Integrating AI and Spatio-Temporal Data for Enhanced SDG Monitoring for Pakistan

June 2024
OVERVIEW

1. SDGs in Pakistan
   National Standing and Priority

2. SDG 15: Life Above Land
   National Initiatives

3. Project Overview
   Project Technical Details

4. Way-Forward
   Implementation
   Local and National Impact assessment

5. Q&A
   Interactive Session
SDGs: NATIONAL PERSPECTIVE

ECONOMIC IMBALANCE

24% of the population lives below the national poverty line

SOCIAL INJUSTICE

Women earn 34% less wages than men

22.7 million Pakistani children age five to 16 are out of school

54.3% of population doesn’t have internet access

100 billion of Pakistanis financially excluded
SDG NATIONAL PERSPECTIVE

SDGs Index: 128 in 2023

1. NATIONAL COMMITMENT
   Pakistan one of the initial signatories of SDGs (2015)

2. 1ST PARLIAMENT IN THE WORLD
   Est. Secretariat in Parliament House for SDGs

3. FEDERAL SDGS SUPPORT UNIT
   Est. by Ministry of Planning, Dev, SI (MoPDSI), to monitor/coordinate on SDGs nationally

4. NATIONAL INITIATIVE FOR SDGS 2030 AGENDA
   A 5-yrs joint project of Ministry of Planning, Dev, and Reform (MoPDSI), with the support of UNDP

5. IMF PROGRAMME
   IMF Bailout puts tremendous pressure on Pakistan to achieve UN SDGs
<table>
<thead>
<tr>
<th>Indicator Description</th>
<th>Baseline Value</th>
<th>Year</th>
<th>Last Value</th>
<th>Year</th>
<th>Latest Value</th>
<th>Year</th>
<th>Data Source</th>
<th>Target</th>
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<tbody>
<tr>
<td>15.1.1 Forest area as a proportion of total land area</td>
<td>5.01%</td>
<td>2012</td>
<td>4.56%</td>
<td>2016</td>
<td>4.68%</td>
<td>2020</td>
<td>Ministry of Climate Change and Environmental Coordination</td>
<td>6%</td>
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<tr>
<td>15.1.2 Proportion of important sites for terrestrial and freshwater biodiversity that are covered by protected areas, by ecosystem type</td>
<td>12.3</td>
<td>2012</td>
<td>13</td>
<td>2018</td>
<td>17.85</td>
<td>2023</td>
<td>Provincial wildlife notifications</td>
<td>0.15</td>
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<td>15.2.1 Progress towards sustainable forest management</td>
<td>65.3 tonnes / ha Above Ground Biomass</td>
<td>2010</td>
<td>65.3 tonnes / ha Above Ground Biomass</td>
<td>2015</td>
<td>73.49 tonnes / ha AGB</td>
<td>2023</td>
<td>Forest Resources Assessment (FRA) 2025</td>
<td>NA</td>
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<tr>
<td>15.3.1 Proportion of land that is degraded over total land area</td>
<td>5%</td>
<td>2015</td>
<td>0.04%</td>
<td>2019</td>
<td></td>
<td></td>
<td>Ministry of National Food Security &amp; Research</td>
<td>3</td>
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<tr>
<td>15.4.1 Coverage by protected areas of important sites for mountain biodiversity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Provincial wildlife departments</td>
<td>NA</td>
</tr>
<tr>
<td>15.4.2 Mountain Green Cover Index</td>
<td>86.29%</td>
<td>2000</td>
<td>87.60%</td>
<td>2015</td>
<td>89.72%</td>
<td>2018</td>
<td>FAOSTAT</td>
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</table>
SDG 15: Life Above Land

NATIONAL INITIATIVES

1. **SLMP**
   Sustainable Land Management Program (SLMP) aim to address land degradation and desertification through sustainable land management practices.

2. **SLCP**
   Snow Leopard Conservation Project and the Markhor Conservation Program, focus on protecting endangered species and their habitats.

3. **BILLION TREE TSUNAMI**
   According to the Food and Agriculture Organization (FAO), Pakistan's forest area increased from 4.9% of total land area in 1990 to 5.1% in 2020. The Billion Tree Tsunami Afforestation Project, launched in Khyber Pakhtunkhwa province, aims to plant one billion trees to combat deforestation and climate change.

4. **BIODIVERSITY CONSERVATION**
   Pakistan has established protected areas and national parks to conserve biodiversity, including the Deosai National Park, Khunjerab National Park, and Hingol National Park.
Project Overview

• Harnessing **AI, Remote Sensing, and GIS** for Refined Forest Monitoring in Support of **SDG 15**

• These technologies can strengthen **forest monitoring efforts, combat land degradation**, and address **deforestation** challenges

• In this context, the Ministry of Climate Change and Environmental Coordination in Pakistan has established **National Forest Monitoring System (NFMS)** under REDD+ Readiness Project
Data Availability

• Available Datasets include:
  • Forest Masks
  • Land Use Land Cover
  • NFI Sample Plots
  • Deforestation Hotspots
  • Linear Plantation
  • Forest Stratification
  • Administrative Boundaries
  • Activity Data
  • Satellite Imagery (province wise)

• Area of Interest
  • Ideally whole country
To meet the essential criteria for international reporting, especially under Enhanced Transparency Framework and Biennial Transparency Report (from 2024 onward), it is imperative for Pakistan to regularly update the existing data.

In order to achieve this, mapping AI and Spatio-temporal data is highly desired for this project.

Beside this, AI algorithms can be used to process and analyze large datasets derived from RS, automating the identification of forest cover changes, illegal logging activities, and potential areas of degradation.

Similarly, machine learning models can help predict trends and assess the impact of anthropogenic activities on forest ecosystems.
PROPOSED APPROACH

METHODOLOGY
• Utilize satellite imagery, such as Landsat and Sentinel-2, to capture detailed forest cover data
• Conduct multi-temporal analysis using Normalized Difference Vegetation Index (NDVI)
• Integrate satellite imagery into GIS platforms for comprehensive spatial analysis and mapping
• Develop geospatial layers to identify deforestation hotspots
• Deploy deep learning models, specifically convolutional neural networks, to classify forest cover and detect changes automatically
2- Early Warning System for Illegal Logging and Land-Use Changes

- Use time-series analysis techniques to detect abrupt changes indicative of illegal activities
- Create GIS layers for high-risk areas based on historical data and predictive modeling
- Develop real-time monitoring dashboards to visualize alerts and changes
- Implement anomaly detection algorithms to identify unusual patterns in forest cover
- Use machine learning models, such as random forests and support vector machines, to predict and flag potential illegal activities based on historical data
3- Reliable Data for International Reporting and Compliance with SDG 15

- Continuously update forest cover data using the latest high-resolution satellite imagery
- Perform regular assessments of vegetation health, biomass density, and land-use changes using remote sensing techniques
- Maintain a comprehensive GIS database to store and manage forest-related geospatial data
- Develop reporting tools within GIS platforms to generate standardized reports for international compliance
- Automate data processing and integration from multiple sources using AI-driven techniques
- Implement data validation algorithms to enhance the reliability of reported data
4- Decision Support Tools for Policy Makers

• Generate detailed thematic maps and change detection reports to inform policy decisions using GIS analysis

• Develop interactive GIS applications and dashboards for scenario analysis and visualization of forest management strategies

• Create spatial decision support systems (SDSS) to analyze the impacts of different management practices

• Build predictive models using machine learning algorithms, such as neural networks and gradient boosting, to forecast the impact of various activities on forest ecosystems

• Use AI-driven simulations to evaluate the effectiveness of policy interventions and management strategies
Stakeholder Engagement and Capacity Building

- Ministry of Climate Change and Environmental Coordination
- Ministry of Planning Development & Special Initiatives- SDG Wing
- Provincial Forest Departments

- Stakeholders workshop + Collaborative Opportunities + Knowledge Sharing
Way Forward

• Implementation of proposed project as a working prototype

• Testing and pilot at national level

• Mapping results with SDG 15

• Preparation for Enhanced Transparency Framework and Biennial Transparency Report

• Stakeholder’s capacity building and knowledge sharing

• Impact assessment
DISCUSSION