

Deforestation Dynamics on New Britain, Papua New Guinea (2001–2023)

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Load R packages

Introduction

New Britain is the largest island in the Bismarck Archipelago of Papua New Guinea (PNG) and is divided administratively into two provinces: East New Britain and West New Britain. The island is characterized by extensive tropical forest cover, high biodiversity, and increasing pressure from agricultural expansion, particularly plantation agriculture. Deforestation is the large scale of clearing forest for other land use such as farming, or urban development. One of the key causes are usually wildfires, droughts, or storms while agricultural causes are harvesting for materials.

Deforestation in Papua New Guinea has important implications for biodiversity conservation, carbon storage, and local livelihoods. While national level trends are often reported, sub national patterns of forest loss can vary substantially. Understanding how deforestation has evolved differently across East and West New Britain provides insight into the spatial and temporal dynamics of environmental change on the island.

The purpose of this project is to examine patterns of forest loss on New Britain from 2001 to 2023, with a specific focus on comparing annual and cumulative deforestation trends between East and West New Britain. The analysis emphasizes visualization and interactive exploration to demonstrate the use of R, Quarto, and Shiny for environmental data analysis.

Data Sources

Multiple publicly available datasets were used in this analysis:

- **Global Forest Watch (GFW):** Subnational tree cover loss data (2001–2023), reported annually in hectares. Data were accessed at the provincial (ADM1) level for Papua New Guinea.
- **Humanitarian Data Exchange (HDX):** Administrative boundary shapefiles for Papua New Guinea provinces, used to map East and West New Britain.
- **Baseline Forest Extent:** Forest area in the year 2000 (threshold = 0) from the GFW dataset, used as a reference for normalization.

```
Reading layer `geoBoundaries-PNG-ADM1' from data source
`/Users/user/Documents/MA-615/Island Project/geoBoundaries-PNG-ADM1-all/geoBoundaries-
PNG-ADM1.shp'
using driver `ESRI Shapefile'
Simple feature collection with 22 features and 5 fields
Geometry type: MULTIPOLYGON
```

Dimension: XY
Bounding box: xmin: 140.8405 ymin: -11.65616 xmax: 159.4818 ymax: -0.757591
Geodetic CRS: WGS 84

Data Processing Methods

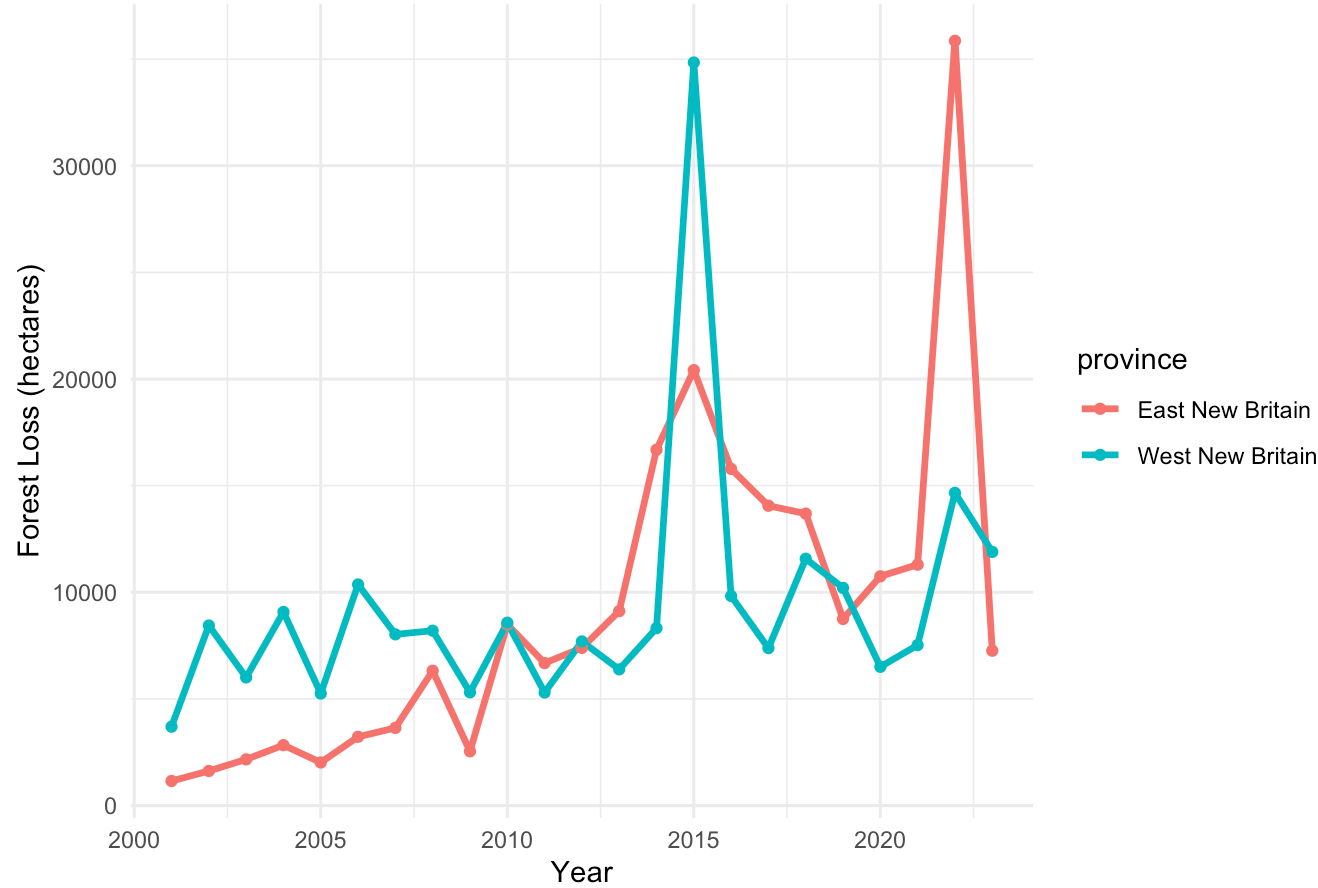
Annual tree cover loss (in hectares) was extracted for East and West New Britain from the Global Forest Watch sub national data set. Data were filtered to include only threshold = 0, corresponding to all tree cover regardless of canopy density.

To allow meaningful comparison between provinces of different sizes, forest loss was analyzed in both absolute terms (hectares) and normalized terms (percentage of baseline forest area). Annual percentage forest loss was calculated by dividing annual loss by baseline forest extent in 2000. Cumulative forest loss was computed as the running sum of annual losses over time.

Administrative boundaries from HDX were harmonized with the forest loss dataset by standardizing province names prior to spatial joins. Choropleth maps were generated using fixed color scales based on the full range of values across all years to ensure temporal comparability.

```
# A tibble: 46 × 3
  province      year loss_ha
  <chr>        <int>   <dbl>
1 East New Britain 2001    1152
2 East New Britain 2002    1623
3 East New Britain 2003    2167
4 East New Britain 2004    2834
5 East New Britain 2005    2022
6 East New Britain 2006    3225
7 East New Britain 2007    3643
8 East New Britain 2008    6322
9 East New Britain 2009    2544
10 East New Britain 2010    8496
# i 36 more rows
```

Annual Forest Loss in East and West New Britain (2001–2023)



This graph shows annual forest loss in East and West New Britain from 2001 to 2023. Over the full study period, West New Britain consistently experienced higher annual forest loss than East New Britain, indicating sustained and comparatively greater deforestation pressure.

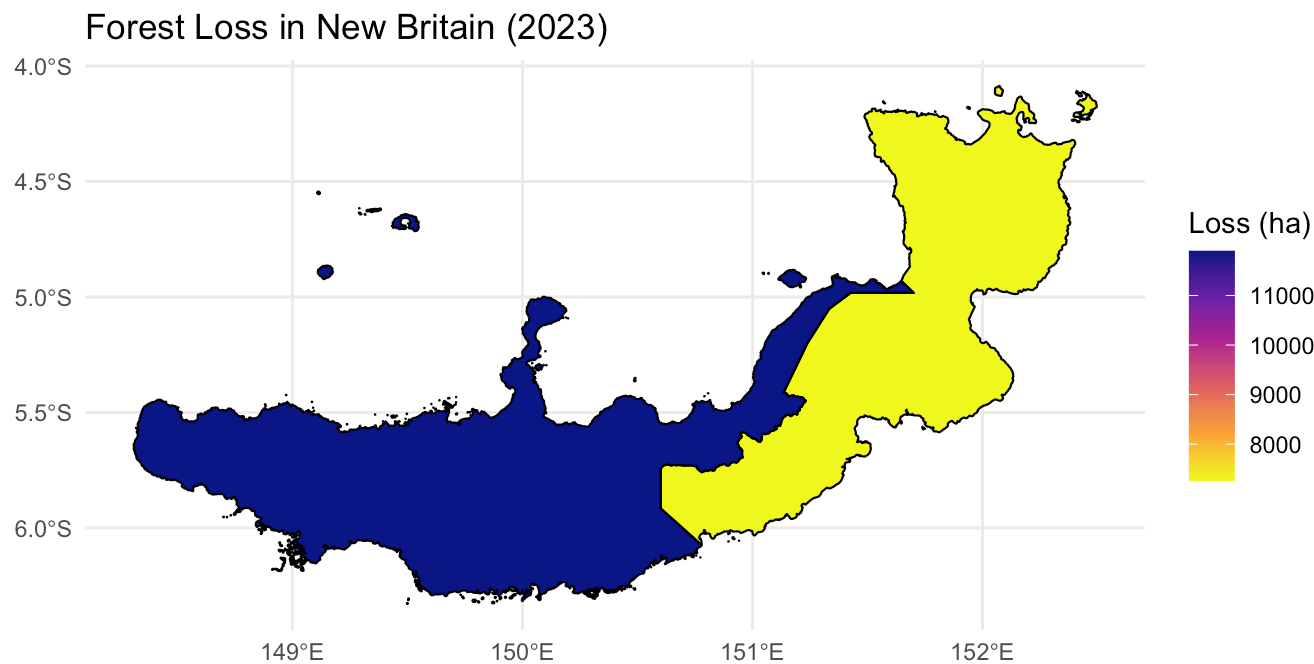
Both provinces exhibit substantial year-to-year variability, with several pronounced spikes rather than a smooth trend. West New Britain shows a notable peak around 2015, where annual forest loss exceeds 30,000 hectares, followed by a decline and then renewed increases in the early 2020s. East New Britain also shows episodic increases, including a sharp spike in 2022, suggesting periods of intensified land conversion rather than gradual change.

Despite these fluctuations, the overall pattern indicates that deforestation pressure intensified after approximately 2010 in both provinces, with West New Britain remaining the dominant contributor to forest loss throughout the period.

	shapeName	year	loss_ha
1	East New Britain Province	2023	7263
2	West New Britain Province	2023	11896

The output of this table quantifies forest loss in 2023 and confirms the visual patterns shown in the figures. West New Britain lost 11,896 hectares of forest in 2023, compared to 7,263 hectares in East New Britain. This represents a difference of more than 4,600 hectares in a single year, underscoring the magnitude of disparity between the two provinces.

Taken together, the table and figures demonstrate that West New Britain not only exhibits higher long-term cumulative forest loss, but also continues to experience higher annual losses in recent years, suggesting that deforestation pressures remain ongoing rather than historical.



This figure is a maps forest loss in New Britain for the year 2023. The spatial pattern reinforces the temporal trends observed in Figure 1. West New Britain exhibits substantially higher forest loss than East New Britain, as indicated by the darker shading across the western portion of the island.

This spatial contrast highlights a clear east–west divide in deforestation intensity. While both provinces experienced forest loss in 2023, loss in West New Britain was more extensive, suggesting stronger or more concentrated land-use pressures in that province during the most recent year of analysis.

Overall, both temporal and spatial analyses indicate persistent and uneven deforestation across New Britain, with West New Britain consistently experiencing greater forest loss than East New Britain, particularly during periods of intensified deforestation activity.

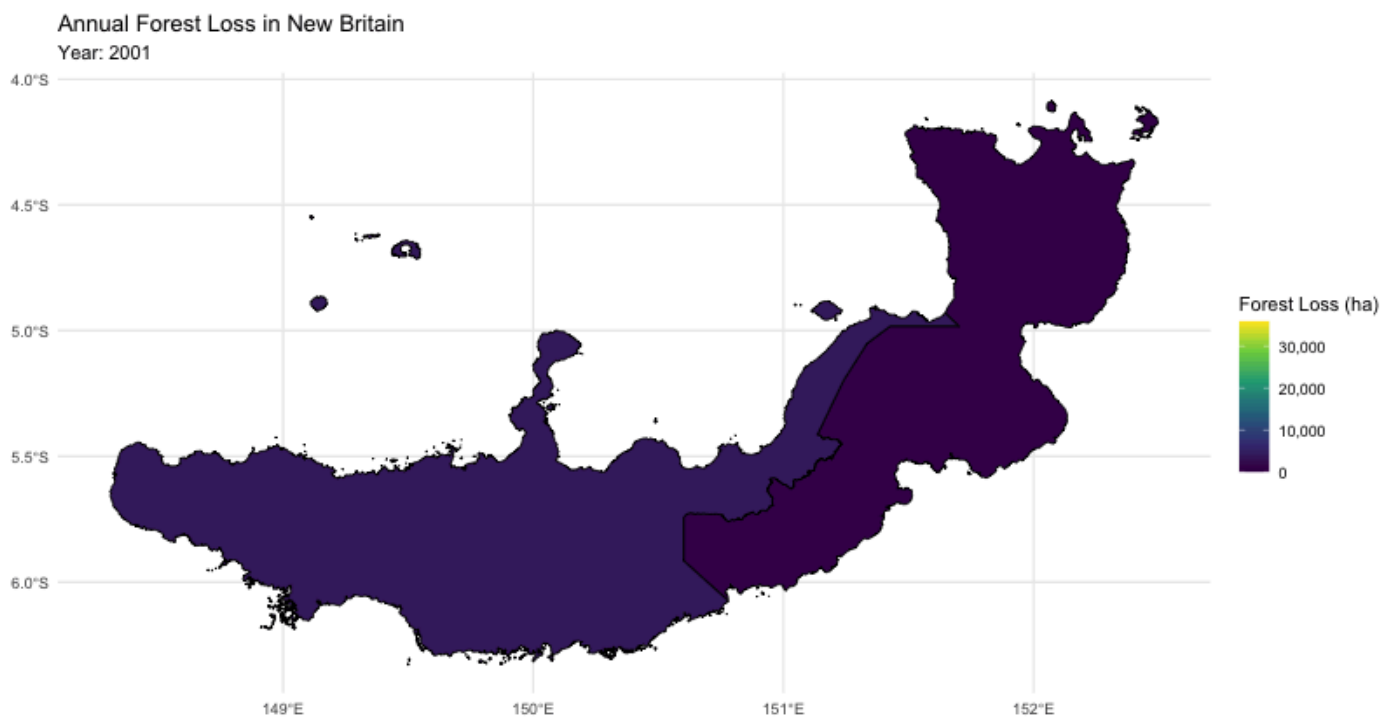
Get Province Forest Area

```
# A tibble: 2 × 2
  province forest_area_ha
  <chr>      <dbl>
1 East New Britain 1535341
2 West New Britain 2038523
```

Results

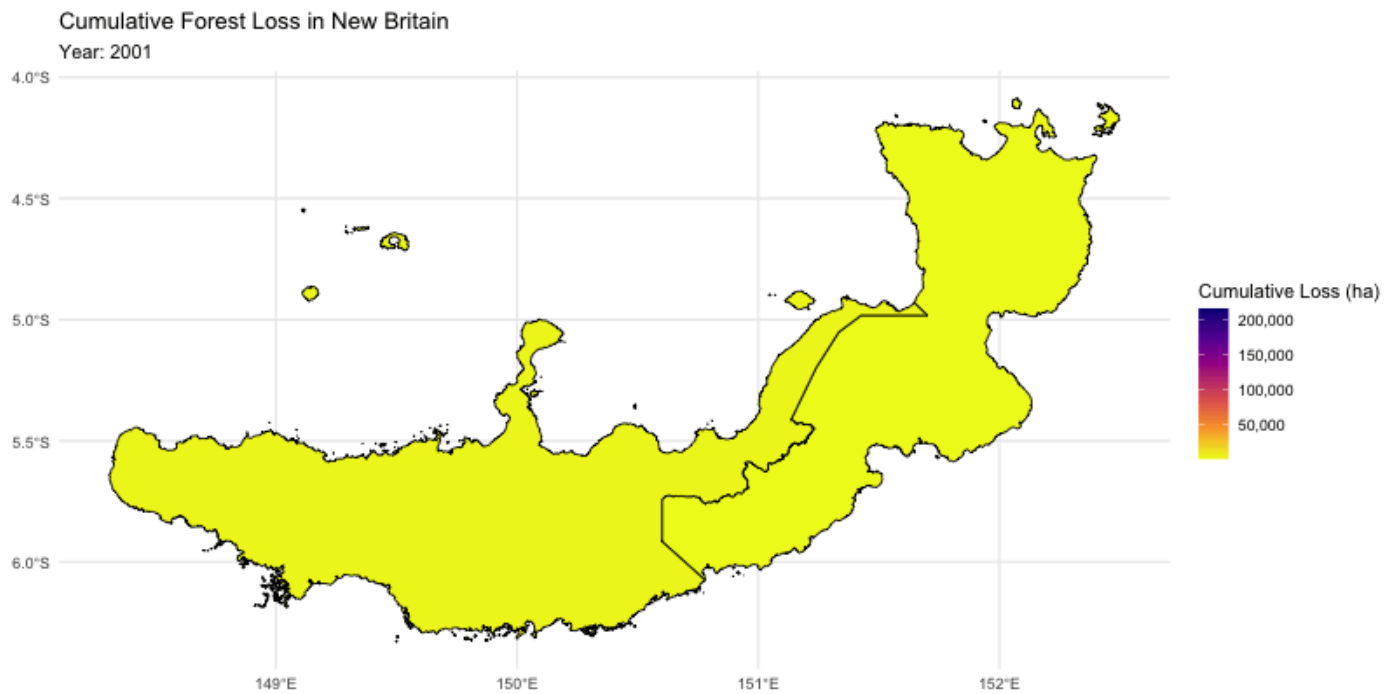
Annual Forest Loss

Annual forest loss varied substantially over time in both provinces. West New Britain consistently exhibited higher annual forest loss than East New Britain, with several years showing pronounced spikes. These patterns are visible in the animated map below, which shows annual forest loss in hectares from 2001 to 2023.



Cumulative Forest Loss

When forest loss is aggregated cumulatively, differences between the two provinces become more pronounced. West New Britain experienced substantially greater cumulative forest loss over the study period, reflecting sustained deforestation pressure over time. Cumulative forest loss provides a clearer picture of long-term environmental change than annual values alone.

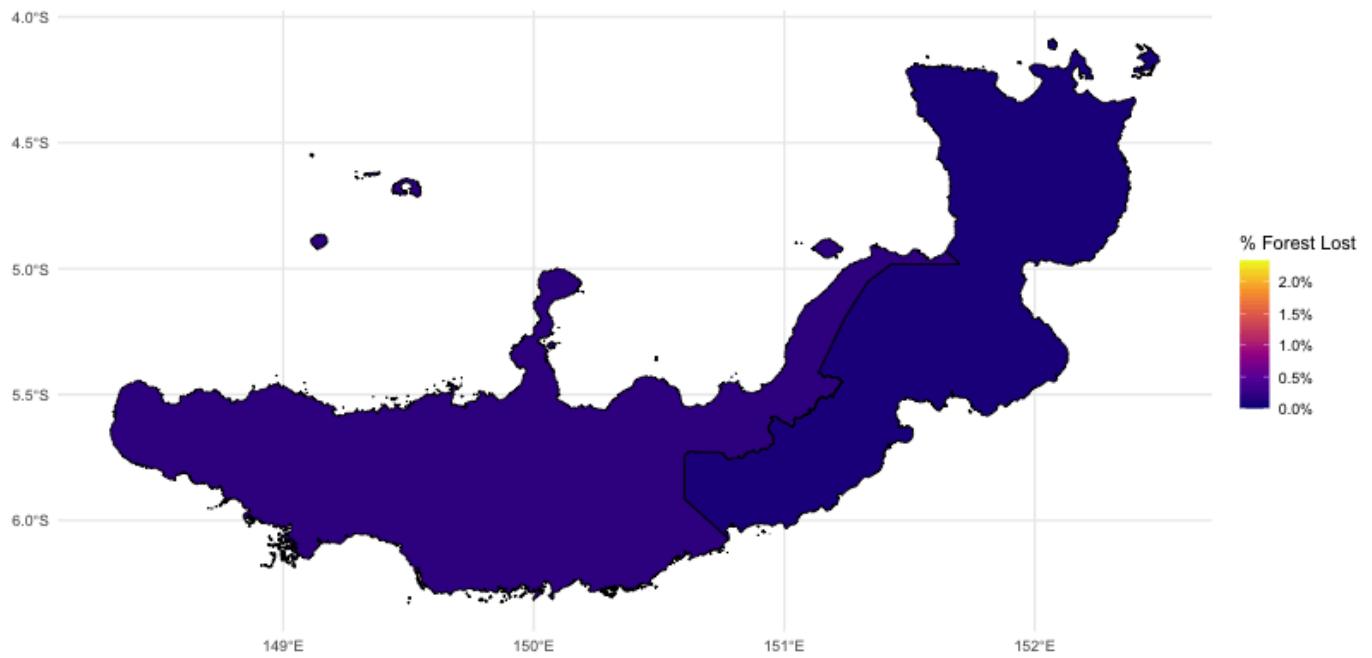


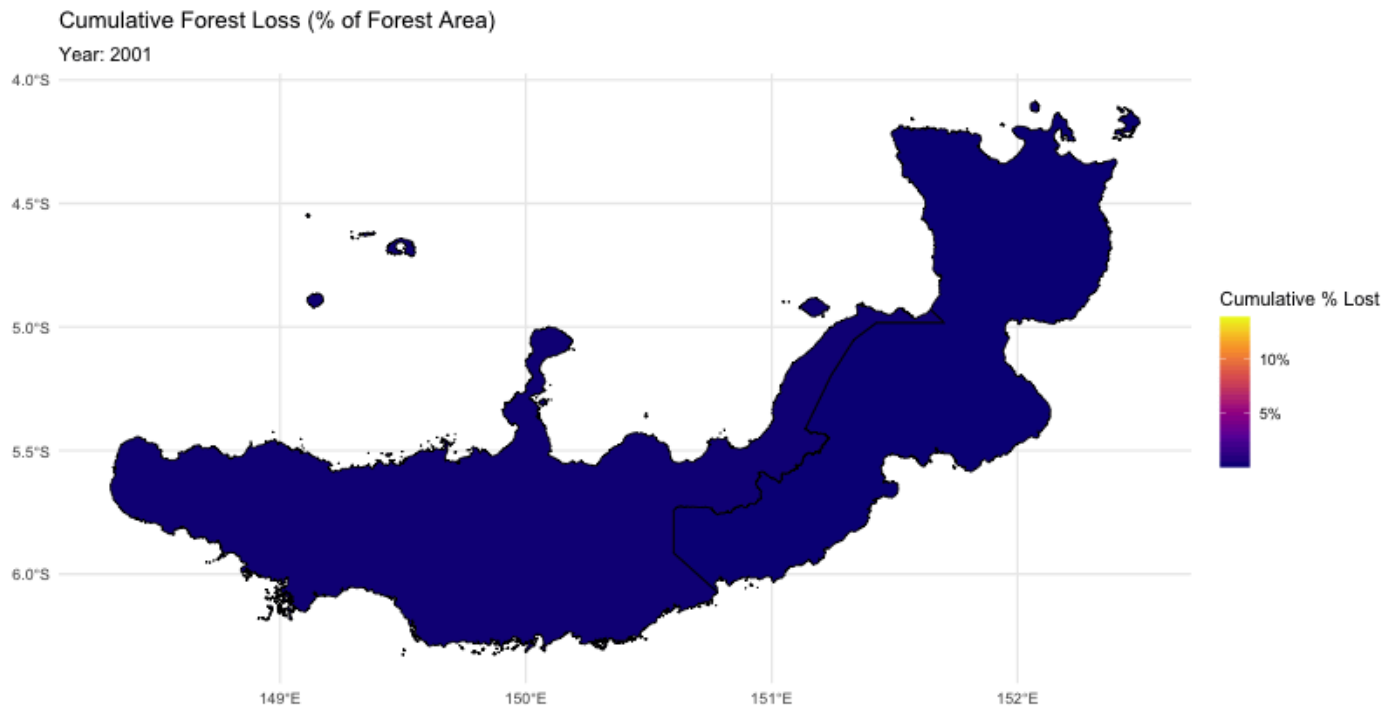
Normalized Forest Loss

To account for differences in province size, forest loss was also expressed as a percentage of baseline forest area. Normalized results confirm that West New Britain not only lost more forest in absolute terms, but also experienced higher rates of forest loss relative to its total forest area. This suggests structural differences in land use and development pressures between the two provinces.

Annual Forest Loss (% of Forest Area)

Year: 2001





Discussion

Results indicate substantial and persistent deforestation on New Britain between 2001 and 2023, with West New Britain experiencing consistently higher forest loss than East New Britain. These differences likely reflect variation in land-use practices, including the expansion of plantation agriculture and infrastructure development.

The use of both absolute and normalized metrics highlights the importance of considering scale when comparing regions. While annual forest loss fluctuates, cumulative and percentage-based measures reveal long-term trends that may be obscured in year-to-year analyses.

Several limitations should be noted. Forest loss estimates are derived from satellite data and may be subject to classification error. Additionally, this analysis does not distinguish among drivers of deforestation, which could be explored in future work.

Conclusion

This project demonstrates how R, Quarto, and Shiny can be used to analyze and communicate environmental change using spatial and temporal data. By focusing on New Britain, the analysis highlights meaningful sub

national variation in deforestation patterns and illustrates the value of interactive visualization for exploring complex environmental data sets.

Future extensions could incorporate land cover transitions, population data, or economic indicators to further investigate the drivers and consequences of deforestation on the island.

References

Global Forest Watch. (2024). Tree cover loss data. <https://www.globalforestwatch.org/>

Humanitarian Data Exchange (HDX). Papua New Guinea administrative boundaries.

<https://data.humdata.org/dataset/cod-ab-png>