An Analysis of the Geographic Distribution of Healthcare Facilities in Senegal

![Figure 1: Senegal's Location in the World](image)

![Figure 2: Administrative Map of Senegal](image)

**Research Question:** What proportion of the Senegalese population lives more than 25 kilometers from a health center?

Senegal is divided between the geographically small but highly populated coastal capital city of Dakar and parts of the somewhat sparsely populated Sahel desert. As a result, it is likely that access to public goods may differ for urban and rural citizens. In particular, access to reliable healthcare has been a noteworthy issue in Senegal recently, in the context of the Ebola scare, and there is a highly uneven geographic distribution of health centers throughout Senegal.

This GIS analysis focuses on determining the significance of the existing urban-rural disparities in access to public goods such as healthcare in order to inform future policymaking in Senegal and other countries in the Sahel Region.

The geoprocessing model for this analysis highlights the relative availability of health centers by creating Euclidean distance-based buffers with 25 kilometer radii then calculating the populations inside and outside of these buffers. Specifically, the model classifies each geographic area depending on whether it is within a 25 kilometer buffer zone then multiplies the land area by population density per square kilometer using the Raster Calculator tool. Finally a zonal statistics calculation of the output of all individual rasters in the analysis area.

Along with the primary analysis of a 25 KM buffer zone, the geoprocessing model can also be utilized to measure the proportion of Senegalese citizens within a closer 10 kilometer distance or a larger 50 kilometer distance from the nearest health center. As shown in Table 1 above, these alternative buffer distances show the substantial larger proportion (~40%) of the Senegalese population lives at least 10 kilometers from a health center while only 4.4% of the population lives greater than 50 kilometers away from a medical facility.

**Conclusion:**

Based on the GIS analysis explained in the geoprocessing model, approximately 10% (1.28 million) of the Senegalese population lives more than 25 kilometers from a listed health facility. While this is a relatively small percentage, it still encompasses greater than 1 million Senegalese people, and is therefore quite noteworthy.

In particular, the largest number of citizens living greater than 25 kilometers from a health center appear to be focused in the Senegalese departments to the east of Dakar but close to the coast including the Tivaouane, Kaolack and Gossas Departments, while geographically larger rural areas such as the Bakel department have very few inhabitants.

It should be noted that this geoprocessing model may underestimate the true number of people without close access to health facilities for three main reasons:

1. underlying factors related to census taking in rural, low-income areas;
2. the potential for inconsistent quality health services at various medical facilities, and;
3. the possible existence of other small health centers that are not included in the NGA dataset. It is also important to note that The Gambia, which is primarily surrounded by Senegal, is likely to have its own medical facilities which are not included in this model but may be accessible to Senegalese citizens.

**Table 1: Geoprocessing Outcomes - Population without Healthcare Access**

<table>
<thead>
<tr>
<th>Buffer Distance</th>
<th>Estimated Population without Healthcare Access</th>
<th>Percentage of Total Senegalese Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 KM</td>
<td>5.68 million</td>
<td>40.2%</td>
</tr>
<tr>
<td>25 KM</td>
<td>1.28 million</td>
<td>9.1%</td>
</tr>
<tr>
<td>50 KM</td>
<td>0.61 million</td>
<td>4.4%</td>
</tr>
</tbody>
</table>

**Bibliography:**

- Medical Center Locations: National Geospatial-Intelligence Agency (NGA), http://ebolaopendata.nga.opendata.arcgis.com/datasets/1a4658be98e649eb395c3006691d.1, 2015.
- Senegalese City Population and Area Data: Agence Nationale de la Statistique et de la Démographie (ANSII), 2013.

Map Created by: Daniel Robinson

NUTF0231 - Fundamentals of GIS
Spring 2015