Photo credit: Olivia Acland / WFP Sierra Leone 2025

AIMS

Asset Impact Monitoring from Space

WFP World Food Programme

SAVING LIVES CHANGING LIVES

Sierra Leone

Western Area Peninsula National Park

Extended Analysis – May 2024 to April 2025 Report

Funded by the European Union

WFP World Food Programme

June 2025

Contents

Glossary of terms

AIMS	**Asset Impact Monitoring from Space** service monitors Food Assistance for Asset (https://www.wfp.org/food-assistance-for-assets) community projects from space with satellite imagery
WAP-NP	**Western Area Peninsula National Park**
Deforestation	permanent removal forested areas and conversion to non-forest cover, often for agricultural or commercial purposes.
Forest Loss	reduction in the area or density of forest cover which can be caused by deforestation, as well as other disturbances like wildfires, disease, or insect infestation.
NDVI	**Normalized Difference Vegetation Index** used as a proxy of vegetation health/productivity
VHR	**Very High-Resolution** satellite imagery ranges from 1m to 5m
FIRMS	NASA's **Fire Information for Resource Management System (FIRMS)** distributes Near Real-Time (NRT) active fire data
VIIRS	**Visible Infrared Imaging Radiometer Suite** detects fires of relatively small areas and provides improved mapping of large fires, at 375 m resolution
LULC	**Land Use Land Cover** geospatial datasets related to the classification of forms of land and uses of that land, whether natural or human-influenced
TMF	**Tropical Moist Forest** includes closed forests in the humid tropics with two main forest types: the tropical rain forest and the tropical moist deciduous forest

Introduction

AIMS

WFP Country Office Sierra Leone 2025 AIMS Subscription

June 2025 Extended Analysis

The **Western Area Peninsula National Park (WAPNP)** occupies approx. **18,000 ha** of Sierra Leone's Western region and lies south of the national capital, Freetown. It has a predominantly equatorial climate, with monsoonal rainfall, and its habitat is comprised of lowland tropical moist forests. Despite being vital to Freetown's environmental health—particularly as the sole viable source of clean water through the Guma Valley Dam—the Western Area Peninsula National Park (WAPNP) faces severe threats from human activities such as land grabbing, charcoal production, quarrying, and illicit crop cultivation. These activities are exacerbated by weak law enforcement and systemic corruption. Deforestation in the area significantly increases the risk of hillside and mountain destabilization, gully formation, soil erosion, and reduced water quality and supply. It also heightens the likelihood of landslides and flooding. As such, closely monitoring forest cover is critically important to inform and strengthen conservation efforts.

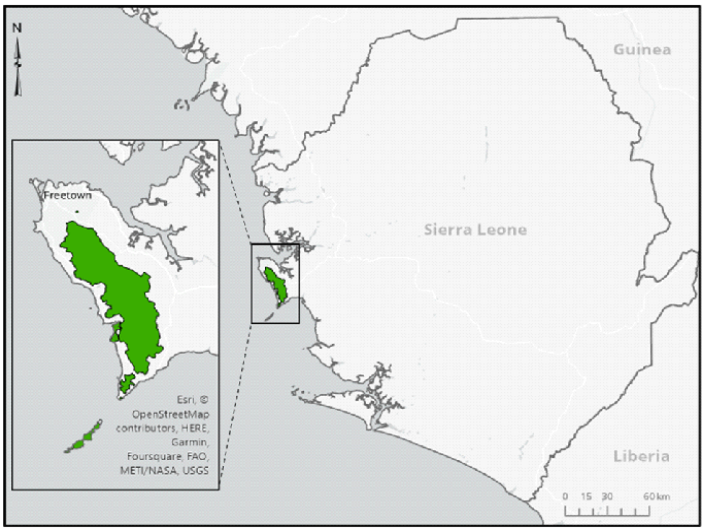


Fig 1. Map showing the WAP-NP (in green) location and extent.

Multiple fires inside WAPNP around Bio Barray

Introduction

AIMS

Forest cover loss assessment in the Western Area Peninsular National Park, Sierra Leone (May 2024 - April 2025)

The objective of the present report is to identify areas experiencing vegetation and/or forest cover loss within the Western Area Peninsular National Park between **May 2024** and **April 2025.** The current report was performed using Sentinel-2 (10 m) for vegetation condition change estimations (NDVI-based). Furthermore, VHR Maxar imagery (0.5 m) was used for validation and the provision of supporting evidence.

To validate the analysis and identify the cause of deforestation, ground truthing exercises were conducted by teams comprised of staff from WFP Sierra Leone Country office and other local entities. Ground photos, drone photos and GPS locations were captured.

Note that although the report is considered an extension of previously delivered assessments, the methodology of the current study was updated and therefore, comparisons with previous reports should be done with caution. For additional details on the methodology and products used please refer to Annex II.

Forest cover loss observed inside the WAPNP, in close proximity to the Guma water reservoir.
Photo credit: Olivia Acland / WFP Sierra Leone 2025

Analysis Results

AIMS

WAPNP- Summary of **assessment findings**

The current analysis assesses changes incurred within the Western Area Peninsula National Park (WAPNP) from May 2024 up until April 2025 (both months included). The findings include:

- **Significant number of forest fires** taking place, with high prevalence within the WAPNP boundary.
- **Decreased forest cover area** – approx. **713 ha** of forest has been lost or significantly degraded inside the WAPNP boundaries
- Overall, **since 2012, approx. 6100 ha** of forest cover has been lost or significantly degraded within WAPNP.

Forest cover loss from May 2024 to April 2025

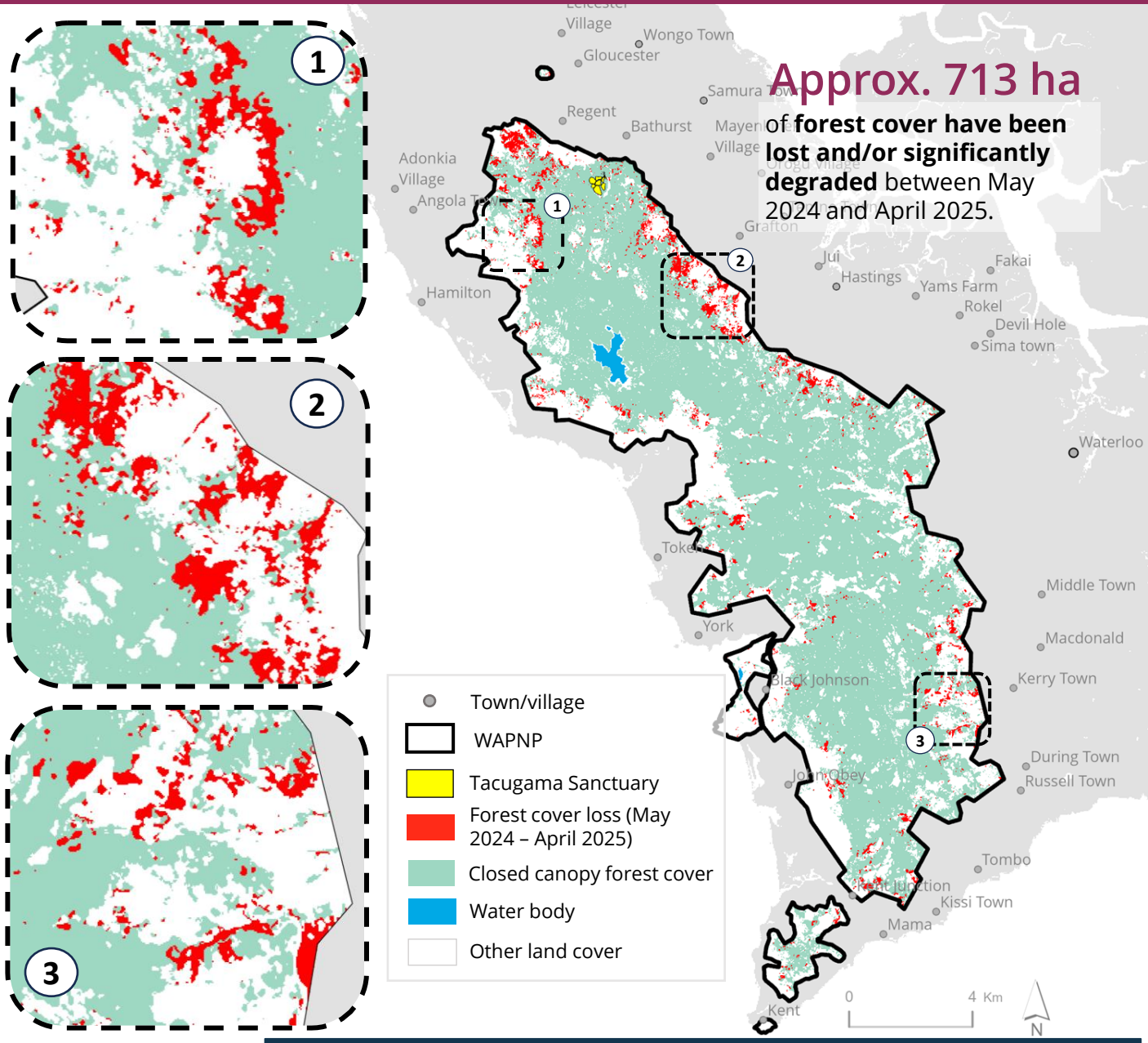


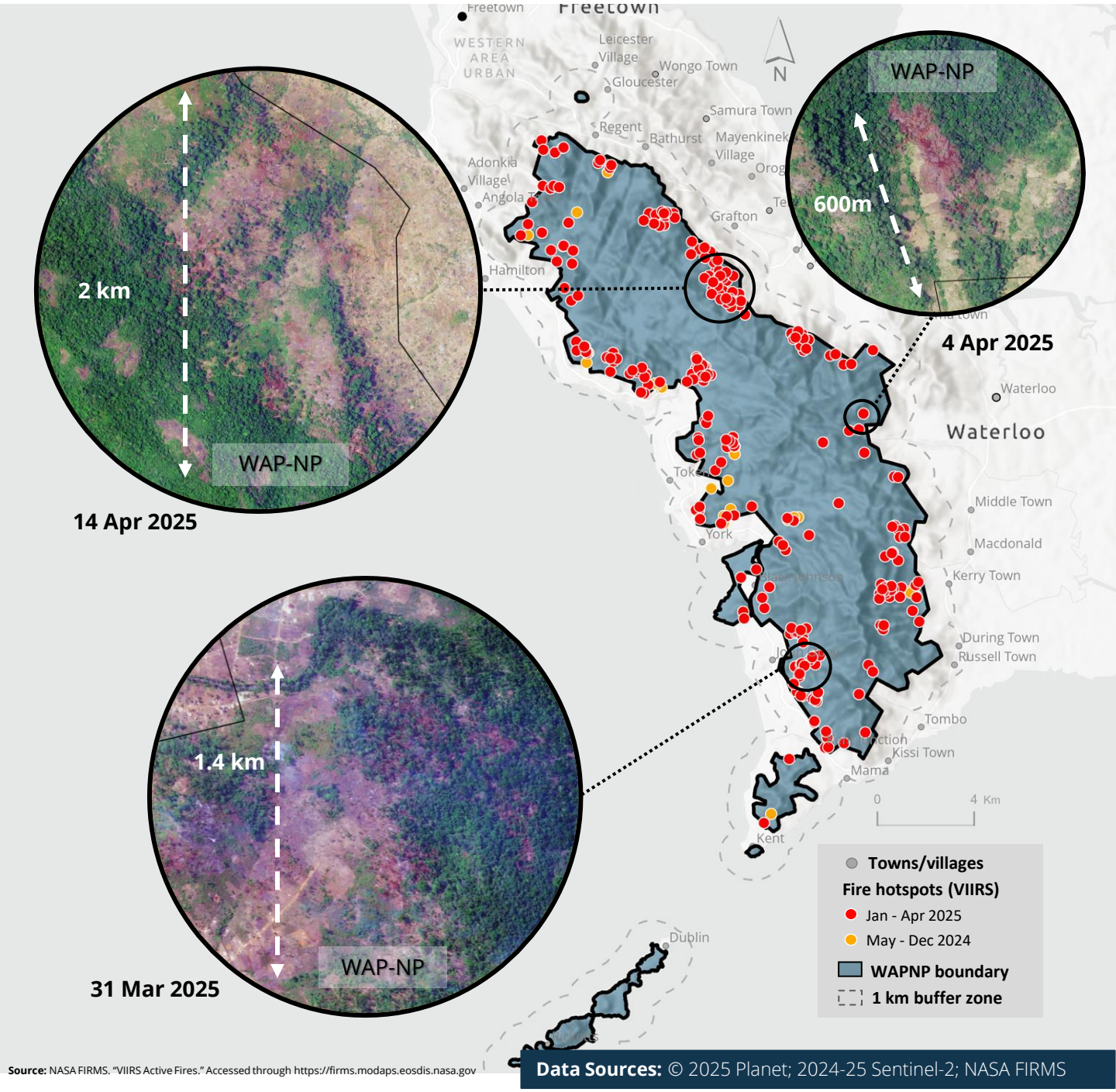
Image Source: © 2024-25 Sentinel-2, Copernicus satellite imagery

Analysis Results

AIMS

WAPNP- Summary of **assessment findings**

Fire hotspots in forest reserve as detected by VIIRS (May 2024 – Apr 2025)



Source: NASA FIRMS. "VIIRS Active Fires." Accessed through https://firms.modaps.eosdis.nasa.gov

Data Sources: © 2025 Planet; 2024-25 Sentinel-2; NASA FIRMS

The map shows the observation of the fire hotspot locations from the NASA Suomi-NPP (VIIRS) satellite (NASA FIRMS, accessed on the 10th of May 2025), detected between May 2024 and April 2025. A total of **303 fire hotspots** were detected within the WAPNP, most of which took place during the month of **March** (143 hotspots).

Forest cover loss - sample site A

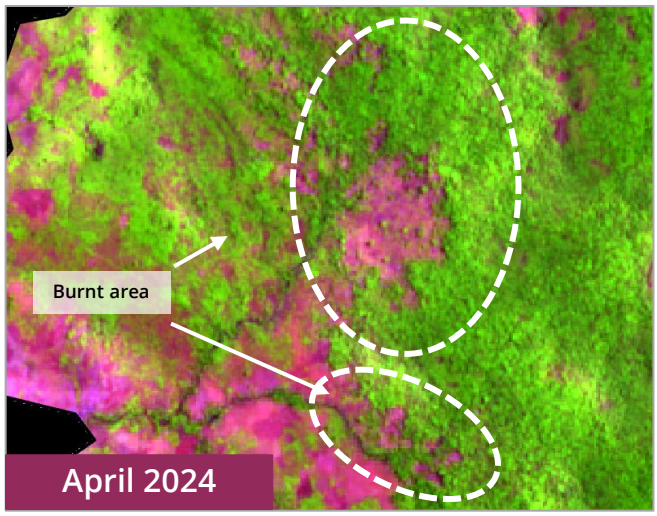
Town/Village
Site location
WAPNP boundary

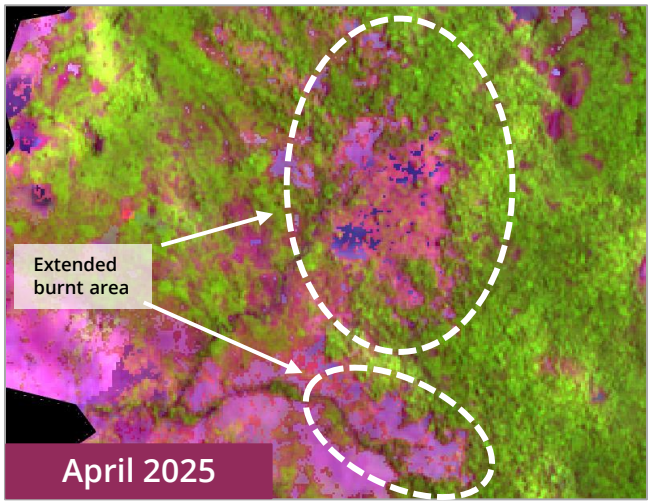
Lat, Lon: 8.4044 -13.225213

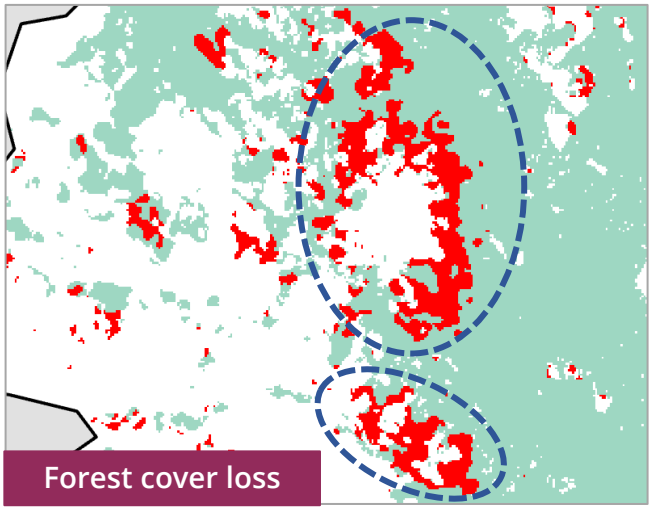
Nearby communities: Angola Town - Hamilton

The comparison of Sentinel-2 satellite imagery (false-colour composites) between late April 2024 and late April 2025 highlights areas within the WAPNP experiencing tree cover loss. An NDVI change analysis reveals significant negative vegetation productivity in areas previously covered by forest, providing an estimation of tree cover loss (refer to map).

The extent of forest cover loss shown in the map is approx. 65 ha







Forest loss May 2024 - Apr 2025
Forest cover
WAPNP Other cover
WAPNP boundary

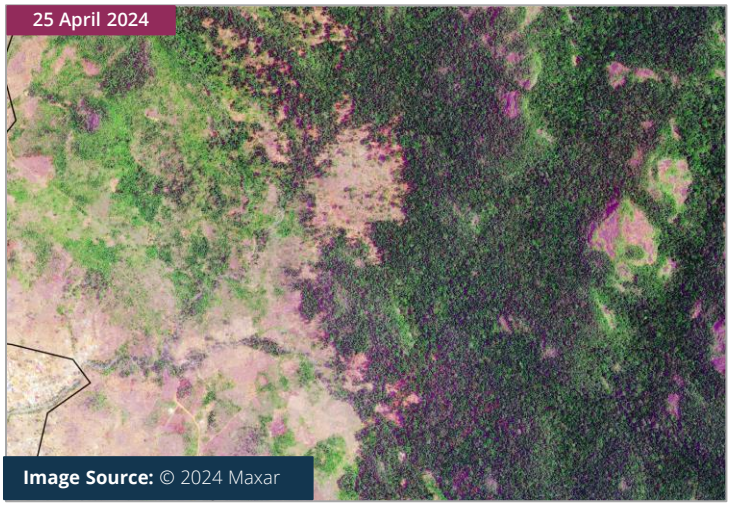
Image Source: © 2024-2025 Sentinel-2, Copernicus satellite imagery

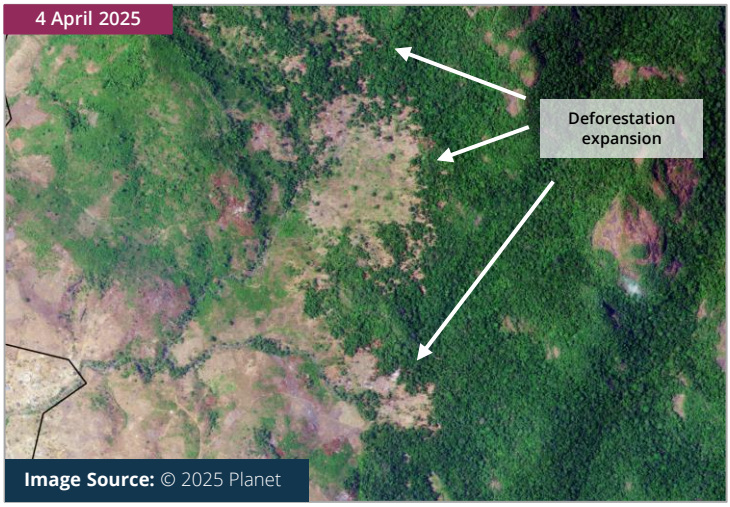
WESTERN AREA PENINSULA NP

Areas experiencing forest cover loss - Drivers

AIMS

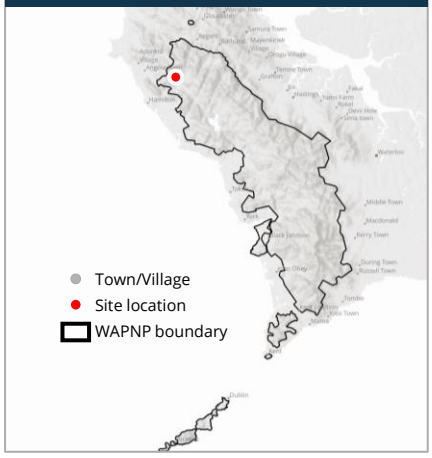
Key Driver: **Settlement expansion**



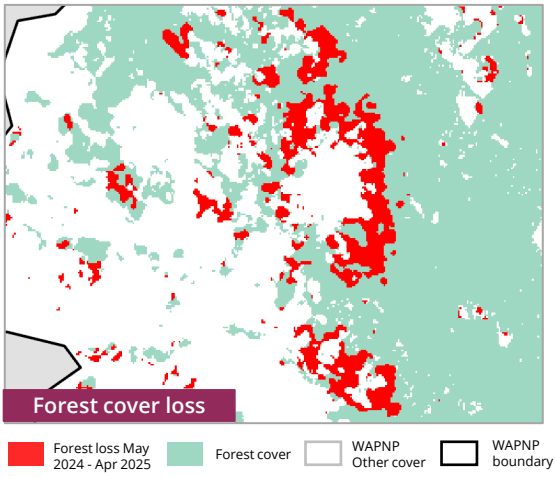


The comparison of VHR satellite imagery from end of April 2024 to April 2025 reveals significant areas of tree cover loss within the WAPNP.

Location map - sample site A



Lat, Lon: 8.4044 -13.225213



Nearby communities: Angola Town - Hamilton

Drone photos – WFP (23 Jan 2025)

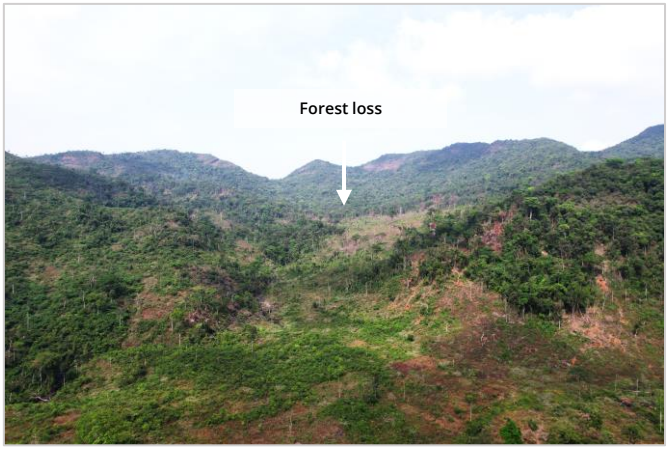


Photo credit: Olivia Acland / WFP Sierra Leone 2025

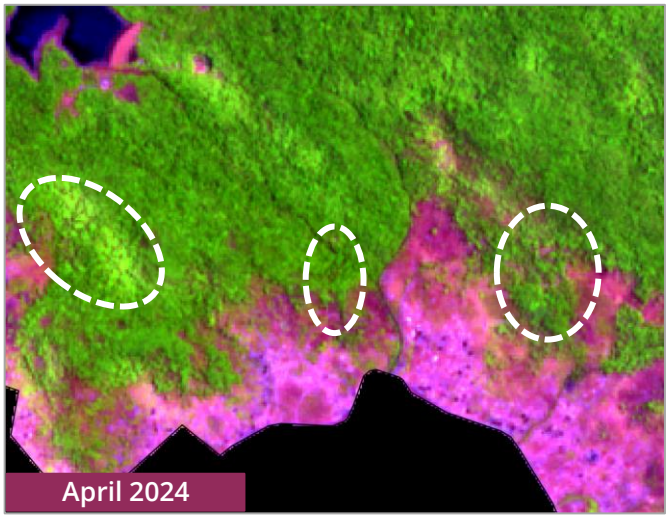
Drone photos captured on January 23rd and 24th, 2025, in the same area provide valuable context, offering a **clear and detailed view of deforestation caused by illegal and ongoing settlement expansion within the WAPNP.**

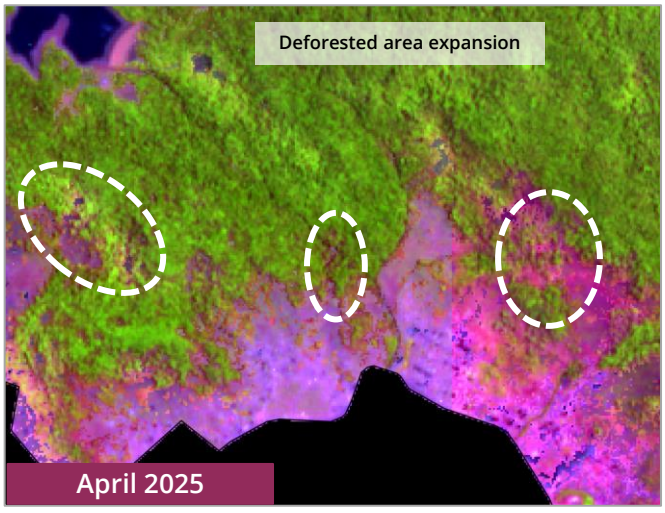
Forest cover loss - sample site B

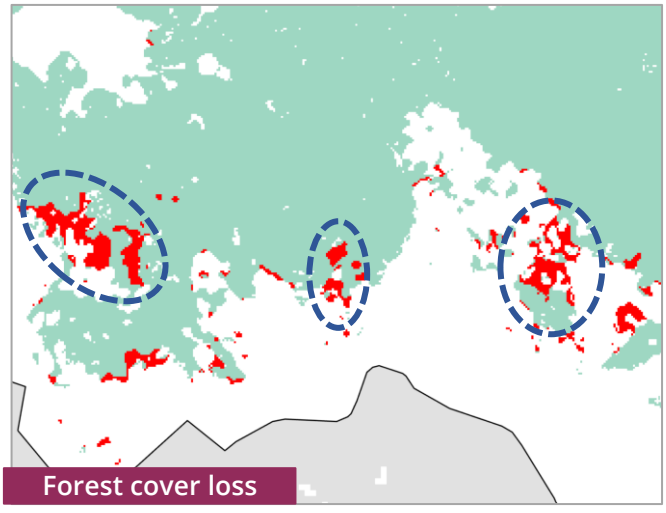
Town/Village
Site location
WAPNP boundary

Lat, Lon: 8.350091 -13.18015

Nearby communities: Bio Barray







Forest loss May 2024 - Apr 2025 | Forest cover | WAPNP Other cover | WAPNP boundary

The comparison of Sentinel-2 satellite imagery (false-colour composites) between late April 2024 and late April 2025 highlights areas within the WAPNP experiencing tree cover loss. An NDVI change analysis reveals significant negative vegetation productivity in areas previously covered by forest, providing an estimation of tree cover loss (refer to map).

The extent of forest cover loss shown in the map is approx. 22 ha

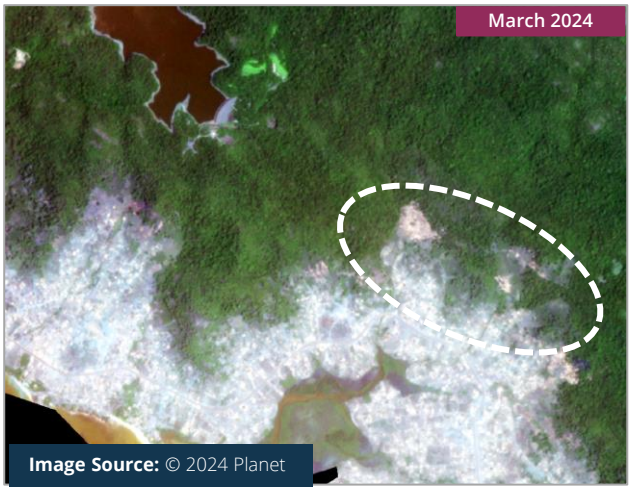
Image Source: © 2024-2025 Sentinel-2, Copernicus satellite imagery

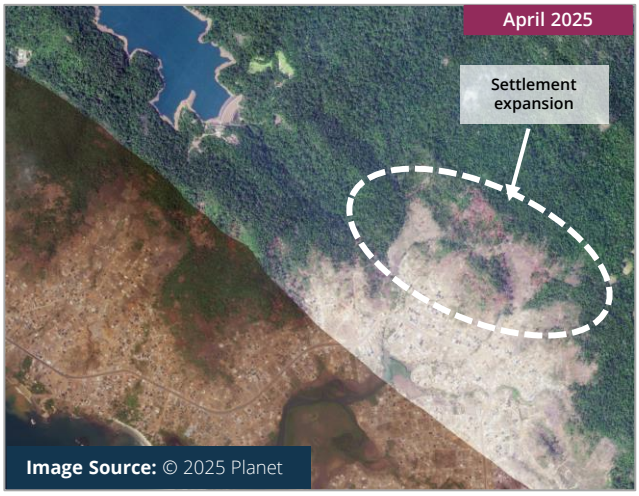
WESTERN AREA PENINSULA NP

Areas experiencing forest cover loss - Drivers

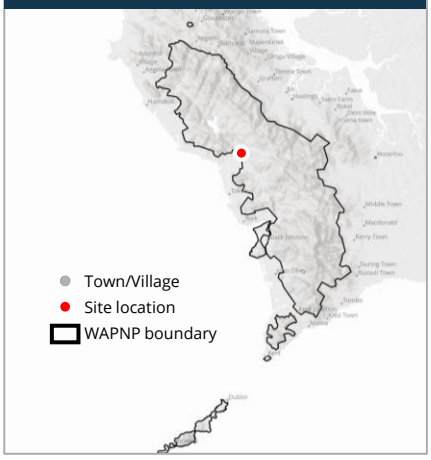
AIMS

Key Drivers: **settlement expansion, stone mining (quarry), logging, and charcoal burning**

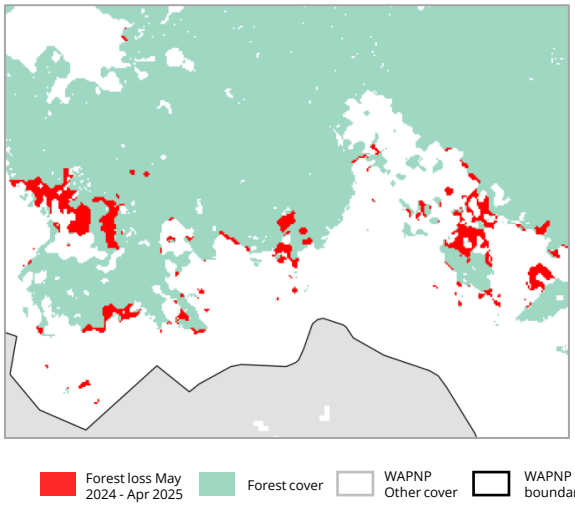




Location map - sample site B



Lat, Lon: 8.350091 -13.18015



The comparison of VHR satellite imagery from end of April 2024 to April 2025 reveals significant areas of tree cover loss within the WAPNP.

Nearby communities: Bio Barray

Drone photo – WFP (4 February 2025)

Drone photo – WFP (23 January 2025)

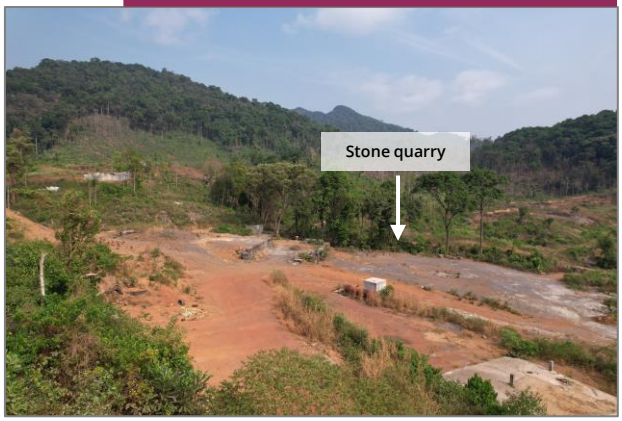


Photo credit: Olivia Acland / WFP Sierra Leone 2025

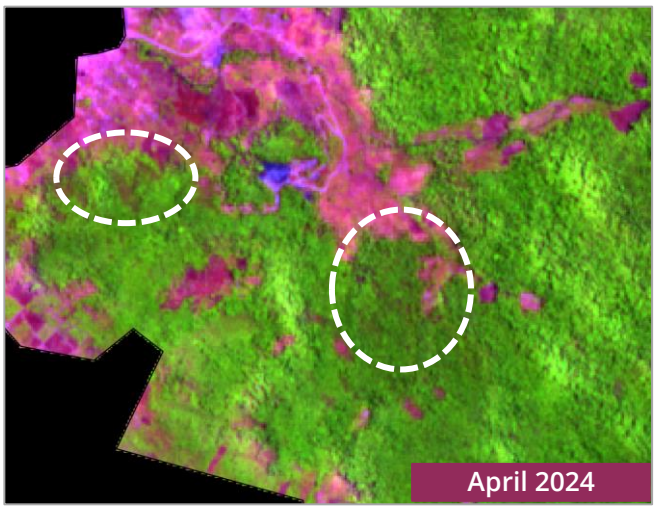
Drone photos captured on January 23rd and February 2nd, 2025, in the same area provide additional context, offering a detailed **view of deforestation driven by illegal settlement expansion, stone mining, logging, and charcoal production within the WAPNP.**

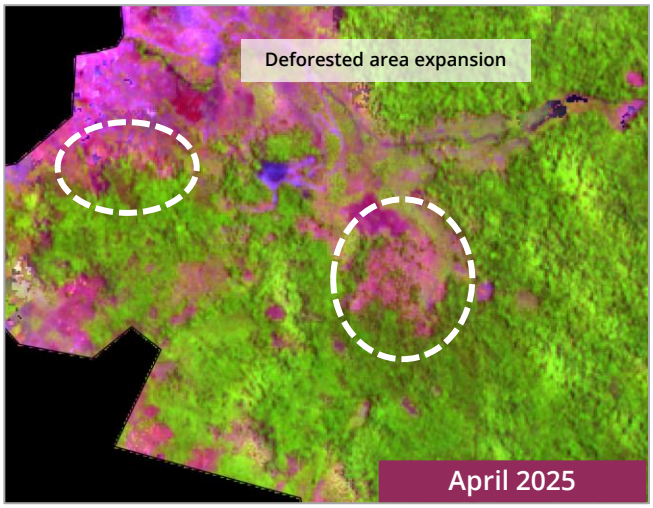
Forest cover loss - sample site C

Town/Village
Site location
WAPNP boundary

Lat, Lon: 8.31991 -13.16751

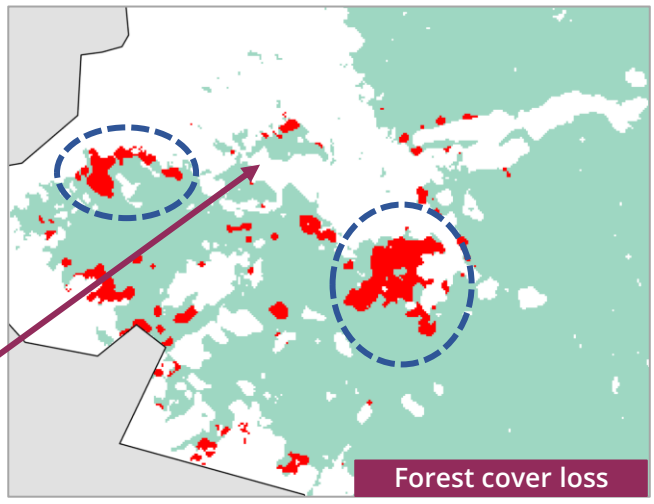
Nearby communities: Bio Barray





The comparison of Sentinel-2 satellite imagery (false-colour composites) between late April 2024 and late April 2025 highlights areas within the WAPNP experiencing tree cover loss. **The extent of forest cover loss shown in the map is approx. 30 ha**

Photo credit: Olivia Acland / WFP Sierra Leone 2025



Forest loss May 2024 - Apr 2025
Forest cover
WAPNP Other cover
WAPNP boundary

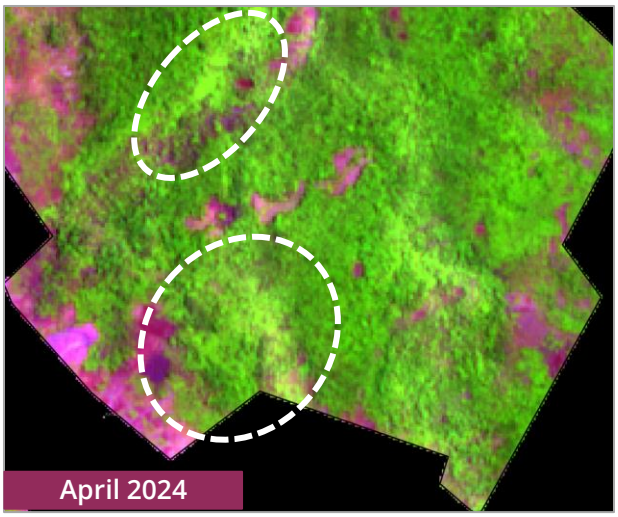
Image Source: © 2024-2025 Sentinel-2, Copernicus satellite imagery

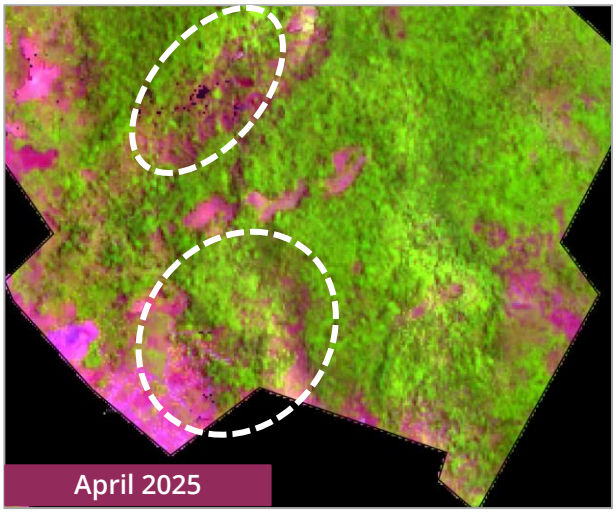
Forest cover loss - sample site D

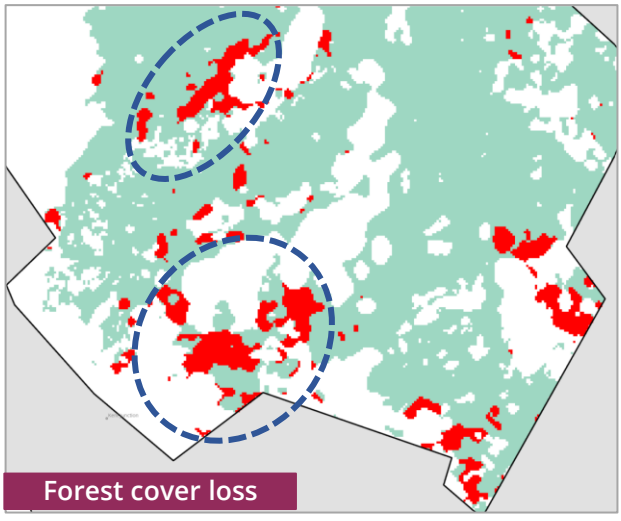
Town/Village
Site location
WAPNP boundary

Lat, Lon: 8.222177 -13.129823

Nearby community: Kent Junction







Forest loss May 2024 - Apr 2025
Forest cover
WAPNP Other cover
WAPNP boundary

The comparison of Sentinel-2 satellite imagery (false-colour composites) between late April 2024 and April 2025 highlights areas within the WAPNP experiencing tree cover loss. An NDVI change analysis reveals significant negative vegetation productivity in areas previously covered by forest, providing an estimation of tree cover loss (refer to map).

The extent of forest cover loss shown in the map is approx. 68 ha

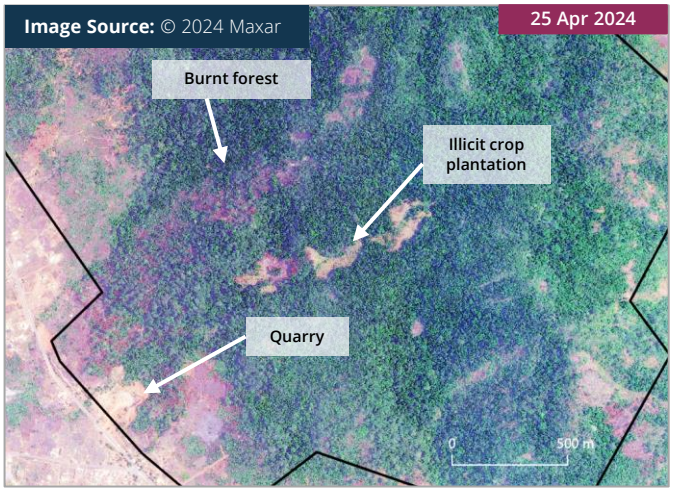
Image Source: © 2024-2025 Sentinel-2, Copernicus satellite imagery

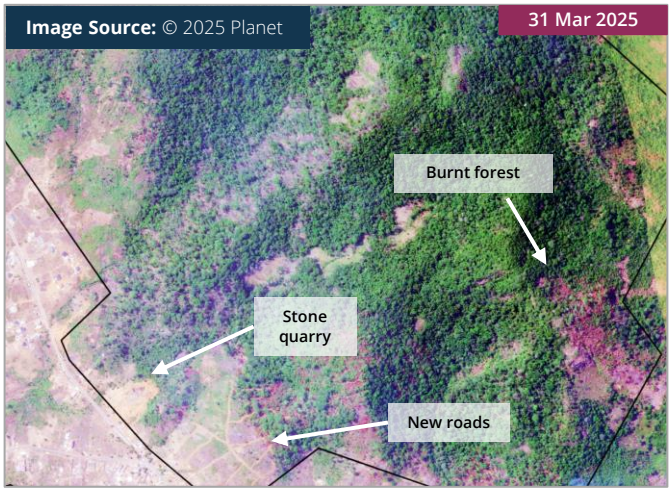
WESTERN AREA PENINSULA NP

Areas experiencing forest cover loss - Drivers

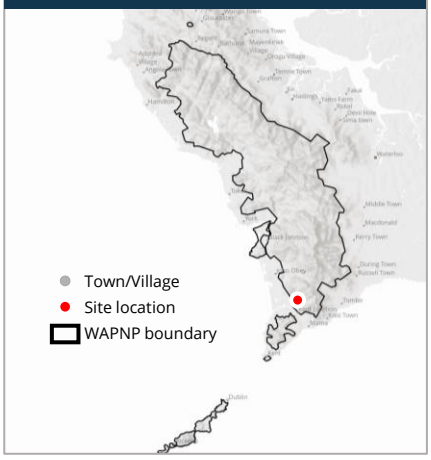
AIMS

Key Drivers: **Stone mining, quarrying, charcoal production, illicit crops**

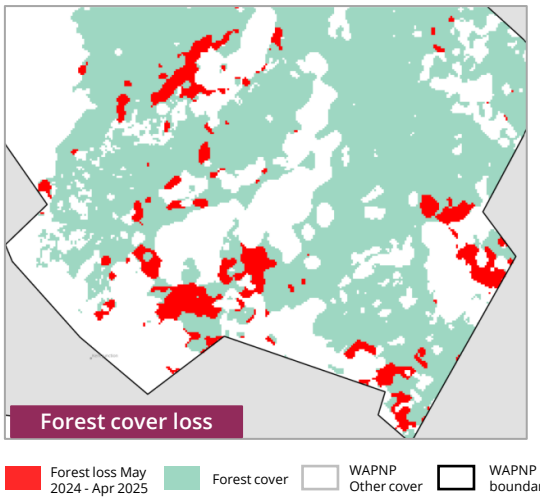




Location map - sample site D



Lat, Lon: 8.222177 -13.129823



Drone photo – WFP (23 Jan 2025)

Photo credit: *WFP Sierra Leone 2025*

Nearby community: Kent Junction

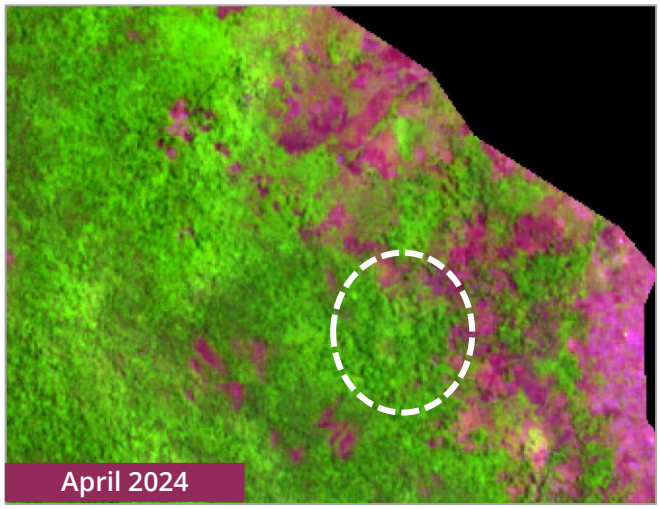
Drone photos captured on January 23rd and 24th, 2025, in the same area provide additional context, offering a **clear view of deforestation linked to stone mining (quarry), charcoal production, and illicit crop cultivation within the WAPNP.**

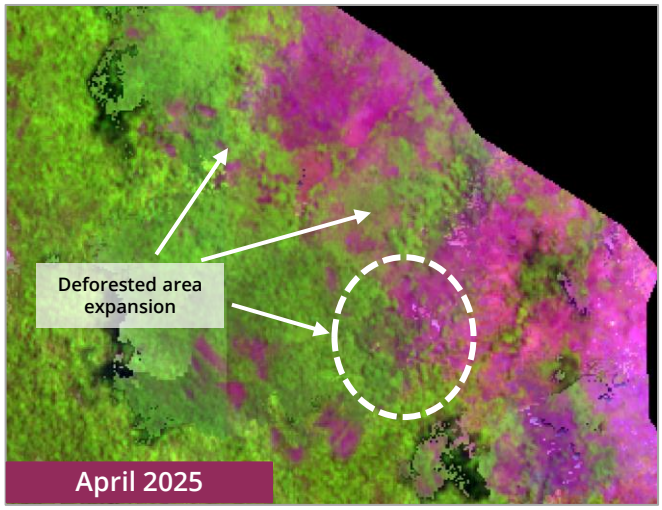
Forest cover loss - sample site E

Town/Village
Site location
WAPNP boundary

Lat, Lon: 8.381276 -13.174425

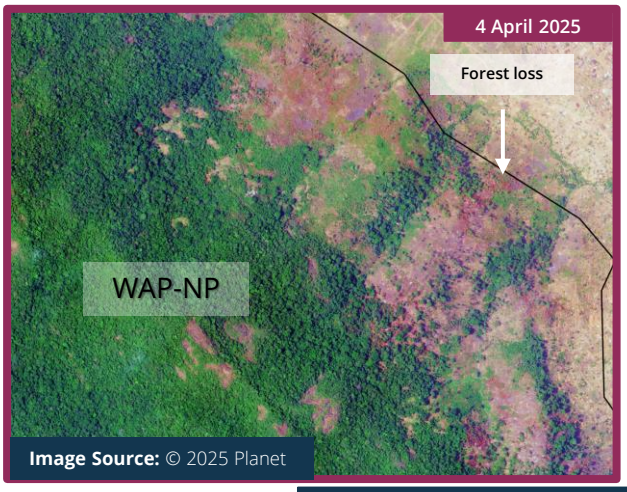
Nearby communities: Grafton





The comparison of Sentinel-2 satellite imagery (false-colour composites) between late April 2024 and April 2025 highlights areas within the WAPNP experiencing tree cover loss.

The extent of forest cover loss shown in the map is approx. 110 ha



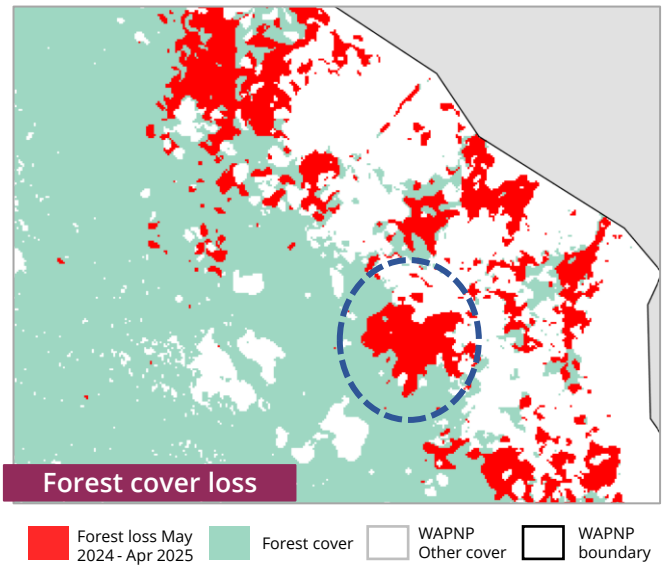


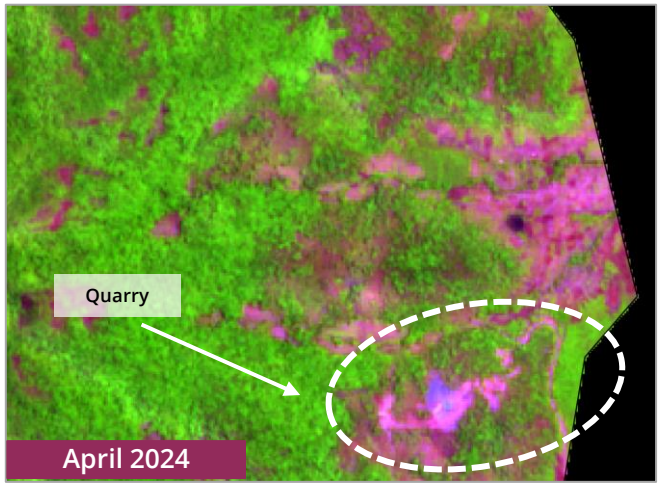
Image Source: © 2024-2025 Sentinel-2, Copernicus satellite imagery

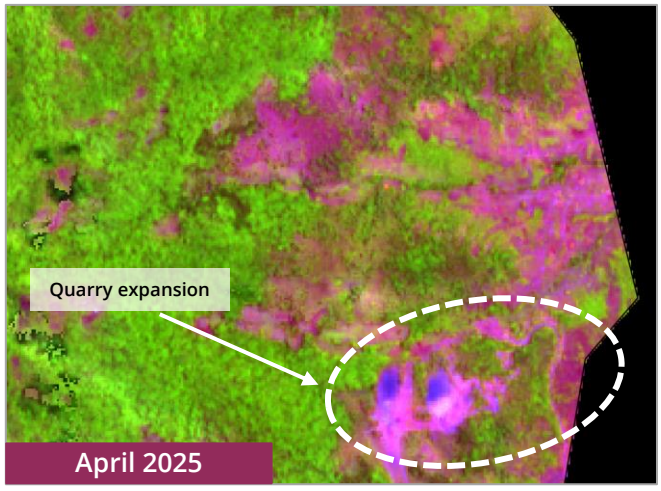
Forest cover loss - sample site F

Town/Village
Site location
WAPNP boundary

Lat, Lon: 8.257876 -13.104445

Nearby community: During Town





The comparison of Sentinel-2 satellite imagery (false-colour composites) between late April 2024 and April 2025 highlights areas within the WAPNP experiencing tree cover loss. An NDVI change analysis reveals significant negative vegetation productivity in areas previously covered by forest, providing an estimation of tree cover loss (refer to map).

The extent of forest cover loss shown in the map is approx. 45 ha

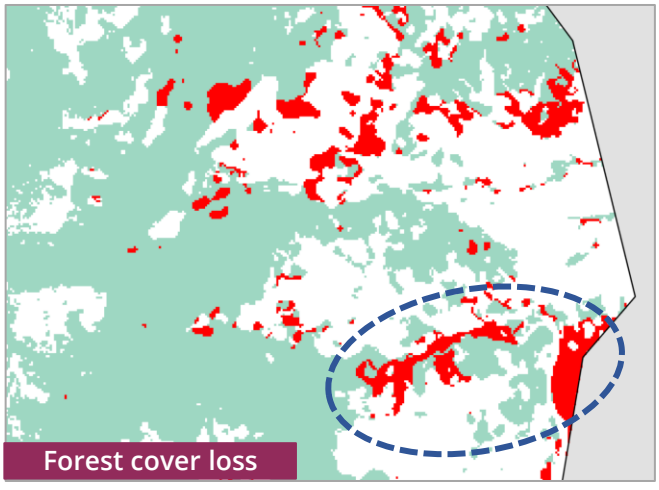


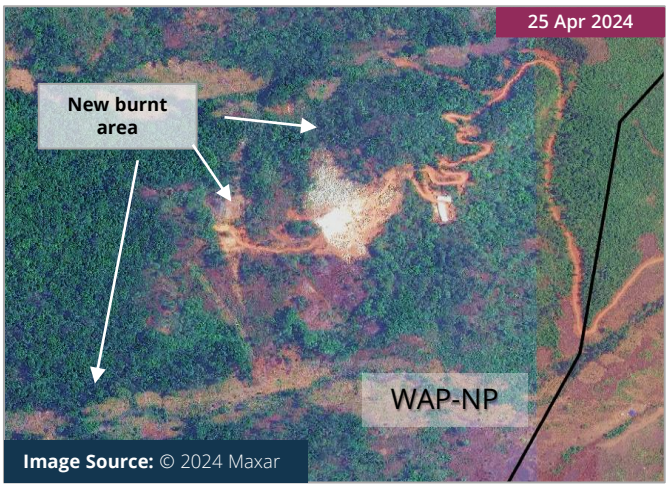
Image Source: © 2024-2025 Sentinel-2, Copernicus satellite imagery

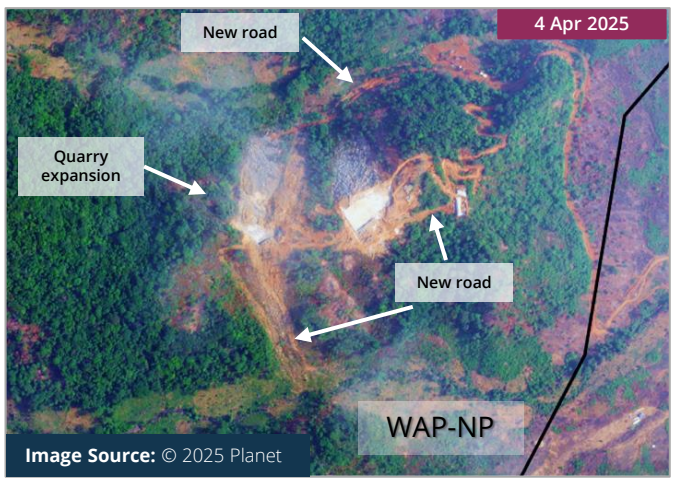
WESTERN AREA PENINSULA NP

Areas experiencing forest cover loss - Drivers

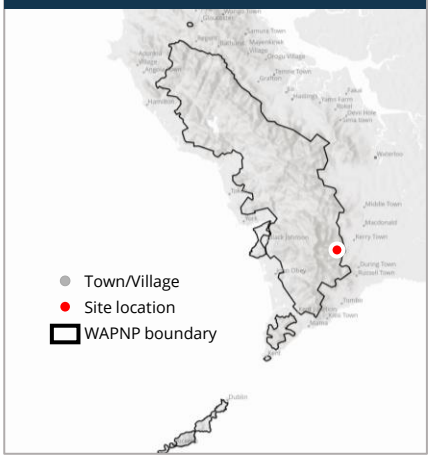
AIMS

Key Driver: **Stone mining (quarry)**

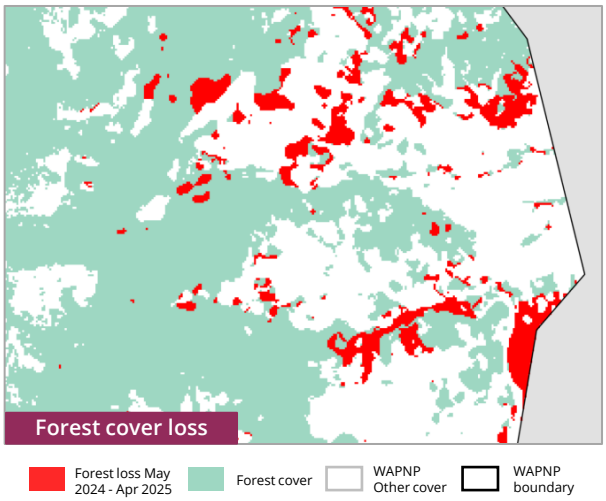




Location map - sample site F



Lat, Lon: 8.257876 -13.104445



Drone photo – WFP (23 Jan 2025)

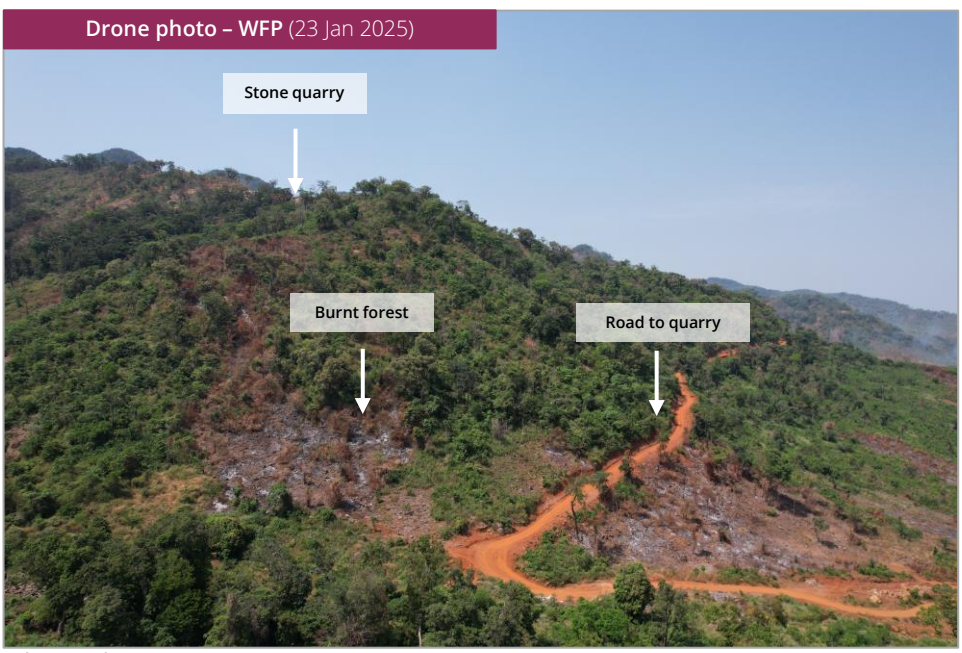


Photo credit: *WFP Sierra Leone 2025*

Nearby commuity: During Town

Drone photos taken on January 23rd and 24th, 2025, in the same area provide further context, offering a **clear visual confirmation of deforestation caused by a quarry development expansion within WAPNP.**

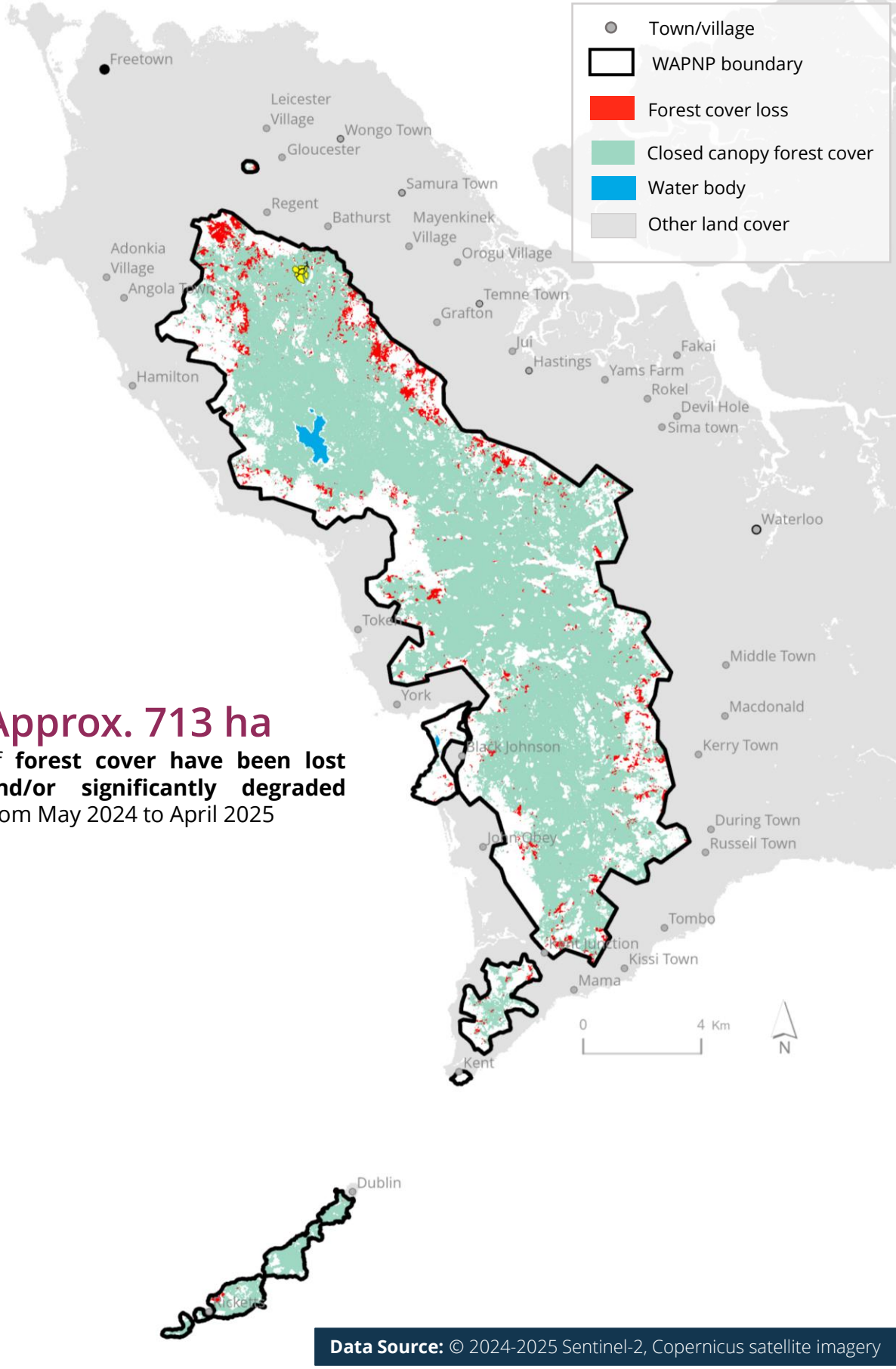
ANNEX I

Additional Maps

WAPNP – Forest Cover Loss

AIMS

Forest cover loss from May 2024 to April 2025



Approx. 713 ha

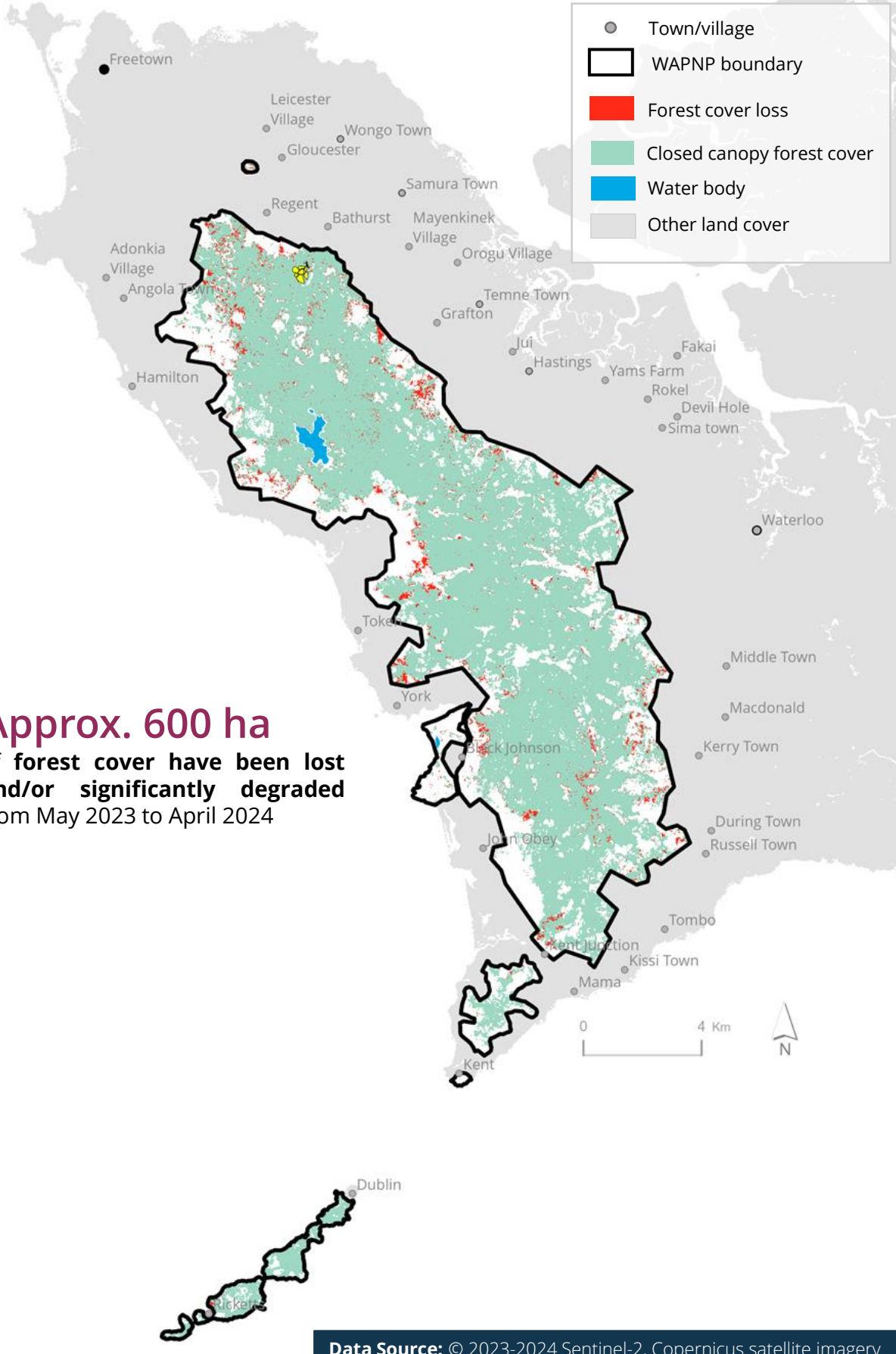
of **forest cover have been lost and/or significantly degraded** from May 2024 to April 2025

Data Source: © 2024-2025 Sentinel-2, Copernicus satellite imagery

WAPNP – Forest Cover Loss

AIMS

Forest cover loss from May 2023 to April 2024



Approx. 600 ha

of **forest cover have been lost and/or significantly degraded** from May 2023 to April 2024

Data Source: © 2023-2024 Sentinel-2, Copernicus satellite imagery

ANNEX II
Methodology

AIMS – Forest Loss/Degradation assessement

The forest loss/degradation assessment was done using a combination of remote sensing products and techniques. Particularly, a change detection method was applied using the Normalized Difference Vegetation Index (NDVI), calculated from monthly Sentinel-2 (10m, ESA), and Planet NICFI imagery (4.7m, PlanetScope). Google Earth Engine was the primary remote sensing tool used to process the imagery, which was then exported to ArcGIS Pro, where the outputs underwent post-processing for the generation of the final results. Additional products like the Dynamic World (v1) land cover dataset and the VIIRS fire hotspot product were used to further support the analysis.

ANALYTICAL PRODUCTS & TOOLS

Product	Description	Processing tool	Earth Observation Dataset Used	Useful Resources
Normalized Difference Vegetation Index (NDVI)	A common index used to estimate vegetation coverage and vigour.	• Google Earth Engine • ArcGIS Pro	• NDVI Planet (4.7 m) • NDVI Sentinel-2 (10m)	NDVI function as explained by ESRI
Forest cover extent (baseline)	Tropical forest cover dataset	• Google Earth Engine • ArcGIS Pro	• JRC Tropical Moist Forest (TMF) dataset	Forest Observations (europa.eu)
VIIRS Fire Hotspots	Latest fire monitoring product to FIRMS which identifies global fire locations in near-real time.	• ArcGIS Pro	• VIIRS active fires (375 m) - NASA	https://www.earthdata.nasa.gov/learn/find-data/near-real-time/firms
VHR	Very-high-resolution imagery used for satellite-based forest loss validation	• Planet platform • Digital Globe platform • AWS • ArcGIS Pro	• Planet (3 m) • Maxar imagery (0.5m)	www.planet.com https://www.maxar.com/maxar-intelligence/products/satellite-imagery

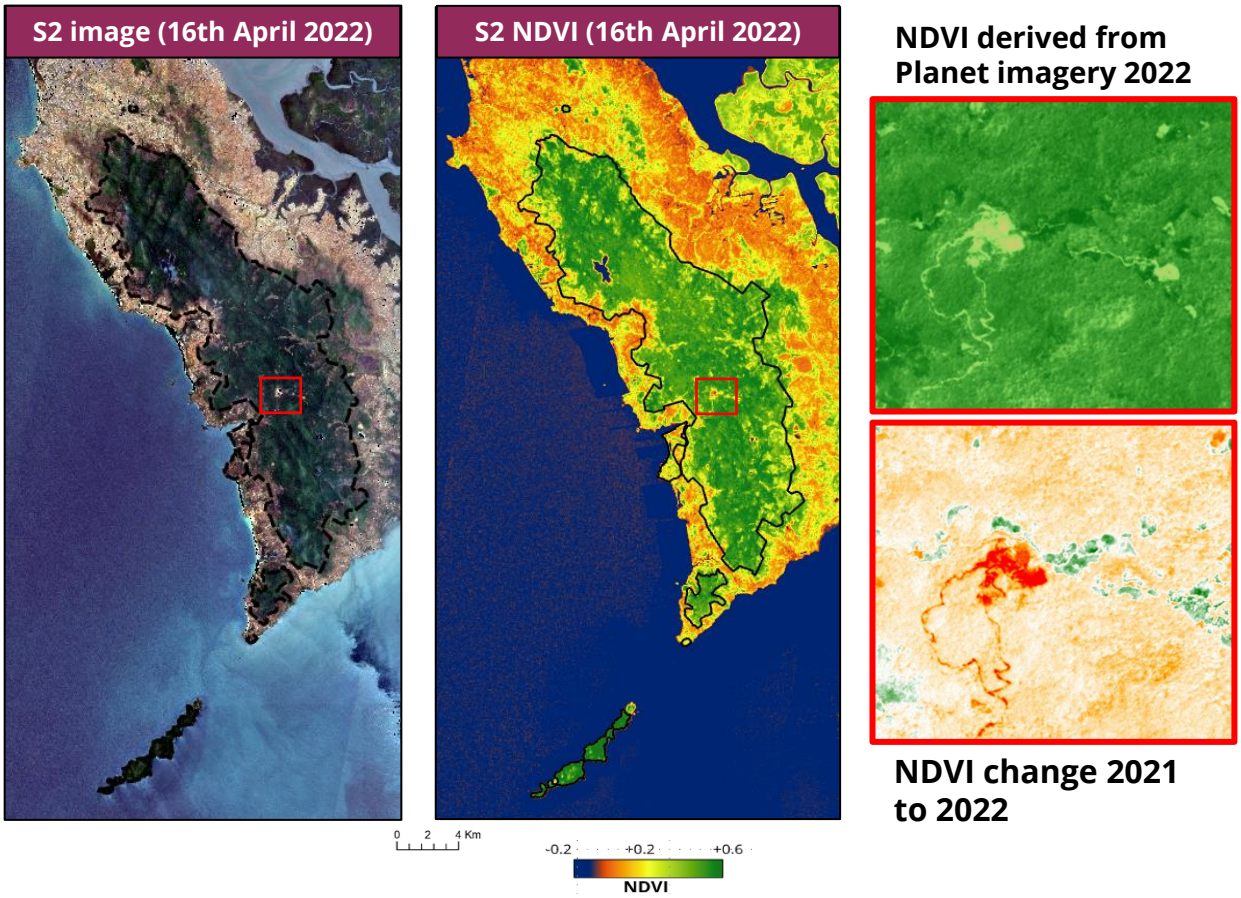
Normalized Difference Vegetation Index (NDVI)

NDVI is a commonly used index to measure vegetation health and/or productivity. It calculates the difference between near-infrared (NIR) and red light reflectance. NDVI values range from -1 to 1, with higher values indicating healthier/more productive vegetation. Changes in vegetation (growth/degradation), like forest cover loss, can be detected by comparing NDVI values over time for a given area.

Vegetation productivity based on NDVI

extracted from Sentinel-2, Planet and satellite imagery

The Western Area Peninsular National Park deforestation assessment was primarily executed by deriving the Normalized Vegetation Index (NDVI), from Sentinel-2 (30 m) imagery (December 2024 to January 2025). The NDVI images where then used to derive change detection maps, in order to help identify areas experiencing significant degradation and/or forest cover loss.

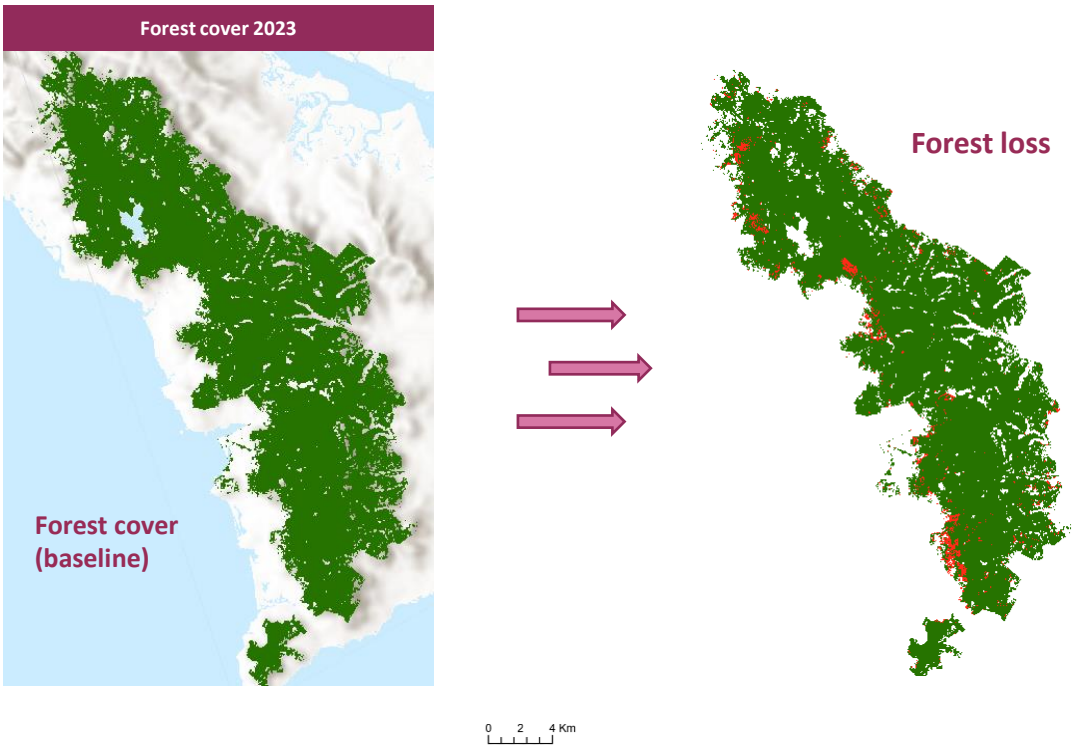


Sentinel-2 and Planet NICFI are satellite systems that provide multispectral, high and VHR resolution images of the Earth's surface. This imagery can be used to detect forest cover loss by deriving and comparing NDVI values over time. For instance, a decrease in > 0.25 NDVI in forested areas will likely signify tree cover loss. NDVI can also be used to support forest cover delineation, as it generally presents NDVI values above 0.5 (dense vegetation).

Methodology

Forest Cover

A Sentinel-2-based baseline for 2023 was established using a supervised Random Forest classification technique. This approach incorporated not only the Sentinel-2 data but also additional supporting datasets, including VHR, field samples and external forest height products, to refine the classification and ensure more precise and context-specific results. Insights derived from this method are further validated through field ground missions, ensuring the robustness and reliability of the monitoring process.

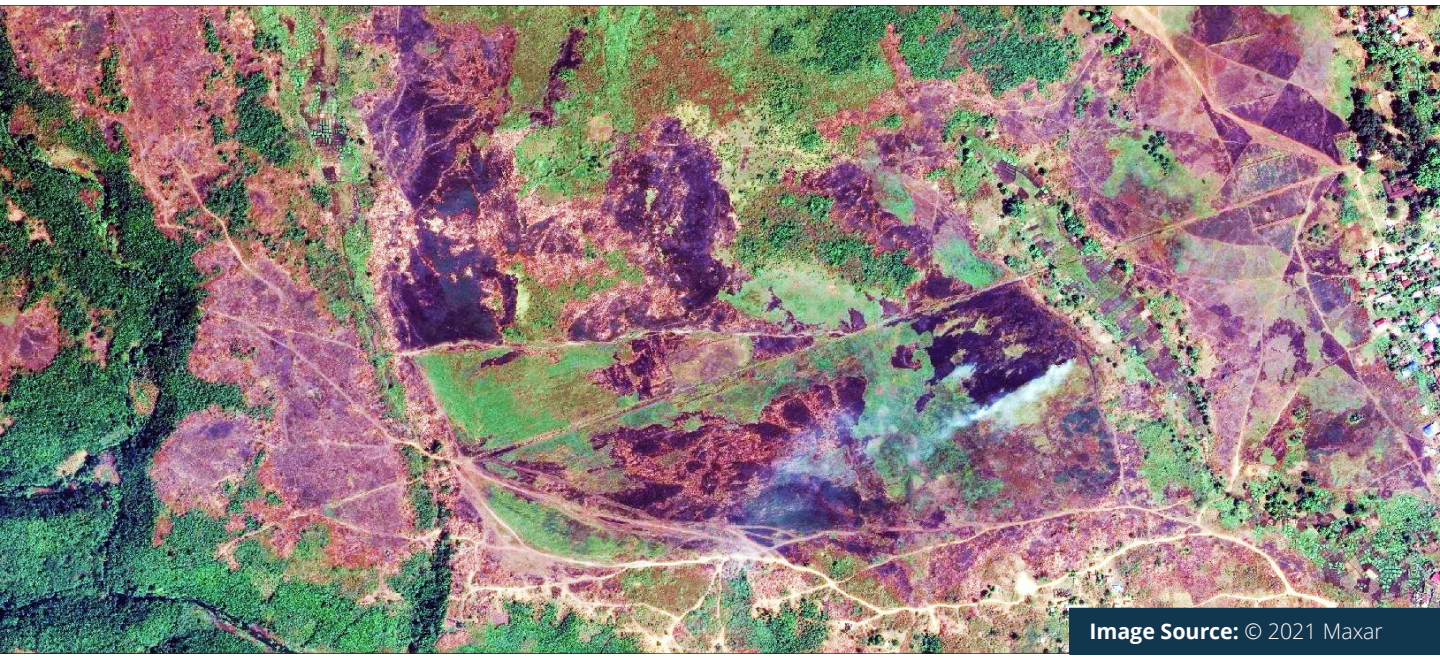


Methodology

Fire Hotspots detected by VIIRS

Accurate monitoring of fire locations and impacts over large areas is crucial for effective resource management and environmental protection. NASA's Fire Information for Resource Management System (FIRMS) provides globally recognized fire products, offering near real-time active fire data from NASA's Visible Infrared Imaging Radiometer Suite (VIIRS) aboard the joint NASA/NOAA Suomi National Polar Orbiting Partnership (S-NPP) and NOAA-20 satellites.

The VIIRS S-NPP fire products have proven to be highly effective in detecting and monitoring fires in diverse ecosystems, including grasslands, peatlands, agricultural, and herbaceous areas. These products have also been widely utilized in identifying wildfires in forested regions, despite challenges posed by closed canopy cover and smoke, which can reduce detection accuracy. Nevertheless, VIIRS fire data remains a valuable tool for tracking fire activity across large landscapes, contributing to timely decision-making and resource allocation.



Fire scaring observed near the WAP national park (November, 2021), location: 08.325512N (lat), 013.092034W (lon)

Photo credit: Olivia Acland / WFP Sierra Leone 2025

FOR FURTHER INFORMATION

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