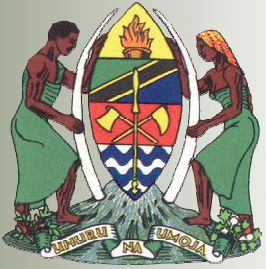


Assessment, Valuation, Mapping and Monitoring Carbon Stocks at Sub-Regional Level

SUPPORTING REDD READINESS IN TANZANIA

December, 2009





Valuing the Arc

*Linking science with Stakeholders
to Sustain Natural Capital*

www.valuingthearc.org/

Presented by: Prof. P.K.T Munishi

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Sokoine University of Agriculture

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Prof. Andrew Balmford
Dr Taylor Rickets*

Project members:

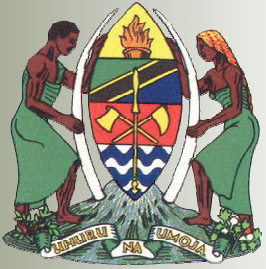
*Dr Ruth Swetnam
Dr Nasser Olwero
Mr Simon Wilcock
Prof. Shadrack Mwakalila
Dr Deo Shirma
Dr Simon Lewis
Dr Jon Lovett
Dr Andrew Marshall
... And many others...*



REDD

Supported by:

*Leverhulme Trust
The Royal Society*



CARBON STOCK MODELLING AND MAPPING PRESENTATION OVERVIEW

- **OBJECTIVES**

What are we doing

- **MEASUREMENTS OF CARBON**

Methodology

- **MAPPING**

Our approach

- **PRELIMINARY RESULTS FOR CARBON ESTIMATES**

- **CARBON VALUE SPECIFIC RESERVES**

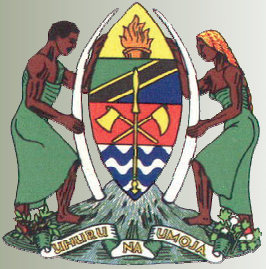
- **SCENARIOS:**

Carbon values under different development scenarios in Tanzania



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CARBON STOCK MODELLING AND MAPPING OBJECTIVES

Valuing and Mapping Ecosystem Services in the Eastern Arc Region and Surrounding Areas:

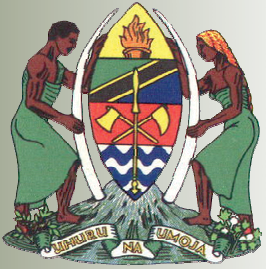
Carbon Mapped as an Ecosystem Service

Involving:

- Assessment & monitoring carbon dynamics in different vegetation types
- Generation of baseline data for emission offset trading
- Exploring scenarios of plausible change and impacts on Carbon as an Ecosystem Service in Tanzania
- Mapping the Distribution of Carbon as an Ecosystem Service
- Exploring Connection of services to livelihoods
- Inform Policy - make science policy relevant in Tanzania e.g. REDD, Forest Policy, Environmental Policy



REDD

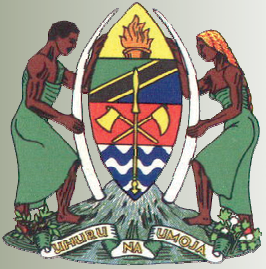


CARBON STOCK MODELLING AND MAPPING THE EASTERN ARC MOUNTAINS



A chain of crystalline mountains from Taita Hills in Kenya to the Udzungwa Mountains in Southern Tanzania





CARBON STOCK MODELLING AND MAPPING

MEASURING & MONITORING CARBON STOCKS

Data Sources:

- Compiling Existing Data (literature)
 - Published means from different studies for different Land Cover Types
 - IPCC Publications
- Collecting New Data
 - Field estimates of Carbon for different land cover types
 - Includes participatory C assessments
 - Measurements on 1 Ha permanent sample plots to enable future monitoring
 - Tropical Ecology Assessment and Monitoring (TEAM) Methodology – a robust international methodology for monitoring



REDD

CARBON STOCK MODELLING AND MA MEASURING & MONITORING CARBON

Use 5 pools of Carbon for each land cover

- Aboveground
- Soil Carbon
- Belowground
- Organic matter
- Dead material

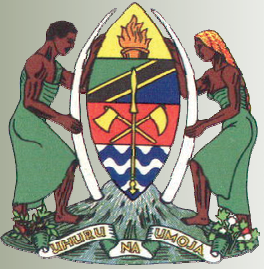
Stratified by elevation and cover types

- Evergreen Forests
- Woodlands – Miombo, Acacia
- Thickets
- Cultivated land – mixed crops / agro-forests

Degradation assessed

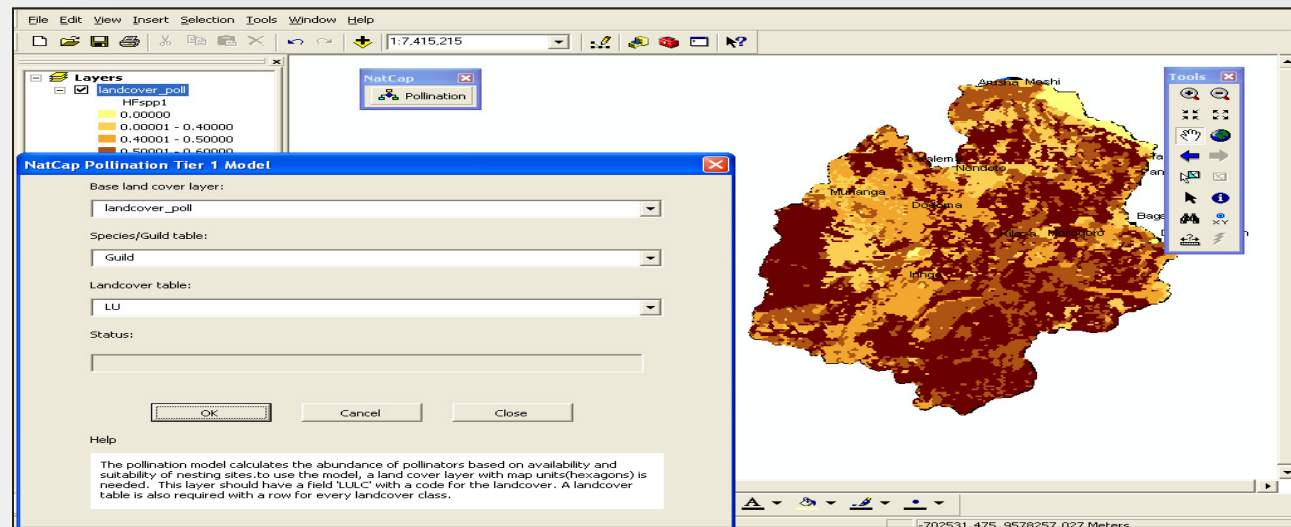
A Total of 2,500 carbon monitoring PSPs already established





CARBON STOCK MODELLING AND MAPPING

MAPPING CARBON STOCKS



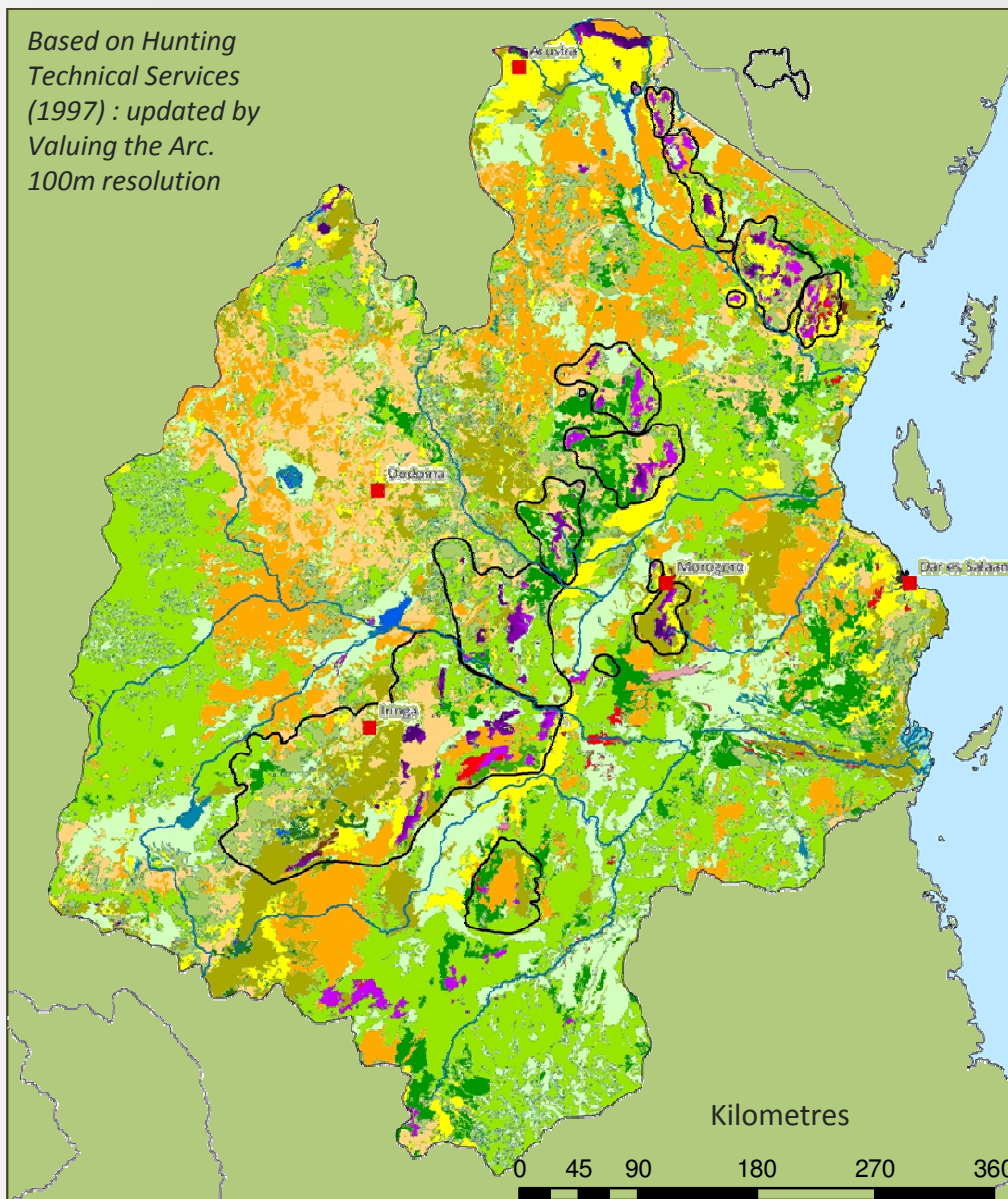
- Use of **InVEST** Mapping Tool (Integrated Valuation of Ecosystem Services & Tradeoffs)
 - Simple inputs – cover type, carbon content for each cover type
 - Relative values
 - Run in an ArcGIS toolbox
- Use of other Tools





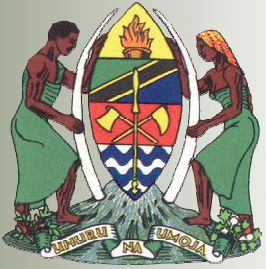
CARBON STOCK MODELLING AND MAPPING LAND COVER MAP

Based on Hunting
Technical Services
(1997) : updated by
Valuing the Arc.
100m resolution



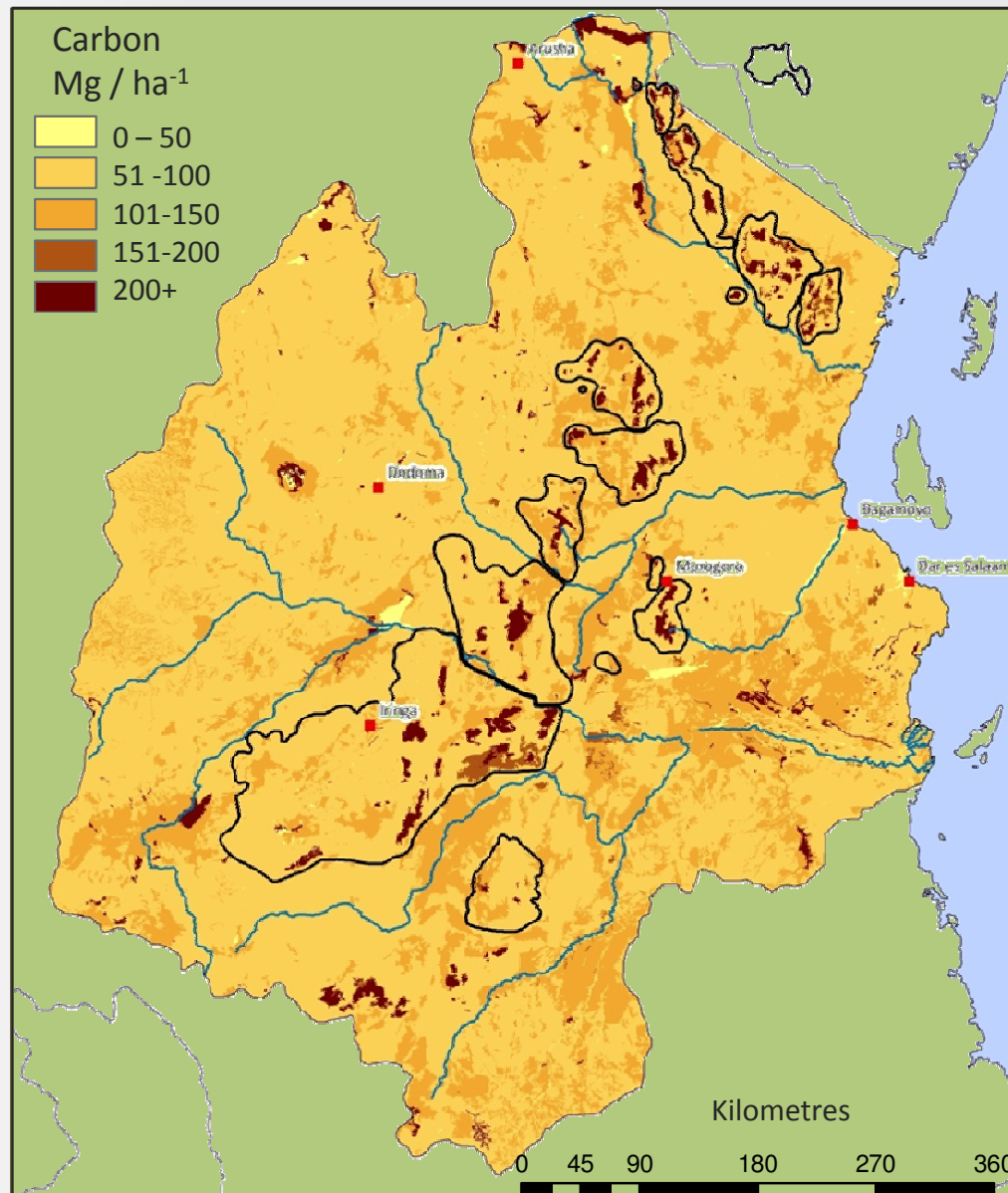
- Bare Soils
- Bush with scattered crops
- Bushland
- Closed Woodland
- Cultivation
- Forest mosaic
- Grass with scattered crops
- Grassland
- Ice / Snow
- Lowland Forest
- Mangrove Forest
- Monocrop unspecified
- Montane Forest
- Ocean
- Open woodland
- Permanent Swamp
- Plantation Forest
- Rice cultivation
- Rock Outcrops
- Rubber Plantation
- Sisal plantation
- Sub-montane Forest
- Sugarcane
- Tea Plantation
- Teak plantation
- Unknown
- Upper montane forest
- Urban Area
- Water
- Woodland with scattered crops





CARBON STOCK MODELLING AND MAPPING

ESTIMATED CARBON STORAGE

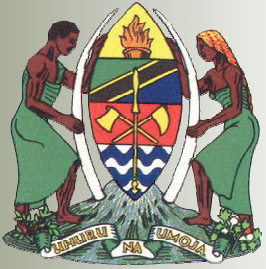


CARBON STORAGE
= Aboveground
+ Belowground
+ Soil

NB: All maps that follow sum these 3 pools

Copyright: Valuing the Arc – Simon Willcock & Ruth Swetnam





CARBON STOCK MODELLING AND MAPPING

CARBON VALUE – SPECIFIC FORESTS

Reserve	Vegetation Type	Elevation Range (m)	Carbon Density (t/ha)
Nyang'anje	Woodland/ Forest	300 - 500	28 ± 2
		500 - 800	30 ± 2
Kitonga	Woodland/ Forest	1300 - 1500	24 ± 1.5
		1500 - 2000	14 ± 1
Kilombero Nature Reserve	Forest/ Woodland	300 - 700	80 ± 12
		700 - 1000	67 ± 8
Longisonte	Woodland	>1000	20 ± 3



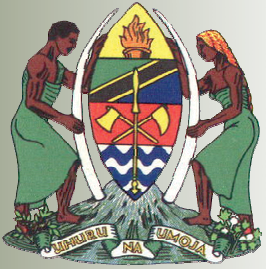
CARBON STOCK MODELLING AND MAPPING

CARBON VALUE – INDIVIDUAL SPECIES

(Kilombero Nature Reserve - Lyondo Forest)

Species	Density (stems/ha)	Basal Area (m ² /ha)	Volume (m ³ /ha)	Biomass (t/ha)	Carbon (t/ha)
<i>Parinari excelsa</i>	40	10.51	111.92	55.96	27.980
<i>Sorindeia madagascariensis</i>	167	6.68	100.39	50.19	25.096
<i>Brachystegia spiciformis</i>	5	1.35	12.69	6.34	3.172
<i>Sapium ellipticum</i>	18	1.96	12.18	6.09	3.045
<i>Vitex doniana</i>	18	1.61	9.72	4.86	2.431
----- 53 species					
Total	387	29.17	292.44	146.22	73.110





CARBON STOCK MODELLING AND MAPPING SCENARIO MODELLING FOR CARBON

An example of changes in carbon storage under two scenarios in Tanzania

(Change in Land Cover = Change in C stocks)

- Agriculture expands in areas with:
 - suitable soils,
 - reasonable rainfall,
 - roads,
 - people, and
 - out from existing agricultural areas.
- More Charcoal/Timber Extraction (Deforestation) where forested areas become more accessible

Scenarios for 2025:

- 1. A Hopeful Future Vision** of Land use Change
- 2. A Less Hopeful Future** (*Business as Usual*) Vision of Land Use Change

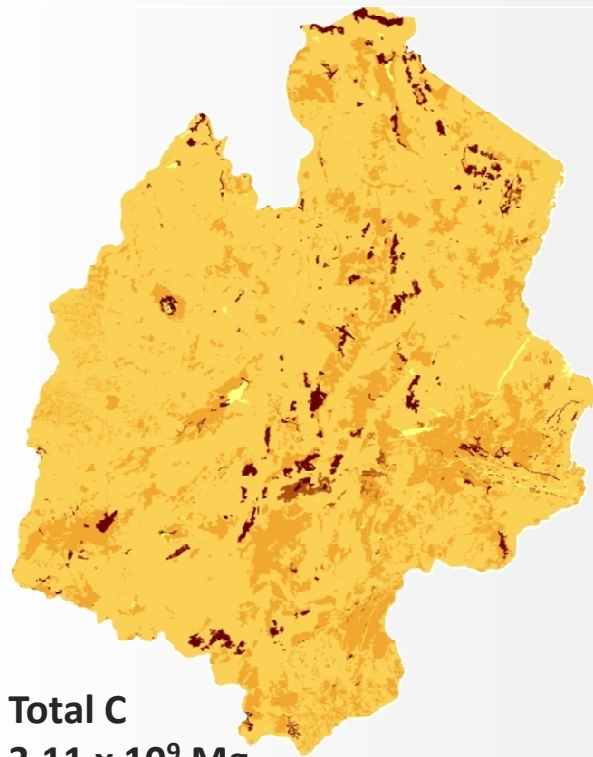


CARBON STOCK MODELLING AND MAPPING

CARBON SCENARIOS: HOPEFUL & PESSIMISTIC

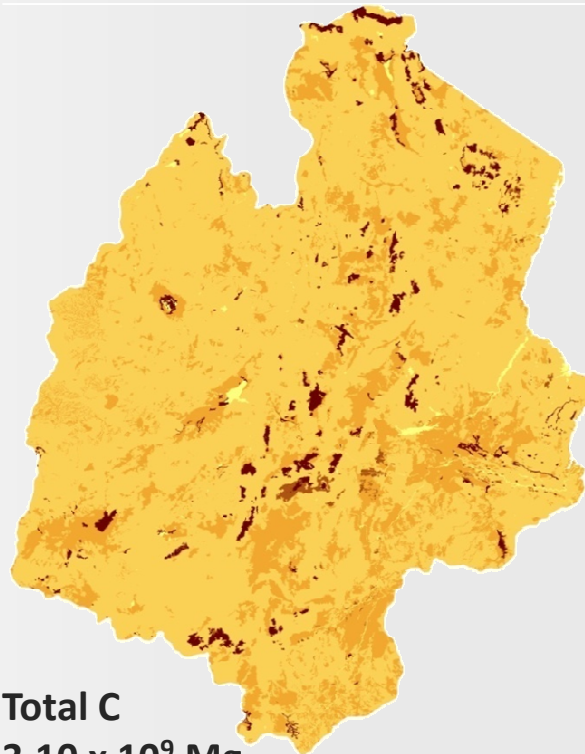
Total Carbon (Mg) predicted for baseline and two scenarios – values represent median

Baseline 2000



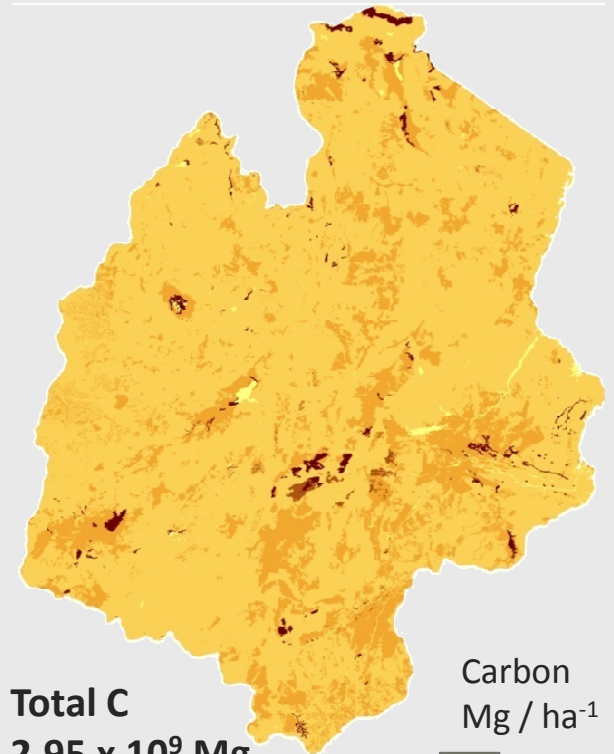
Total C
 3.11×10^9 Mg

Matazamio Mazuri 2025
"hopeful / greener"

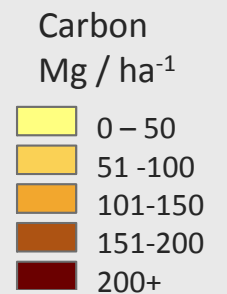


Total C
 3.10×10^9 Mg

Kama Kawaida 2025
"pessimistic BAU"

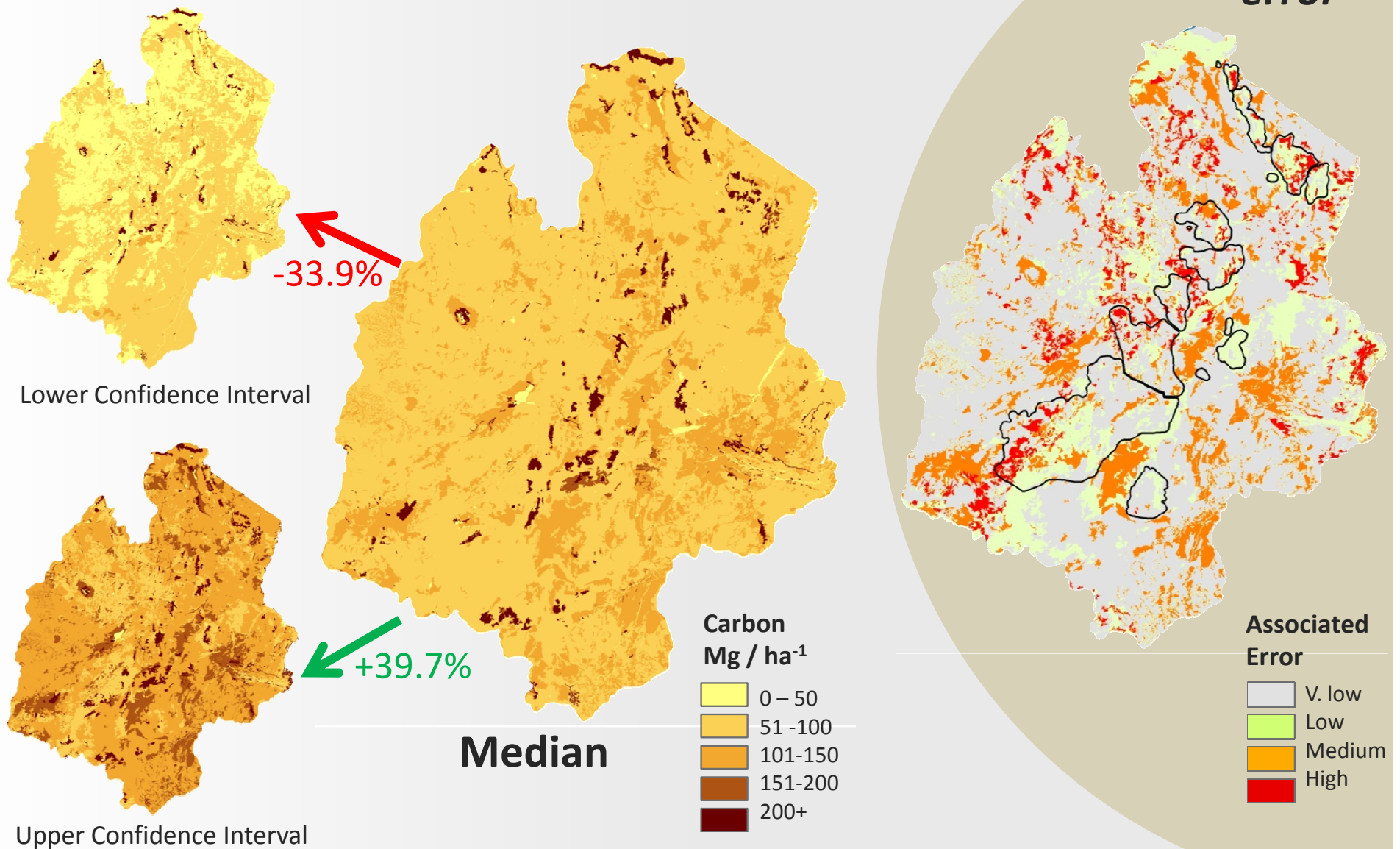


Total C
 2.95×10^9 Mg



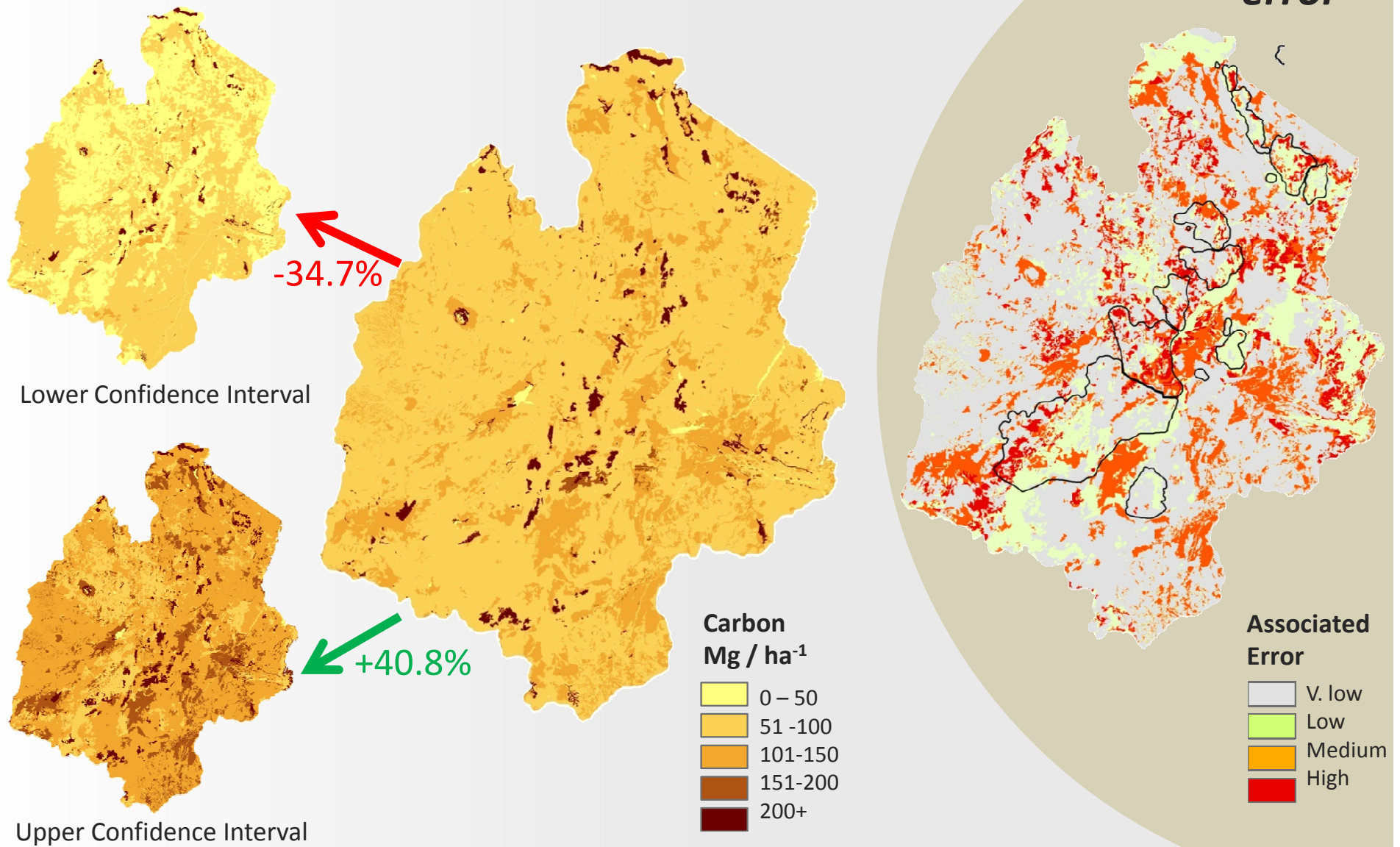
CARBON STOCK MODELLING AND MAPPING

CARBON SCENARIOS: BASELINE 2000



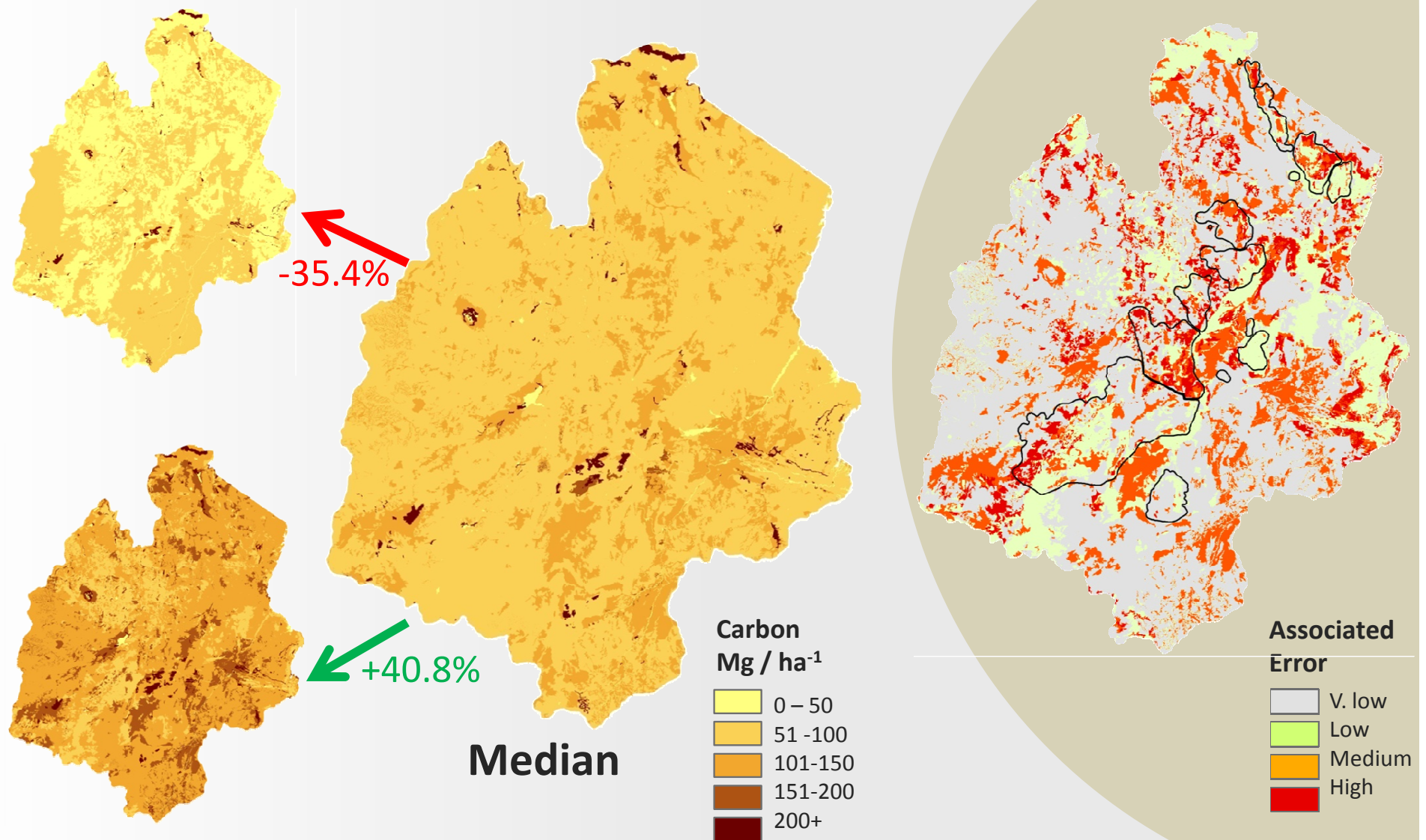
CARBON STOCK MODELLING AND MAPPING

CARBON SCENARIOS: HOPEFUL IN 2025



CARBON STOCK MODELLING AND MAPPING

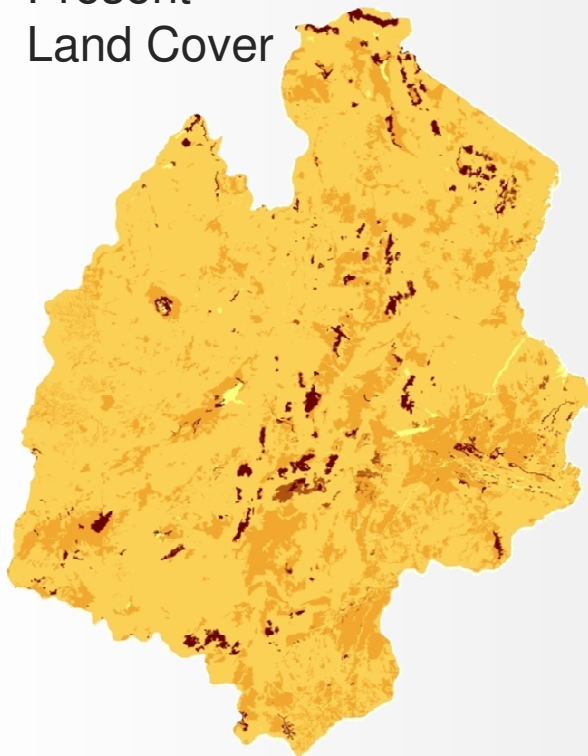
CARBON SCENARIOS: 'BAU' IN 2025



CARBON STOCK MODELLING AND MAPPING

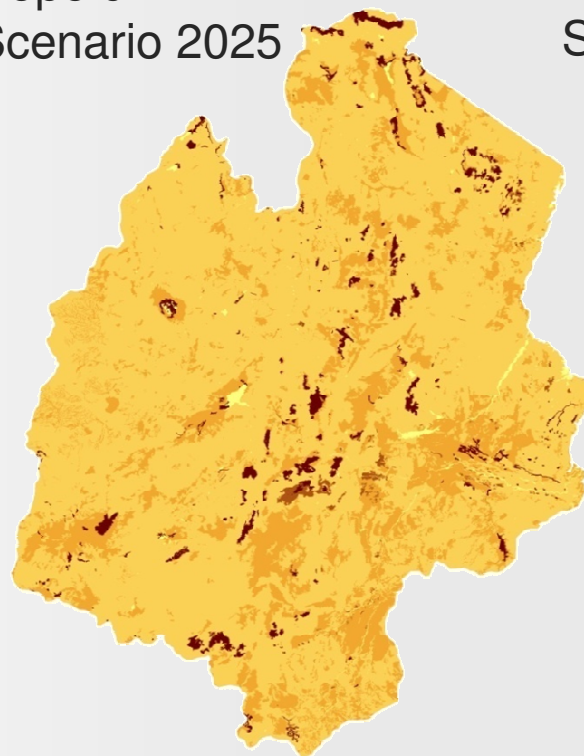
CHANGES IN SERVICE PROVISION


Present
Land Cover



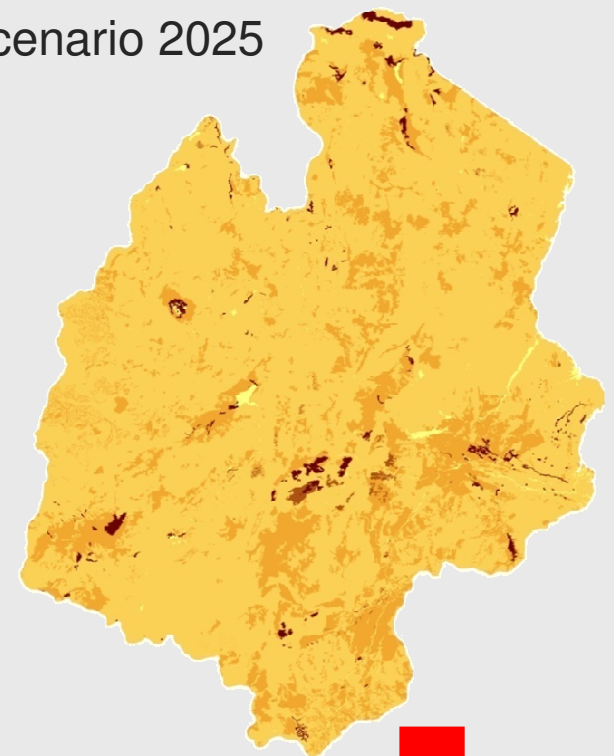
➔ 3.116×10^9
tonnes of
carbon


Hopeful
Scenario 2025

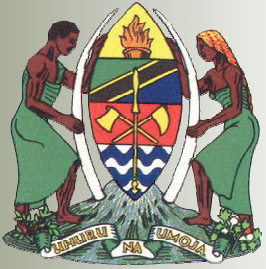


LOSS

 0.015×10^9
or – 0.5% of
2000 value

Business as Usual
Scenario 2025



LOSS

 0.158×10^9
or – 5.1% of
2000 value



THE END

