Charting the Path to Sustainability: Integrating Land Sector Data with SDGs

Task 1- Land sector management and Exploratory Data Analysis (EDA)

Case in Study; Nigeria

TABLE OF CONTENT

The aim of the analysis is to carry out Exploratory Data Analysis on the administrative, bioclimatic and ecological zones, land cover and soil categories of the land sector dataset for Nigeria.

Importing libraries is a critical step before loading the dataset. It is critical to import only the libraries that you are certain you will need to work with your dataset. To import to libraries, use the keyword import.

In [ ]:
```
# Import all necessary libraries
import numpy as np
import pandas as pd
import seaborn as sns
import geopandas as gpd
from matplotlib.colors import ListedColormap
import matplotlib.patches as mpatches
import matplotlib.pyplot as plt
%matplotlib inline
```

ADMINISTRATIVE

3.0 BOUNDARY

LOAD DATASET

In [ ]:
```
# Load dataset to define Nigeria's admin boundaries
nga_admin = (r"C:\Users\User\Documents\NGA_AL2_Nigeria.json")

# Read geojson file into a geodataframe
nga_admin_gdf = gpd.read_file(nga_admin)
nga_admin_gdf
```

In [ ]:
```
# Check no.of rows and columns for Nigeria's admin boundary dataframme
nga_admin_gdf.shape
```

In [ ]:
```
# Load the dataset for all states in Nigeria
ngastates_admin = (r"C:\Users\User\Documents\NGA_ALL_states.json")

# Read geojson file into a geodataframe
ngastates_admin_gdf = gpd.read_file(ngastates_admin)
ngastates_admin_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for states in Nigeria boundaries dataframe
ngastates_admin_gdf.shape
```

DEFINE THE BOUNDARY

In [ ]:
```
# Create subplot with two panels
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(20, 10))

# Plot the administrative boundary of Nigeria in panel 1
```

```
nga_admin_gdf.plot(ax=ax1, color="green", edgecolor="yellow")
ax1.set_title("ADMINISTRATIVE BOUNDARY IN NIGERIA")

# Plot the administrative boundaries of all states in panel 2
ngastates_admin_gdf.plot(ax=ax2, color="green", edgecolor="yellow")
ax2.set_title("ADMINISTRATIVE BOUNDARY FOR ALL STATES IN NIGERIA")

plt.show()
```

3.1 PROTECTED AREAS

LOAD DATASET

In [ ]:
```
# Load dataset to define world database of protected areas
wdpa = (r"C:\Users\User\Documents\WDPA_WDOECM_wdpa_gdb_polygons\WDPA_WDOECM_wdpa_gdb_polygons.shx")

# Read the shapefile into geodataframe
protected_areas_gdf = gpd.read_file(wdpa)
protected_areas_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for global protected areas dataframe
protected_areas_gdf.shape
```

In [ ]:
```
# Filter data for Nigeria
nga_protected_areas_gdf = protected_areas_gdf[protected_areas_gdf["PARENT_ISO"] == "NGA"]
```

In [ ]:
```
nga_protected_areas_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for global protected areas dataframe
nga_protected_areas_gdf.shape
```

In [ ]:
```
# Check for unique value and their counts in the selected column
nga_protected_areas_gdf["DESIG"].value_counts()
```

In [ ]:
```
# Create plot
fig, ax = plt.subplots(figsize=(12, 8))

# Plot the protected areas
nga_protected_areas_gdf.plot(column="DESIG", cmap="viridis", ax=ax, legend=True)

plt.title("PROTECTED AREAS IN NIGERIA BY DESIGNATION NAMES")

# Add a legend
legend = ax.get_legend()
legend.set_title("DESIGNATIONS")
legend.set_bbox_to_anchor((1, 0.01))

plt.show()
```

3.2 ROADS

In [ ]:
```
# Load dataset to define global roads open access
global_roads= (r"C:\Users\User\Documents\Global Roads Open Access Data Set_dissolved.json")

# Read the json into geodataframe
global_roads_gdf = gpd.read_file(global_roads)
```

In [ ]:
```
global_roads_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for global roads dataframe
global_roads_gdf.shape
```

In [ ]:
```
# Perform a spatial join to select roads within Nigeria
roads_in_nigeria = gpd.sjoin(global_roads_gdf, nga_admin_gdf, how="inner", op="intersects")

# Reset the index of the resulting GeoDataFrame
roads_in_nigeria.reset_index(drop=True, inplace=True)
```

In [ ]:
```
# Create plot
fig, ax = plt.subplots(figsize=(12, 8))

# Plot the administrative boundary of Nigeria
nga_admin_gdf.plot(ax=ax, color="green", edgecolor="yellow")

# Plot the road network
roads_in_nigeria.plot(ax=ax, color="blue", linewidth=0.5)

plt.title("ROAD NETWORKS IN NIGERIA")

plt.show()
```

BIOCLIMATIC AND ECOLOGICAL ZONES

4.0 ECOLOGICAL ZONES

In [ ]:
```
# Load dataset to define country's ecological zones
nga_ecozones = (r"C:\Users\User\NGA_AL2_Nigeria_GEZ.json")
nga_ecozones_gdf = gpd.read_file(nga_ecozones)
nga_ecozones_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for Nigeria's ecological zones
nga_ecozones_gdf.shape
```

In [ ]:
```
# Check for unique value and their counts in the selected column
nga_ecozones_gdf["gez_name"].value_counts()
```

In [ ]:
```
# Create plot
fig, ax = plt.subplots(figsize=(12, 8))

# Plot the ecological zones
nga_ecozones_gdf.plot(column="gez_name", cmap="viridis", ax=ax, legend=True)

plt.title("ECOLOGICAL ZONES IN NIGERIA")

# Add a legend
legend = ax.get_legend()
legend.set_title("ECOLOGICAL ZONES")
legend.set_bbox_to_anchor((1, 0.3))

plt.show()
```

4.1 AGROECOLOGICAL ZONES

In [ ]:
```
# Load dataset to define global agroecological zones dataset
global_aeczones= (r"C:\Users\User\Documents\GlobalAgroEcologicalZones_GAEZ.geojson")

# Read the json into geodataframe
global_aeczones_gdf = gpd.read_file(global_aeczones)
global_aeczones_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for global ecological zones
global_aeczones_gdf.shape
```

In [ ]:
```
# Check for unique values present in the value column
global_aeczones_gdf["Value"].unique()
```

In [ ]:
```
# Fix the data and replace numbers with acgroecological zones

values = {"1": "Tropical-Arid", "2": "Tropical-Dry Semi-Arid", "3": "Tropical -Moist Semi-Arid", "4": "Tropical-Sub-Humid", "5": "Tropical-Humid",
          "6": "Tropical-Humid (year round)", "7": "Temperate-Arid", "8": "Temperate-Dry Semi-Arid", "9": "Temperate-Moist Semi-Arid",
          "10": "Temperate-Sub-Humid", "11": "Temperate-Humid", "12": "Temperate-Humid (year round)", "13": "Boreal-Arid",
          "14": "Boreal-Dry Semi-Arid", "15": "Boreal-Moist Semi-Arid", "16": "Boreal-Sub-humid", "17": "Boreal-Humid",
          "18": "Boreal-Humid (year round)"}
```

In [ ]:
```
# Standardize the column names
global_aeczones_gdf.columns = global_aeczones_gdf.columns.str.lower()
```

In [ ]:
```
# Rename class name
global_aeczones_gdf.value = global_aeczones_gdf.value.astype("str").replace(values)
```

In [ ]:
```
# Check to see replaced values
global_aeczones_gdf.head(2)
```

In [ ]:
```
# Extract Nigeria's agroecological zones
ngaaeczones_gdf = global_aeczones_gdf.clip(nga_admin_gdf)
ngaaeczones_gdf = ngaaeczones_gdf.reset_index(drop=True)
```

In [ ]:
```
ngaaeczones_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for Nigeria's agro ecological zones
ngaaeczones_gdf.shape
```

In [ ]:
```
# Check for unique value and their counts in the selected column
ngaaeczones_gdf["value"].value_counts()
```

In [ ]:
```
# Create plot
fig, ax = plt.subplots(figsize=(12, 8))

# Plot the agroecological zones
ngaaeczones_gdf.plot(column="value", cmap="viridis", ax=ax, legend=True)

plt.title("AGRO ECOLOGICAL ZONES IN NIGERIA")

# Add a legend
legend = ax.get_legend()
legend.set_title("AGRO ECOLOGICAL ZONES")
legend.set_bbox_to_anchor((1, 0.01))

plt.show()
```

4.2 BIODIVERSITY HOTSPOTS

In [ ]:
```
# Load dataset to define global biodiversity hotspots
global_biodivhotspots= (r"C:\Users\User\Documents\CI_BiodiversityHotspots (1).geojson")
# Read the json into geodataframe
global_biodivhotspots_gdf = gpd.read_file(global_biodivhotspots)
global_biodivhotspots_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for global biodiversity hospots
global_biodivhotspots_gdf.shape
```

In [ ]:
```
# Extract Nigeria's biodiversity hotspots
nga_biodivhotspots_gdf = global_biodivhotspots_gdf.clip(nga_admin_gdf)
nga_biodivhotspots_gdf = nga_biodivhotspots_gdf.reset_index(drop=True)
```

In [ ]:
```
nga_biodivhotspots_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for Nigeria's biodiversity hotspots
nga_biodivhotspots_gdf.shape
```

In [ ]:
```
 # Create subplot with two panels
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(20, 10))

# Plot the hotspots by name in panel 1
nga_biodivhotspots_gdf.plot(column="NAME", cmap="viridis", ax=ax1, legend=True)
nga_admin_gdf.plot(ax=ax1, color="none", edgecolor="black", alpha = 0.8)
ax1.set_title("BIODIVERSITY HOTSPOTS IN NIGERIA BY NAME")

# Plot the hotspots by type in panel 2
nga_biodivhotspots_gdf.plot(column="Type", cmap="viridis", ax=ax2, legend=True)
nga_admin_gdf.plot(ax=ax2, color="none", edgecolor="black", alpha = 0.8)
ax2.set_title("ABIODIVERSITY HOTSPOTS IN NIGERIA BY TYPE")

plt.show()
```

LAND COVER

5.0 PLANTED FORESTS

In [ ]:
```
# Load dataset to define Nigeria's planted forests
plantforests = (r"C:\Users\User\Documents\NGA_Nigeria_SDPT.json")

# Read the json into geodataframe
nga_plantforests_gdf = gpd.read_file(plantforests)
nga_plantforests_gdf.head(2)
```

In [ ]:
```
# Check for the no.of rows and columns
nga_plantforests_gdf.shape
```

In [ ]:
```
# Check for unique values present in the value column
nga_plantforests_gdf["common_name"].unique()
```

In [ ]:
```
# Check for unique values present in the value column
nga_plantforests_gdf["species"].unique()
```

In [ ]:
```
# Create subplot with three panels
fig, (ax1, ax2, ax3) = plt.subplots(1, 3, figsize=(20, 10))

# Plot the hotspots by name in panel 1
nga_plantforests_gdf.plot(column="common_name", cmap="viridis", ax=ax1, legend=True)
nga_admin_gdf.plot(ax=ax1, color="none", edgecolor="black", alpha = 0.8)
ax1.set_title("PLANTED FORESTS IN NIGERIA BY SPECIES COMMON NAME")

# Plot the planted forests by type in panel 2
nga_plantforests_gdf.plot(column="species", cmap="viridis", ax=ax2, legend=True)
nga_admin_gdf.plot(ax=ax2, color="none", edgecolor="black", alpha = 0.8)
ax2.set_title("PLANTED FORESTS IN NIGERIA BY SPECIES")

# Plot the planted forests by plantation in panel 3
nga_plantforests_gdf.plot(column="plant_ag", cmap="viridis", ax=ax3, legend=True)
nga_admin_gdf.plot(ax=ax3, color="none", edgecolor="black", alpha = 0.8)
ax3.set_title("PLANTED FORESTS IN NIGERIA BY PLANTATION")

plt.show()
```

SOIL

6.0 SOIL RESOURCES

In [ ]:
```
# Load dataset to define Nigeria's soil resources
nga_soil_resources = (r"C:\Users\User\Documents\``NGA_AL2_Nigeria_WSR.json")
nga_soil_resources_gdf = gpd.read_file(nga_soil_resources)
nga_soil_resources_gdf.head(2)
```

In [ ]:
```
# Check no.of rows and columns for Nigeria's Soil Resources
nga_soil_resources_gdf.shape
```

In [ ]:
```
# Check for unique value and their counts in the selected column
nga_soil_resources_gdf["IPCC"].value_counts()
```

In [ ]:
```
# Create plot
fig, ax = plt.subplots(figsize=(12, 8))

# Plot the soil resources
nga_soil_resources_gdf.plot(column="IPCC", cmap="viridis", ax=ax, legend=True)

plt.title("SOIL RESOURCES IN NIGERIA")

# Add a legend
legend = ax.get_legend()
```

```
legend.set_title("SOIL RESOURCES")
legend.set_bbox_to_anchor((1, 0.3))
```

SUMMARY

Nigeria, located in West Africa, boasts diverse natural features and abundant resources. The country hosts protected areas that safeguard its unique biodiversity and features an extensive road network connecting regions both domestically and beyond its borders.

Within Nigeria's protected areas, there are 925 forest reserves, along with a single community forest and a strict nature reserve, highlighting the country's commitment to preserving its natural heritage

Nigeria's ecological zones encompass a rich variety of environments, including tropical dry forests, moist forests, mountain systems, rainforests, shrublands, and water bodies. The tropical mountain system stands as the largest among these ecological zones, contributing to the nation's rich natural heritage.

Regarding agro-ecological zones, Nigeria exhibits a wide range of climates and agricultural potential. These zones encompass various categories, such as Tropical-Arid, Tropical-Dry Semi-Arid, Tropical-Moist Semi-Arid, Tropical-Sub-Humid, Tropical-Humid, Tropical-Humid (year-round), Temperate-Arid, Temperate-Dry Semi-Arid, Temperate-Moist Semi-Arid, Temperate-Sub-Humid, Temperate-Humid, Temperate-Humid (year-round), Boreal-Arid, Boreal-Dry Semi-Arid, Boreal-Moist Semi-Arid, Boreal-Sub-humid, Boreal-Humid, and Boreal-Humid (year-round). The Boreal-Dry Semi-Arid zone stands as the largest, fostering diverse agricultural practices and crop cultivation in Nigeria.

The Guinean Forests of West Africa represent a biodiversity hotspot in the region, contributing to the country's ecological significance. These lush forests are home to an array of unique species and play a vital role in maintaining the ecological balance.

Oil palm, scientifically known as Elaeis guineensis, plays a significant role in Nigeria's economy, yielding valuable products like palm oil and palm kernel oil.

The country's soil resources encompass various types, including ariesols, arenosols, fluvisols, gleyisols, lixisols, verisols, and water bodies, with lixisols being the most prominent. These soils significantly influence land use, agricultural practices, and ecological dynamics across the nation.

REFERENCES

Wikimedia

Definition of Agroecological Zones Used in GTAP

Agroecological Zone Emission Factor