Name: Mandela Kwame GADRI

Course Title: CRP 558 Web Mapping (SPRING 2020)

FINAL PROJECT REPORT

Forest Reserves and Mineral Resources Areas in Ghana

1. Introduction

Ghana is well endowed with a wide range of mineral resources which includes but not limited to gold, timber, diamonds, bauxite and manganese. A significant proportion of these resources are located in or close to forest reserves which pose a danger to plant and animal life species during their exploitation.

Mining is an inherently destructive industry, and mining effects of a single operation can have a severe impact on the environment and the wildlife that lives nearby. Although there are some regulations in place that are intended to minimize the damage, they are not enough to allow mining and wildlife to exist in harmony, especially in cases where the regulations are difficult to enforce. The mining industry has the potential to disrupt ecosystems and wipe out wildlife populations in several different ways if not properly managed and regulated.

Thus, the focus of my project was to create interactive maps that show the spatial location of mineral resources and how mining operations affects or could impact nature reserves negatively in Ghana.

2. Objectives

Specific objectives for my project include:

1. Identify the various locations of minerals and forest/game reserves in Ghana.
2. Examine the impact of mining operations on the environment.
3. Create interactive maps form minerals, forest/game reserves
4. Create a heatmap that shows areas of high mining impacts on the environment.

3. Data Sources

The data used in this project were obtained from data.gov.gh, an open data initiative platform supported by the government of Ghana. This includes:

- Shapefiles of mineral resource in Ghana. https://data.gov.gh/dataset/shapefiles-mineral-resource ghana-2010.
- Shapefiles of forest and game Reserves in Ghana. https://data.gov.gh/dataset/shapefiles-forest-and game-reserves-ghana-2010.

- Shapefiles of all Regions in Ghana. https://data.gov.gh/dataset/shapefiles-all-regions-ghana-2010-10-regions.

4. Methodology and web mapping technologies

In order to achieve the objective of this project, the following technologies were employed:

4.1 Leaflet plugin

I used this technology primarily to create a heatmap for my project, using the leaflet heatmap plugin. I also used this technology to load different base maps and provide and set layer controls for my maps.

```
    <script src="https://leaflet.github.io/Leaflet.heat/dist/leaflet-heat.js"></script>
//basemaps
var Stamen_Toner = L.tileLayer('https://stamen-tiles-{s}.a.ssl.fastly.net/toner/{z}/{x}/{y}{r}.{ext}', {
   attribution: 'Map tiles by <a href="http://stamen.com">Stamen Design</a>, <a href="http://creativecommo
   subdomains: 'abcd',
   minZoom: 0,
   maxZoom: 20,
   ext: 'png'
   });
var OSM = L.tileLayer('https://{s}.tile.osm.org/{z}/{x}/{y}.png', {attribution: '&copy; <a href="https://o
});
var Esri_WorldImagery = L.tileLayer('https://server.arcgisonline.com/ArcGIS/rest/services/World_Imagery/Ma
});
var baseMaps  = {
    "Esri World Imagery": Esri_WorldImagery,
    "open street map": OSM,
    "Stamen_Toner": Stamen_Toner,
    };
    L.control.layers(baseMaps).addTo(map);
```

4.2 QGIS2Web plugin

I essentially used this technology to turn my QGIS layers (mineral and forest shapefiles into HTML, JavaScript, and CSS files to create interactive web map for minerals and forest. I later edited and inserted my own layers into these codes to produce two maps for my project.

```
    <!-- adding maps of QGIS-->
    <!-- Creates interactive buttons -->
    <p style=text-align:center><button  id="forest">Zoom to view major forest areas</button> <button
        <script src="js/qgis2web_expressions.js"></script>
        <script src="js/leaflet.js"></script><script src="js/L.Control.Locate.min.js"></script>
        <script src="js/leaflet.rotatedMarker.js"></script>
        <script src="js/leaflet.pattern.js"></script>
        <script src="js/leaflet-hash.js"></script>
        <script src="js/Autolinker.min.js"></script>
        <script src="js/rbush.min.js"></script>
        <script src="js/labelgun.min.js"></script>
        <script src="js/labels.js"></script>
        <script src="js/leaflet-control-geocoder.Geocoder.js"></script>
        <script src="js/leaflet-measure.js"></script>
        <script src="js/leaflet-search.js"></script>
        <script src="data/Ghana_Shapefile_New_1.js"></script>
        <script src="data/forest_game_reserves_2.js"></script>
        <script>
```

```
    <!-- adding maps of QGIS-->
    <!-- Creates interactive buttons -->
    <p style=text-align:center><button  id="gold">Zoom to view major gold mining areas</button> <button
    <script src="js/qgis2web_expressions.js"></script>
    <script src="js/leaflet.js"></script><script src="js/L.Control.Locate.min.js"></script>
    <script src="js/leaflet-svg-shape-markers.min.js"></script>
    <script src="js/leaflet.rotatedMarker.js"></script>
    <script src="js/leaflet.pattern.js"></script>
    <script src="js/leaflet-hash.js"></script>
    <script src="js/Autolinker.min.js"></script>
    <script src="js/rbush.min.js"></script>
    <script src="js/labelgun.min.js"></script>
    <script src="js/labels.js"></script>
    <script src="js/leaflet-control-geocoder.Geocoder.js"></script>
    <script src="js/leaflet-search.js"></script>
    <script src="data/Ghana_Shapefile_New_1.js"></script>
    <script src="data/Minerals_points_2.js"></script>
```

4.3 Mapbox

This technology was extremely useful to me in creating my own map tile layers (Navigation and Monochrome) that I used as a basemap in my Leaflet maps. I did this by using the Mapbox Studio style editor tool.

```
    //add Mapbox Studio Style
var navigation = L.tileLayer('https://api.mapbox.com/styles/v1/mkgadri/{id}/tiles/{z}/{x}/{y}?access_t
    attribution: 'Map data &copy; <a href="https://www.openstreetmap.org/">OpenStreetMap</a> contribut
    maxZoom: 30,
    id:'ck8o5rgfs3bcg1ipnelhnyg66',
    // This is a unique access token, you must register for your own from https://account.mapbox.com/a
    accessToken: 'pk.eyJ1IjoibWtnYWRyaSIsImEiOiJjazZzMG80ZngwOWJuM2Vxczc3Y3l5dWI1In0.Jgyb7Q-hriDlmi858
    }).addTo(map);
```

4.5 Storymap

I explore this technology to give my readers an in-depth knowledge into how mining activities can or are negatively impacting nature reserves and water bodies. I did this by combining pictures and videos on mining impacts on the environment in Ghana from online sources to create a storymap journal using ArcGIS online.

4.5 Using containers

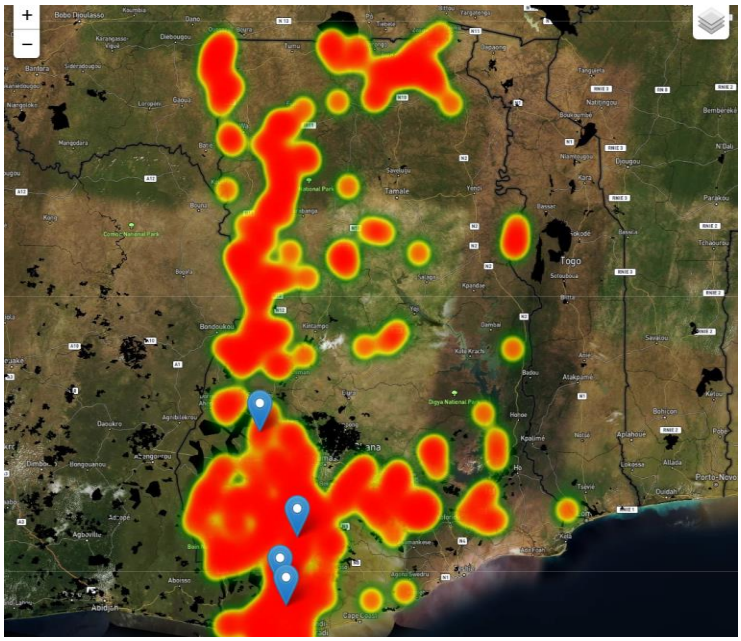
In organizing my webpage, I created a number of containers to hold all my texts and maps.

```
.map-container {
  display: flex;
  flex-direction: column;
}
.map-container .maps, .misc-container .misc-contents {
  border-radius: 3px;
}
.map-container .maps {
  background: #FFF;
  padding: 20px;
  border-radius: 3px;
}
.map-container .maps .map-source {
  margin: 5px 1pc;
}
```

5. Results

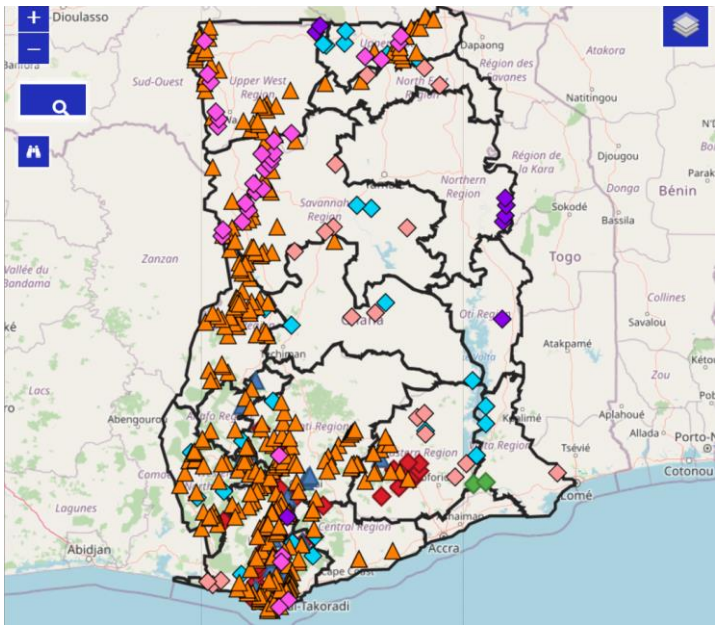
5.1 Heat map

The heatmap below shows areas concentration of mining activities. It is obvious from the map that most forest reserves are negatively impacted as mining activities are predominant in areas where these forests are located.



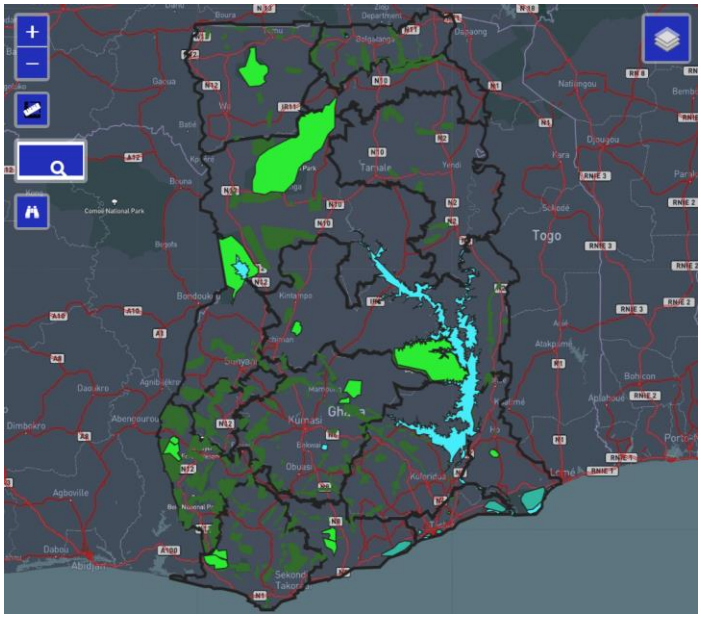
5.2 Mineral location map

This map shows the locations and type of various minerals in Ghana. This includes gold, bauxite, diamond and other minerals. Most of these resources are located in the western and southern parts of the country compared to other areas.



5.3 Forest and game reserves maps

As shown in the map below, most of nature reserves can be found in the western and southern portion of the country where mining activities are high. Thus, chances of these reserves being degraded are very high.



6 Significance of this project

Many environmentalists are concerned about global warming and climate change due to human activities. Thus, this project fits into the wide spectrum of sustainable environments, and speaks volume of how illegal mining activities in forest reserves that lead to severe environmental issues such as climate change and global warming. It is also worth noting that the findings documented in this project are not conclusive and such stands to benefit from further research works such as studying the extent to which mining has affected agricultural land in particular in Ghana.

Conclusion

The impact of mining on environment and wildlife cannot be underestimated, as mining operations results in habitat loss, air and water pollutions and environmental degradation. The interactive maps show that mining and nature reserves in Ghana cannot co-exist, as most of these mining operations take place in wildlife or nature reserves without any regards to their impacts on wildlife and the environment.