

Off-grid Solar (OGS) Application in Ethiopia



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Introduction

- Sub-Saharan Africa (SSA) is home to .975 billion people [4].
- Less than half (~44%) of Africans living in SSA have access to electricity due to the complexity of grid expansion and the low population density that characterizes most of this area [3].
- Short-term solutions like solar mini-grids and solar home systems must be utilized to meet off-grid energy demand with limited universal grid access.
- Developmental partners can collaborate with industry leaders in order to establish support initiatives for the modernization of SSA's electrical network.
- Power Africa (PA) is a global partnership established by the United States Agency for Development (USAID) to expedite electrification in SSA. Beyond the Grid, a PA-funded initiative, focuses more specifically on improving electricity access in SSA through financial, political, and technical assistance. The Power Africa Off-grid Project, a USAID contract held by RTI, is a prime example of a collaborative network created to identify and administer solutions that enable further OGS development.
- Determining which market sectors can be most heavily influenced by OGS is essential for establishing a lucrative and sustainable market for solar technology advancement in SSA.
- OGS investments in rural, agricultural areas can improve access to groundwater, increasing agricultural productivity and enhancing food security.

Research Objectives

- Identify the primary indicators that influence the progression of OGS implementation.
- Explore the potential market for OGS application in Ethiopia and estimate the potential impacts associated with OGS implementation.
- Map areas with sufficient groundwater stocks and OGS market potential where solar-powered pumps can benefit agricultural producers.

Key Considerations

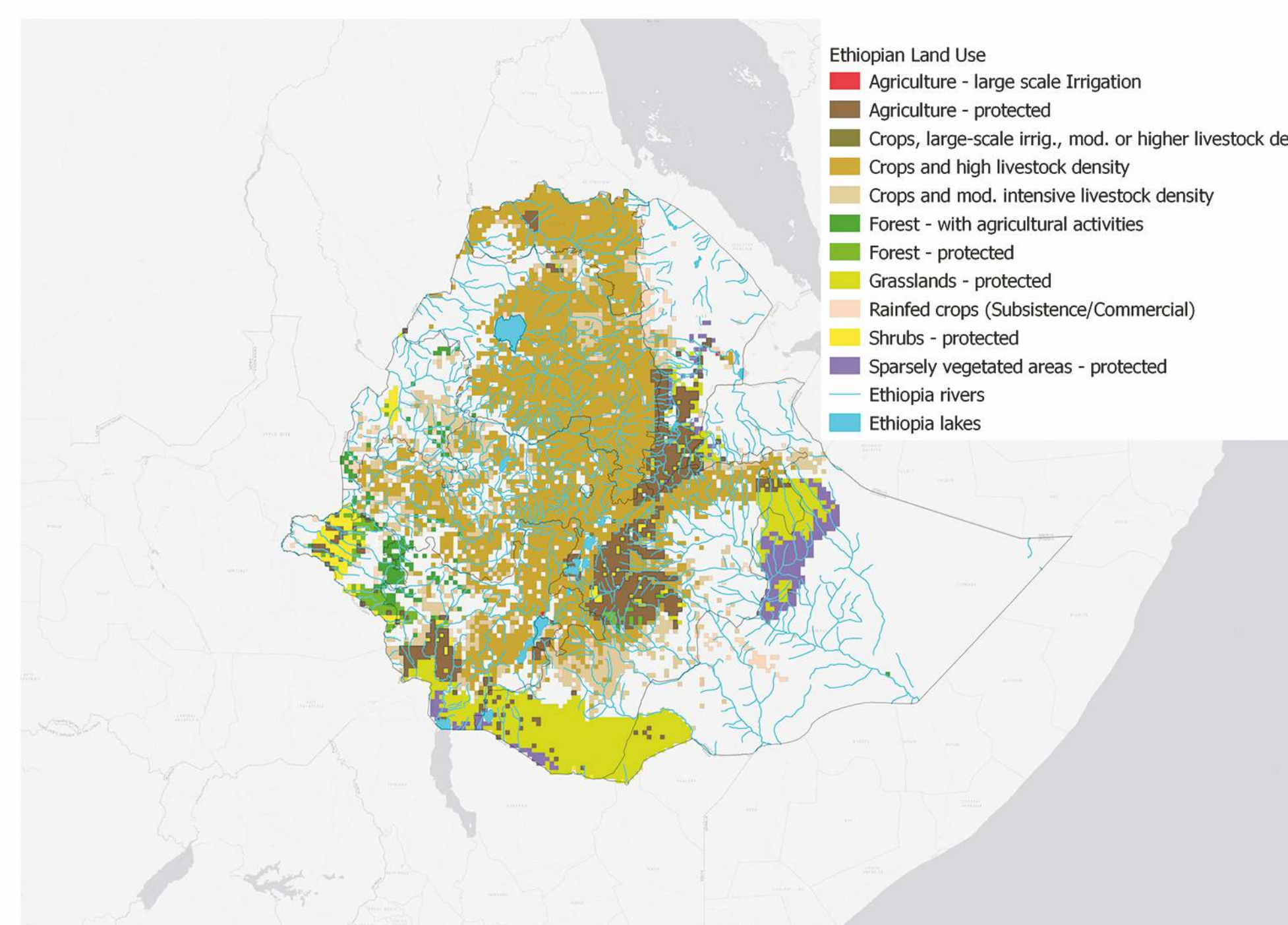
The most important considerations for stakeholders when exploring OGS implementation are:

- Feasibility:** Financial, environmental, and technical constraints
- Infrastructure:** Location, cost and reliability factors
- Land Use:** Existing agriculture and protected areas
- Policies/Regulations:** Import taxes and duties
- Population:** Density and urban vs. rural distribution
- Solar Irradiation:** Solar energy output over land area

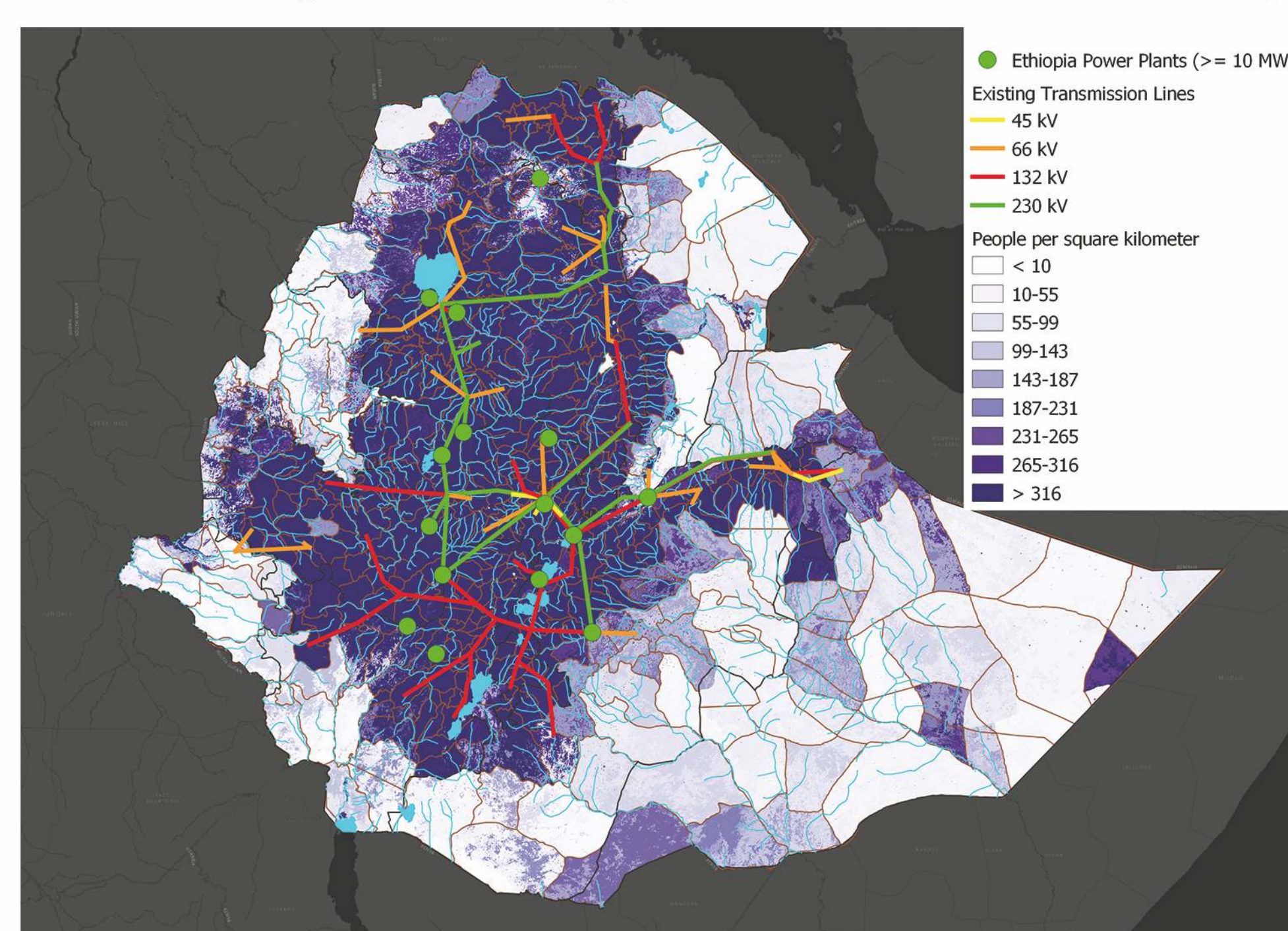
Ethiopia as a Potential Market for OGS

- Ethiopia is the primary focus of this project because it is the second most populated country in Africa, yet only 44% of Ethiopians have access to electricity [1]. This rate of access ranks at about 23rd out of all SSA countries.
- Ethiopia's agricultural sector represents about 31% of its gross domestic product [3]. Given the strong dependence upon agriculture in this country, improvements in productivity will lead to greater economic prosperity. Irrigation enabled via OGS is one potential solution that can increase yields, extend growing seasons, and improve drought resiliency.

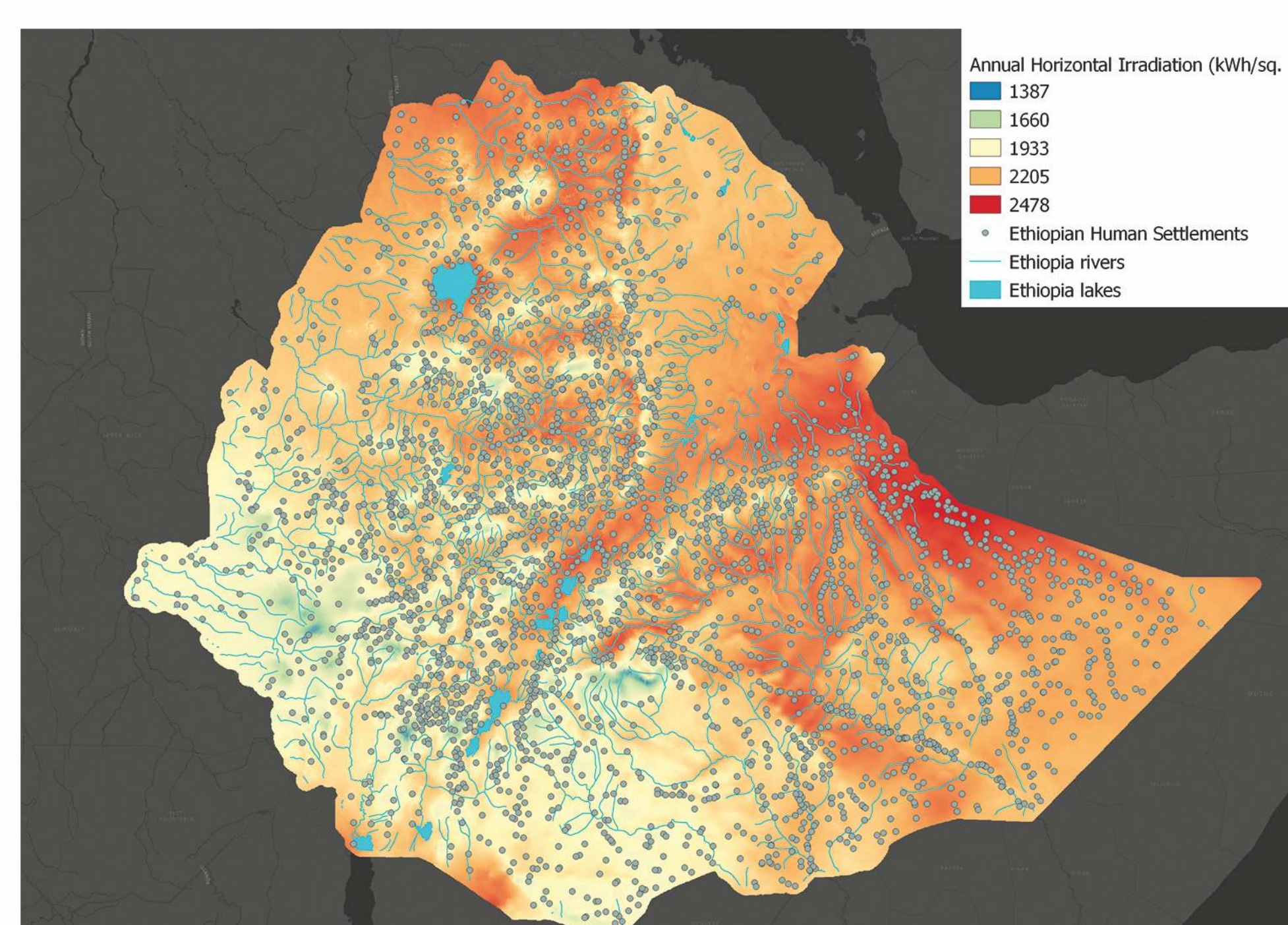
Land Use in Ethiopia (Existing Agriculture and Protected Areas)



Population Density and Existing Electrical Network in Ethiopia

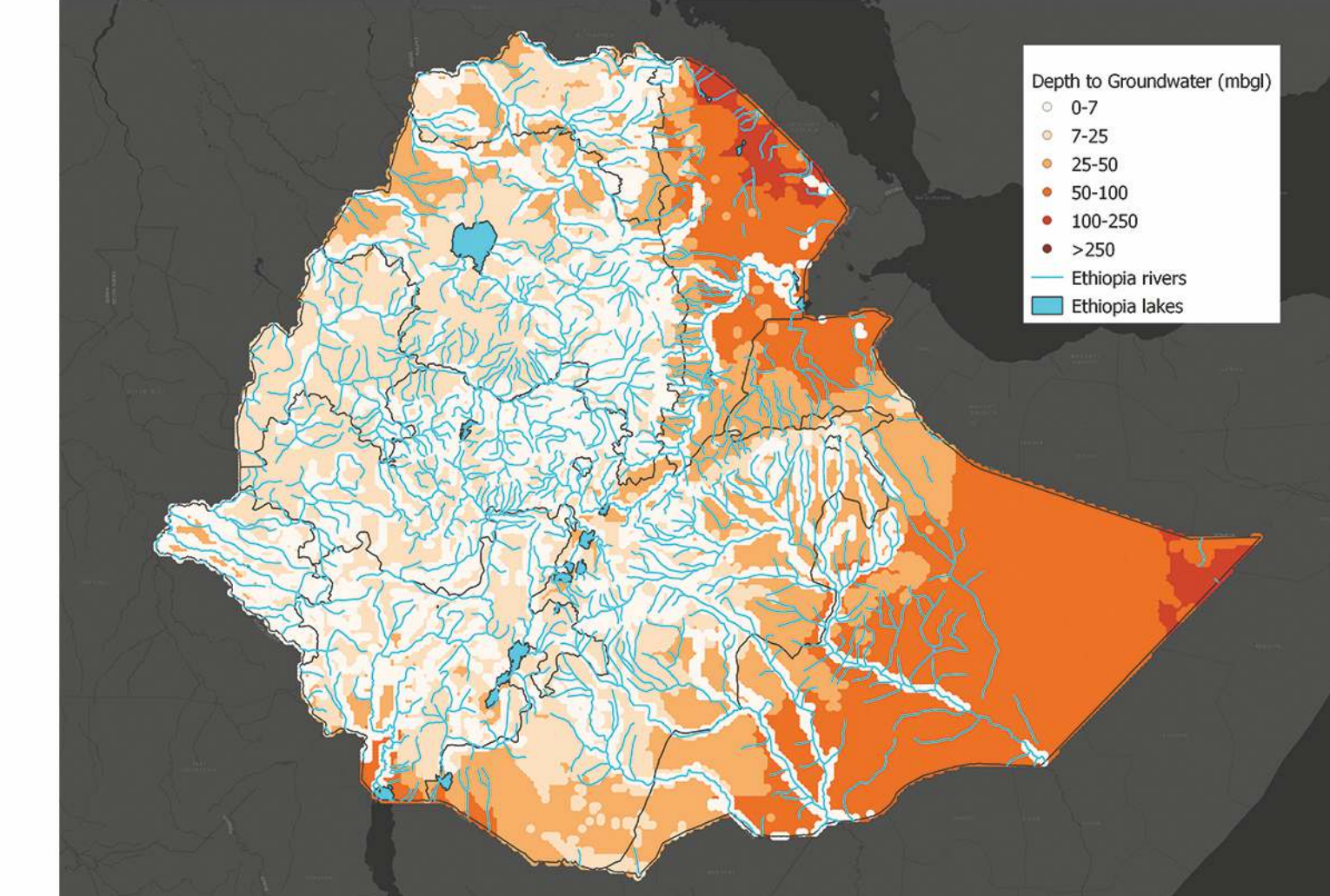


Global Horizontal Irradiation and Human Settlements in Ethiopia

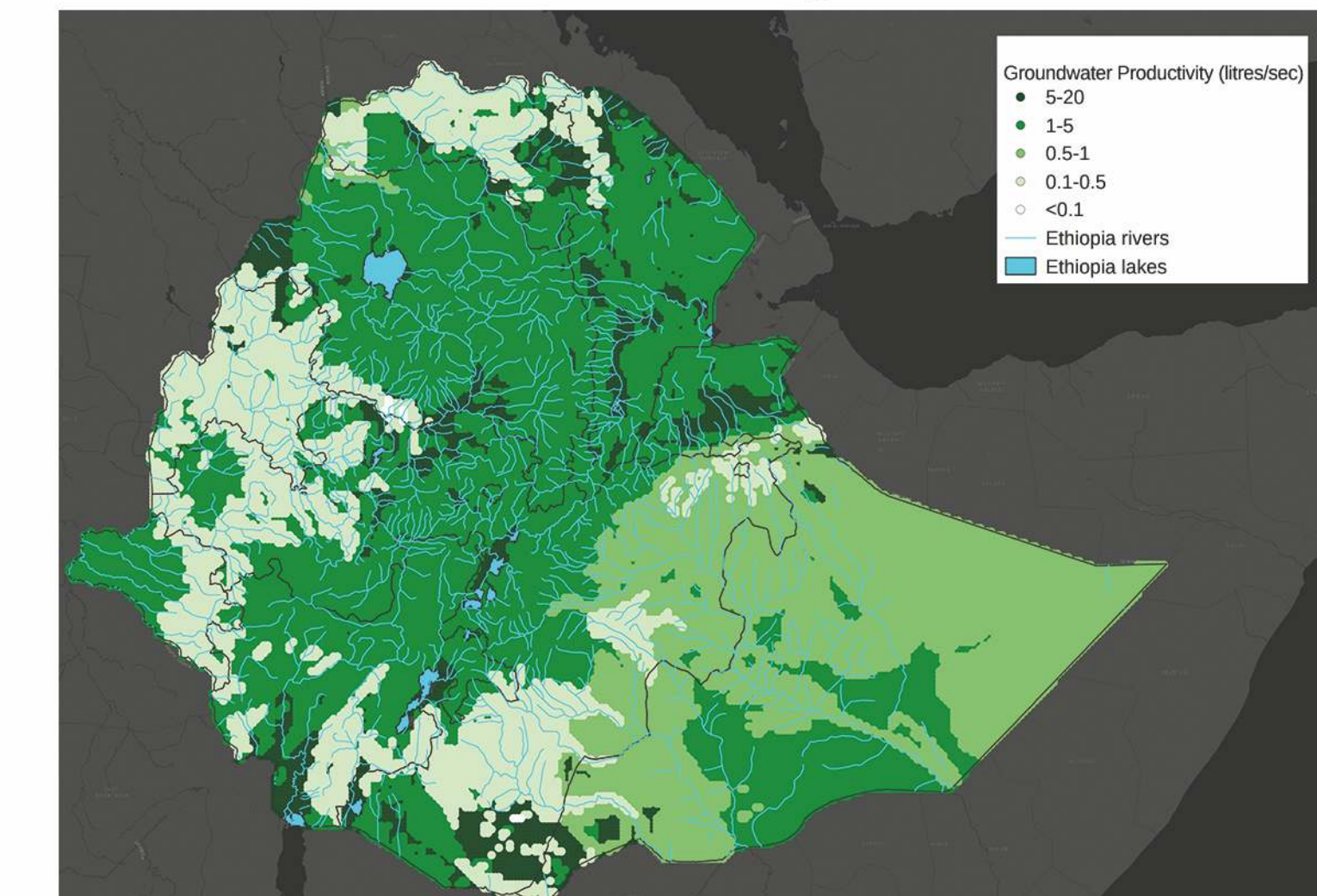


Initial Assessment of OGS Groundwater Irrigation in Ethiopia

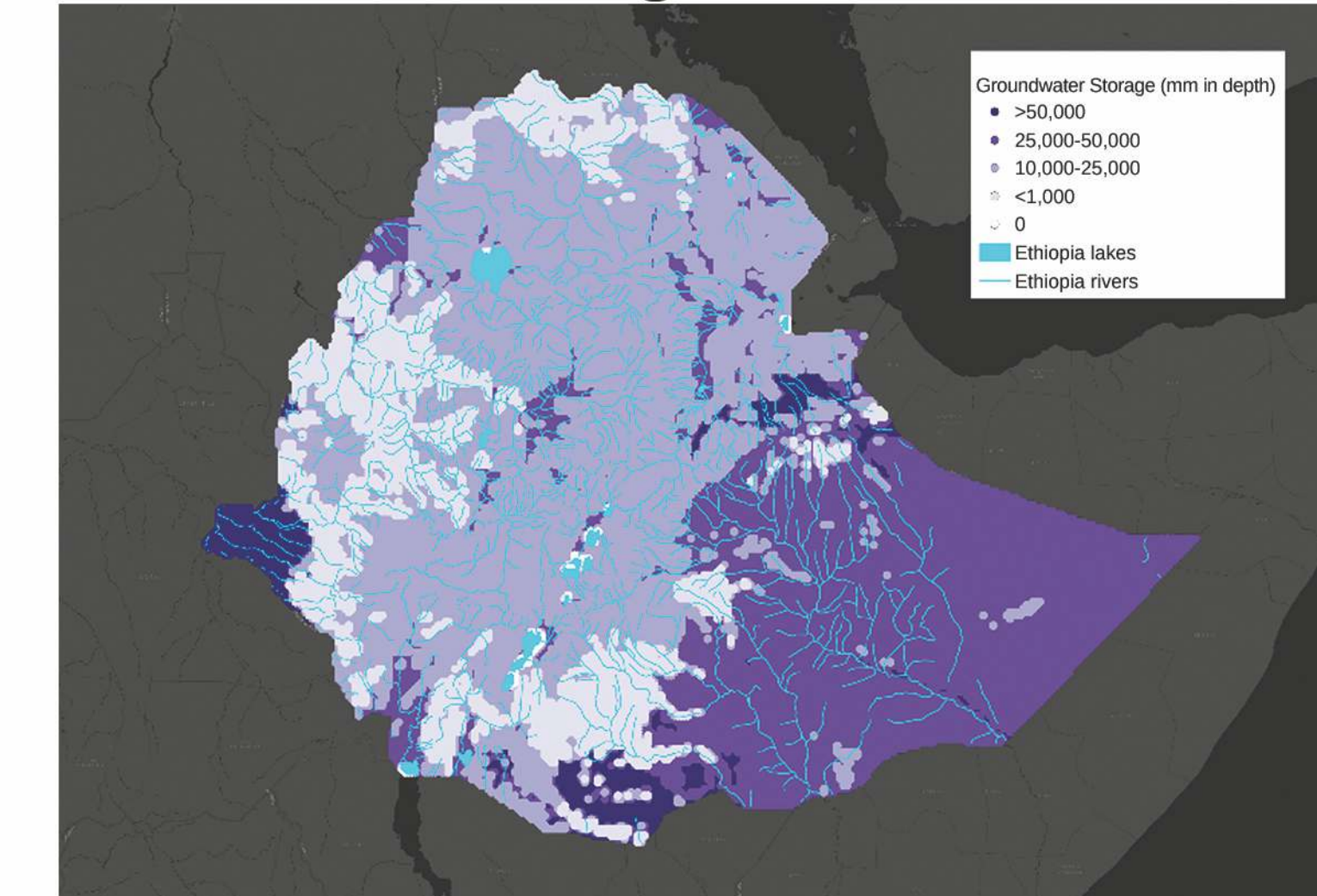
Depth to Groundwater



Groundwater Productivity



Groundwater Storage



The Problem

- Ethiopia's current irrigation efforts rely heavily on rain, which means that agricultural production is highly vulnerable to climate change.
- Only 1%–3% of arable land in SSA is irrigated [2].
- Developing countries will place greater demands on their agricultural systems as their populations and economies expand.
- Developed countries must discourage over-consumption and establish sustainable processes for resource extraction.

A Potential Solution

Groundwater irrigation, pumped via OGS, is a viable solution for developing countries like Ethiopia, when considering the food-water-energy nexus:

- Increased access to water can increase productivity of ongoing irrigation efforts and also expand the area of land suitable for irrigation.
- OGS provides clean, reliable electricity for farmers and dispersed populations alike.
- Policy and regulatory improvements can protect water resources while ensuring that needs are met.

References

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- Population of Africa (2019) | Data. (n.d.). Retrieved July 24, 2019, from <https://www.worldometers.info/world-population/africa-population/>
- Geospatial datasets available upon request.

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