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Coastal change detection of the South-Western Peninsula of Trinidad, using GIS and remote sensing techniques (2014-2023)

Caribbean Sea Comission of the Association of Caribbean States – First Conference

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Source: Aleem Kalloo
SW Peninsula, Trinidad

Outline

- Introduction
  - Study Area
  - Why was this study chosen?
- Methodology
- Results & Discussion
- Conclusion
- How does this relate to Integrated Coastal and Ocean Management (ICOM)?
- Acknowledgments
- References

Goal

- To assess coastal change in the south-western (SW) Peninsula (2014-2023)
  2023)

Objectives

- identify the areas along the south-western peninsula that have experienced significant changes.
  experienced significant changes.
- develop a classification scheme using previous literature, maps and knowledge of the area.
  knowledge of the area.
- conduct field surveys to collect field points to conduct accuracy and verification assessments.
  verification assessments.
- map the land-use/ land cover (LULC) changes within the coastal zone of the south-western
  the south-western peninsula, Trinidad.
- calculate the land cover changes within the SW Peninsula.

Introduction

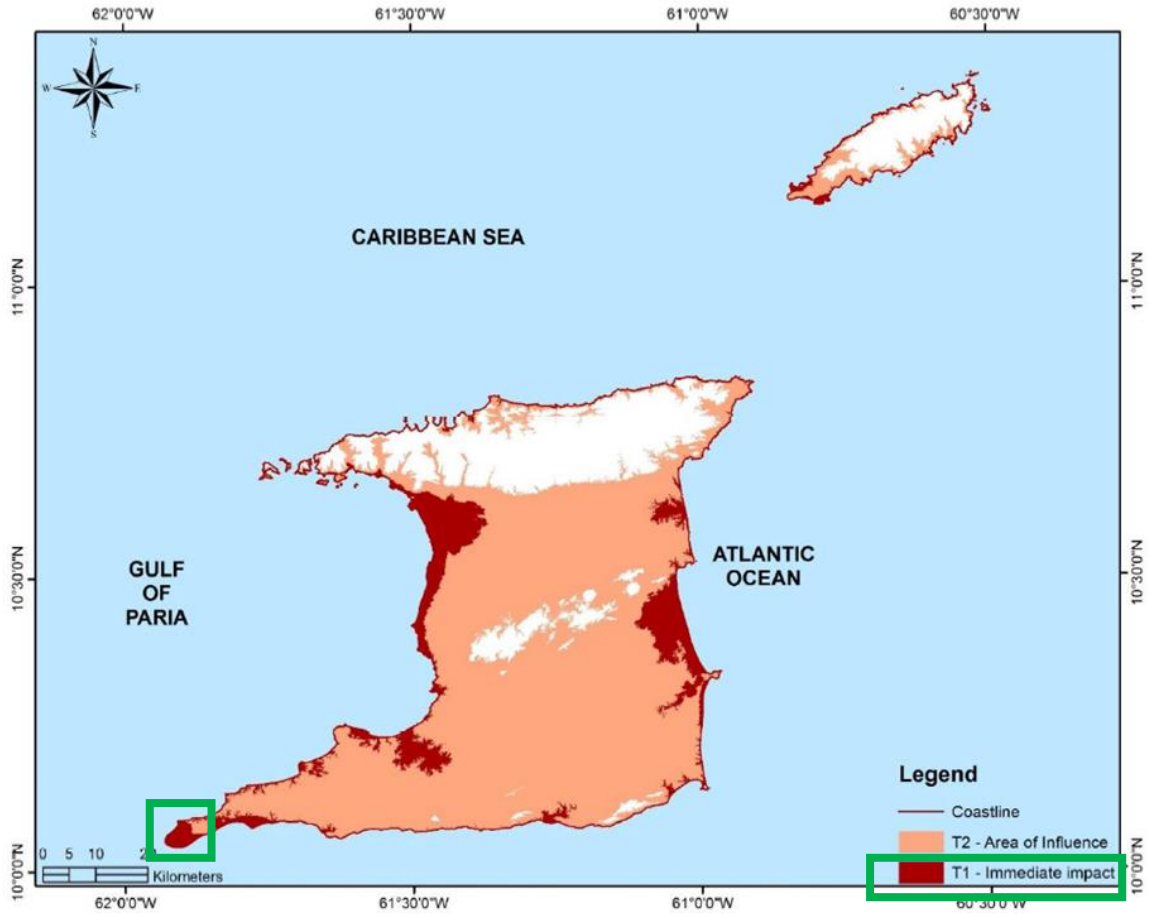


Figure 1 above illustrates the Terrestrial Boundaries of Coastal Zone of Trinidad and Tobago

Source: ICZM Framework Policy, 2019

Introduction

- Trinidad and Tobago (T&T) has a diverse shoreline as any other coast around the world (Kenny, 2002; Darsan et al., 2012).
- Indicators that coastal erosion is likely to occur at the South coast
  - young and unconsolidated sediments
  - flow of water within the Columbus Channel (Kenny, 2002; Chee et al., 2014)

Image 1 above displays Barren Land at SW Trinidad
Source: Kalloo, 2023

Introduction

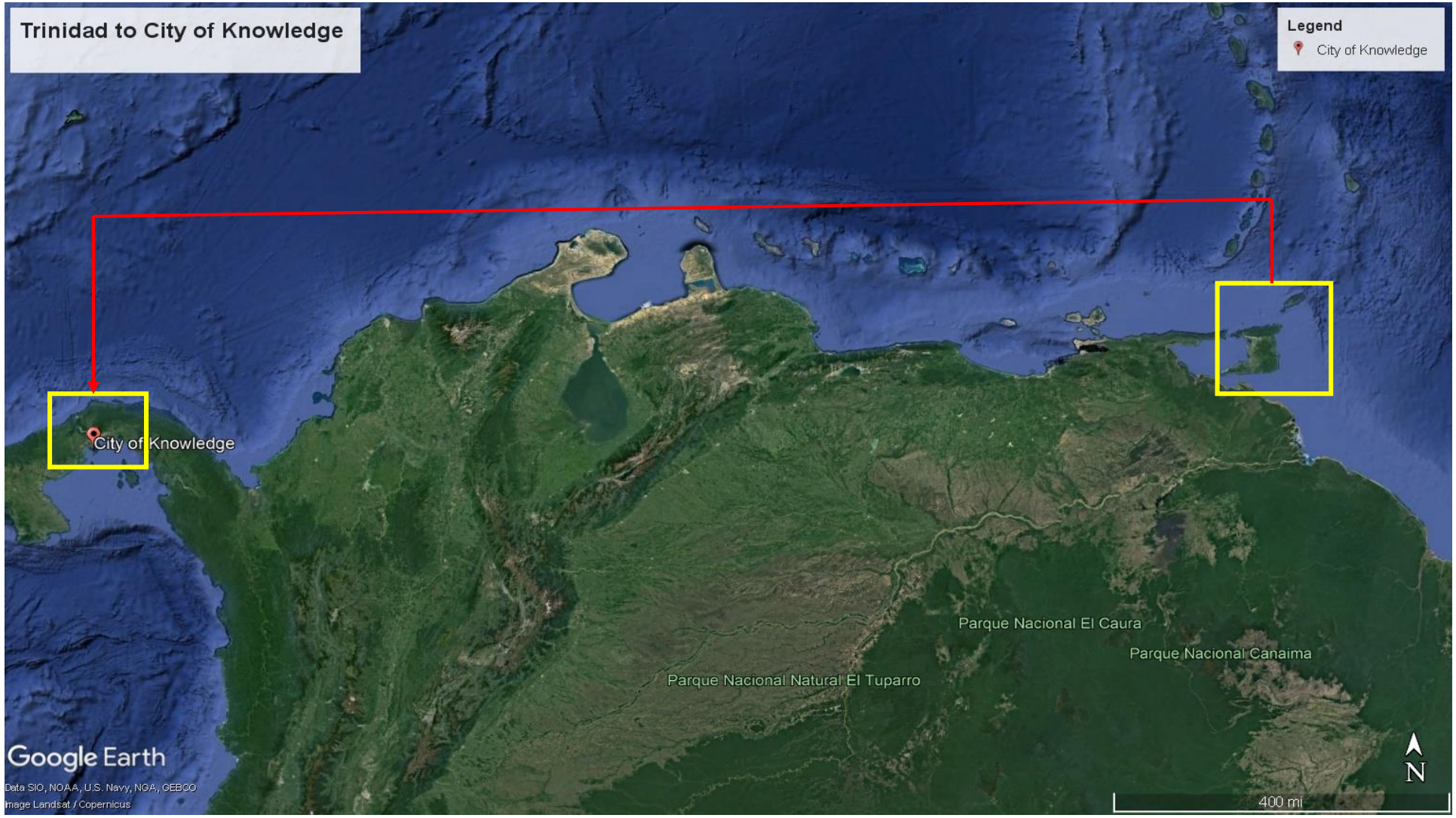
- What is land use/ land cover (LULC)?
- Land use –refers to the interface between the land cover and human activities in the environment (FAO, 2000).
- Land cover - can be defined as the biophysical cover that is present on the Earth's surface (Rai et al., 2017).
- The conversion of undeveloped land into cultivated land, grassland, woodland, infrastructure, and human settlement is known as land use change (Islam, 2020).

Images 2 & 3 illustrates LULC features within the SW peninsula, Trinidad
Source: Kalloo, 2023

Introduction

- Various unsupervised and supervised classification approaches have been used on LULC research (Alphan 2005; Ekerun, 2007; Dewidar & Frihy, 2010; Abualtayef et al., 2021).
- Supervised vs Unsupervised
- Supervised - "the user develops the spectral signatures of known categories, such as urban and forest, and then the software assigns each pixel in the image to the cover type to which its signature is most comparable" (Eastman, 2003).
- Unsupervised - an algorithm is selected to locate a predetermined number of clusters using a collection of remotely sensed data. This strategy can be utilised without prior knowledge of the ground (Hasmadi et al., 2009).

Study Area – Trinidad & Tobago to The City of Knowledge, Panama



Source: Google Maps, 2023

Study Area

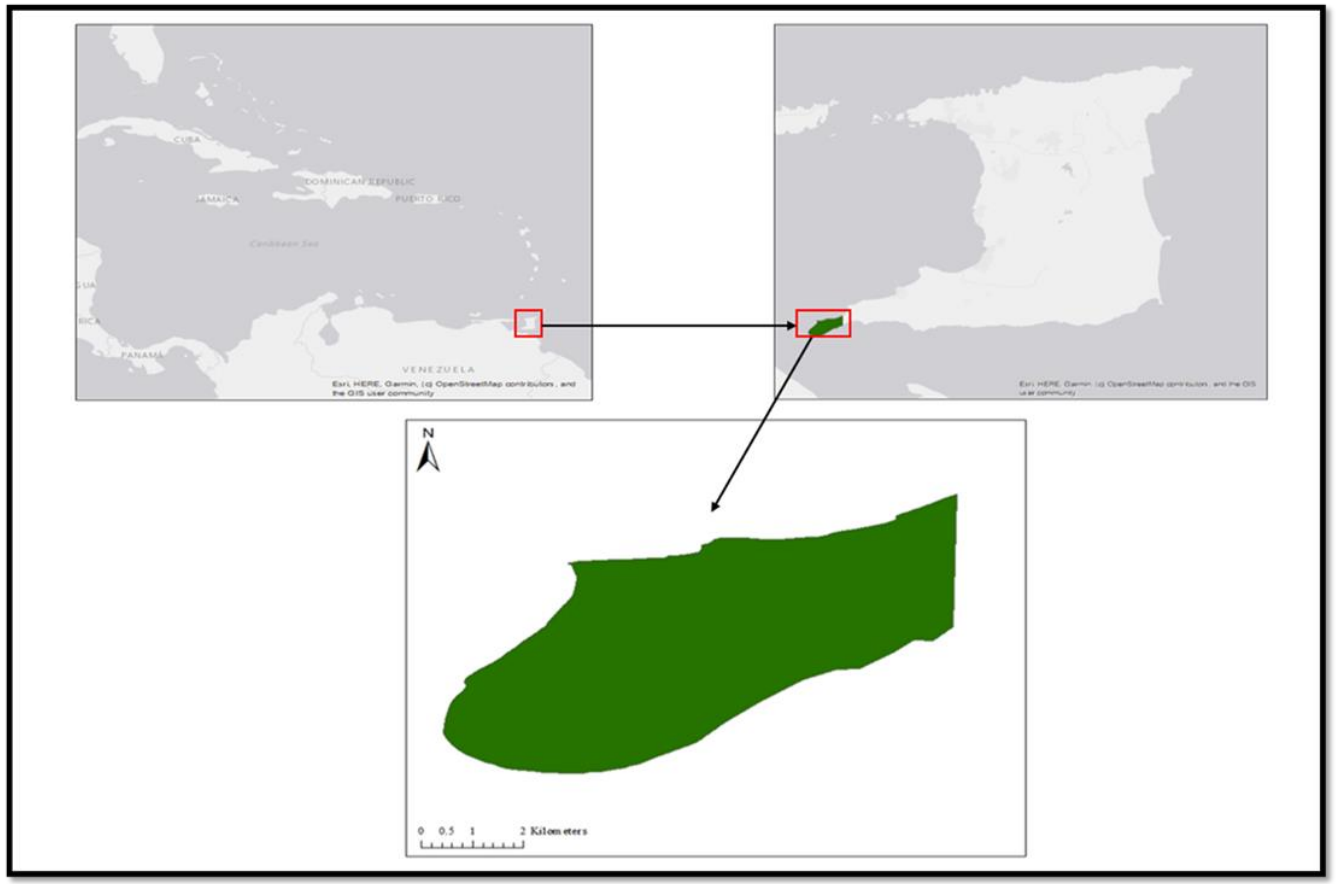


Figure 2 above illustrates map of study area
Source: Kalloo, 2023

- Located southernmost end of the Caribbean Island chain between 10º 02’ -10º 50’N latitude and 60º 55’ -61º 56’W longitude (Juman & Hassanali, 2013).
- SW peninsula study area is approx. 35.62 km^2

Why this study area?

Sinanan: Cedros erosion can't repair

Image 4 above displays newspaper clipping at SW Trinidad
Source: Moreno, 2018

Hungry sea bites into Cedros

'What is that word? Migration? Leaving here is very sad...'

Image 5 above displays newspaper clipping at SW Trinidad
Source: Mohammed, 2018

Dry season accelerates red palm mite

Coconut estates under attack

Image 6 above displays coconut estate in SW Trinidad
Source: De Silva, 2019

Methodology

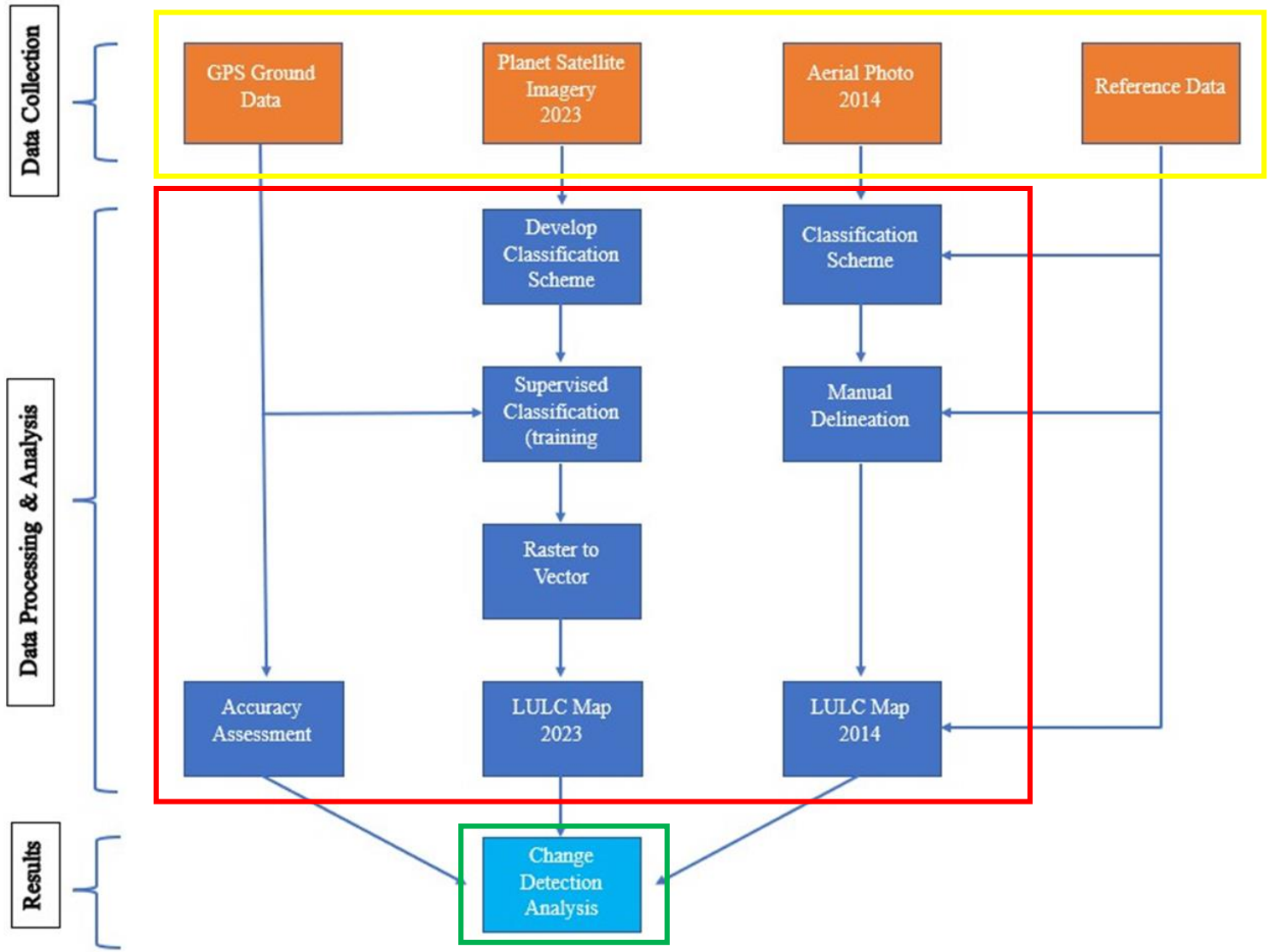


Figure 3 illustrates methodological flowchart

Data collection and acquisition

- Satellite imagery was obtained from Planet's database (2023)
- Aerial photography was obtained from ArcGIS online database (2014)
- Ancillary data included the ground truth points collected using the Geographical Positioning System (GPS)

Planet's satellite imagery was pre-processed

- Mosaicking
- Clipping

Image Classification

7 classes were developed for this project:

Images 7 – 13 illustrates LULC features at the SW peninsula, Trinidad
Source: Kalloo, 2023

Data collection and acquisition

GPS Ground Data Collection

- Field Day – 12th April 2023
- Collected GPS points (accuracy and verification points)

A total of 122 points were collected

82 were accuracy points and 40 were verification points.

Supervised Classification – 2023 imagery

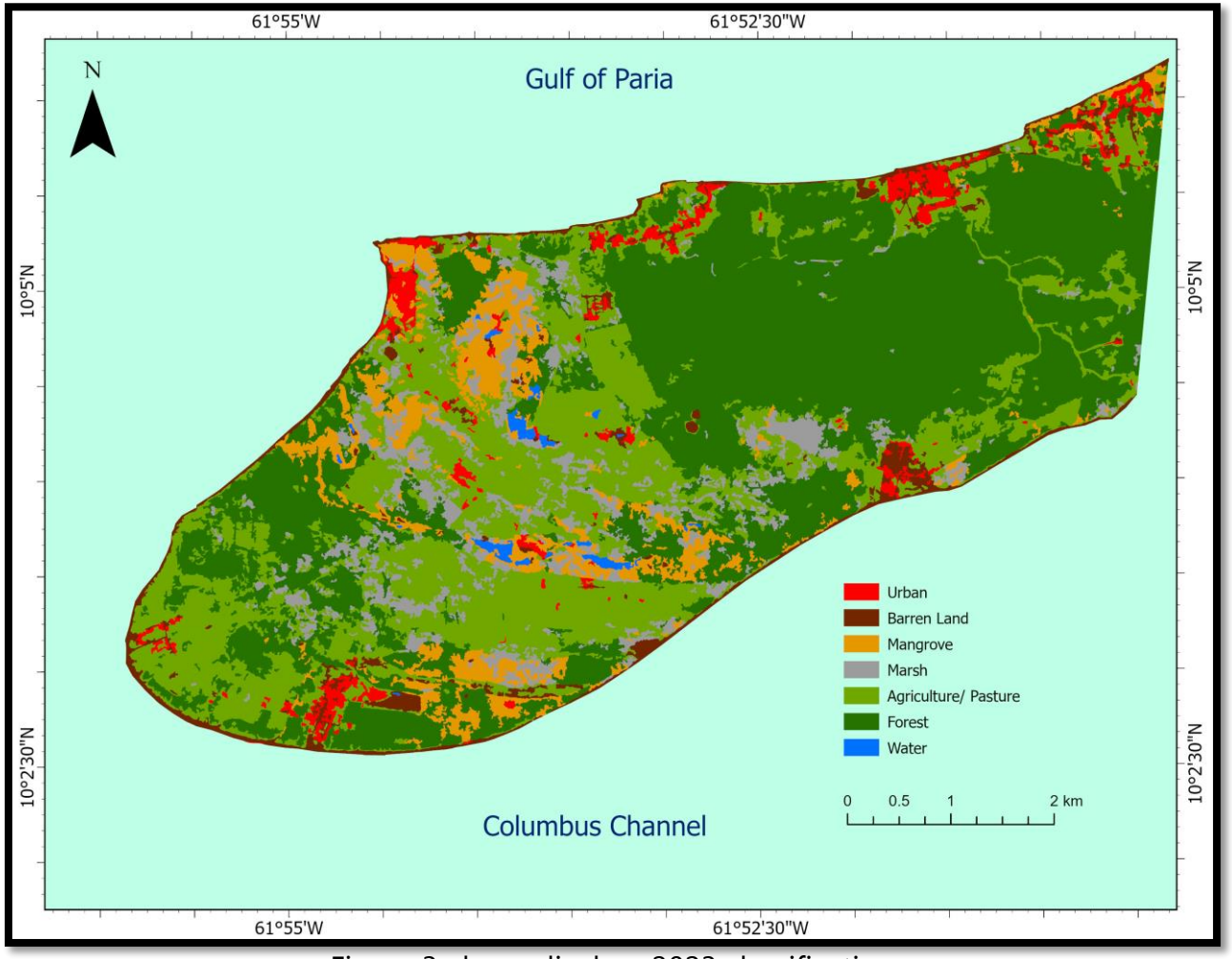


Figure 3 above displays 2023 classification

Manual Delineation – 2014 imagery

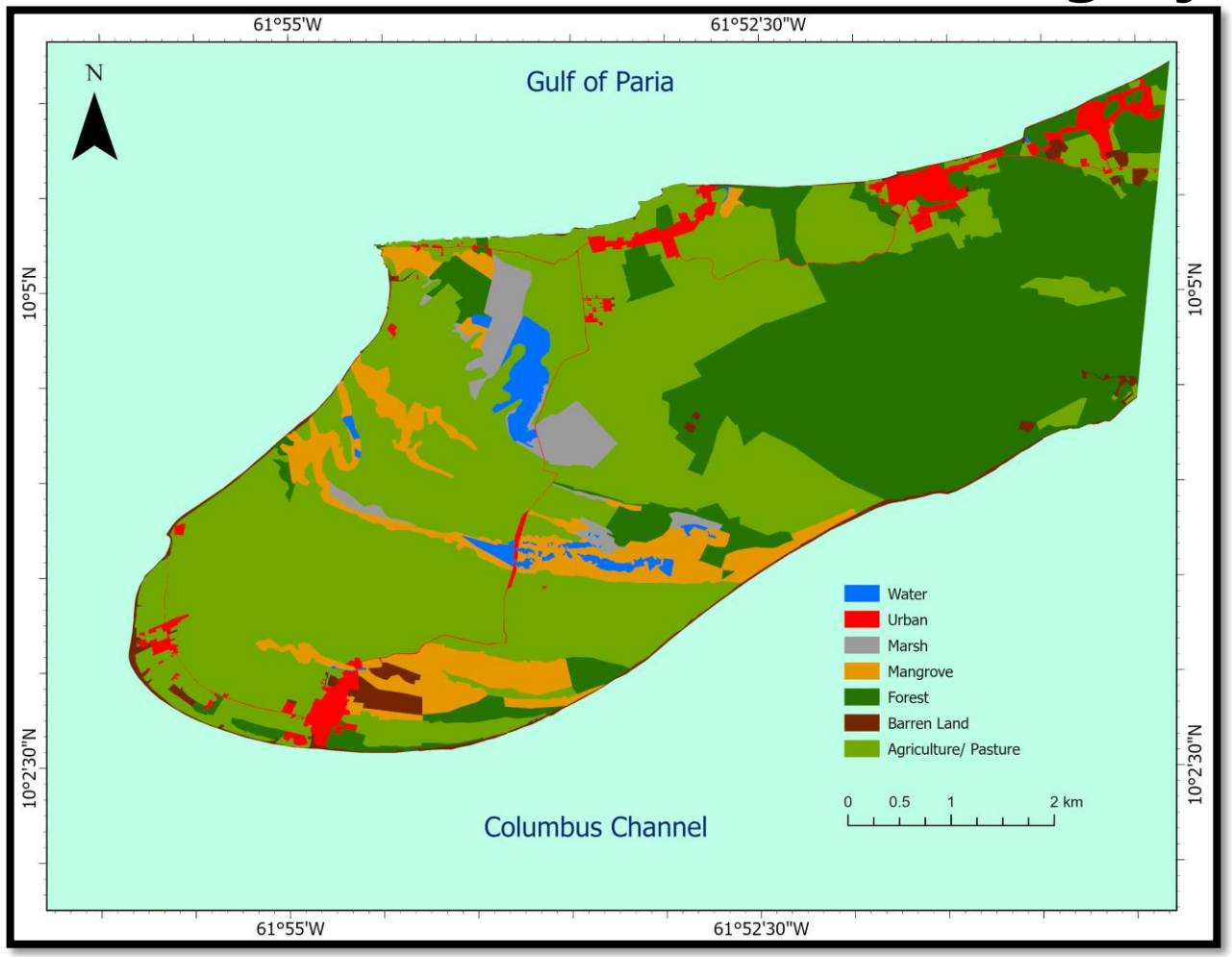


Figure 4 above displays 2014 manual delineation

Manual Delineation - 2014

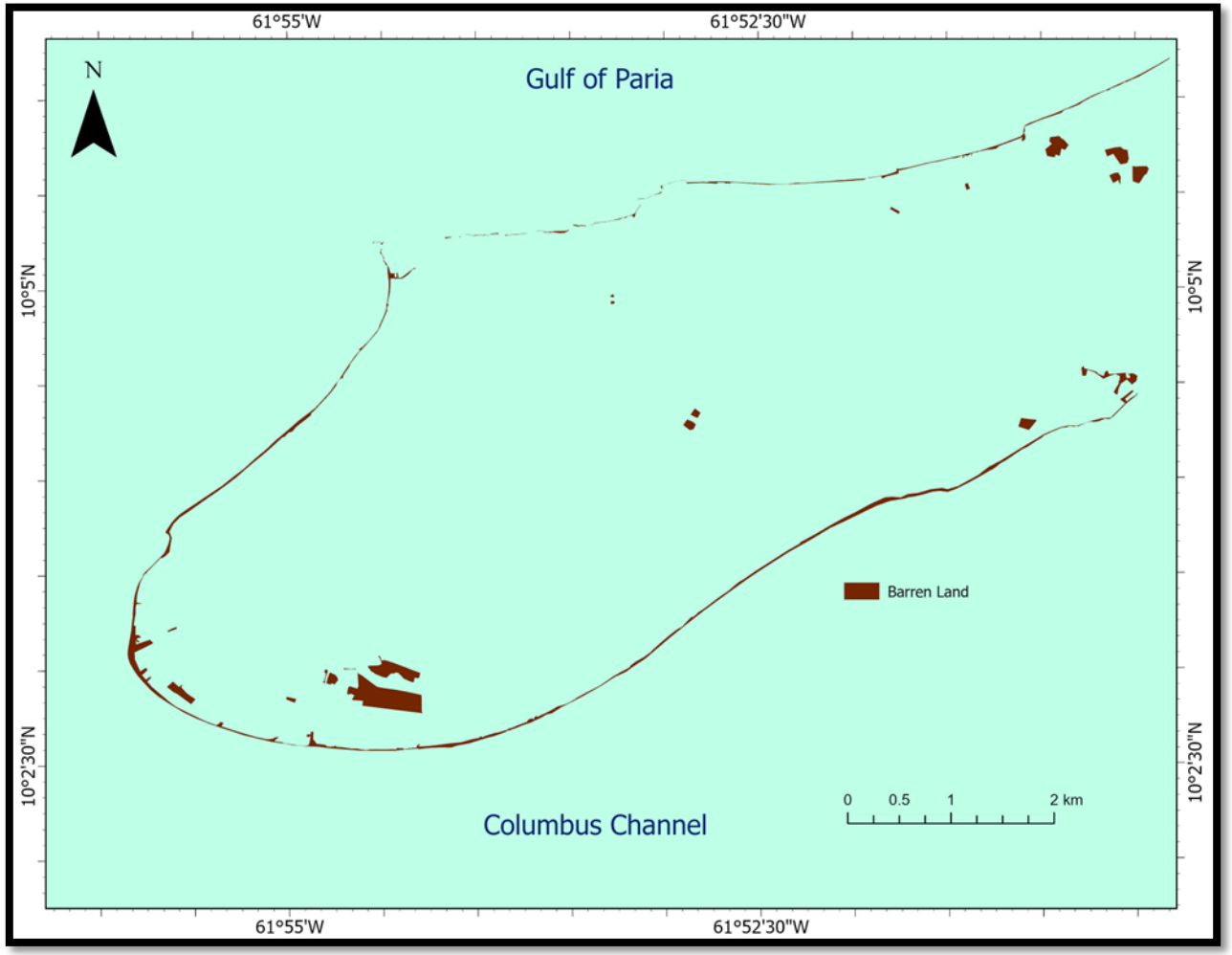


Figure 5 above displays Barren Land only

Manual Delineation - 2014

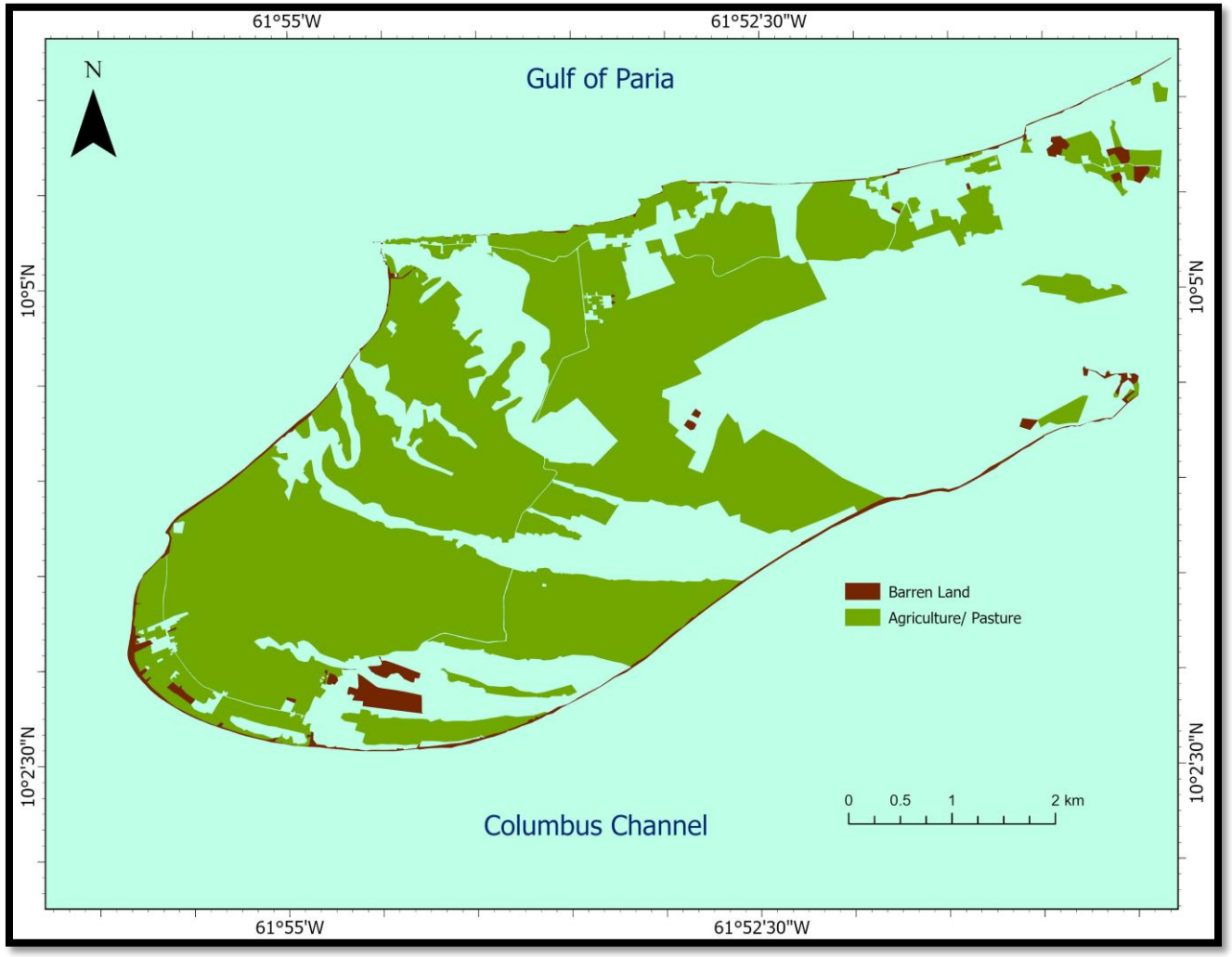


Figure 6 above displays Barren Land & Agri/Pasture only

Manual Delineation - 2014

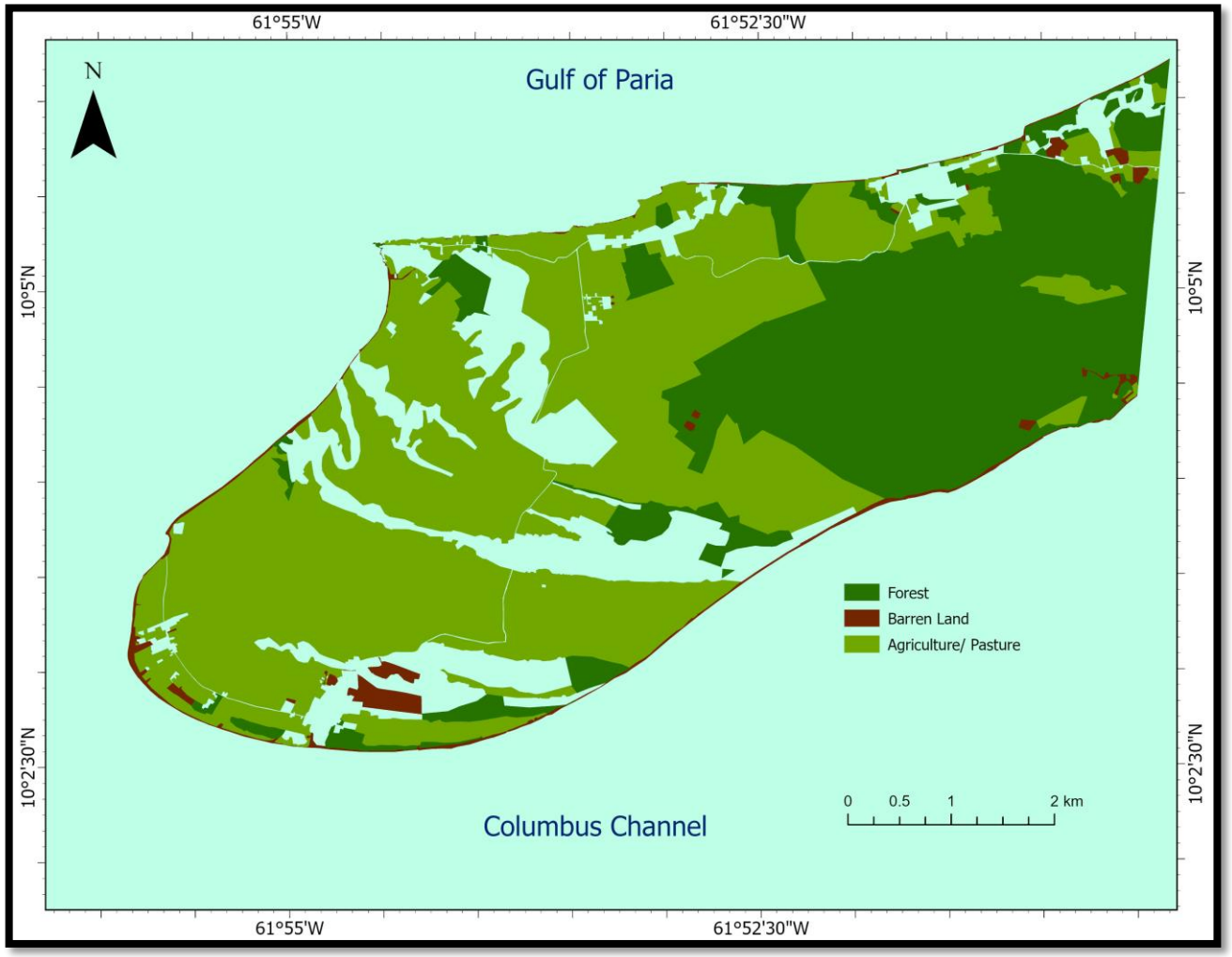


Figure 7 above displays Barren Land, Agri/Pasture & Forest only

Manual Delineation - 2014

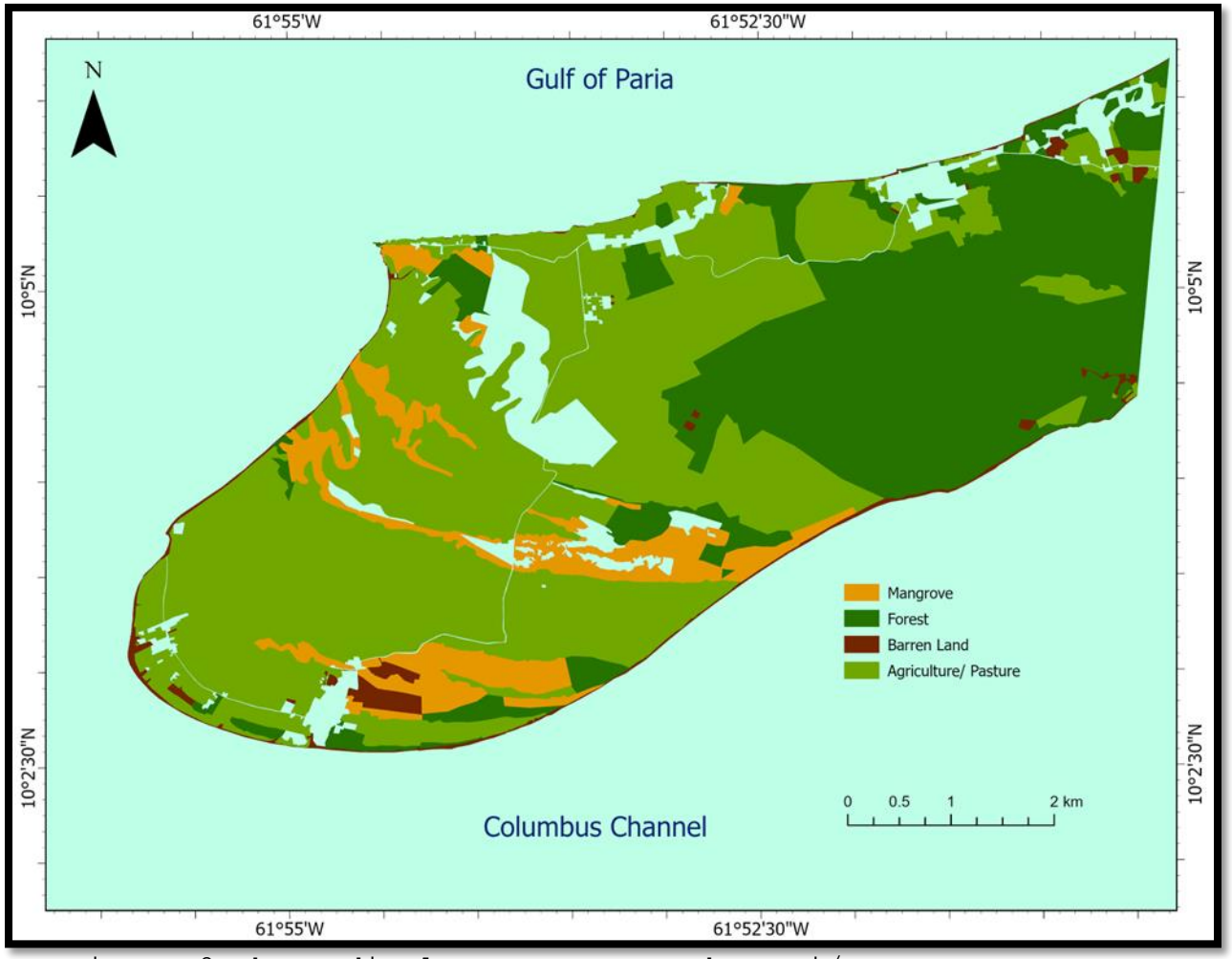


Figure 8 above displays Barren Land, Agri/Pasture, Forest & Mangrove only

Manual Delineation - 2014

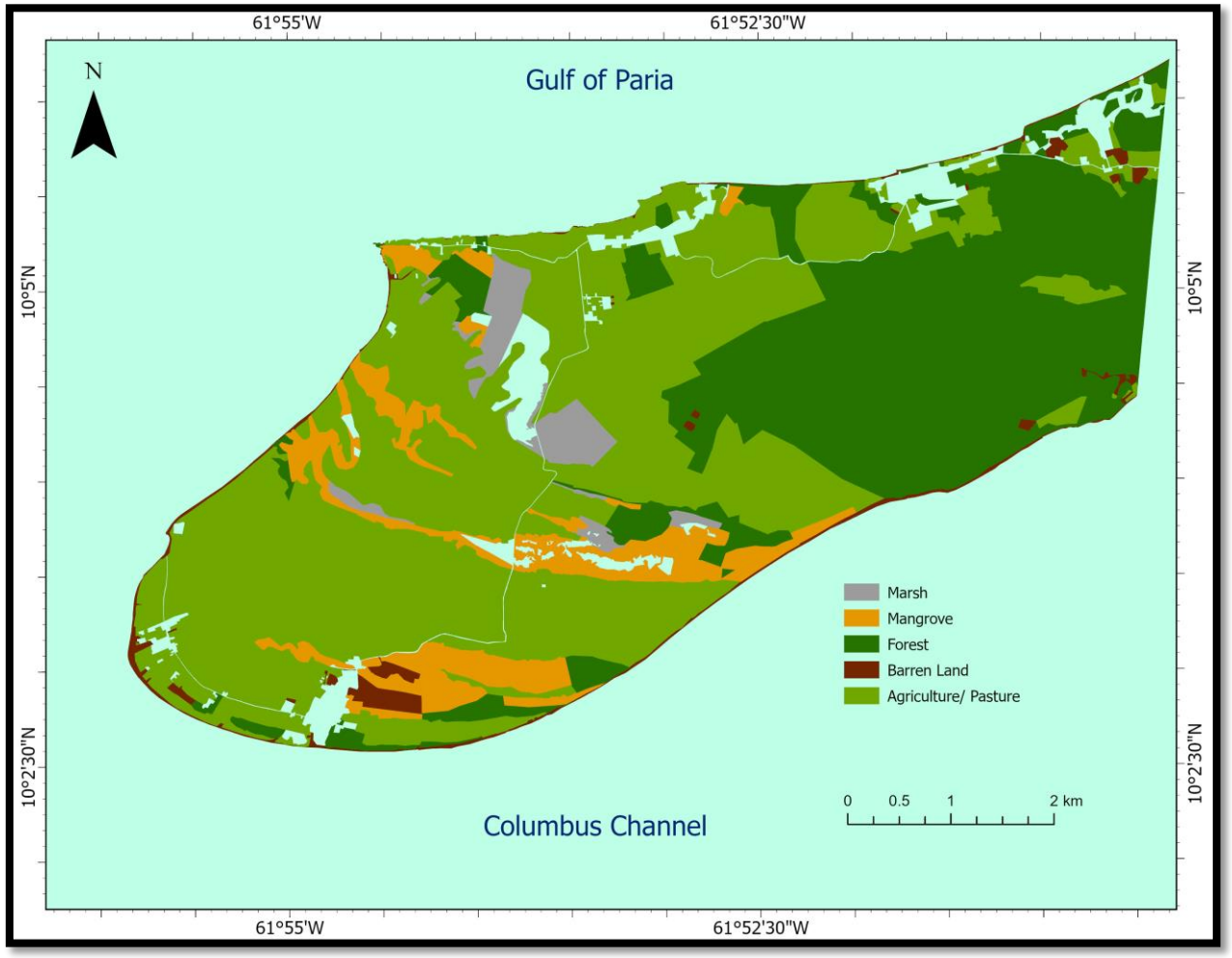


Figure 9 above displays Barren Land, Agri/Pasture, Forest, Mangrove & Marsh only

Manual Delineation - 2014

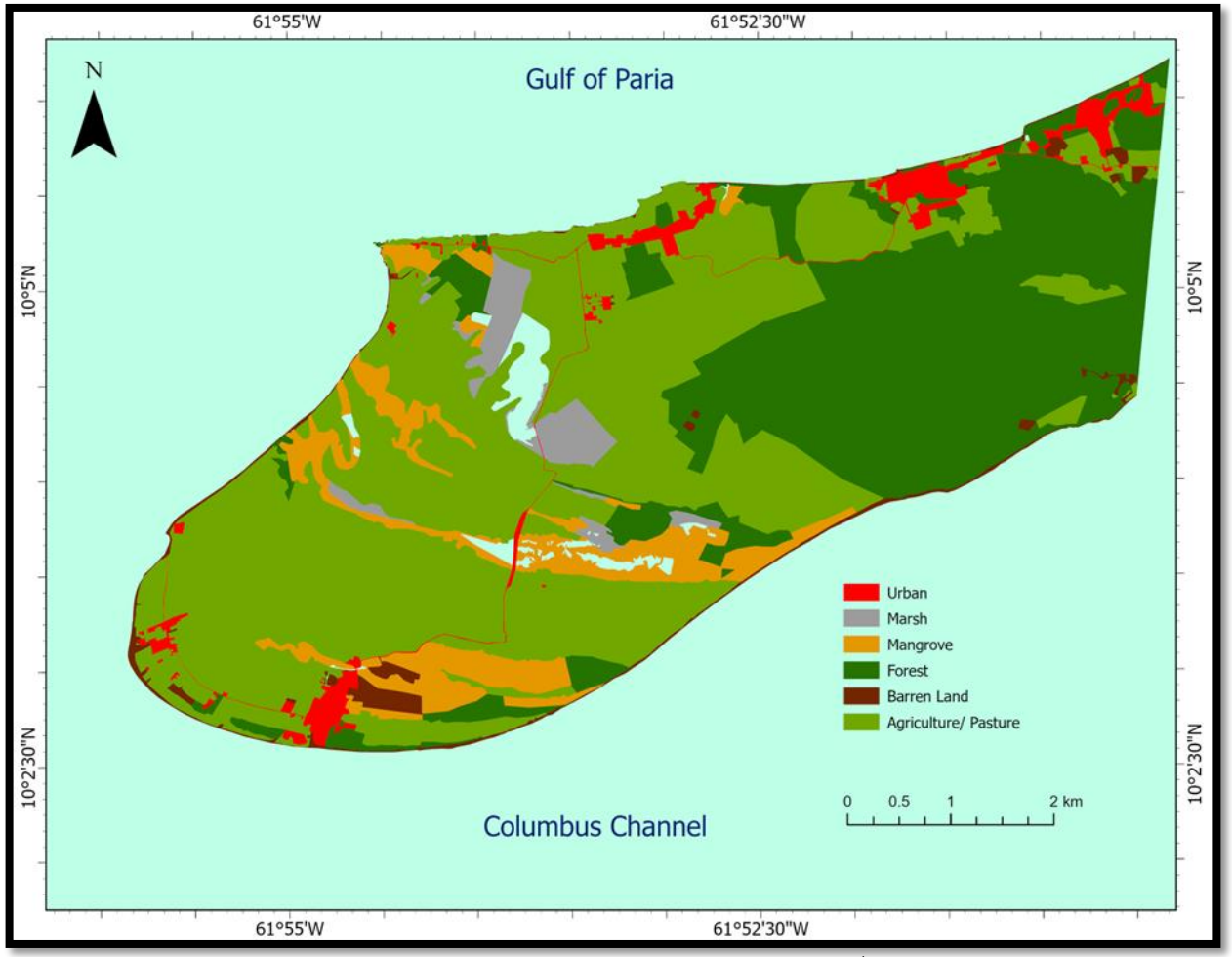


Figure 10 above displays Barren Land, Agri/Pasture, Forest, Mangrove, Marsh & Urban only

Manual Delineation - 2014

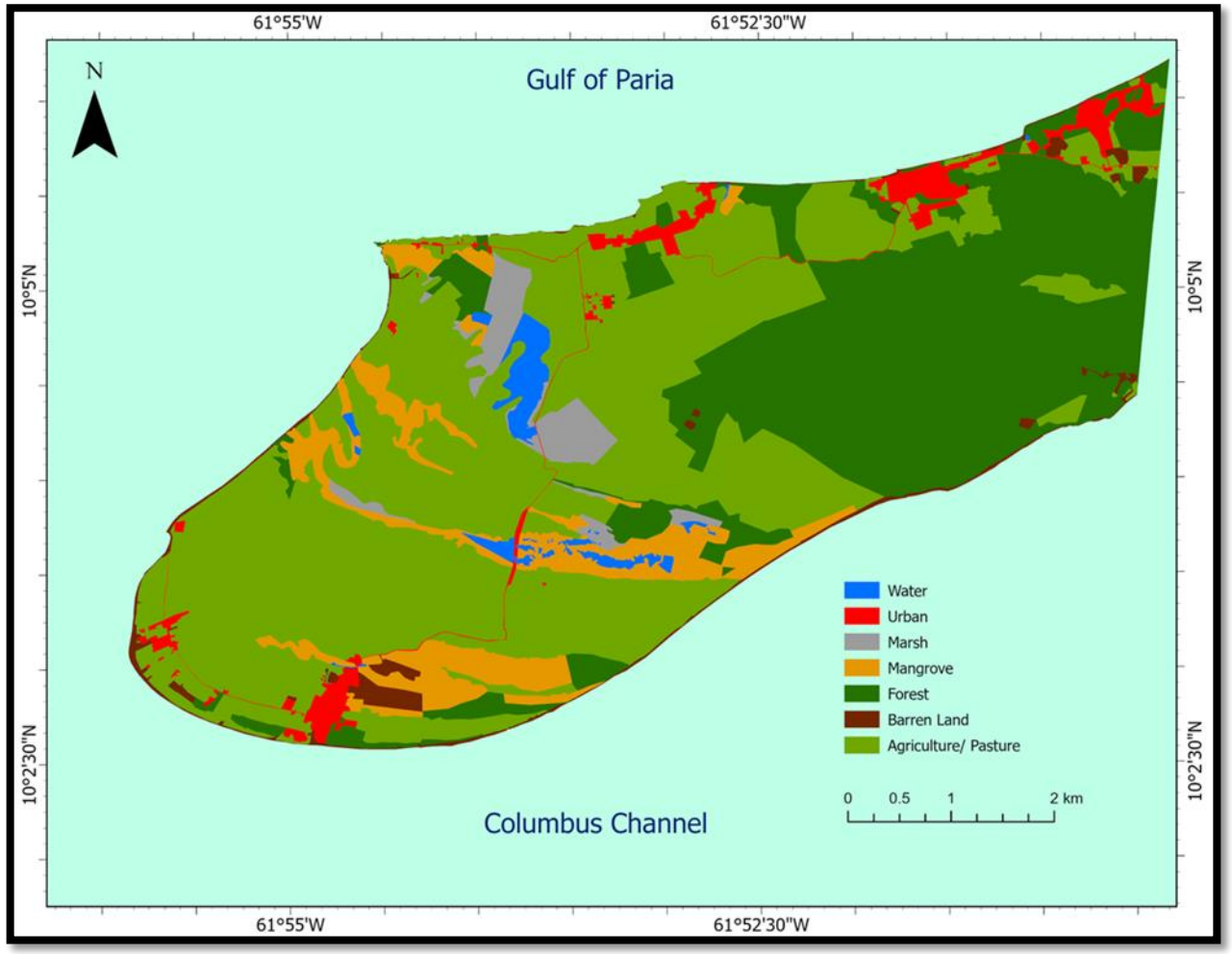


Figure 11 above displaying all classes

Accuracy Assessment

Can be used to determined

- User's accuracy
- Producer's accuracy
- Overall accurac= 79.27%

Results and Discussion – Change detection analysis

Figure 12

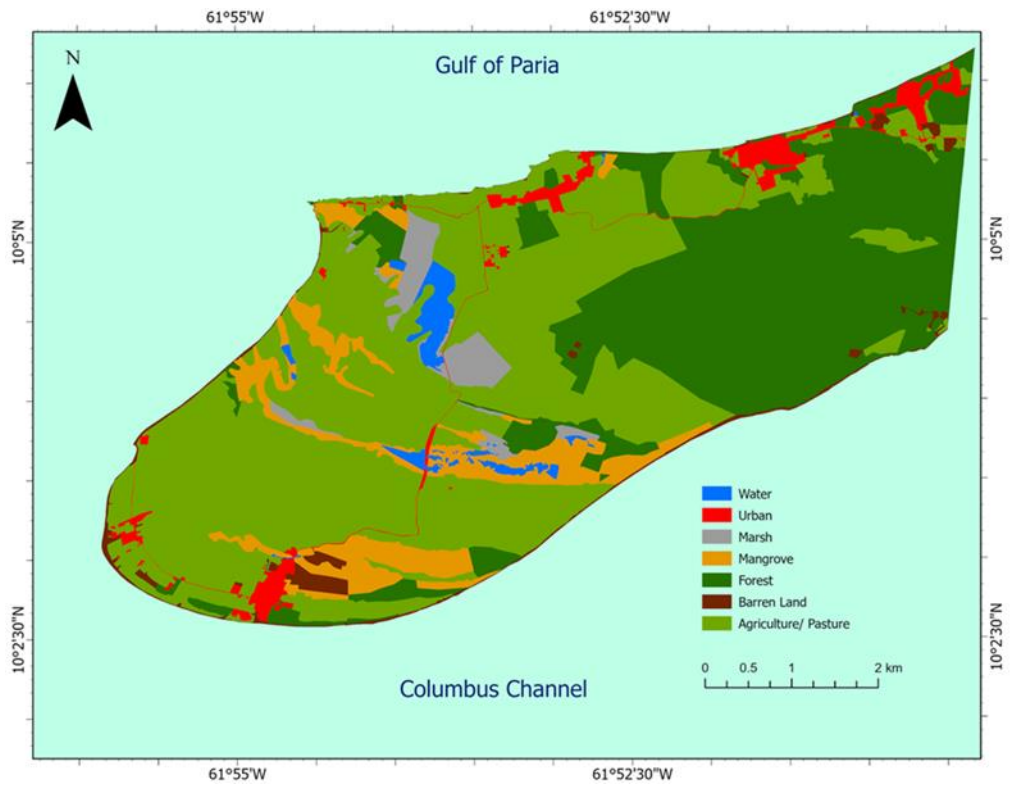


Figure 13

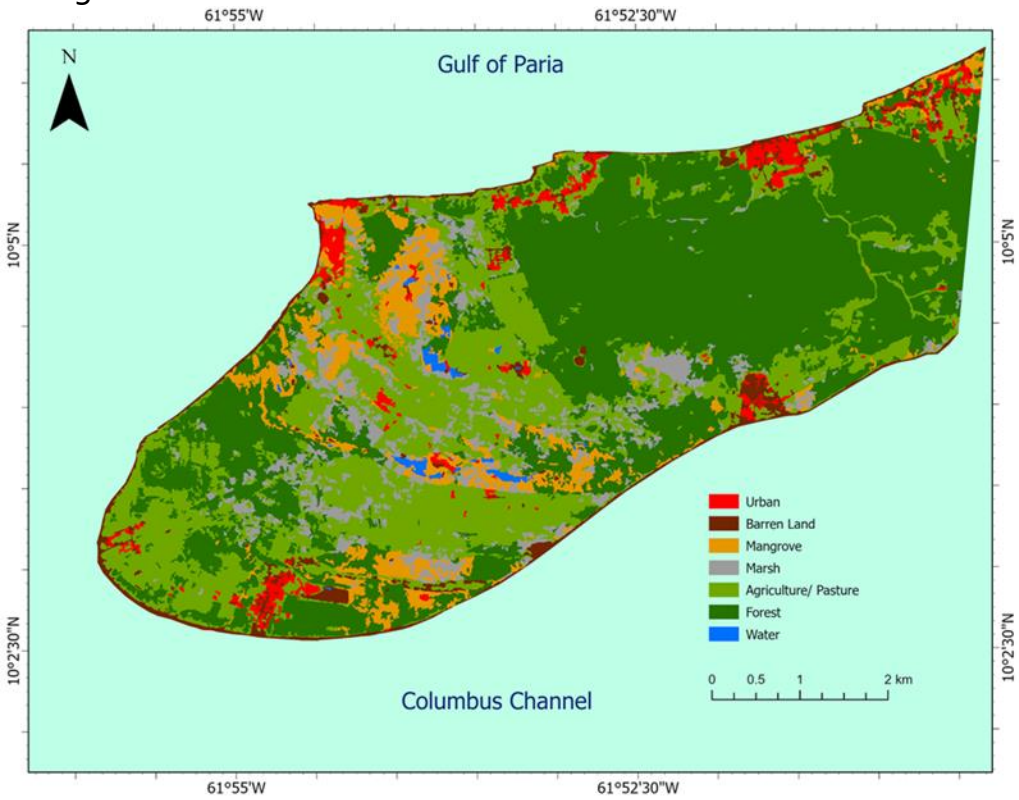


Figure 12 & 13 above a contrast of 2014 (left) and 2023 (right) maps

Results and Discussion – Change detection analysis

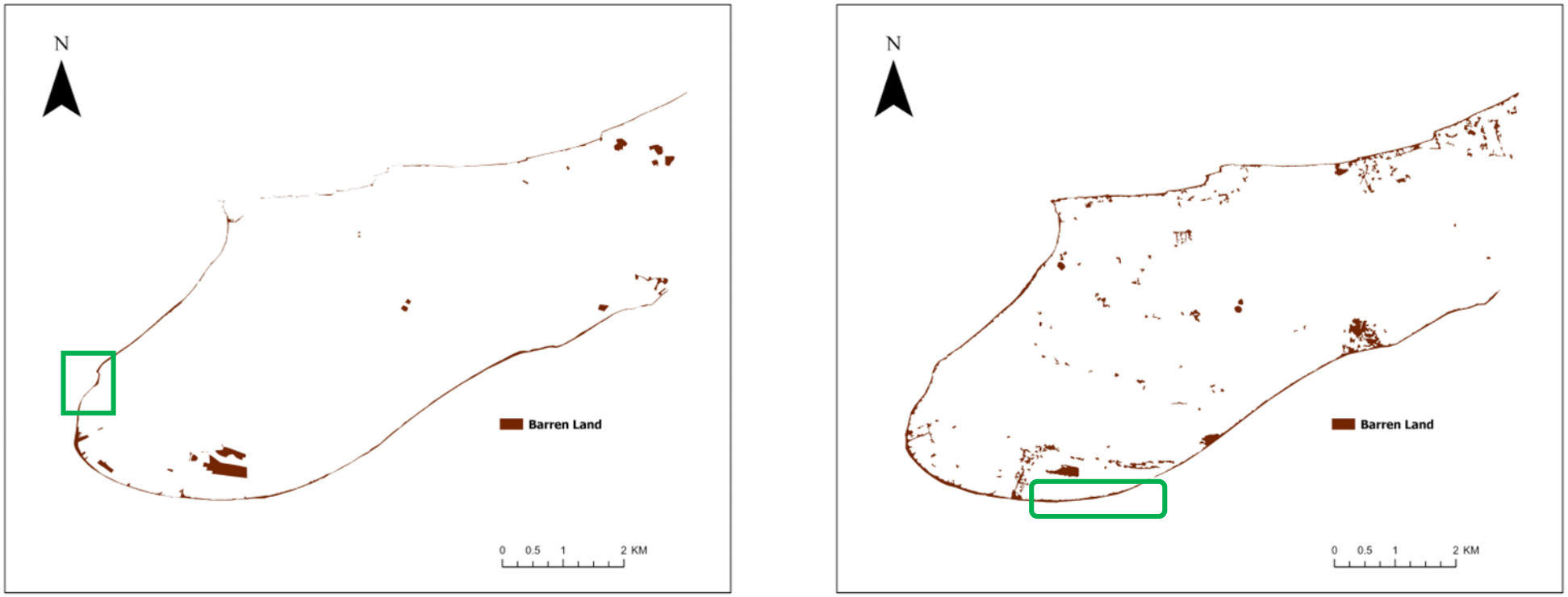


Figure 14 above displays change in Barren Land between 2014 (left) and 2023 (right)

Results and Discussion – Change detection analysis

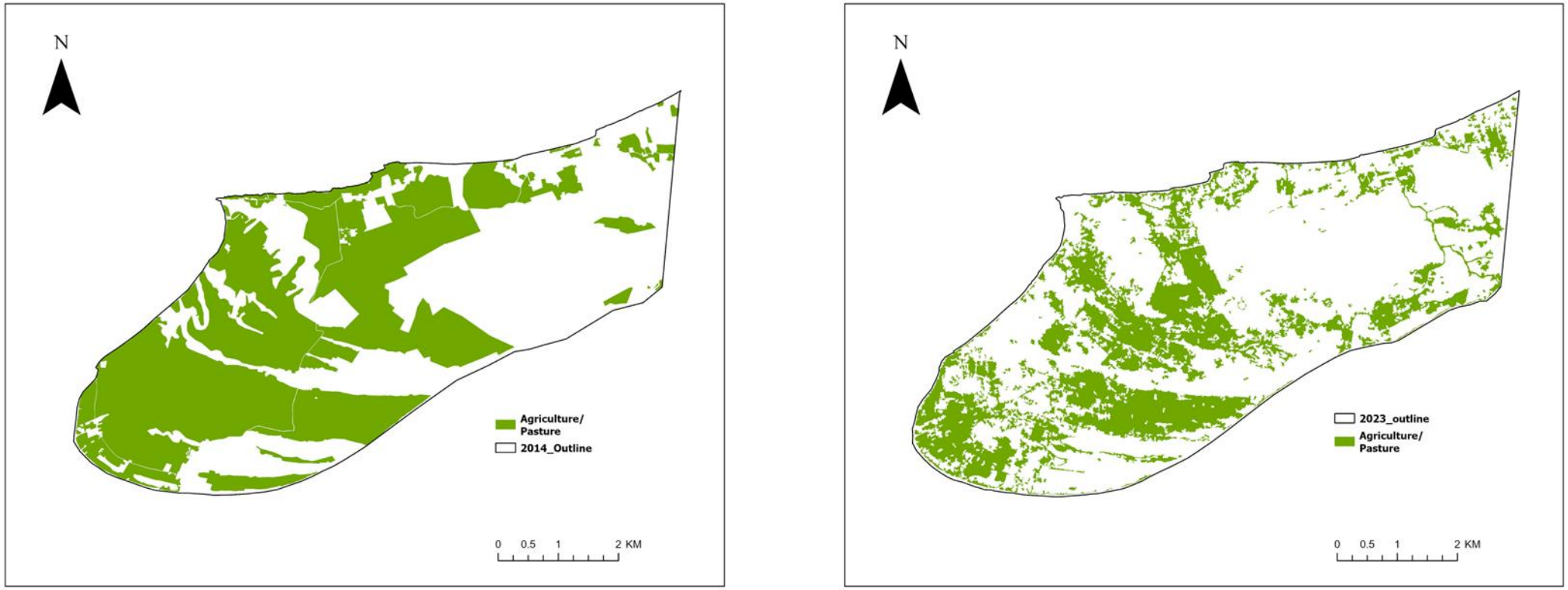


Figure 15 above displays change in Agriculture/ Pasture between 2014 (left) and 2023 (right)

Results and Discussion – Change Detection Analysis

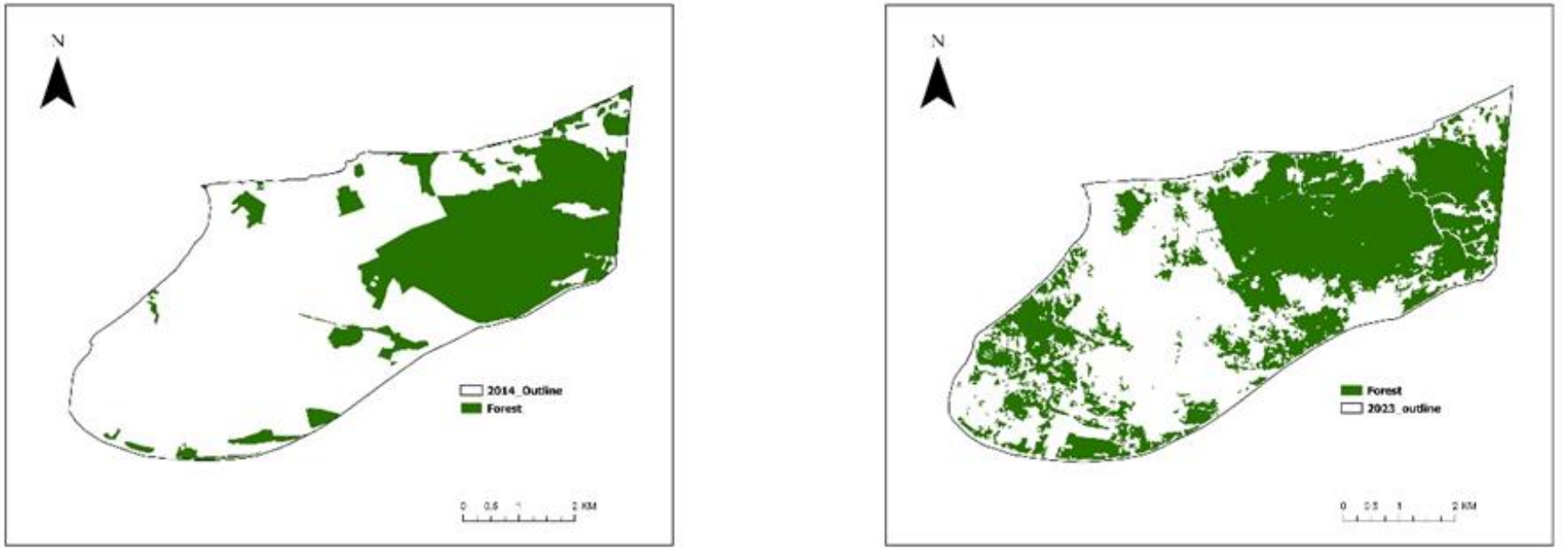


Figure 16 displays change in Forest between 2014 (left) and 2023 (right)

Results and Discussion – Change Detection Analysis

Quantitative Assessment of land use/cover change on the SW peninsula for the period 2014 - for the period 2014 - 2023

Land use/ cover class	2014 (km^2)	2023 (km^2)	Land use/ cover change (km^2)	Land use/ cover change (%)
Urban	1.25	1.14	- 0.11	- 8.80
Barren Land	0.80	1.50	0.70	87.50
Mangrove	2.80	2.60	- 0.20	- 7.14
Marsh	1	2.70	1.70	170
Agriculture/ Pasture	18.15	11	-7.15	- 39.39
Forest	11	16.60	5.60	50.90
Water	0.60	0.20	- 0.40	-66.66

Table 1 above represents the Quantitative Assessment of LULC change for 2014 - 2023

Conclusion

Quantitative Assessment of land use/cover change on the SW peninsula for the period 2014 – for the period 2014 – 2023 indicated:

- 87.50% increase in Barren Land
- 8.80% decrease in Urban
- 39.39% decrease in Agriculture/ Pasture
- 50.90% increase in Forest
- 170% increase in Marsh
- 7.14% decrease in Mangrove
- 66.66% decrease in Water

How does this relate to ICOM?

Anthropogenic activities along the coast can have both positive and negative impacts on the negative impacts on the natural environment (Davis, 2019).

- Sediment and runoff
- Increase pollutants

By engaging in LULC studies, we achieve greater awareness of land cover features that cover features that can be used to develop and implement measures to protect our to protect our marine biodiversity.

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