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ENVIRONMENTAL IMPACT ASSESSMENT OF QUARRY ACTIVITIES IN AKURE NORTH, ONDO STATE, NIGERIA USING REMOTE SENSING AND GIS TECHNIQUES: AIR QUALITY ASSESSMENT AND QUARRY SITE EXPANSION

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INTRODUCTION & AIM

Quarrying drives infrastructure growth but causes environmental degradation, especially in urbanizing areas such as Akure North, where quarry sites are adjacent to residential areas. Environmental challenges include air pollution (dust/PM) and uncontrolled site expansion. This study uses remote sensing and GIS to assess air quality ($PM_{2.5}$, PM_{10}) and quarry site expansion in Akure North, Ondo State, from 2014–2024, focusing on three sites (Stoneworks, Ebenezer, and FCC). It addresses urban expansion's impact on ecosystems and human health, aligning with SDGs 11, 13, and 15.

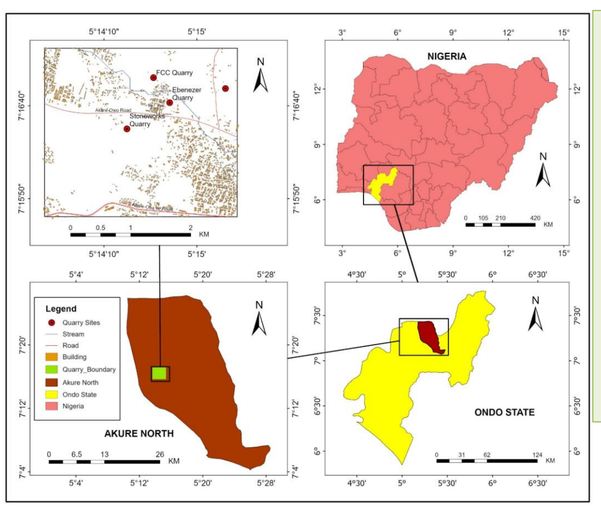


Fig 1: Study Area

Akure North LGA, Ondo State, southwestern Nigeria (headquarters: Iju/Itaogbolu). Borders Akure South, Ifedore, Ekiti, and Ose LGAs. Population ~131,587 (2006), area 680.62 km². Topography: undulating, 250–500m elevation, hilly with valleys and spurs. Geology: granite-rich (charnockite, migmatite gneiss). Climate: rainforest, 1,300mm annual rainfall, 18–33°C temperature. Economy: agriculture (cocoa, yams) and quarrying (granite extraction in Oba-Ile). Drainage: streams/rivers vulnerable to sedimentation.

METHOD

Data

- High-resolution satellite imagery (Google Earth Pro for RGB; Landsat 8/9 via GEE for multispectral/thermal)
- Air quality (OpenWeatherMap API, 2021–2024)
- Field surveys at Stoneworks/Ebenezer; building data (OpenStreetMap)
- Wind (NASA Power/DAV).

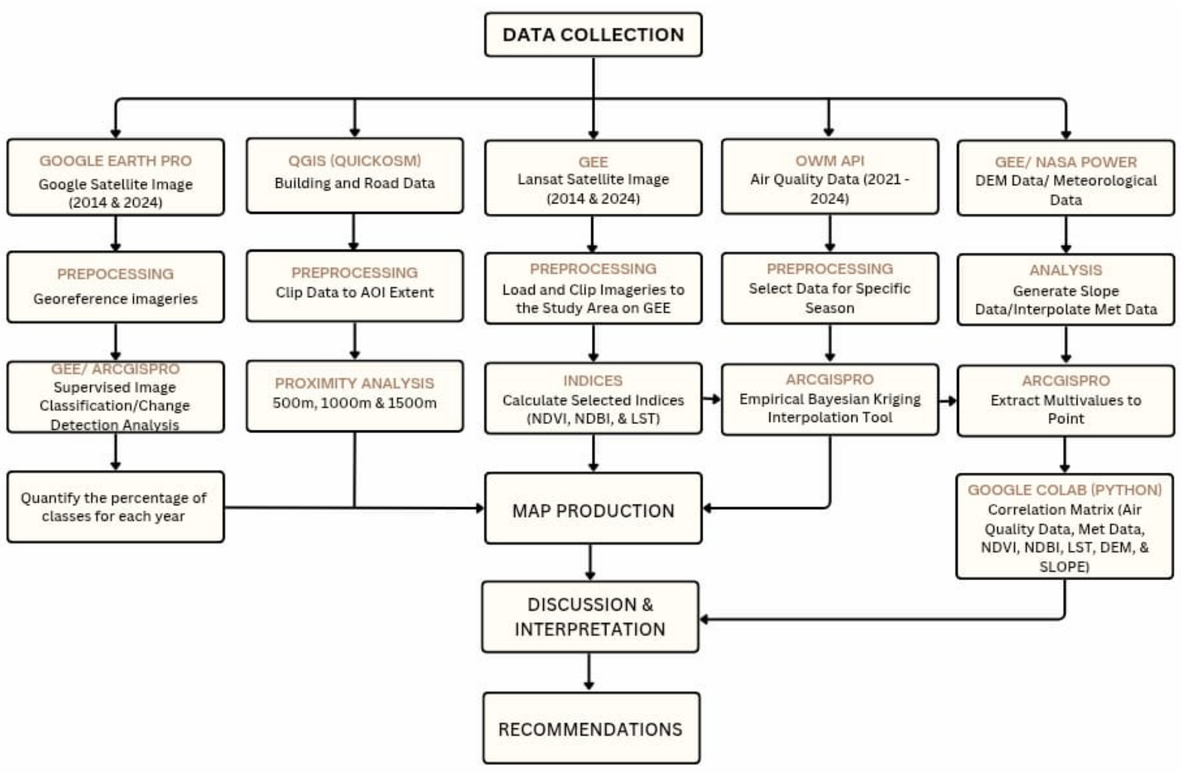
Software

- ArcGIS Pro (spatial analysis, EBK interpolation, buffers), QGIS (OSM building data)
- GEE (image classification, NDVI/LST/NDBI)
- Google Colab (API scripts, correlation analysis)
- KoboToolbox (surveys).

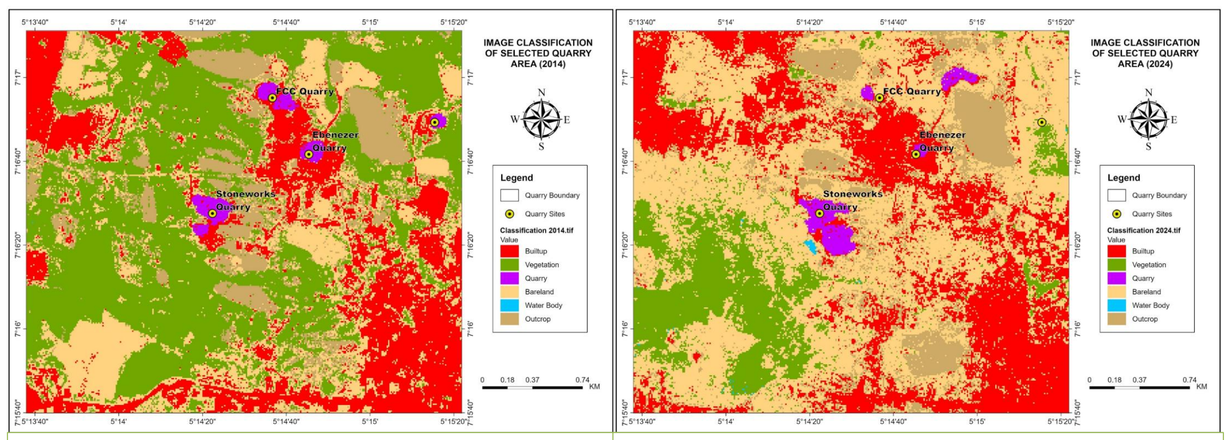
Processing

- Georeference imagery
- Random Forest classification for LULC (accuracy 98.4–99.8%)
- Compute indices (NDVI = (NIR-Red)/(NIR+Red), LST from TIRS)
- EBK interpolation for air quality raster surfaces
- Buffers (500m, 1000m, 1500m) for proximity analysis
- Pearson correlation matrix.

Google Earth Engine · ArcGIS Pro



RESULTS & DISCUSSION



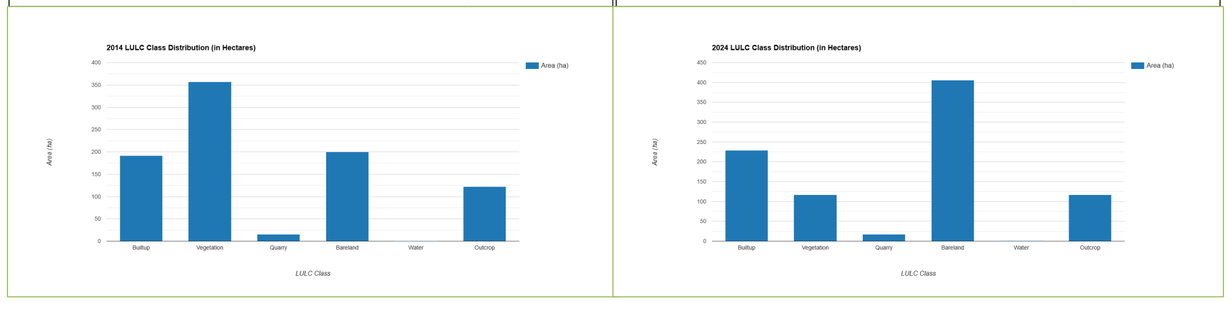


Fig 3: LULC 2014 *Fig 4: LULC 2024*

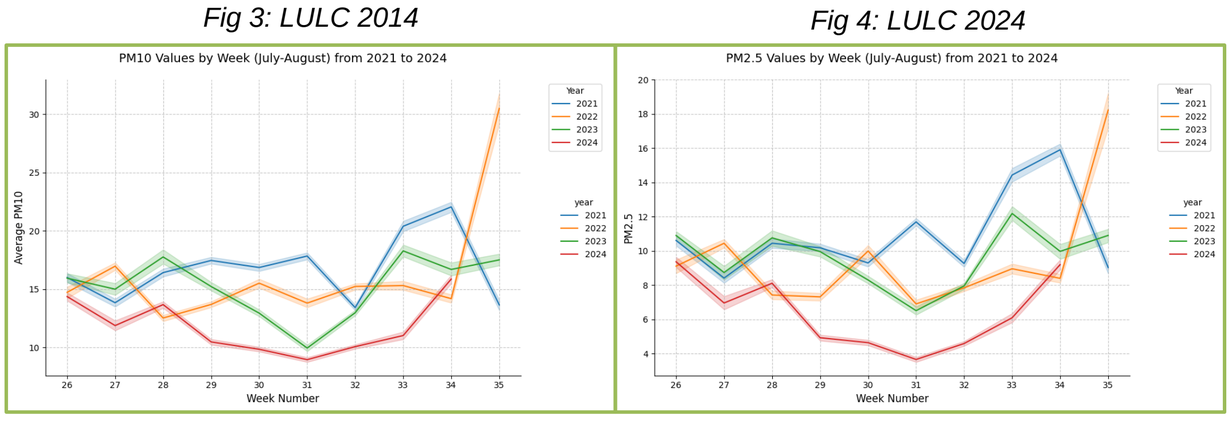


Fig 5: PM_{10} (2021 to 2024) *Fig 6: $PM_{2.5}$ (2021 to 2024)*

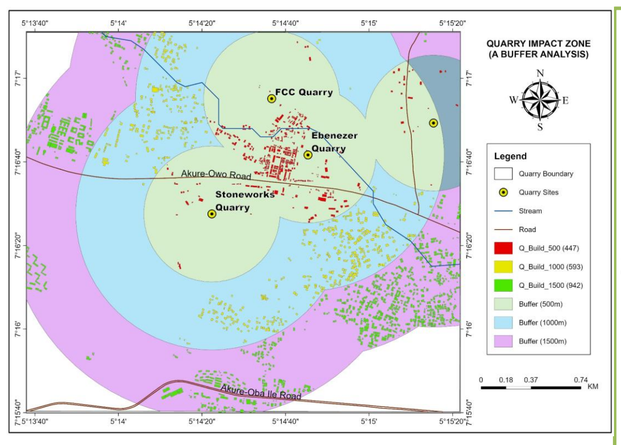
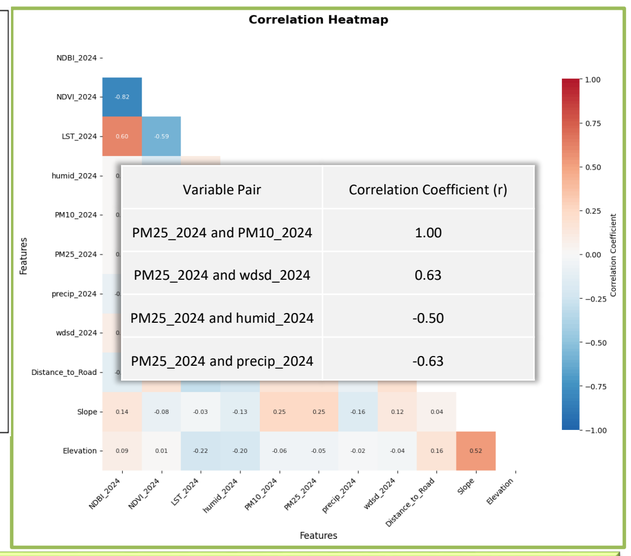


Fig 7: Proximity Analysis



Variable Pair	Correlation Coefficient (r)
PM25_2024 and PM10_2024	1.00
PM25_2024 and wdsd_2024	0.63
PM25_2024 and humid_2024	-0.50
PM25_2024 and precip_2024	-0.63

Fig 8: Pearson's Correlation Matrix

DISCUSSION / CONCLUSION

LULC changes (2014–2024): Vegetation decrease by 67.34% (357.53 to 116.75 ha); bareland increase by 102.73% (200.04 to 405.59 ha); built-up increase by 19.18% (192.21 to 229.07 ha); quarry increase by 14.97% (11.02 to 12.67 ha); water increase by 4150% (0.02 to 0.85 ha due to craters); outcrop decrease by 4.04%. Indices: NDVI 0.064–0.408 to 0.030–0.406 (vegetation loss); NDBI -0.184–0.136 to -0.174–0.121 (urban spread); LST 29.23–40.72°C to 31.12–42.62°C (heat island effect)

Air quality: $PM_{2.5}$ 4.91–10.34 μg/m³; PM_{10} 10.24–17.03 μg/m³; compliant with WHO (annual: 10/20 μg/m³), decreasing trend due to rainy data collection.

Correlations: $PM_{2.5}/PM_{10}$=1.00; with wind +0.63, humidity -0.50, precip -0.63; NDVI/NDBI -0.82; LST/NDBI +0.60; LST/NDVI -0.60

Proximity: 447 buildings (500m), 563 (1000m), 942 (1500m); vegetation decrease by 87.27% (500m), built-up increase by 147.68% (1000m).

Impacts indicate landscape transformation despite air compliance.

RECOMMENDATIONS

- Implement annual environmental audits with adaptive management to monitor/update dust controls.
- Collaborate on urban planning to enforce buffer zones (e.g., 3km) and relocate at-risk residents.
- Develop post-quarrying restoration plans: fill craters, reshape land, replant natives for reuse (farming/parks).
- Establish community engagement programs with accessible grievance systems for noise/dust complaints.