Forestry Department

Protecting our Forests; Sustaining Lives

STATE OF JAMAICA'S FORESTS, 2024

Land Use/Land Change Assessment (LULCA) Stakeholder Validation Meeting

Wednesday, June 26, 2024

Outline

- Context
- Methodology
- Findings

The **Who**, **What** and **Why** of Data Products?

Presented by: Mr. Jumaine Remikie
Senior Director, Forest Resources Information Management (FRIM)

Forestry Department's Mandate

- The functions of the Department are mandated under the **Forest Act, 1996**.
- To manage forests on a sustainable basis to maintain and increase the environmental services and economic benefits they provide.

To fulfill the Agency's mandate, Land Use and Land Cover assessments must be conducted every 10 years for the purposes of:

Environmental monitoring

Policy making and governance

Sustainable development

Background

As development and environmental protection are often in conflict, Jamaica constantly seeks to find a balance.

Access to timely and accurate data on forest cover and changes, especially at the national level is of utmost importance

With each decade, access to better quality data, processing software and other technologies allows for improved insight of land use changes.

As of 2024, 60% of Jamaicans live in urban and peri-urban areas, hence the constant need for more green space.

1998 Land Use/Cover Assessment

- Done by the “Trees for tomorrow” Project: A Canadian International Development Agency (CIDA) and Forestry Department
- Average annual deforestation rate of 0.1% between 1989 and 1998
- Bauxite mining was a major contributor to deforestation
- Forested lands recorded at 343,935 ha

2013 Land Use/Cover Assessment

- Done by the Forestry Department
- Average annual growth rate at 0.4% between 1998 and 2013
- Forest growth evidenced by the development and expansion of secondary forests
- Forested lands recorded at 431,612 ha
- Secondary forest & Bauxite category added

2023 Land Use/Cover Assessment

- Completed in one (1) year
- Done by the Forestry Department, supported by UWI and UTECH interns
- Featured empirical testing of the dataset for reliability and accuracy
- Included Urban Tree Cover as a new Land Cover Classification.

Benefits

- Environmental Monitoring and Management
  - Habitat Protection
  - Climate Change Mitigation
- Conservation Efforts
  - Protected Areas Management
  - Wildlife Corridors
- Economic Analysis
  - Valuation of Ecosystem Services
  - Land Value Assessment

Benefits

- **Policy and Decision Making**
  - Informed Policy Making
  - Resource Allocation
- **Scientific Research**
  - Data for Modeling
  - Baseline for Studies
- **Urban Planning and Development**
  - Sustainable Development
  - Infrastructure Planning
  - Disaster Risk Reduction

Methodology

Presented by:

Thomas Donaldson

GIS Analyst

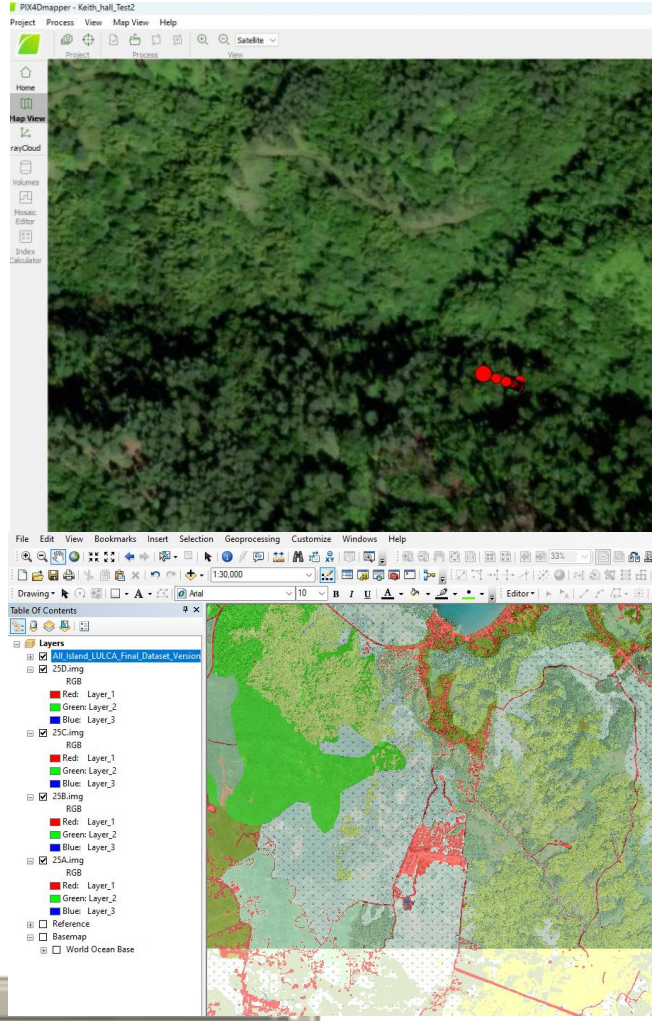
Methodology

The methodology employed 3 key activities:

- Use of Advanced remote sensing technologies
- Geographic Information Systems (GIS)
- Field surveys

Methodology- Software

- Erdas Imagine
- Pix4Dmapper
- ArcGIS suite of products with Feature Analyst extension



Methodology

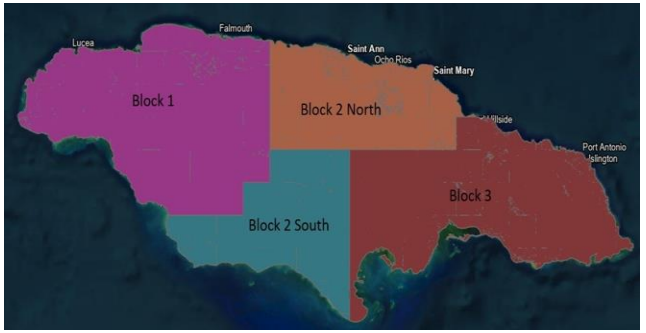
The island was split into 4 blocks.

Each Block was then subdivided by 10x10km sub-blocks.

Output of supervised classifications were thoroughly examined and edited using ArcMap's editing toolset from the ArcGIS Suite

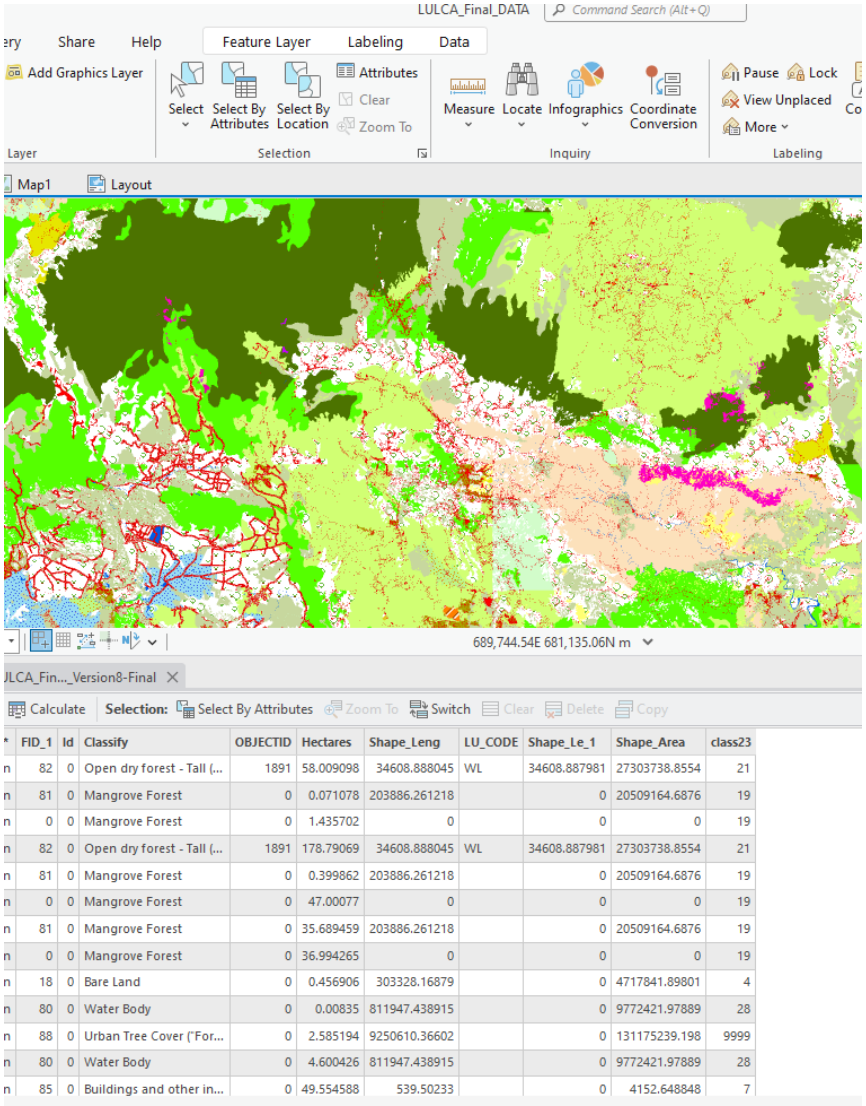
Continuous Quality Assurance &

Quality Control identified inconsistencies or irregularities, which were rectified.



Quality Assurance (QA)

- **Planning and Protocols:**
  - Clear Objectives, Standardized Methods and Documentation
- **Training and Expertise:**
  - Training and Expert review
- **Data Quality:**
  - Data Sources and Data Validation



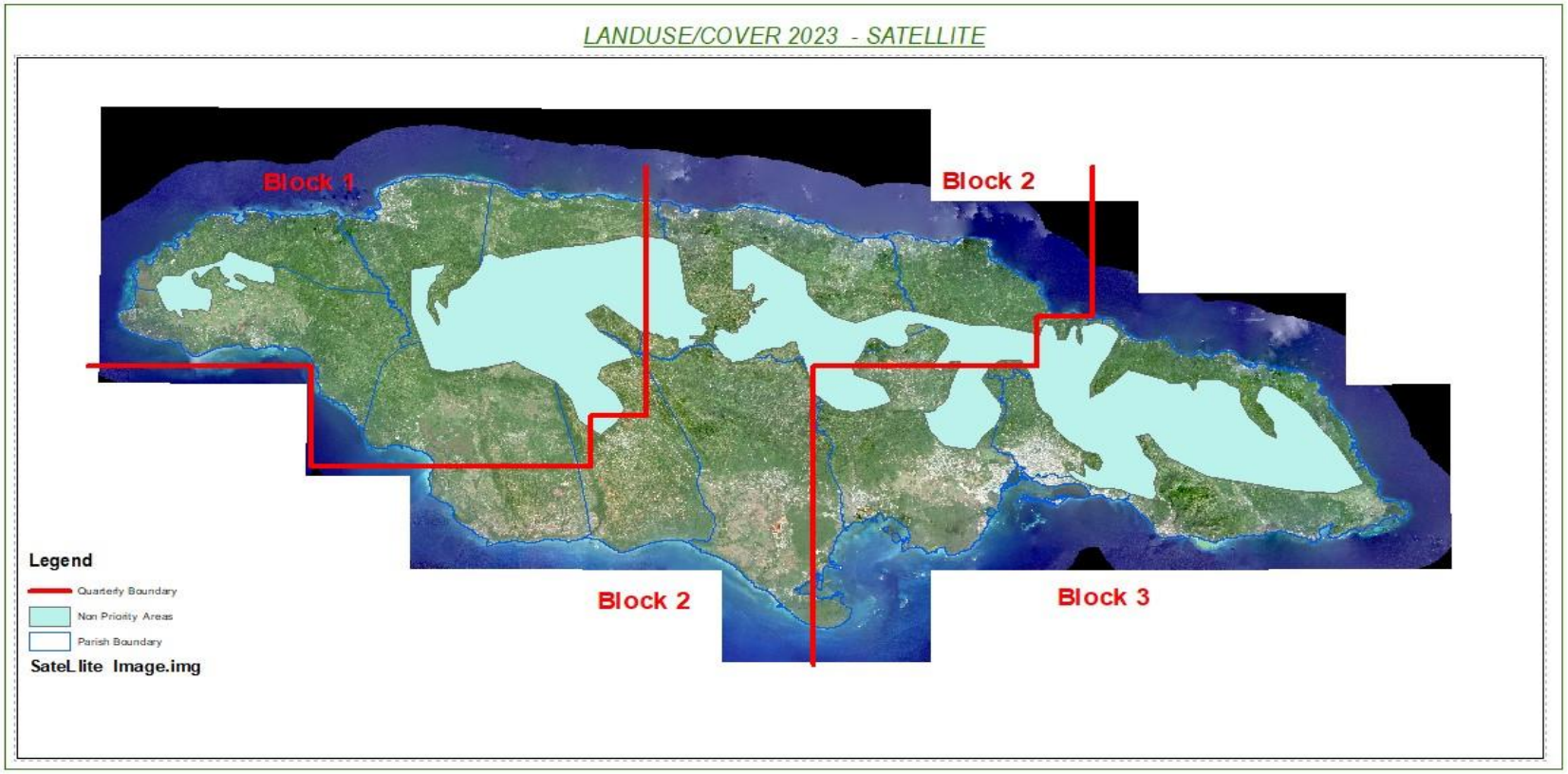
FID_1	Id	Classify	OBJECTID	Hectares	Shape_Leng	LU_CODE	Shape_Le_1	Shape_Area	class23
82	0	Open dry forest - Tall (...	1891	58.009098	34608.888045	WL	34608.887981	27303738.8554	21
81	0	Mangrove Forest	0	0.071078	203886.261218		0	20509164.6876	19
0	0	Mangrove Forest	0	1.435702	0		0	0	19
82	0	Open dry forest - Tall (...	1891	178.79069	34608.888045	WL	34608.887981	27303738.8554	21
81	0	Mangrove Forest	0	0.399862	203886.261218		0	20509164.6876	19
0	0	Mangrove Forest	0	47.00077	0		0	0	19
81	0	Mangrove Forest	0	35.689459	203886.261218		0	20509164.6876	19
0	0	Mangrove Forest	0	36.994265	0		0	0	19
18	0	Bare Land	0	0.456906	303328.16879		0	4717841.89801	4
80	0	Water Body	0	0.00835	811947.438915		0	9772421.97889	28
88	0	Urban Tree Cover ("For...	0	2.585194	9250610.36602		0	131175239.198	9999
80	0	Water Body	0	4.600426	811947.438915		0	9772421.97889	28
85	0	Buildings and other in...	0	49.554588	539.50233		0	4152.648848	7

Quality Control (QC)

- **Data Collection:**
  - Accuracy Checks and Error Identification
- **Data Processing:**
  - Classification Accuracy, Repeatability and Consistency Checks
- **Output Verification:**
  - Ground Truthing and Accuracy Assessment

Remote Sensing Data - Aerial Images

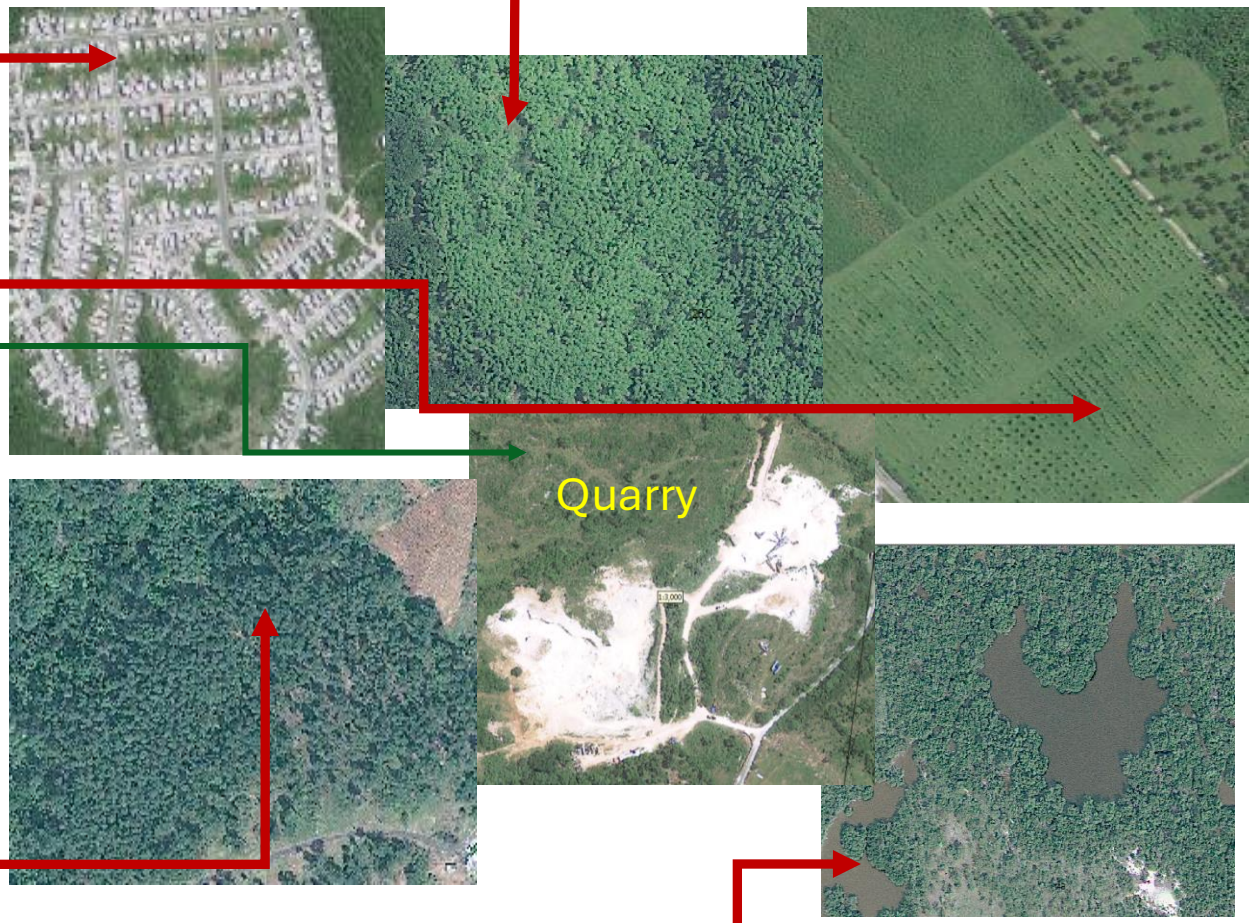
- <5% cloud free
- Pilot Area - 12cm
- Satellite imagery - 50cm
- NICFI - 5 meter



2019-2021

Signature Identification

Non Forest land use/cover
Bauxite Extraction
Bamboo
Bare Rock
Buildings and other infrastructures
Bare Land
Herbaceous crops, fallow, cultivated vegetables
Pasture and grassland
Herbaceous Wetland
Agriculture Plantation: Tree crops, shrub crops, sugar cane, banana
Quarry
Water Body
Urban Tree Cover ("Forest")
Mixed Landuse/cover (first class> 50%, second class> 25%)
Secondary Forest and Fields
Bamboo and Fields
Fields and Bamboo
Fields and Secondary Forest
Forest Landuse /Cover >75%)
Mangrove Forest
Closed broadleaf forest
Disturbed broadleaf forest
Secondary Forest
Swamp Forest
Open dry forest - Short
Open dry forest - Tall (Woodland/Savanna)
Hardwood Plantation
Pine Plantation



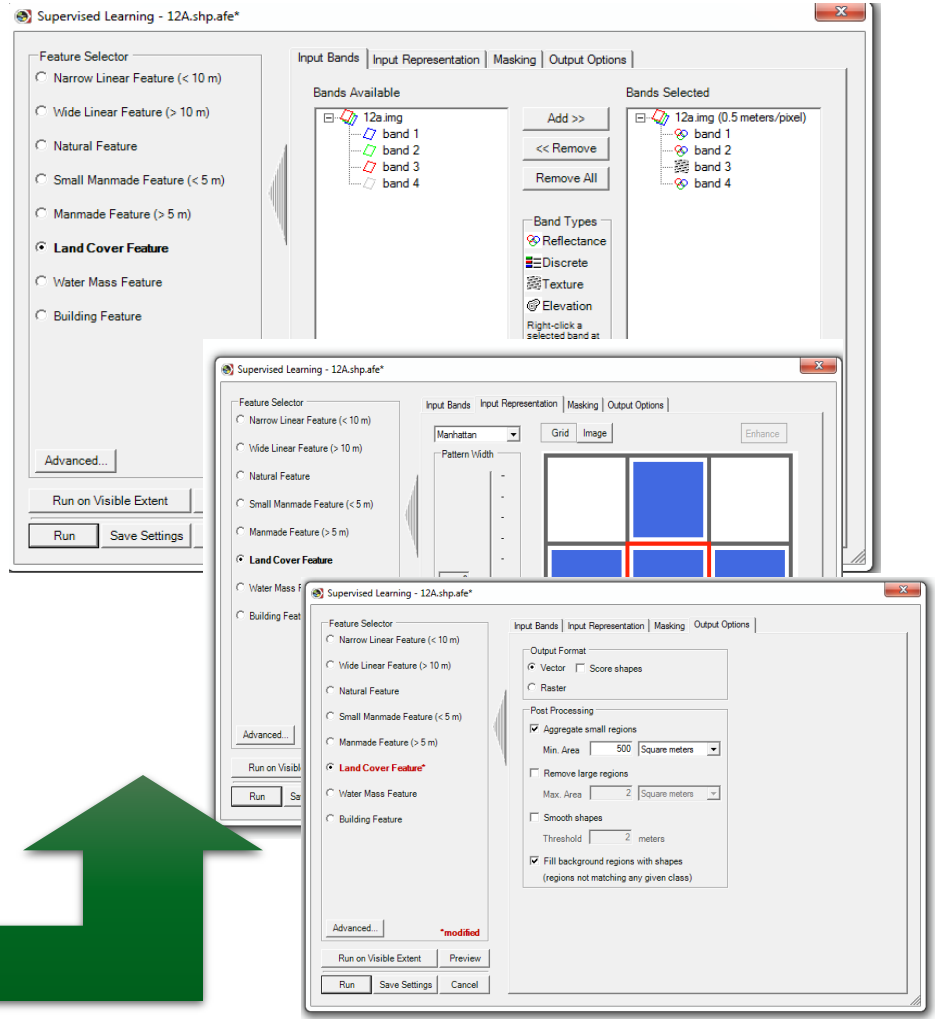
28 Land use/cover classifications

Supervised Classification- Feature Analyst

Create Training sets using existing data

Combine training data sets into a single shapefile for each land use/cover class

Set up learning parameters and run the extraction



Feature selector- Land Cover Features Bands- RGB combined for reflectance and texture

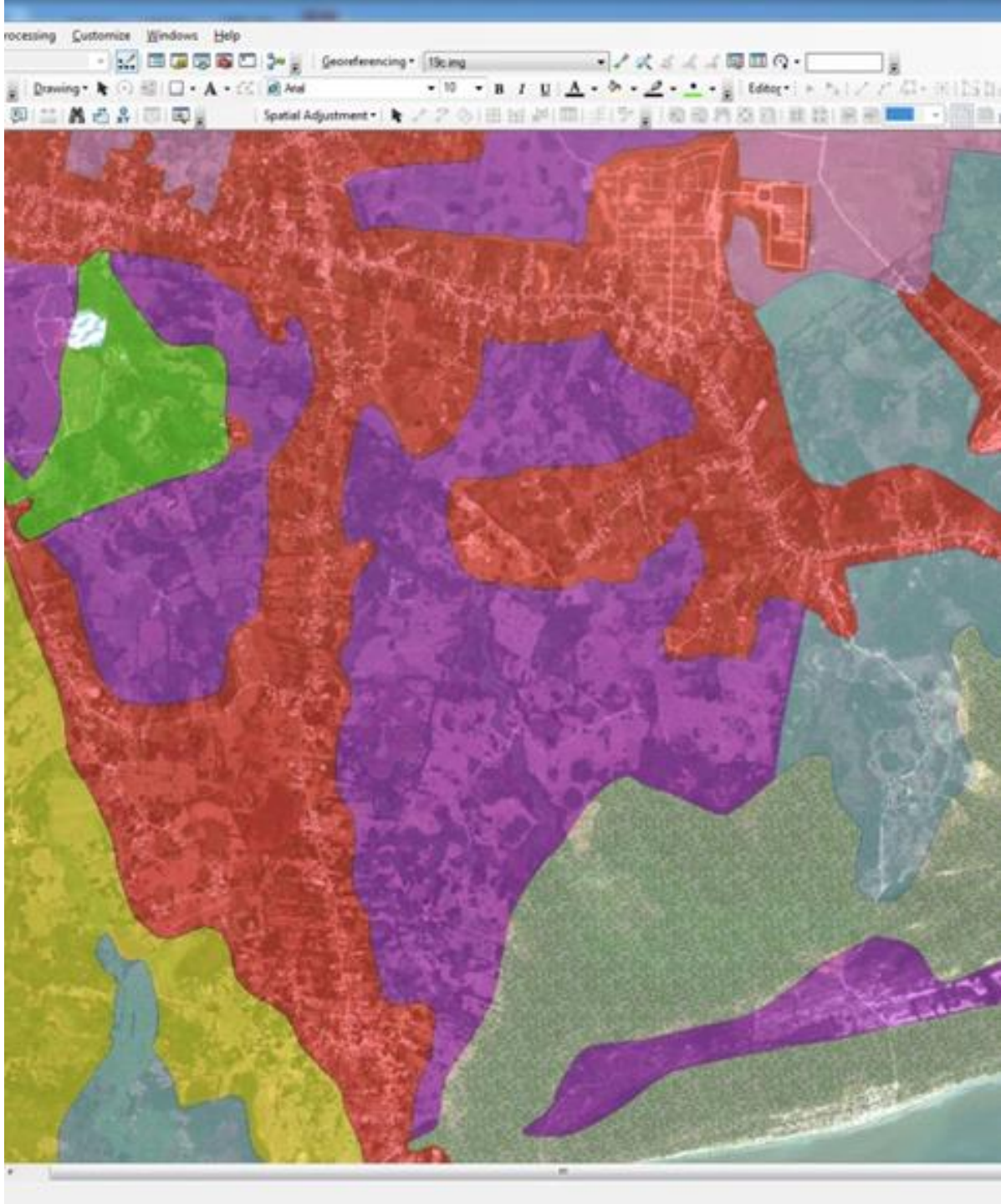
Image resolution- 2 Input Representation – Manhattan Aggregate area - >500 sqkm

Supervised Classification

- The Results from the classification algorithm
- Next Step is Digitizing / Editing and Labelling Process

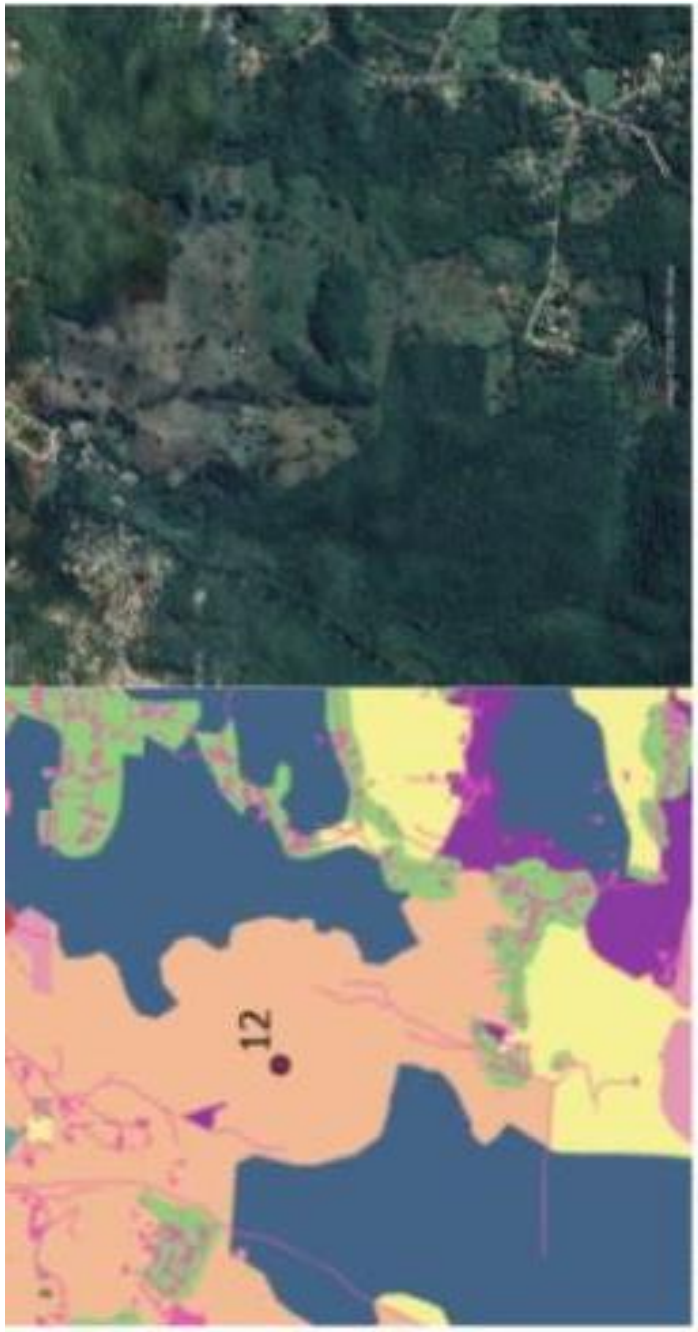
Supervised Classification

- Example of the of Land use/ cover at the Final Editing stage



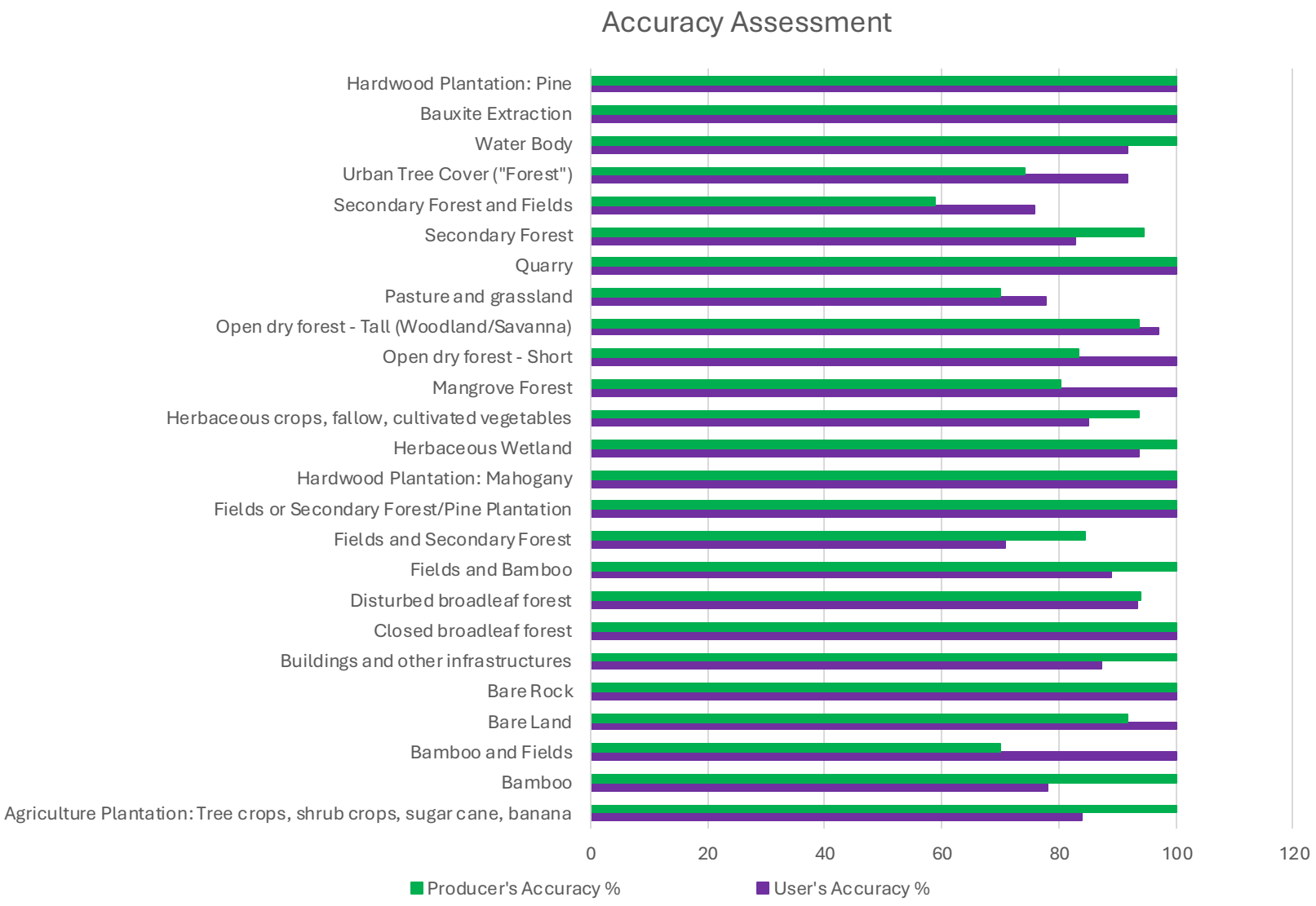
Accuracy and Validation

- Three tiers of verification/validation throughout the entire classification process to guarantee precision, comprehensiveness, uniformity, and data integrity.
  - Verification and editing of classifications.
  - Continuous QA/QC procedure.
  - Accuracy Assessment (Confusion Matrix and Kappa Coefficient).



Confusion Matrix

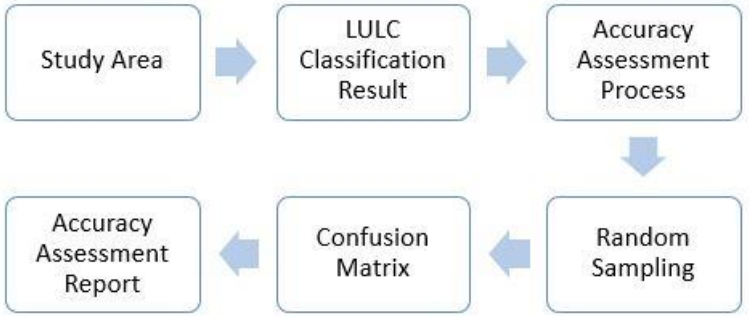
- The assessment encompassed overall accuracy, user accuracy, and producer accuracy.
- 396 sample points were used across 26 classes
- Sample points assessed through field verification and satellite imagery

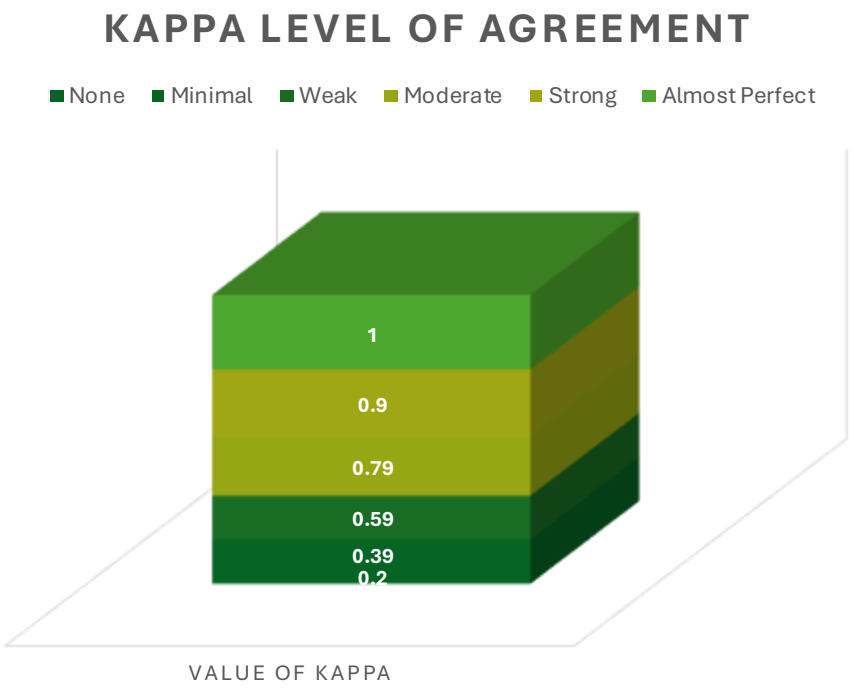

Accuracy Assessment
Hardwood Plantation: Pine
Bauxite Extraction
Water Body
Urban Tree Cover ("Forest")
Secondary Forest and Fields
Secondary Forest
Quarry
Pasture and grassland
Open dry forest - Tall (Woodland/Savanna)
Open dry forest - Short
Mangrove Forest
Herbaceous crops, fallow, cultivated vegetables
Herbaceous Wetland
Hardwood Plantation: Mahogany
Fields or Secondary Forest/Pine Plantation
Fields and Secondary Forest
Fields and Bamboo
Disturbed broadleaf forest
Closed broadleaf forest
Buildings and other infrastructures
Bare Rock
Bare Land
Bamboo and Fields
Bamboo
Agriculture Plantation: Tree crops, shrub crops, sugar cane, banana
0
20
40
60
80
100
120
Producer's Accuracy %
User's Accuracy %

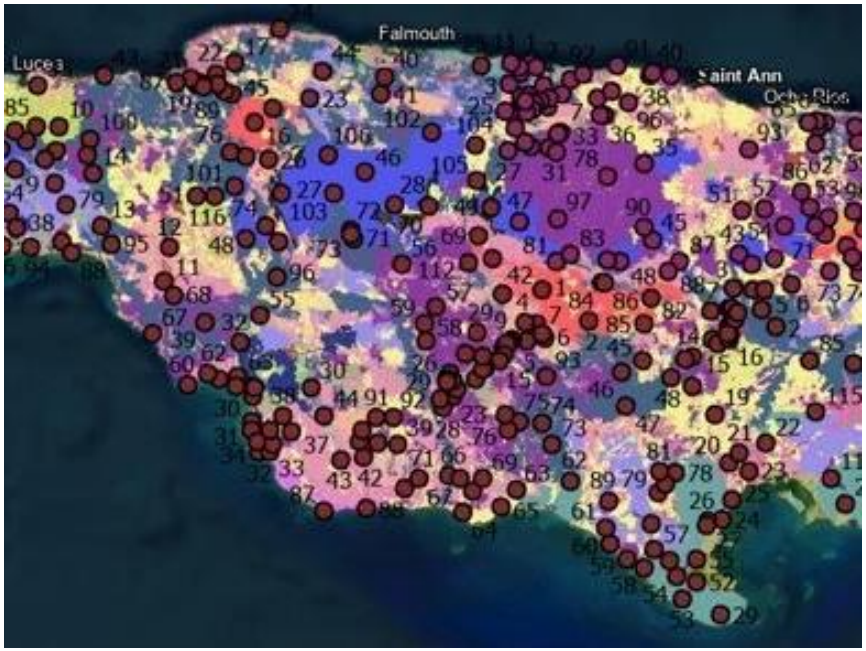
Accuracy Assessment

Kappa Coefficient

- 0.87(87%)
  - Block 1 87%
  - Block 2 North 88%
  - Block 2 South 92%
  - Block 3 88%



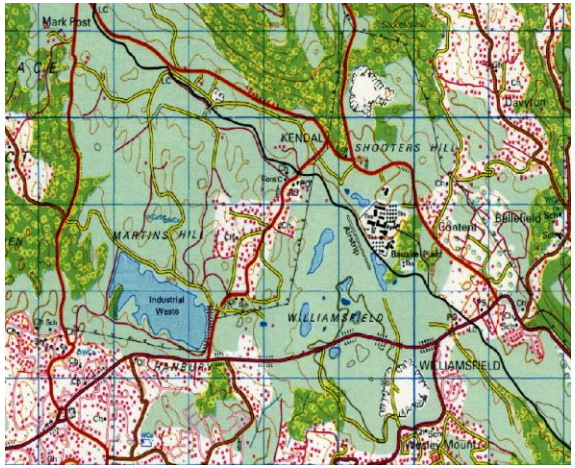




Limitations

- **Data Availability and Quality:**

- **Limited Historical Data**
  - scarce
  - incomplete
  - inconsistent



Data Resolution:

Limitations

Inconsistent Data Sources: Combining data from different sources

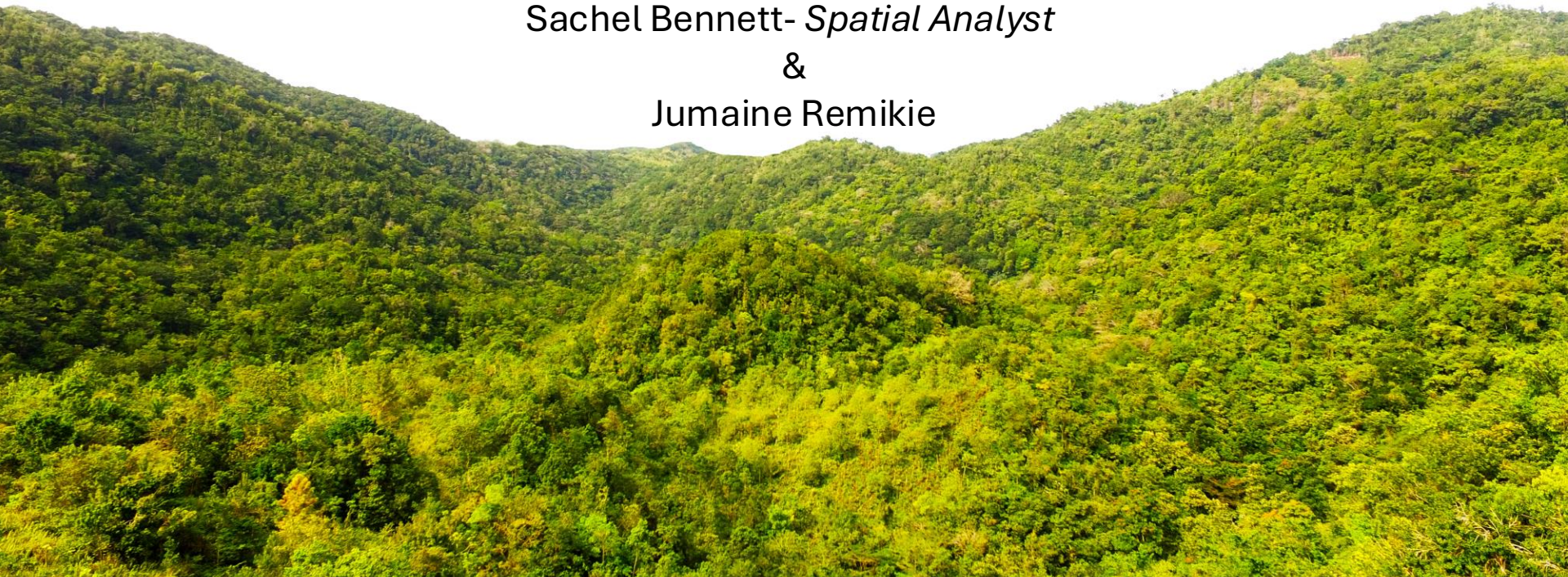


- **Costs and Resources**:
- **High Costs**: Acquiring high-resolution satellite imagery, advanced software, and skilled personnel can be expensive.
- **Resource Intensive**: Conducting comprehensive LULC analysis requires significant time, computing power, and human resources.

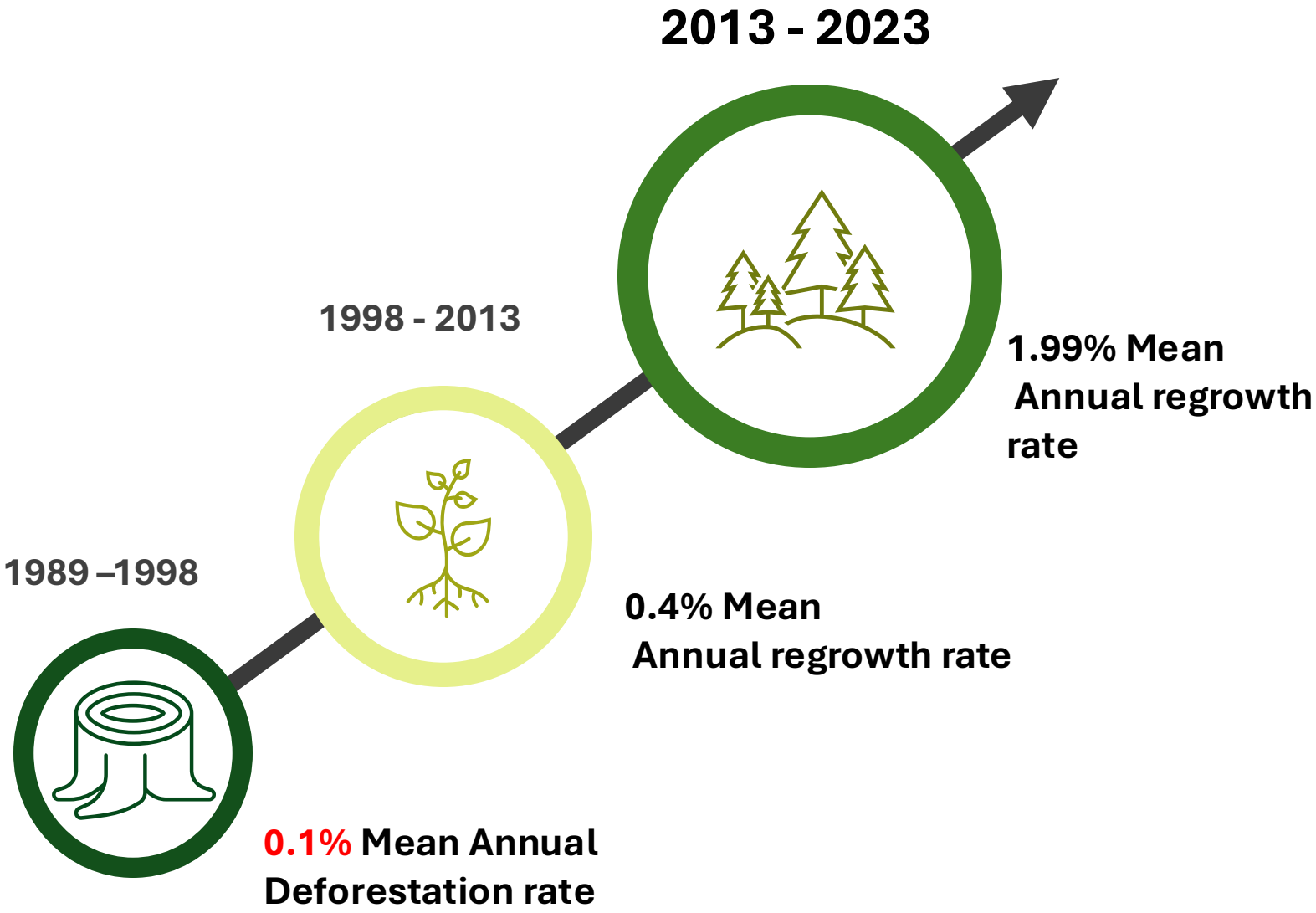
Findings

How much forest have we lost or gained?

Presented by:
Sachel Bennett- *Spatial Analyst*
&
Jumaine Remikie



Land use Trends over 34 Years



Forest Cover

1. Jamaica's forest cover has increased by 7.9% (from **439,929.63** hectares to **527,394.51** hectares)

2. 47.9% of Jamaica is covered in Forest.

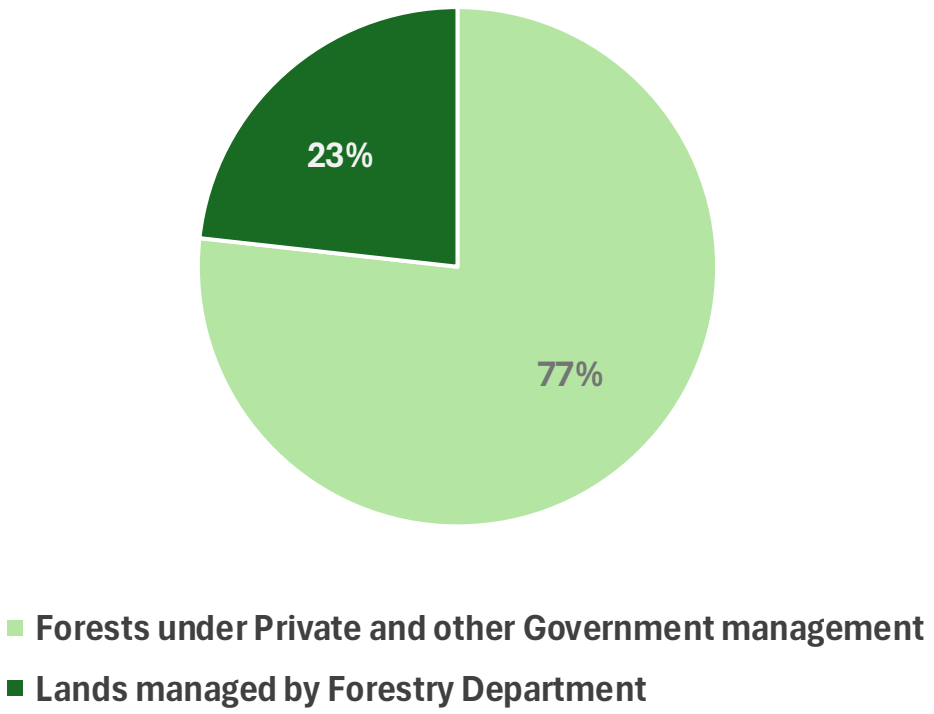
3. Secondary Forest is the largest forest class

4. Trelawny, Portland, and St. Ann accounts for 72% of closed broadleaf forest.

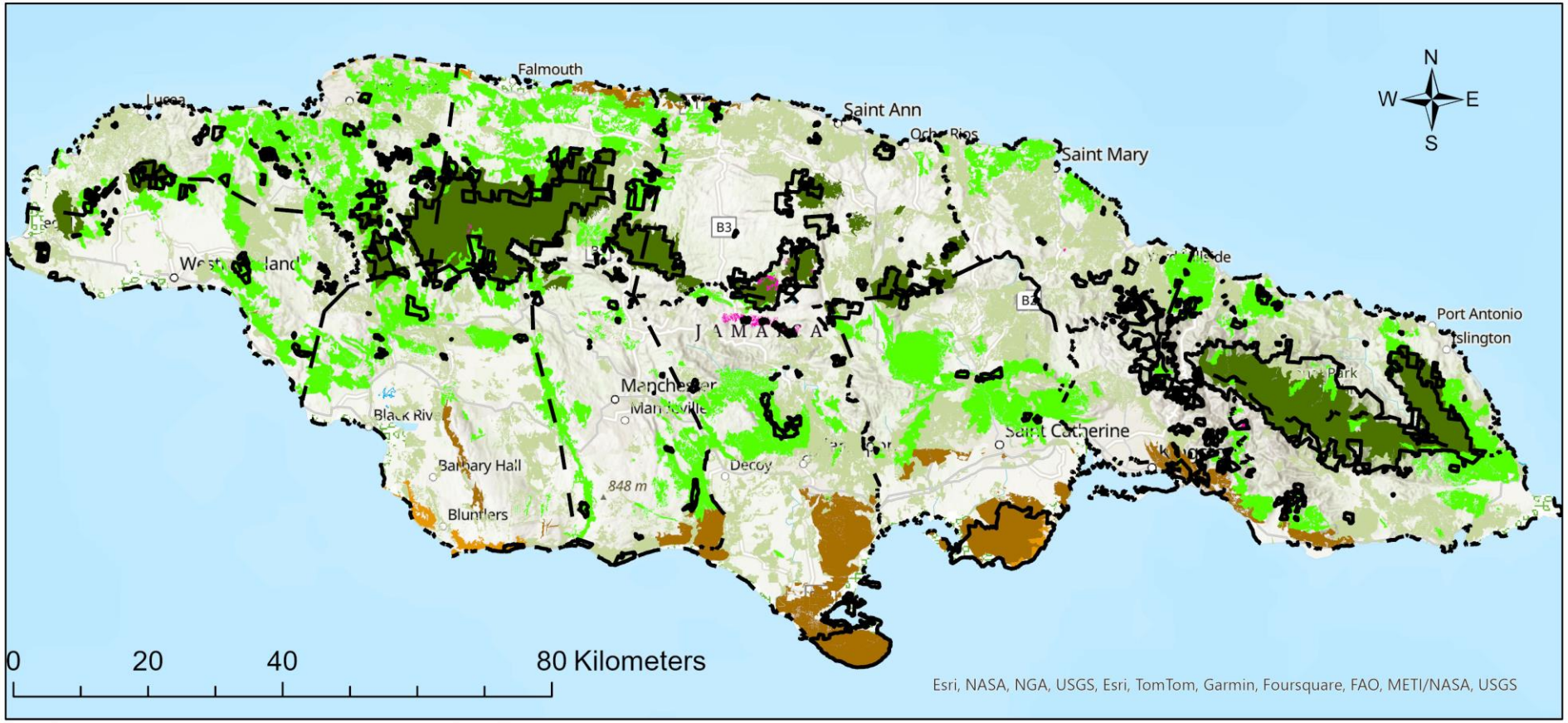
5. Trelawny has the most hectares of forest cover of all parishes.

Forest Cover

- The lands managed by the Forestry Department spans 122,573.60 ha and account for 23% of the island's forest cover.
- 72% (64,182.58 ha) of all closed broadleaf forests are managed by the Forestry Department
- Forest cover managed by FD observed 1% increase over the past 10 years



Jamaica Forest Areas



Forestry Boundaries

Parishes

Forested Areas

- Closed broadleaf forest
- Disturbed broadleaf forest
- Hardwood Plantation: Eucalyptus
- Hardwood Plantation: Mahoe
- Hardwood Plantation: Mahogany
- Hardwood Plantation: Mixed
- Hardwood Plantation: Pine
- Mangrove Forest
- Open dry forest - Short
- Open dry forest - Tall (Woodland/Savanna)
- Secondary Forest
- Swamp Forest

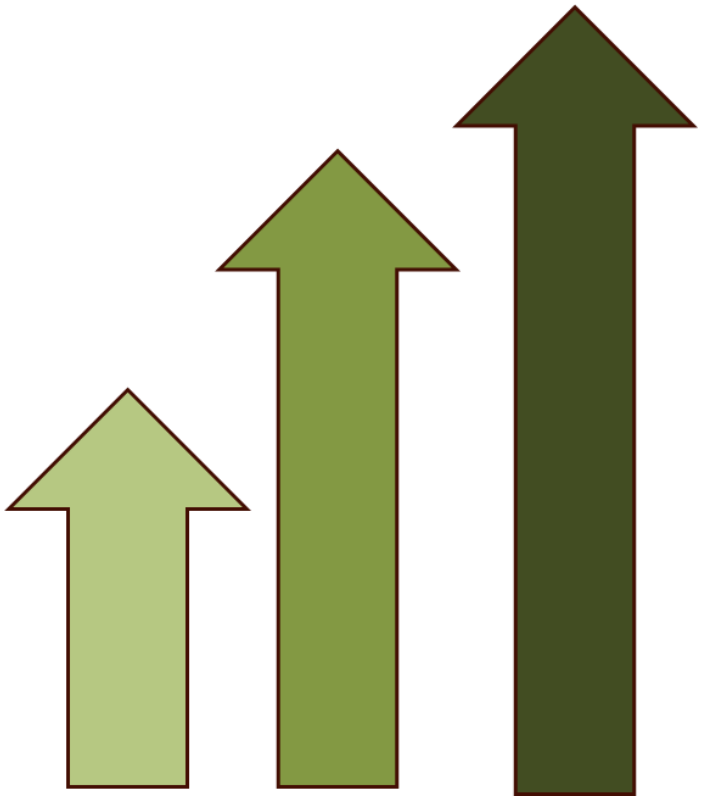
Projected Coordinate System: JAD 2001
Geographic Coordinate System: JAD 2001
Datum: D Jamaica 2001
Prime Meridian: Greenwich
Angular Unit: Degree

Prepared By:
GIS Operator: The GIS Unit
Forest Resource Information Management Branch
Forest Science & Technology Services Division
The Forestry Department
Date: Monday, June 24, 2024

Change in Forest Cover 2013-2023: Forest Gain

7.9% more land is covered by Forests

- Closed Broadleaf Forest now covers 5.4% more of Jamaica's land.
- The coverage of secondary forests on the island has increased from 11% to 18%.
- The coverage of Open Dry Forests has marginally increased (0.5%)
- Mangrove Forests have increased by 0.5%

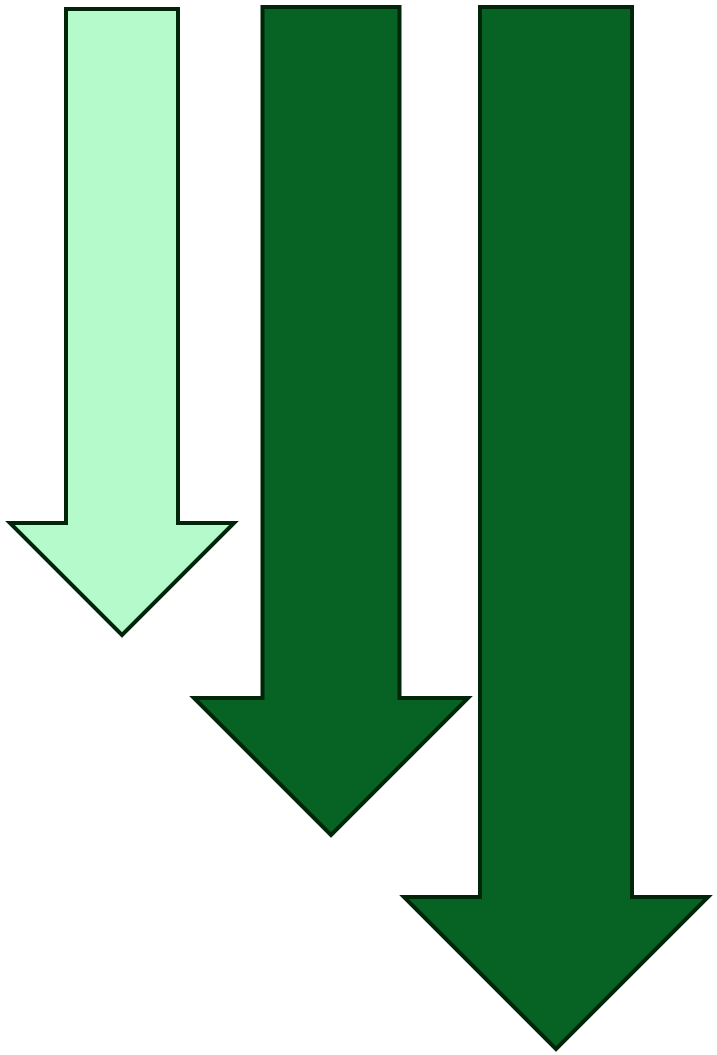


Change in Forest Cover 2013-2023: Forest Loss

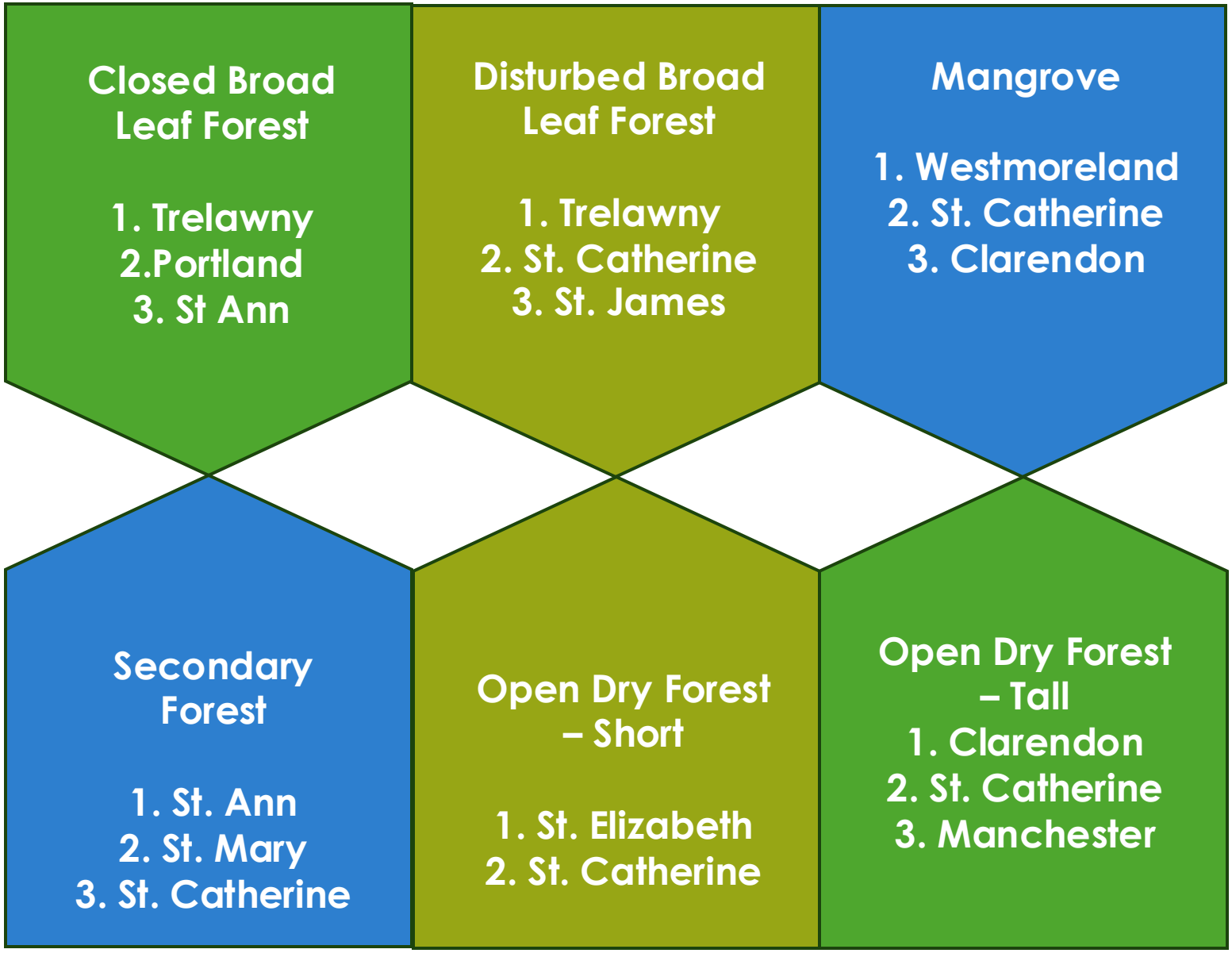
- 422.2 hectares of disturbed broadleaf forest converted to Secondary Forest.

- 2,413.21 hectares of secondary forest has transition to buildings and other infrastructure.

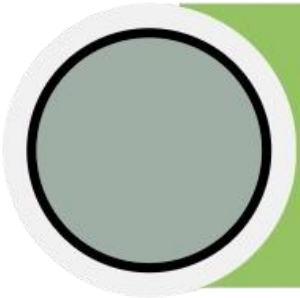
- 3,922.29 hectares of secondary forest has converted for peasant farming.



Forest Cover: Parish Winners



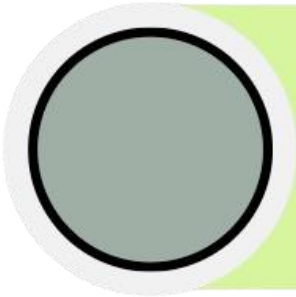
Forest Cover Change 2013-2023
Parish Overview



St. Ann's Shift

3300 ha of forest transitioned from Disturbed to Closed Broadleaf Forest

Since 2013, eleven out of fourteen parishes have observed a net increase in forest cover.

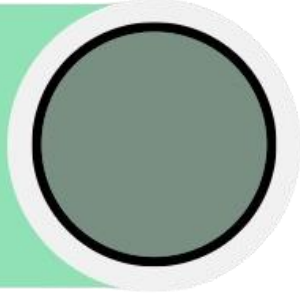


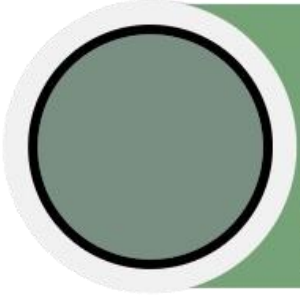
St. Elizabeth's Gain

Largest gain (1509 ha) in Mangrove forest

St. Mary's Growth

Secondary Forest expanded by 18,652 ha.



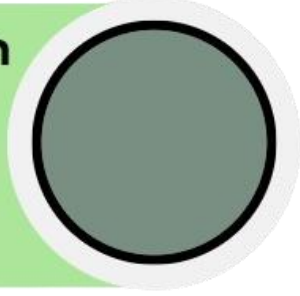


Clarendon's Shift

256 ha of Mangrove transitioned to Herbaceous Wetland

Clarendon's expansion

Clarendon expanded by 4,799 ha in Open Dry Forest

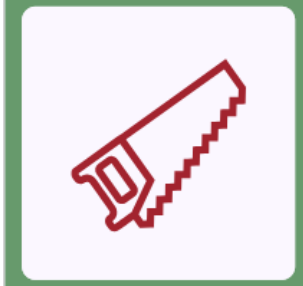


Change in Forest Cover 2013-2023:

Forest gain vs Deforestation

St. Elizabeth, Hanover, and St. Mary show the highest forest recovery rates. St. Ann's deforestation rate dropped 11%.

Portland and St. Andrew have the highest deforestation rates at 4.66% and 5.06%, respectively. In 2013, regrowth rates were 6.23% and 14.76%, respectively.



Notably, most of Portland's deforestation is taking place in its Disturbed Broadleaf Forest.

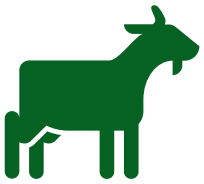
National Land Cover/ Land Use Breakdown

Forest Cover 47.9%

Mixed Land Use 23.1%

Non-Forest 29%

Non-Forest Land use/Cover



Agriculture

17% of land in Jamaica

Buildings and other infrastructure

5.8% of land in Jamaica

Urban Tree Cover 'Forest'

1.8% of land in Jamaica

Bamboo

2.2% of land in Jamaica

Land Use Changes in 'Non-Forest' Category

'Agriculture Plantation,' **declined by 11.5%.**

Peasant Farming shows the biggest reduction of **25%.**

33.8% increase in building and other infrastructures from **48,170.88 ha** to **64,461.47 ha.**

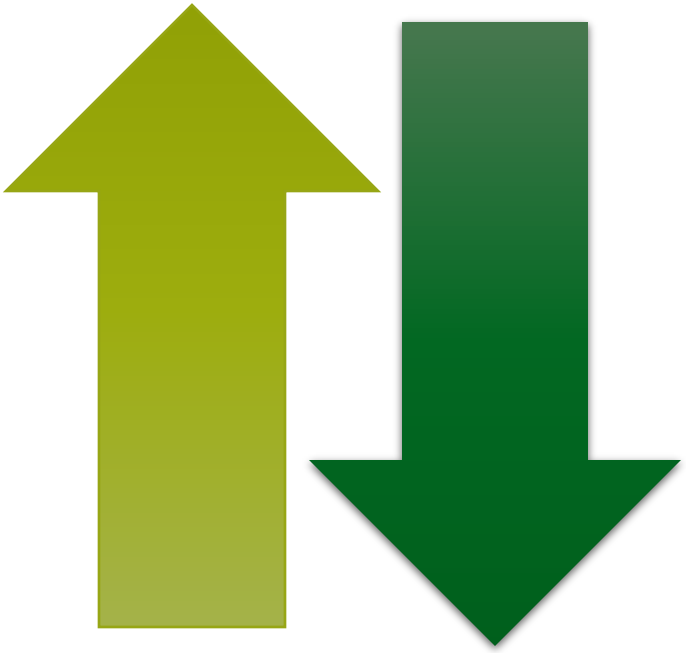
Land use changes in Non-Forest Category Parish Overview

Bauxite:
Clarendon

Peasant Farming:
St. Mary

Agriculture Plantation:
St. Catherine

Buildings and other infrastructure is increasing at an annual rate of **1629 ha** between 2013-2023.



Bauxite:
Manchester, St. Ann, St. Elizabeth

Peasant Farming:
St. Elizabeth and Westmoreland

Agriculture Plantation:
Clarendon and Trelawny

Non-Forest Cover: Urban Tree Cover

11 Parishes met and exceeded the 30% tree cover in Local Planning Areas (LPA)

Manchester, St. Thomas and Westmoreland did not meet the 30% baseline

Tree coverage differs depending on the population density of regions within the Local Planning area.

Urban Tree Cover: **Kingston Metropolitan Area**

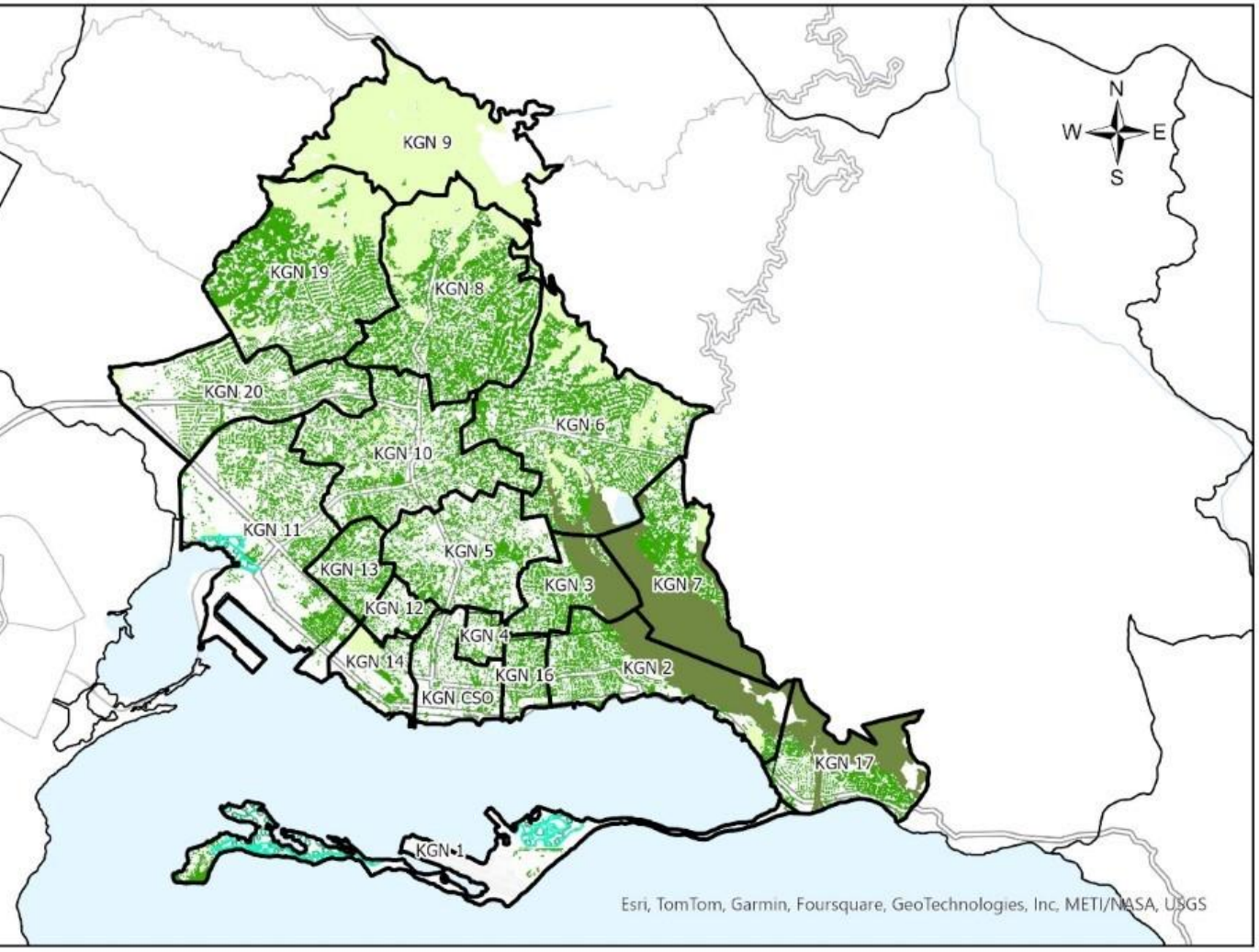
Tree coverage in KMA is 35%

This coverage rivals international green cities.

These densely forested areas are Plantation Heights, Stony Hill, Jacks Hill and Parts of Port Royal Mountain

Tree coverage in built up areas did not meet the recommended 30% coverage.

on Metropolitan Area (KMA): Urban Tree and Forest Cover



Legend

- Parish Boundary

Class

- Disturbed broadleaf forest
- Mangrove Forest
- Open dry forest - Tall (Woodland/Savanna)
- Secondary Forest
- Urban Tree Cover ("Forest")
- KMA

0 2.75 5.5 11 km

1:135,000

Projected Coordinate System: JAD 2001
Geographic Coordinate System: JAD 2001
Datum: D Jamaica 2001
Prime Meridian: Greenwich
Angular Unit: Degree

Prepared By:
GIS Operator: sbennett@forestry.gov.jm
The GIS Unit
Forest Resource Information Management Branch
Forest Science & Technology Services Division
The Forestry Department
Date: Saturday, June 1, 2024

Change and distribution of Bamboo across the island

Growth

Average annual growth of 2,208.51 ha in 10 years.

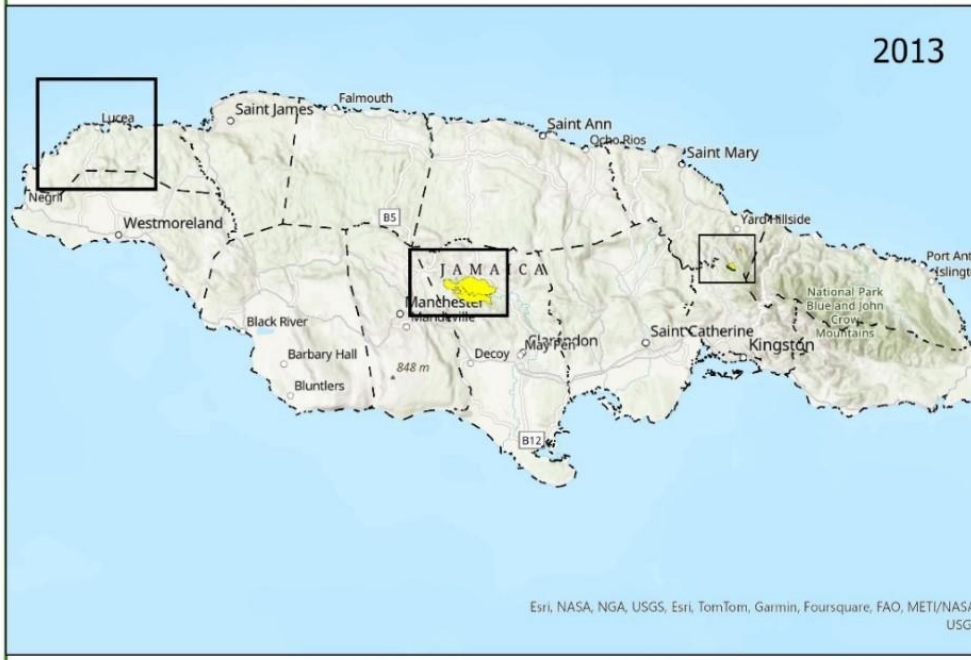
Dominance

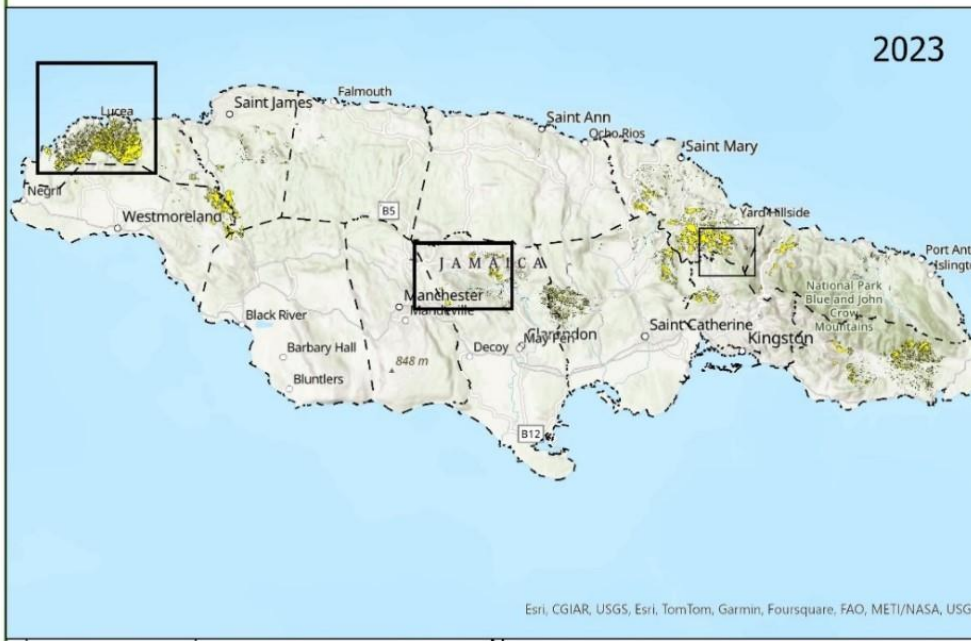
Hanover takes over from Clarendon with the highest concentration of Bamboo

Speed

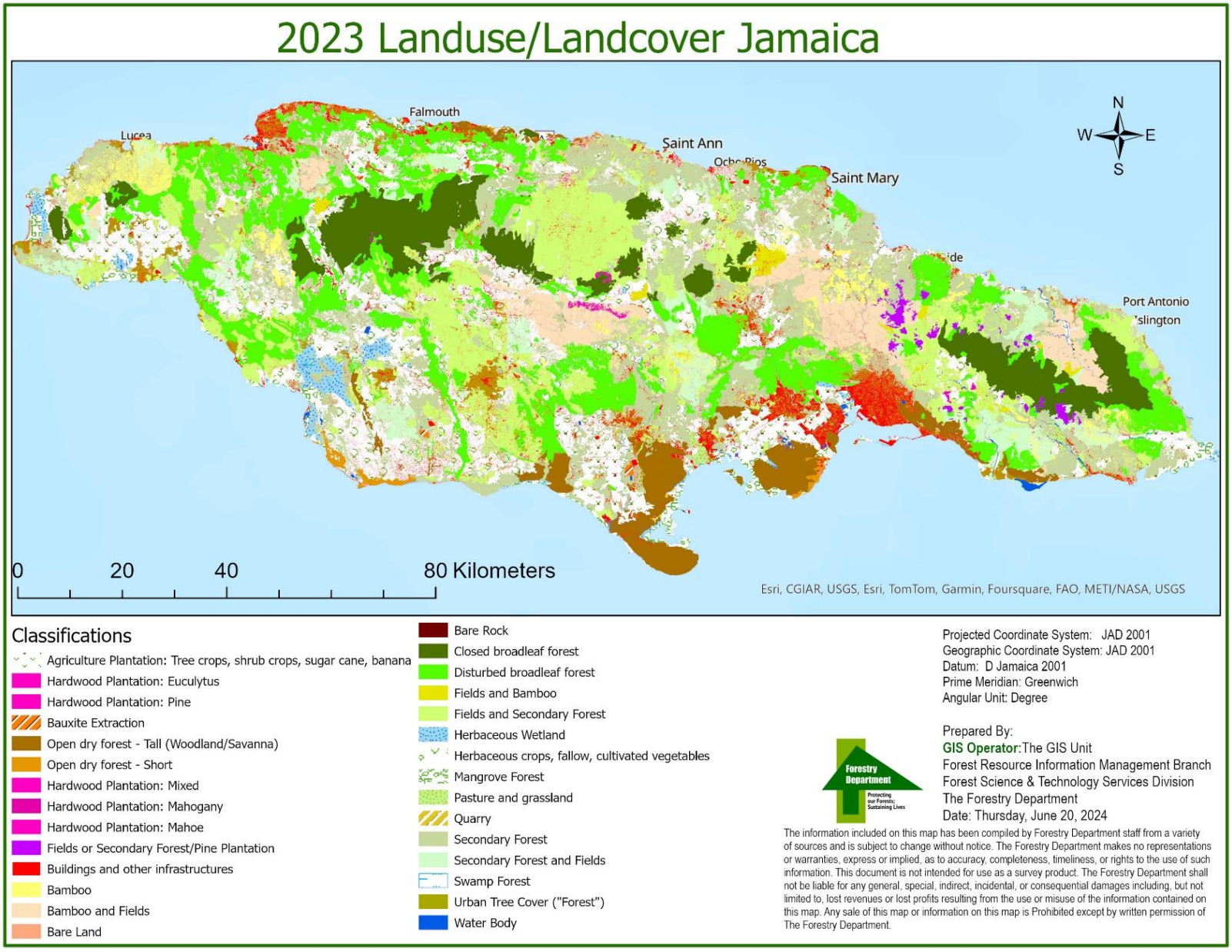
Bamboo is the fastest growing land use/ cover, a growth rate of 473%

Bamboo Change Analysis for Jamaica 2013 & 2023





Island distribution of land use classes



Summary of Findings

Jamaica is observing an annual regrowth rate of 1.99%.
Regrowth is attributed to the expansion of secondary forest.
Forest cover on lands managed by FD remains stable with consistent growth
Trelawny has the highest amount of forest cover.
Agriculture continues to decline, with peasant farming observing the highest reduction.
Building and other infrastructure areas have increased over the ten-year period.
Bamboo is the fastest growing land use/ land cover
79% of parishes have met and or exceeded the recommended baseline of 30% tree cover for urban areas.

- Computation of GHG for the forest sector
- Development of other customized products
- Expanding our UAV technology in Biodiversity and species assessment.
- Building an interactive platform for data sharing commencing with our mangroves.
- Identifying other prime forested areas and taking the necessary steps to have these areas protected (supporting the REDD+ initiative).
- Boundary Verification activities
- Urban Tree Cover Analysis (Montego Bay, St. Catherine)
- Revenue generation


Thank you!

YOUR FEEDBACK MATTERS

QUESTIONS?
COMMENTS?
CONCERNS?