THE POWER OF WATER: LOCATING POTENTIAL OFF-GRID ELECTRICITY INTERVENTIONS TO ALLEVIATE WATER FETCHING BURDENS

INTRODUCTION

In 2015, the Millennium Development Goals assessment found that most regions met their drinking water goals. However, the sub-Saharan Africa region fell short of their goal of 74% coverage, achieving only 68% (UNICEF, 2015). The report also found that two-thirds of the 159 million people still using surface water, live in sub-Saharan Africa (UNICEF, 2015). This means that more than two thirds of the population in Africa still has to leave their homes to collect water for drinking and household use. Recent findings by the Intergovernmental Panel on Climate Change (IPCC) suggest these disparities are likely to worsen with the effects of climate change.

Access to clean drinking water is essential to reducing poverty, bettering health outcomes, increasing human capital and promoting gender equality. The United Nations recognizes this again in its Sustainable Development Goals (SDG) and features access to clean water and sanitation as goal number 6: "Ensure availability and sustainable management of water and sanitation for all by 2030" (UN, 2015). Furthermore, the UNICEF/WHO Joint Monitoring Program developed a drinking water service ladder which includes the need for water to be collected in 30 minutes or less (roundtrip) to be considered a basic drinking water service (JPM, 2017). This emphasizes the importance of reducing fetching times and ensuring water is reasonably accessible on premises and available when needed.

Additionally, some studies have found that electricity interventions in isolation are not sufficient to lift households out of poverty (Wolfram, 2018). This project looks at access to electricity as a vehicle to meet more basic needs such as access to drinking water and examines where electricity access might help alleviate water fetching burdens the most. Understanding where fetching times are longest, where power access is poorest and where population is highest can help inform new development policies.

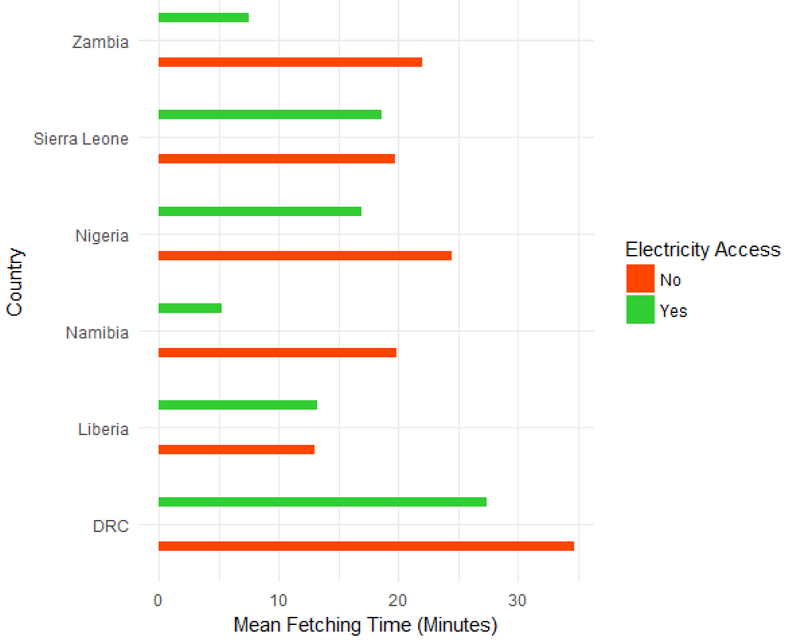


Figure 1. The above chart summarizes the mean fetching times of rural households with and without access to electricity. As we can see, fetching times are generally reduced when a household has access to electricity.

Lee, Kenneth, Eric Brewer, Carson Christiano, Francis Meyo, Edward Miguel, Matthew Podolsky, Javier Rosa, and Catherine Wolfram. "Barriers to Electrification for "Under Grid" Households in Rural Kenya." NBER. June 2016. Accessed May 08, 2018. http://www.nber.org/papers/w20327.

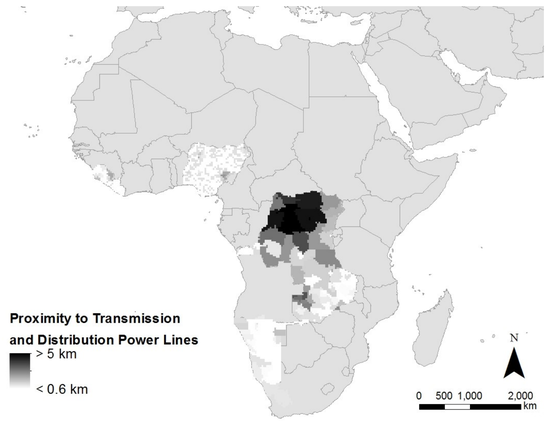
Wolfram, Catherine. "Does Solving Energy Poverty Help Solve Poverty? Not Quite." Energy Institute Blog. April 02, 2018. Accessed April 23, 2018. https://energyathaas.wordpress.com/2018/03/12/does-solving-energy-poverty-help-solve-poverty-not-quite/.

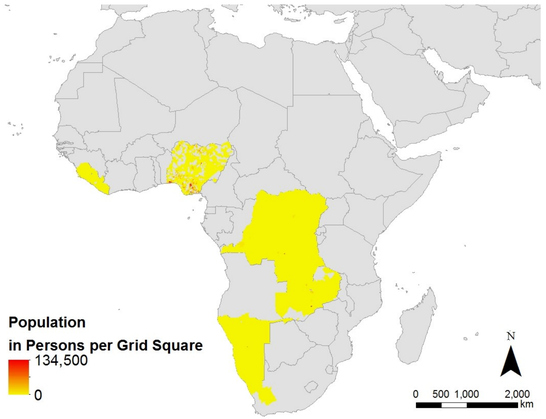
METHODOLOGY

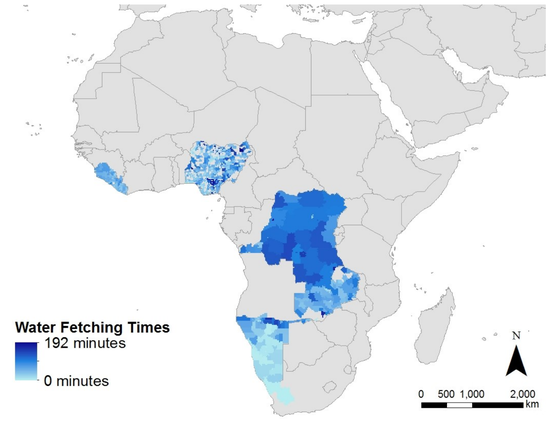
This project attempts to answer the following research questions: (1) Where do people in six countries in sub-Saharan Africa spend the most time collecting water? (2) What areas in six countries in sub-Saharan Africa are furthest from power lines (poor grid connectivity)? (3) Where would off-grid power interventions benefit the most people? In order to answer these questions, data from the Demographic and Health Survey (DHS) Program was obtained for six countries in sub-Saharan Africa: Zambia, Sierra Leone, Nigeria, Namibia, Liberia and the Democratic Republic of the Congo (DRC). The information of interest, water fetching times, was obtained from the most recent surveys in 2015 for 92,597 households in the six countries. A dataset containing the planned and existing transmission and distribution power lines in Africa, as well as, population data for Africa in 2015 were obtained. The three datasets were analyzed by level 2 boundaries and ranked from 1 to 5 as follows:

- Power. Lowest ranking for areas within 600m from a power line (the distance at which the utilities deem a building eligible to apply for a grid connection)
- Water. Lowest ranking for fetching times of 0 (access to water at home)
- Population. Lowest ranking for least populated areas.

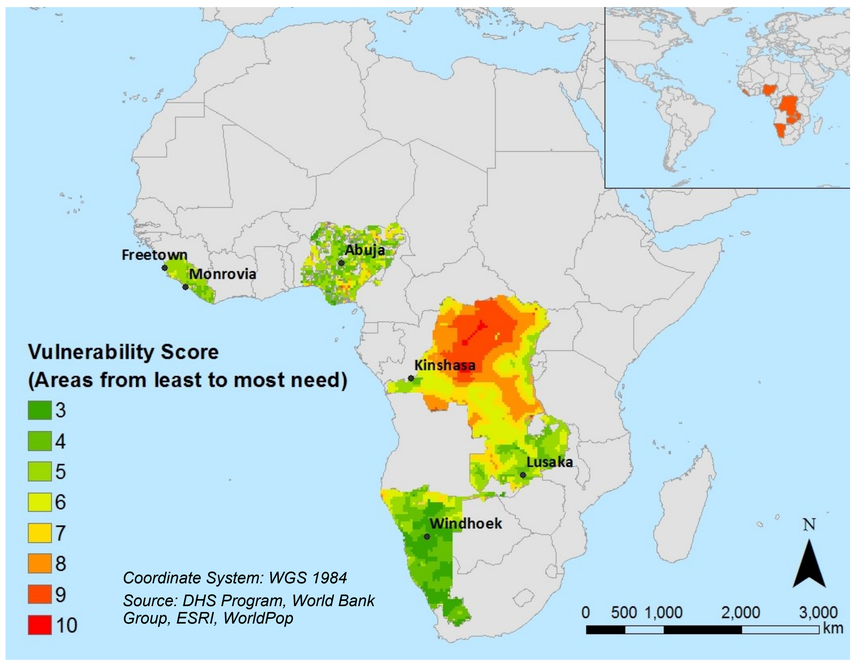
RESULTS







As can be seen in the figures above the DRC sub-regions are furthest from power lines (the furthest area is 33 km from a transmission or distribution line); areas in the coast of Nigeria have the highest population per grid square and again regions in the DRC have the highest household fetching times (on average 192 minutes per round trip to collect water). After completing the analysis described in the methodology, 12 of the 785 sub-regional districts (from 6 countries) included in the data set were identified as potential areas for off-grid interventions. These 12 sub-regional districts are all in the DRC and have a total population of 693 persons per grid square. The highest vulnerability score below is 10 because the population is low in the sub-regional areas of the study. Areas in Namibia and Liberia are in general less vulnerable based on the project criteria.



DISCUSSION & CONCLUSION

The 12 sub-regional districts identified in the analysis are suitable candidates for off-grid power interventions. As pointed out in Figure 1, a simple review of the DHS data suggests that access to electricity can alleviate some of the water fetching burdens. In the DRC for example, households with access to electricity have on average 7-minute shorter trips for water collection. This project also suggest further research would be most useful in the DRC out of the 6 countries studied. However, this project is not without limitations. Since the purpose of this project was to identify areas for off-grid interventions based on high fetching times, the parameters to assess suitability were limited. Data availability was also a challenge at this large geographic scale. In the future, a more meaningful analysis can be completed by narrowing the research area and including more detailed parameters on the population such as urban vs rural households, employment, poverty, and land cover. Despite its limitations, this project presents valuable findings for six countries in sub-Saharan Africa which can have important implications for international development agencies, national governments, development banks and non-governmental organizations interested in ensuring the availability of water for all by 2030.

Cartographer: Mariela Medina Castellanos
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DHP P207 GIS for International Applications
Professor: Patrick Florance