Not All That Glitters is Gold: Linking Environmental Degradation and Resource Extraction in Sub-Saharan Africa

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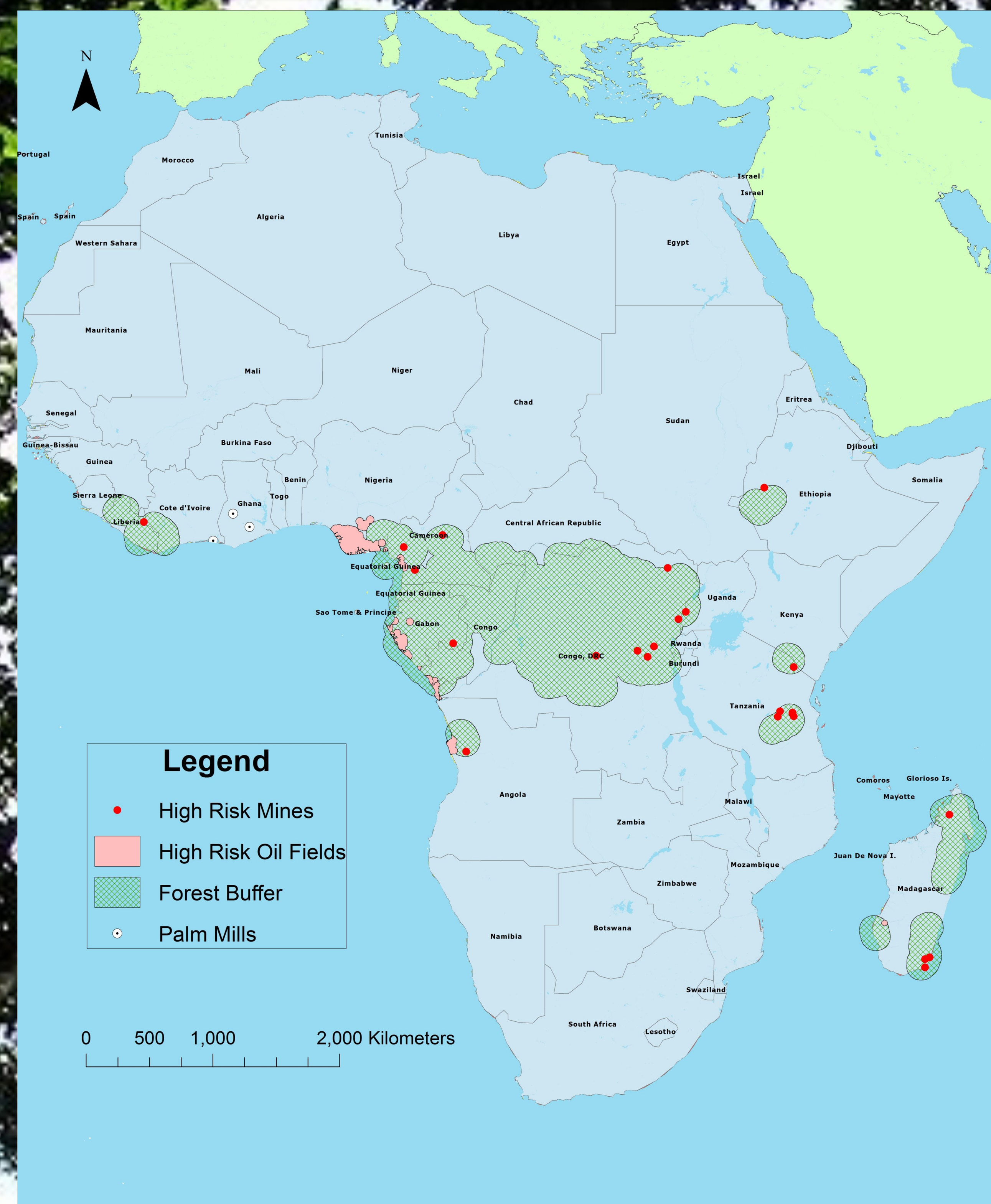
Introduction

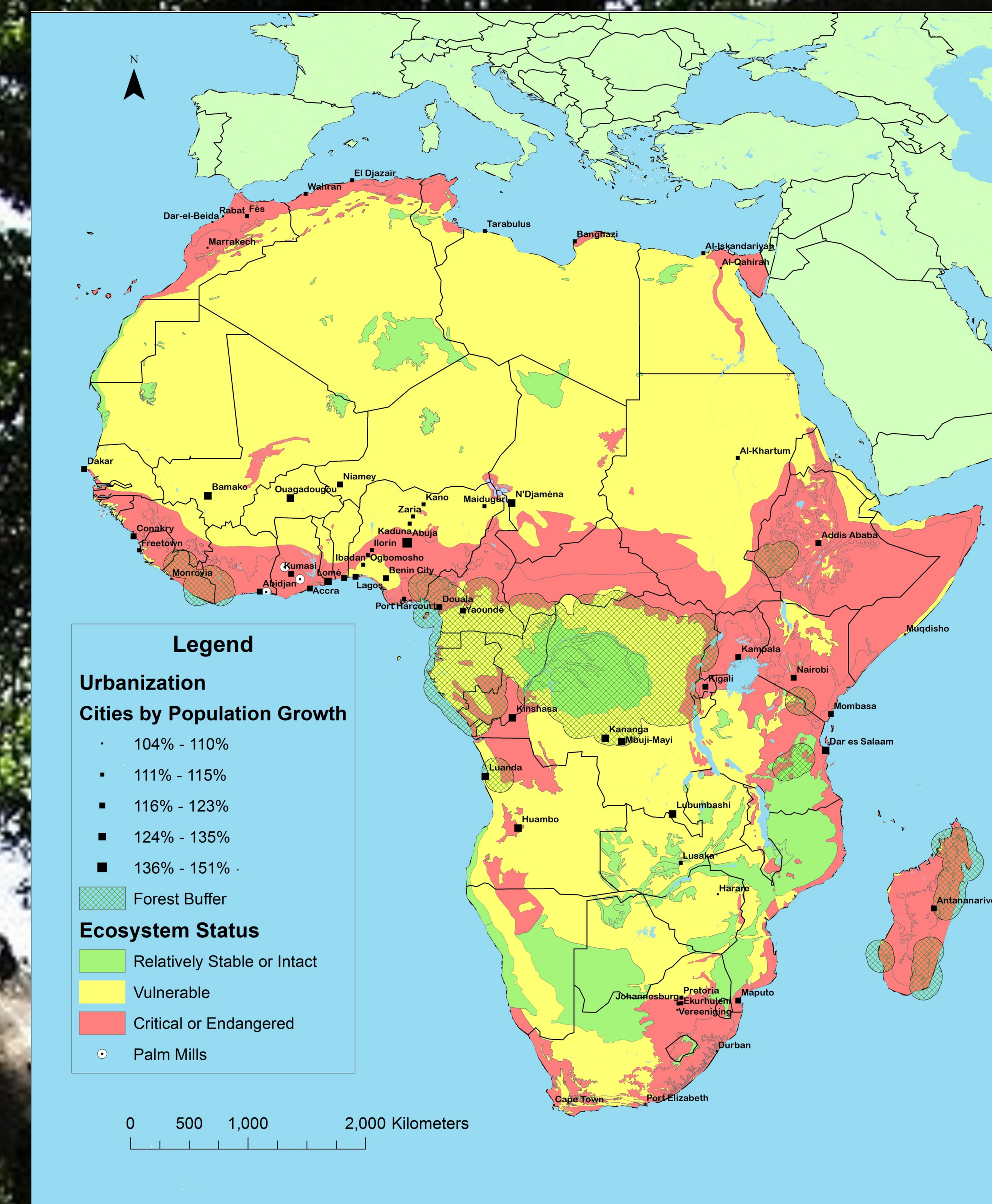
Considering the extensive global effects of climate change on natural ecosystem processes with incredible importance to humanity, the question of land use and its associated emissions is especially crucial in the regional context of Sub-Saharan Africa. Seeing that some land activities are more resource intensive than others, they result in varying degrees of environmental degradation. This project will use tools in ArcGIS to understand patterns of industrialization, with special attention to mineral mining activities, palm mills, oil extraction, and urban population growth.

Loss of tree cover and other vegetation is directly correlated with soil erosion, increased flooding, climate change, desertification, loss in agricultural yield, higher levels of greenhouse gases in the atmosphere, as well as a host of other environmental problems for surrounding communities. As the global demand for manufactured products and raw materials alike grows, so does the corporate inclination to acquire resources at the lowest monetary cost. As seen in the Scramble for Africa around the early 19th century, the European nations that carved up the continent decades ago can be likened to contemporary transnational corporations that have financial stakes in Africa's critically endangered environments and rainforests.

This project aims to analyze the spatial relationship between Africa's most "at-risk" environments and resource extraction activities, while considering the fallacy of environmental degradation being the sole consequence of rapid population growth.



Distribution of High-Risk Mineral and Oil Reserves in Continuous Forest



Africa's Fastest-Growing Cities and Ecosystem Status

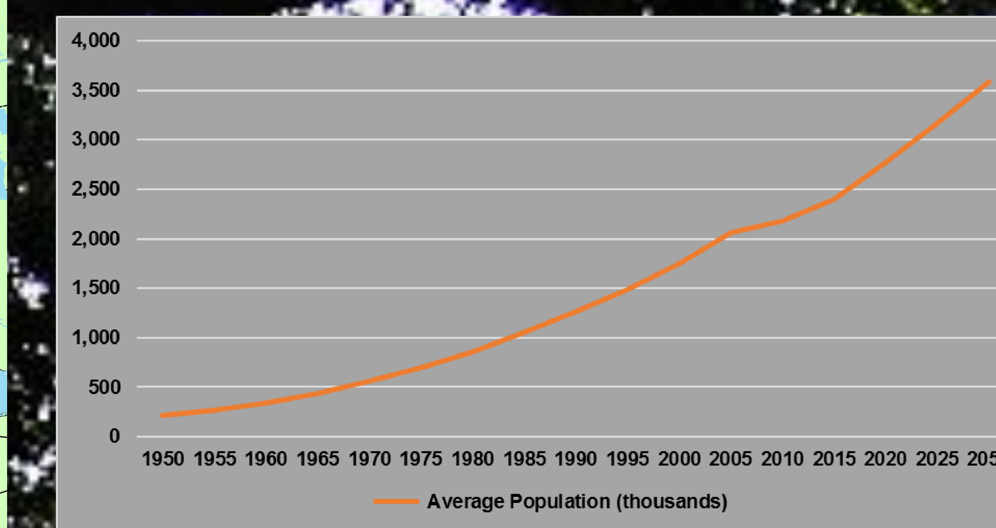


Fig. 1: Average Population of Largest Cities in Sub-Saharan Africa (1950-2050)

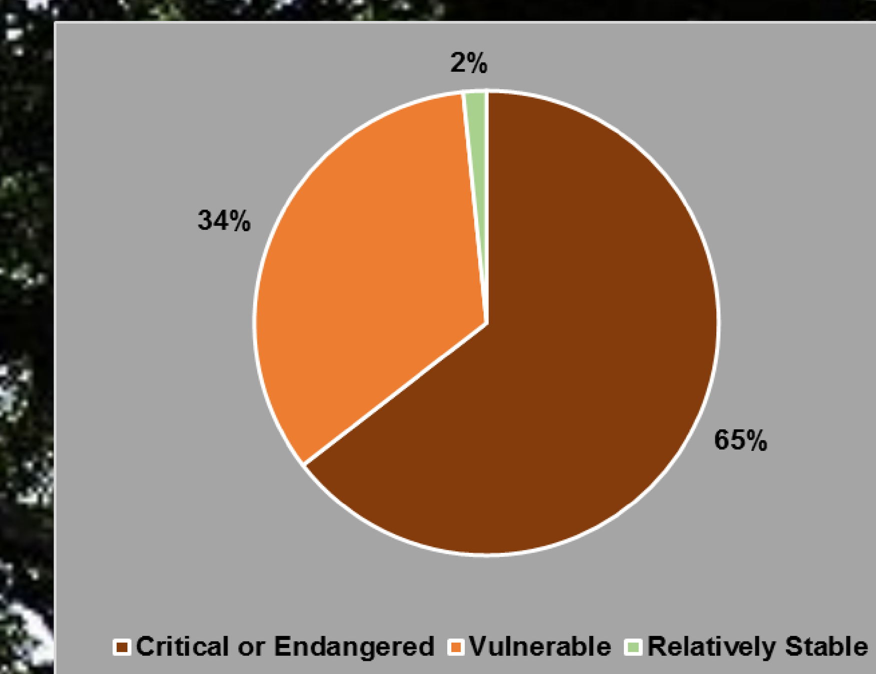
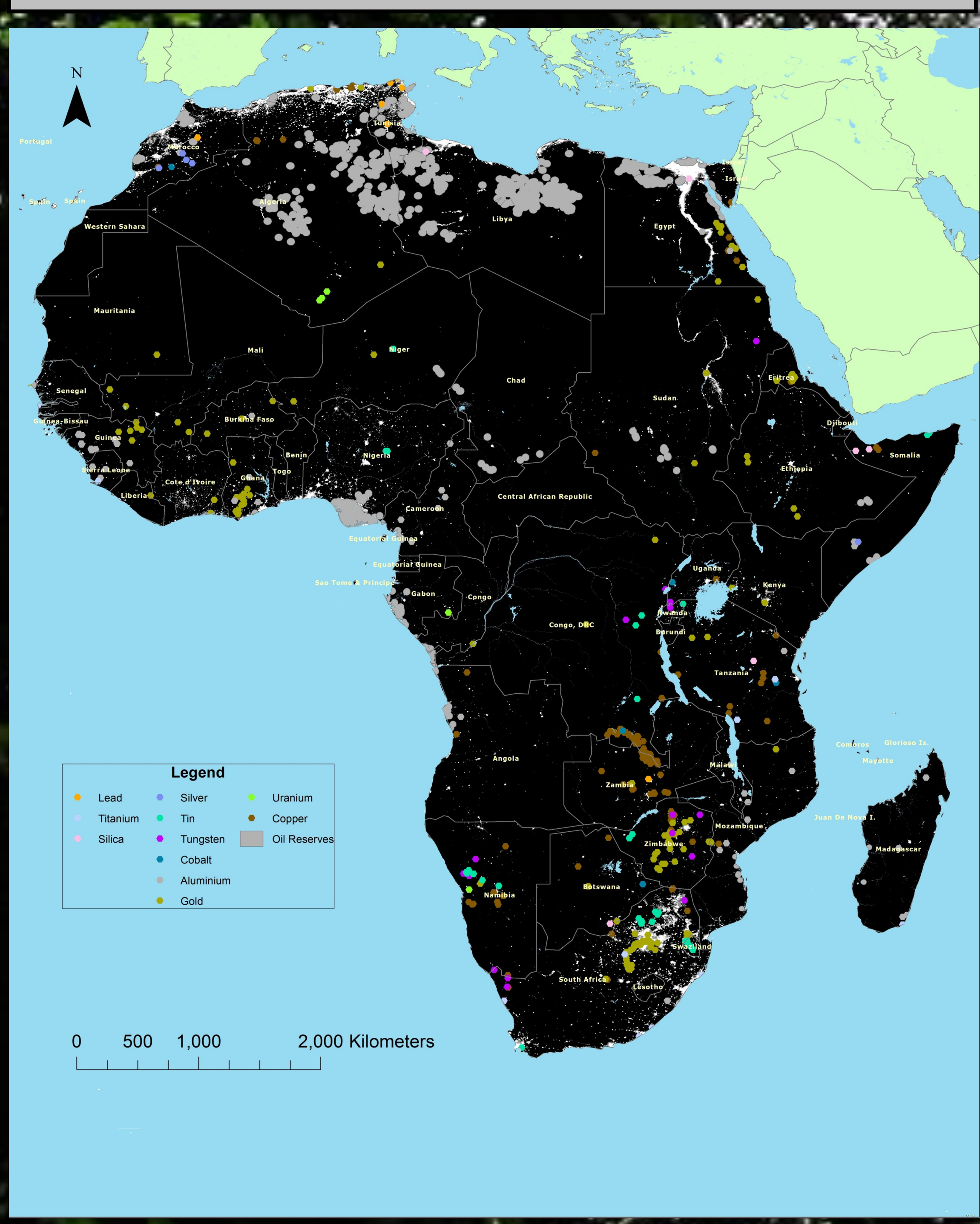


Fig. 2: Cities with High Growth and their Ecosystem Status



Mineral and Oil Mining

(against a nighttime lights raster to show extent of urban areas)

Methodology

I began with Africa's biome polygons from the Tufts M Drive, and I then reclassified the values to reflect three distinct categories for the status of the ecosystem. I then defined the new biomes as relatively stable or intact, vulnerable, and critical or endangered. I then focused on finding data on palm mills, global mineral resources and oil fields, and clipping the shape files provided by the World Resources Institute (WRI), United States Geological Survey and Peace Research Institute Oslo (PRIO). I then clipped the data series of mines as point to isolate the values for Africa. To specify the values even further, I performed an attribute query that isolated the values for types of mining that are recognized as highly carbon, land, or water intensive. I also obtained data on continuous forests also from the WRI, which I also clipped to isolate forests in Africa. I used this forest data to create a buffer of 75km to create some distance between land that *should* be protected in the interest of reducing carbon emissions. I then performed a spatial query to identify the "high-risk" mines and oil fields, which are mines and oil reserves that intersect with the newly created forest buffer. In addition to considering environment health, I used city population data to calculate growth from the past decade (2005-2015 data). I joined these points to the ecosystem status polygons, and adjusted the symbology to display the fastest-growing cities as graduated symbols.

Results and Limitations

As displayed in Figure 2, a staggering majority of Africa's cities are located in either critical/endangered or vulnerable environments. This already puts a large (and rapidly increasing) population at a higher risk of experiencing adverse environmental effects from intense resource extraction. As reflected in the map of mines and oil fields against a nightlights raster, there is a strong spatial relationship between urban areas and mining activities. This connection shows that there is a logistical convenience to mining adjacent to an urban area, and that demand markets for resources are more likely to exist closer to cities. However, this does not justify the spatial relationship displayed in the map showing high risk mines/oil fields and continuous forest.

In terms of limitations, I had initially planned to include agricultural activity in my analysis of land use and environmental degradation in Africa, however I found it difficult to find relevant and accurate data that clearly shows spatial patterns of land clearing. However, it is important to note that the majority of research implies that mining activities have a far greater impact on the environment than subsistence farming. Additionally, another possible source of error is that there are hundreds of data points for mines in the continent, and many primarily mine more than one mineral, however my analysis focuses on mines that only produce one mineral. As a result, when looking at these maps, it would not be inaccurate to assume that for every mine on the map producing a specific mineral type, there are dozens more that have an equally potent environmental impact.

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8 May 2018
GIS 101: Intro to GIS
Projection: Africa Equidistant Conic
Coordinate System: WGS 1984

References:

"Effects of Deforestation | The Pachamama Alliance." Sources and Solutions | Pachamama Alliance. Accessed May 2, 2018. https://www.pachamama.org/effects-of-deforestation.

Nemera Mamo & Sambit Bhattacharyya & Alexander Moradi & Rabah Arezki, 2017. "Intensive and Extensive Margins of Mining and Development: Evidence from Sub-Saharan Africa," OxCarre Working Papers 189, Oxford Centre for the Analysis of Resource Rich Economies, University of Oxford.

Data Sources: Tufts M Drive, United States Geological Survey (2014), World Resources Institute (2015), Peace Research Institute Oslo (2014)