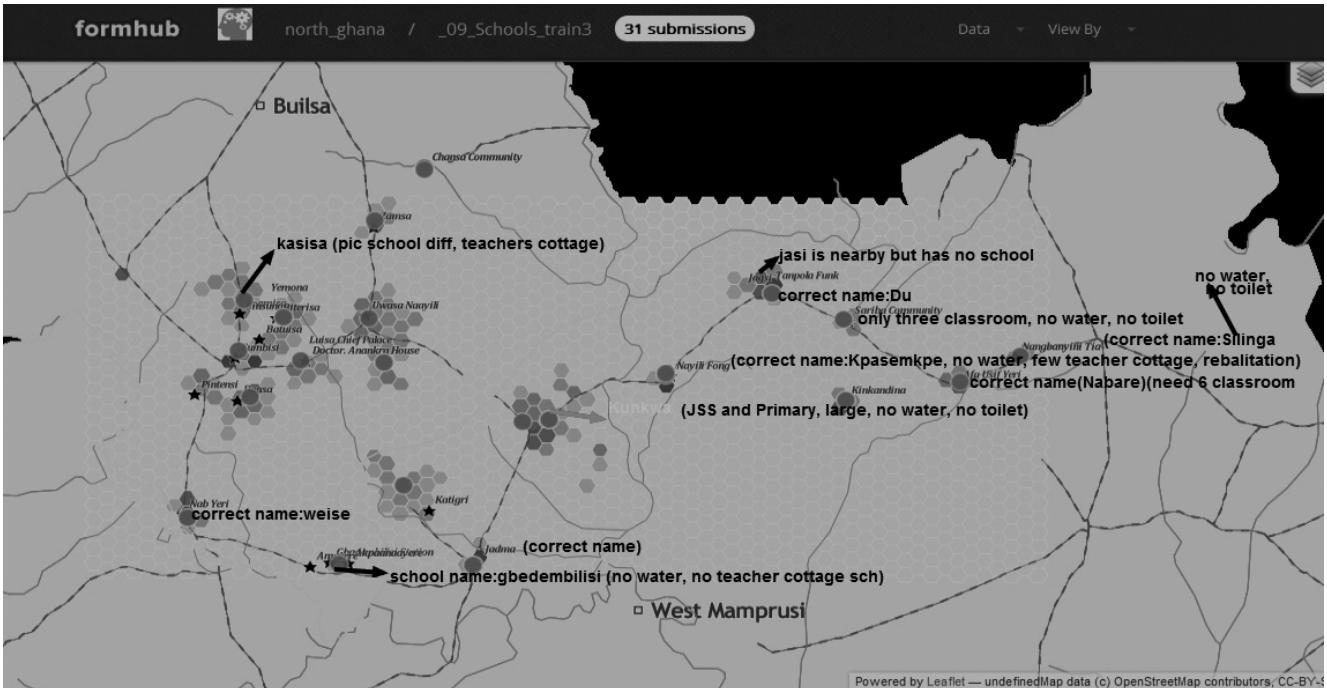
Given the high costs and resources required for such data collection efforts, the process is often funded centrally, with the resulting data usually flowing up to and closely guarded by the collecting agency. Donor willingness to fund such initiatives can actually lead to inter-agency competition instead of cooperation, something the authors have unfortunately witnessed in numerous countries. This in turn leads to unnecessary duplication of efforts with identical data being collected, without harmonization, wasting valuable resources that might have been channeled to direct intervention efforts.



Pictured above is a map of educational institutions. The collection of accurate data can lead to greater accountability, improving important projects such as aid distribution.

All images courtesy author

Finally, traditional one-off data collection efforts also make it difficult to track progress and hold the project implementers accountable. They miss the opportunity provided by citizen feedback or "crowdsourcing" that can offer close to real-time verification of what is happening, which makes it difficult to respond to community needs in a timely way. Lack of data can lead to a dangerous lack of accountability, which limits the amount of aid that is given due to shifts by funding agencies towards giving only output-based aid or providing payment only upon verification.

Mobile Advantage

Smartphones combine a camera, GPS, and the functionality of a personal digital assistant to collect structured survey data into a single networked device. The resultant data is also of a higher quality. Data entry is done directly on the phone on site and is assisted by automated constraint checks that greatly reduce the need for data cleaning. For example, responses can be restricted to a numeric format that is consistent with some meaningful parameter (such as age ranges, for example). The automation of complex skip patterns also limits the possibility of human error. Surveys can also be collected offline, stored on a memory card, and sent from the field whenever a sufficient mobile network is encountered. This reduces the time and cost related to transport and management of paper surveys. All of this allows data to be available in "real-time" or within a few days or weeks, enabling opportunities for evidence-based planning and operations heretofore impossible.

Electronic data collection confers another major advantage: it can be shared instantaneously after it is collected without cost. With the ability to collect data in real-time, data should be thought of as a "living entity" that only retains its value if it is kept up to date. Since it will be difficult for any one organization or agency to do this alone, a natural incentive is created to share this data with other stakeholders, other government agencies, or citizens themselves, to help keep the shared data current. This supports the open data maxim that the more you share data, the more its value increases. This highlights the importance of the national facility registry and other national databases with application programming interfaces that make it easy to share and update data.

Towards "Live" Data and Local Planning

Instead of relying on two-year-old data on the status and location of water points in a particular community, live data allows planners to accurately budget a measured response in real-time. While old data is not the sole cause of the large amount of broken infrastructure we see in the developing world, our hope is that the opportunity for planning based on near-real-time data of service quality allows policy makers and planners to consider rehabilitating and upgrading infrastructure instead of defaulting to rebuilding it.

Having information flow back to the local level (in the form of printed digital maps and spreadsheets) not only provides an important opportunity to collect ground truth, but also allows local communities to be more engaged in their own planning processes. Local communities are better equipped to make sense of their local data, which sometimes results in the clarification of local misconceptions, and can help determine the most efficient priorities for planning.

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Redefining Access

Geo-referenced service delivery data allows us to extend planning to address equitable access more deeply. Using geo-referenced data, we can calculate spatially-based metrics that highlight the stark differences in access between high population peri-urban areas and rural areas with population densities as low as a few people per square kilometer. The combination of knowing where people live and the location of facilities allows us to see how far women live, on average, from a facility with emergency delivery services on a district, state, or regional level. The distance one lives from a road or facility point is one of the strongest determinants of access to services and forms the basis for an evidence-based planning process. Within the MDG context, planning is also usually constraint-driven. Spatial planning methods can be used to determine the optimal location to build the next clinic to improve access or to calculate the coverage rates you can achieve by building X number of new schools.

What can visiting schools tell an education planner? Systematic, rapid assessments done during visits to schools can be used to provide a comprehensive picture of the challenges facing education in an area. The distance students travel to school corresponds closely with access and school enrollment rates, as does access to potable water, improved pit latrines, and gender-separated toilets (especially for girls). Process indicators like delayed or missing payments to teachers, the use of national curricula, and adequate availability of pencils and textbooks are potentially helpful

proxy indicators for education quality in general. Pupil-to-teacher ratios and pupil-to-classroom ratios provide an important indication of schools' current capacities.

For effective local planning, this data cannot just be viewed in aggregate. Rather, education planners must take into account each school's condition on an individual basis. A lack of adequate classrooms can be overcome by the availability of good teachers. This cannot be said for the reverse. Sometimes even determining what qualifies as a school can be a challenge. Must there be a building? Does a chalkboard under a tree count? Since it is now possible to capture and review data locally at such detail, it is now possible for local education planners to decide.

Monitoring and Verification

Moving beyond planning, mobile-based data collection systems can serve as a crucial backbone in the monitoring and verification of service provision. A photo, tied to a location through a GPS point, can be enormously illustrative in showing whether services contracted by the government have been delivered or not. Furthermore, the speed with which this verification can be conveyed back to the contracting agency allows for sophisticated monitoring and verification schemes.

Citizen Sensors

While verifying if a service has been delivered can go a long way towards improving accountability in service provision, ongoing monitoring is critical in helping to ensure that service delivery is sustained over the long term. Since public infrastructure items like water pumps are so numerous and widely dispersed, ongoing monitoring represents an enormous challenge. Fortunately, citizens armed with mobile phones represent an omnipresent sensor with a vested interest to report when there is a problem. Text message and voice based methods to "crowdsource" citizen feedback have shown promise; however, they will only be sustained if they elicit an actual response.

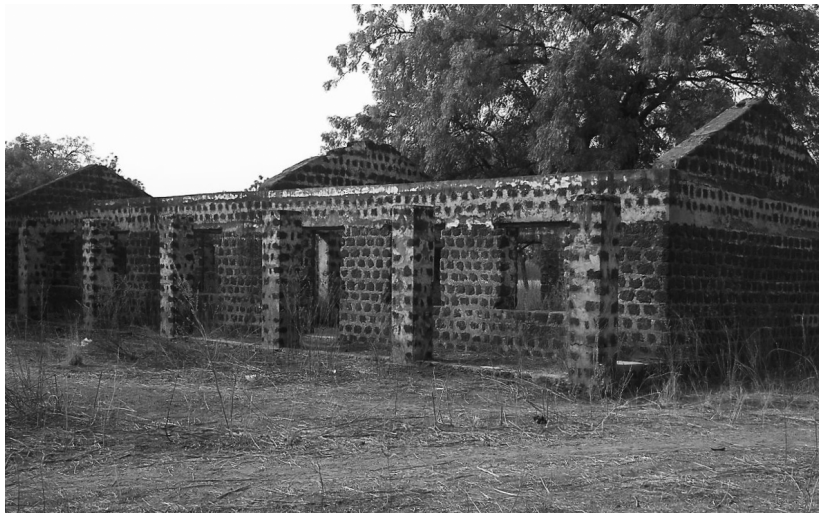
Facilitating citizen monitoring will also require that public infrastructure items like water points be adapted to include visible unique IDs or "QR codes" (smartphone-readable bar codes) to enable them to be properly identified when a problem is reported. A longitudinal history of these failures provides invaluable insight towards developing better strategies to improve the reliability of these services in the long run.

Challenges and Opportunities

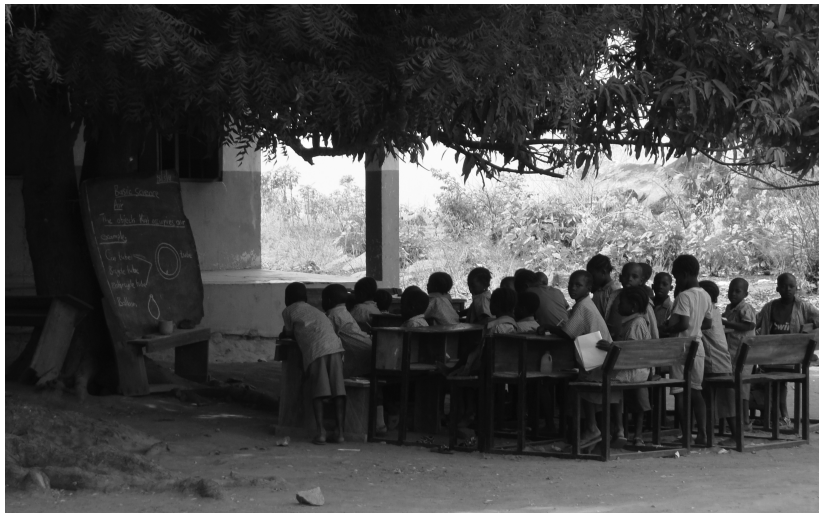
Where People Live

Planning requires thinking in terms of supply and demand of services. As discussed in this paper, estimating supply, location, and capacity of service points and facilities is becoming increasingly possible. Understanding demand, however, requires knowing where people live, which is a much larger challenge. While it is feasible to manually capture the locations of schools and water points with a mobile phone, gathering the locations of households is much more labor-intensive and costly.

Government population data is usually demarcated by administrative and political boundaries (states, districts, and voting precincts), which are too disaggregated to enable proper planning at the community level. Proper geospatial planning requires knowledge of the locations and populations of local communities, which is either



Thanks to mobile technology, any space can become a classroom. Above, this roofless structure exemplifies how a local asset can be transformed into a school.



In order to improve educational facilities, visiting planners must take time to collect data from schools on an individual basis. Pictured here are students learning in an outdoor setting.

nonexistent or so politically contentious that it is not made available, even internally, for planners.

One of the best available options to identify where people live is to use remote sensing (satellite imagery) and machine learning algorithms to detect the rooftops on homes. In Africa, however, there are many challenges with this approach. Satellite imagery is proprietary because it is costly to obtain. Deriving population data from Google Satellite imagery would be a violation of Google's privacy policy. There are also research challenges such as the fact that thatched and mud roofs are hard to detect because they look so similar to the surrounding soil. If a company with the means of Google created a high-resolution map of the world, the planning benefits would be tremendous.

Open Data

The ultimate goals are real-time reporting and decision making dashboards that reflect the "current" state of things with data fed in from mobile phones. While we are approaching this ability, significant value is created in simply sharing data sets like the location of health facilities.

Sharing of data between government ministries, however, usually requires getting approval, which takes time and introduces potential political factors. As a result, the simplest way to ensure that everyone who needs data has access is to make data completely open. Open data creates new possibilities for increasing the effectiveness of service provision—ministries can coordinate joint activities, parallel data collection efforts, and optimize planning and budgeting across sectors. Health planners, for example, could take into account the location of schools and water points when planning new health facilities.

With the exception of countries like Kenya, government's general embrace of open data practices has been slow for a number of reasons. First is a simple matter of technical know-how. Better tools for leveraging open standards are needed, like facility registries, to make the process of sharing and updating health facility and school data easier. Second, governments must realize that this type of data is, by nature, dynamic, and it will never be complete; holding onto data only decreases its potential relevance. This represents a paradigm shift in practice from government data that typically goes through a vetting and approval process before its release - a process that can take years. Embracing open data means realizing that creating a market to harness the value of the data, both within the government and publicly, outweighs any perceived risks in sharing it.

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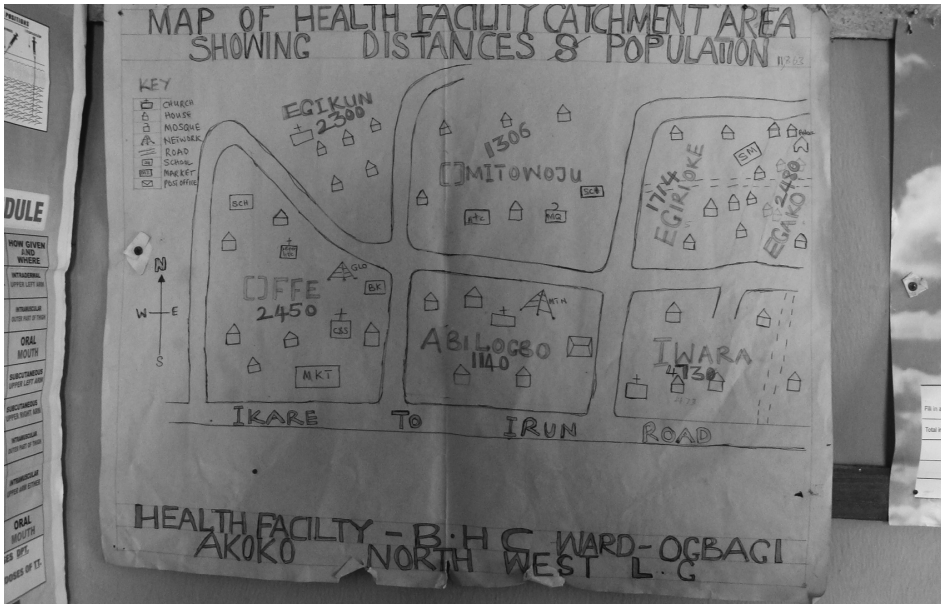
Conclusion

One of the keys to closing the poverty gap is to provide planners with increased access to accurate and up-to-date data that mobile data collection systems are making increasingly possible. Not only are these new approaches more cost-effective and efficient, but they also allow for the use of more sophisticated geospatial-based planning methods. Data sharing has also facilitated increased harmonization between government agencies while strengthening cross-sectoral planning capacity at the local level.

Better planning should translate to better investments and hopefully more meaningful impacts on outcomes. Through improved means of verification, not only can communities hold governments and service providers more accountable, but they must also be active participants as service delivery performance becomes increasingly tied to real-time data. H



Open data provides more opportunities for coordination between different developing projects. A healthcare facility could coordinate with surrounding schools and water points.