

Concept Note: Field-Calibrated Mangrove Monitoring and Blue Carbon Intelligence Dashboard

Project Title

Integrating Field Data, Earth Observation, and Environmental Variables for Mangrove Restoration Monitoring and Blue Carbon Intelligence in Lamu, Kenya

Background

Mangroves in Lamu represent one of Kenya's most important coastal ecosystems, supporting fisheries, shoreline protection, biodiversity, and blue carbon storage. Existing studies show that Lamu contains extensive mangrove forests with significant ecosystem carbon value, but these systems are increasingly affected by degradation, sedimentation, salinity stress, climate variability, and anthropogenic pressure.

TerraVerge Solutions has begun developing a geospatial workflow using Global Mangrove Watch extent data, MODIS Gross Primary Productivity, Sentinel-2 vegetation indicators, and satellite-based mapping to assess mangrove productivity, condition, and carbon-related proxies. The next step is to improve the accuracy of this workflow by integrating field data and soil measurements as training and validation data for predictive modeling.

Core Objective

To develop a field-calibrated mangrove monitoring dashboard that integrates satellite data, soil and vegetation field measurements, environmental variables, and anthropogenic pressure indicators to support restoration monitoring, ecosystem health assessment, and blue carbon decision-making.

Proposed Approach

1. Field Data Integration

Field data will be collected and organized from existing mangrove forests, degraded areas, and restoration sites. Key variables will include:

- GPS location of sampling plots
- Mangrove condition: healthy, degraded, restored, recovering, or bare/silted
- Species composition
- DBH and tree height
- Canopy cover
- Seedling survival and regeneration
- Soil organic carbon

- Bulk density
- Soil salinity, moisture, pH, and texture
- Sedimentation indicators
- Evidence of human disturbance

This field data will act as ground-truth training data for improving model accuracy.

2. Earth Observation and Environmental Data Layers

The dashboard will integrate:

- Global Mangrove Watch mangrove extent
- Sentinel-2 NDVI, NDMI, NBR, and canopy indicators
- MODIS GPP productivity trends
- Rainfall and temperature data
- Salinity and sedimentation proxies
- Shoreline change and erosion/accretion indicators
- Distance to settlements, roads, landing sites, farms, and other disturbance sources

3. Model Development

Machine learning models such as Random Forest, XGBoost, or spatial regression will be trained using the field data and satellite/environmental variables.

The models will generate:

- Mangrove health classification
- Restoration success probability
- Degradation risk index
- Biomass and carbon proxy maps
- Soil carbon prediction zones
- Environmental stress hotspots
- Anthropogenic pressure zones

4. Dashboard Development

The monitoring dashboard will include:

Mangrove Extent Dashboard

Shows current mangrove distribution using Global Mangrove Watch and updated satellite layers.

Mangrove Health Dashboard

Displays NDVI, NDMI, productivity, canopy condition, and stress indicators.

Restoration Monitoring Dashboard

Tracks restoration sites, recovery trends, survival proxies, and failed or stressed restoration zones.

Blue Carbon Dashboard

Displays field-calibrated biomass and soil carbon proxy outputs, carbon recovery potential, and reporting-ready summaries.

Environmental Stress Dashboard

Shows salinity stress, sedimentation, rainfall variability, erosion, and inundation-related risks.

Anthropogenic Pressure Dashboard

Maps disturbance from settlements, cutting, access paths, pollution, aquaculture, and other human activities.

Expected Outputs

1. Field-calibrated mangrove monitoring database
2. Lamu mangrove extent and condition maps
3. Mangrove health and restoration performance indicators
4. Soil carbon and biomass proxy maps
5. Environmental and anthropogenic pressure layers
6. Interactive dashboard for monitoring and reporting
7. Technical report with methodology, findings, and recommendations
8. Scalable workflow for other coastal counties and restoration sites

Value and Use Cases

The system will support:

- Mangrove restoration planning
- Blue carbon project development
- County and national reporting
- Conservation finance
- Community-based monitoring
- Early detection of degradation and restoration failure
- Targeting of priority restoration and protection zones

Proposed Collaboration Request

We seek collaboration to integrate existing mangrove field datasets, soil sampling data, restoration site records, and institutional knowledge into the current Earth observation workflow. This will enable development of a more accurate, field-calibrated mangrove intelligence system for Lamu and, later, the wider Kenyan coast.

Proposed Product Name

Lamu Mangrove Restoration and Blue Carbon Intelligence Dashboard