

**MAPPING SPATIOTEMPORAL
DISTRIBUTION OF MANGROVES IN MAFIA
ISLAND IN TANZANIA USING LANDSAT
IMAGERY**

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Presentation Outline

- **Introduction**
- **Mangroves management in Tanzania**
- **Mangrove loss in Tanzania**
- **Data and Methodology**
- **Results and Discussion**
- **Conclusion and Recommendations**

Introduction

- Mangroves are important for survival of coastal communities as they provide ecosystem services that support coastal population and their livelihoods.
- Mangroves act as a buffer that protects coastal communities from natural hazards such as tropical storms, strong winds, and even tsunamis.

Introduction cont...

- Despite the important role of mangrove forests in protecting coastal communities, more than 35% of the world's mangroves have already been cleared (Giri et al. 2011).
- There is currently little or no systematic empirical research that has been conducted to assess decline of mangroves in Mafia Island.

Objectives of the Study

- Assess spatial and temporal distribution of mangroves in Mafia Island using LANDSAT imagery for three decades (1985-2013).
- Identify and analyze main causes of mangrove deforestation in Mafia Island for three decades.
- Identify policy options that can guide planning for mangrove management.

Mangroves Management in Tanzania

- The government of Tanzania has been developing various initiatives to ensure protection and sustainable management of mangroves.
- Mangroves in Tanzania are gazetted as forest reserve since 1928 (Wang et al. 2003).
- They are protected by law to regulate and control extraction and to ensure sustainable management (Mangora 2011).

Mangroves protection initiatives in Mafia Island

Period	Year	Government Initiatives to Protect Mangroves in Mafia
1985-1995	1987	Tanzania Forest Division declared a ban on cutting mangroves
	1988	Establishment of Mangrove Management Plan (MMP)
1995-2006	1995	Establishment of Mafia Island Marine Park (MIMP)
	2002	Tanzania Forest Act allowed cutting of mangroves with a permit
	2004	Mafia Island became part of the Rufiji-Mafia-Kilwa Marine Ramsar site
2006-2013	2006	No recorded initiatives during this period
	2013	No recorded initiatives during this period

Mangrove Loss : A Global Trend

- Globally, it is estimated that about 35% of mangroves has been lost from 1980 to 2000 (Giri et al. 2011).
- This rate is expected to increase, especially in developing countries due to anthropogenic pressures such as over-harvesting of mangroves for timber.
- It is predicted that if the current rate of mangrove clearance continues worldwide, all mangroves could disappear in the next 100 years (Duke et al. 2007).

Mangrove Loss in Tanzania

- For the period between 1989 and 2000 mangroves in Tanzania decreased from 115,475.6 ha to 108,138 ha.
- This is a decrease of 7,337.6 ha or 6% for the period of about ten years

Mangroves Loss in Tanzania (1989 -2000)

Region/District	1989	2000	1989-2000
	Mangroves coverage area(ha)	Mangroves coverage area(ha)	Rate of loss/gain of mangroves (%)
Mkinga & Tanga	9,403.3	9,313	-1
Pangani	1,755.6	3,879	+121
Bagamoyo	5,635.8	5,051	-10
Dar es Salaam	2,168.2	2,516	+16
Kisarawe	3,858.3	4,092	+6
Rufiji	53,254.8	48,030	-10
Mafia	3,472.9	-	-
Kilwa	22,438.7	21,755	-3
Lindi	4,546.5	4,044	-11
Mtwara	8,941.5	9,458	+6
Total	115,475.6	108,138	-6

Source: Semesi (1992) and Wang et al., (2003)

Data and Methodology

The Study Area

Mafia covers an area of 972 km², of which 407 km² is dry land and 565 km² is covered by water.

Mafia main Island is about 48 km long and 17 km wide at its widest point

According to the 2012 census, the population of the Island was 46,438



Data and Methodology cont..

- We used Landsat 5 (1985,1995, and 2006) and Landsat 8 OLI (2013) with a spatial resolution of 30m to determine the spatial temporal changes of mangrove forests in Mafia Island.
- Analysis of the satellite images involved georeferencing, preparation of training site, classification, and accuracy assessment.
- We used supervised image classification method (Maximum likelihood algorithm) to classify the images.

Data and Methodology cont..

- Data for image classification and ground truthing for accuracy assessment were collected using GPS with accuracy of ± 10 meters.

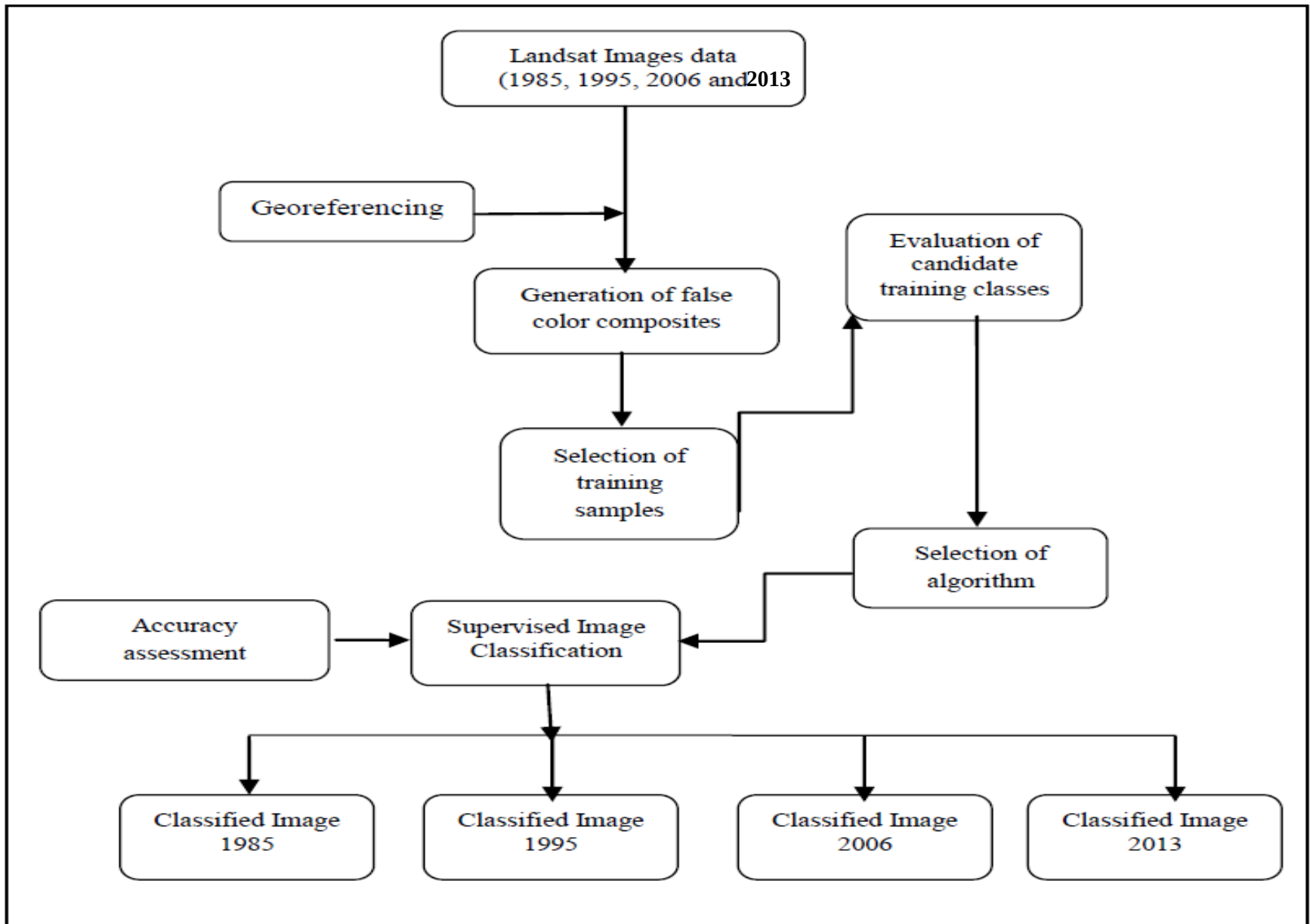


A researcher collecting sample site points using hand held GPS

Data and Methodology cont..

- The images were obtained free of charge from USGS and the RCMRD.
- In this study we used ILWIS version 3.3, an open source software for image processing, and
- ArcGIS software version 10.3.1 which is commercial software for preparation of final output maps.

Methodology Flow Chart



Results and Discussion

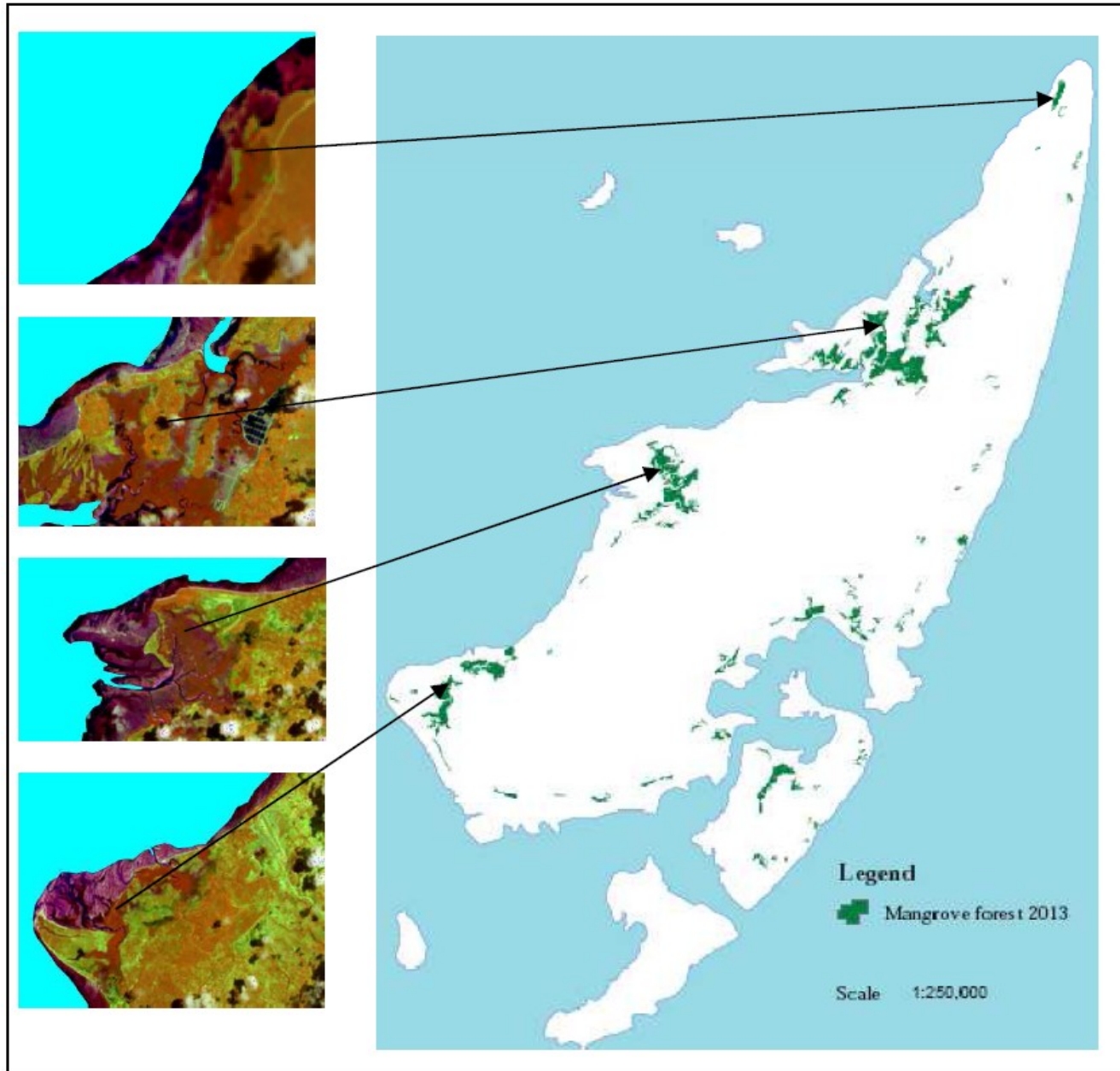
- Accuracy assessment indicated an overall accuracy of 82.14% based on the maximum likelihood classification algorithm.
- The results show a user accuracy of 90.30% and producer accuracy of 67.23%.

Colour Composite

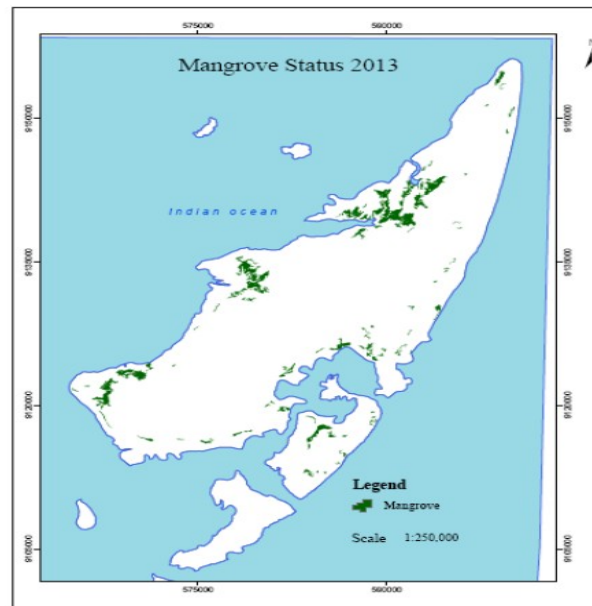
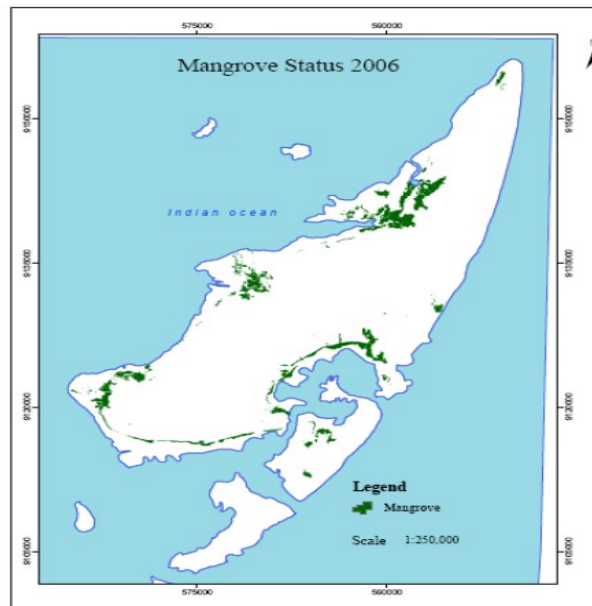
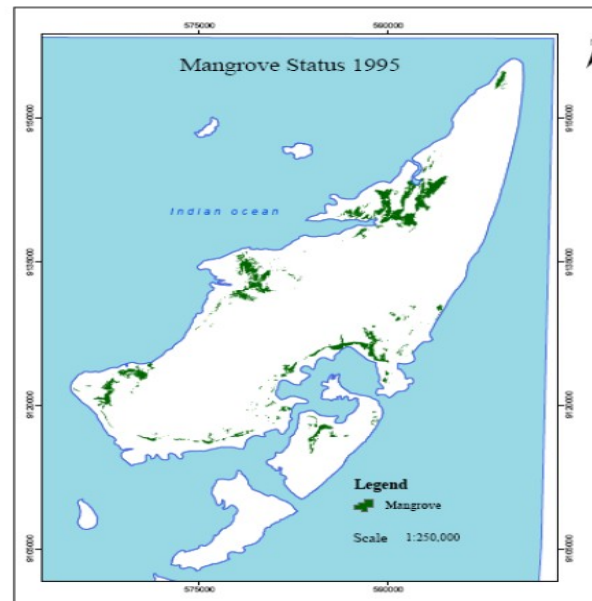
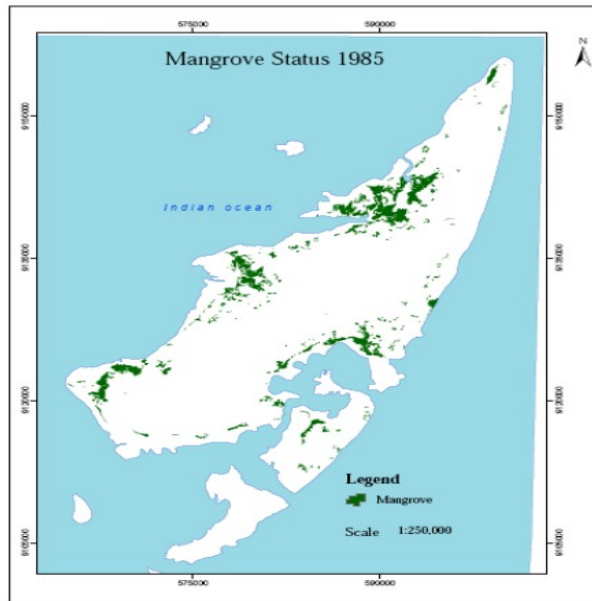
The colour composite scheme allowed mangroves to be easily detected in the image.

In the colour composite generated, mangroves appear in dark red since they have a high reflectance in the Near Infrared band.

Sections of colour composite of mangrove rich areas in Mafia Island and the final output map of classified images showing distribution of mangrove in the year 2013



Spatiotemporal Distribution of Mangroves, 1985-2013



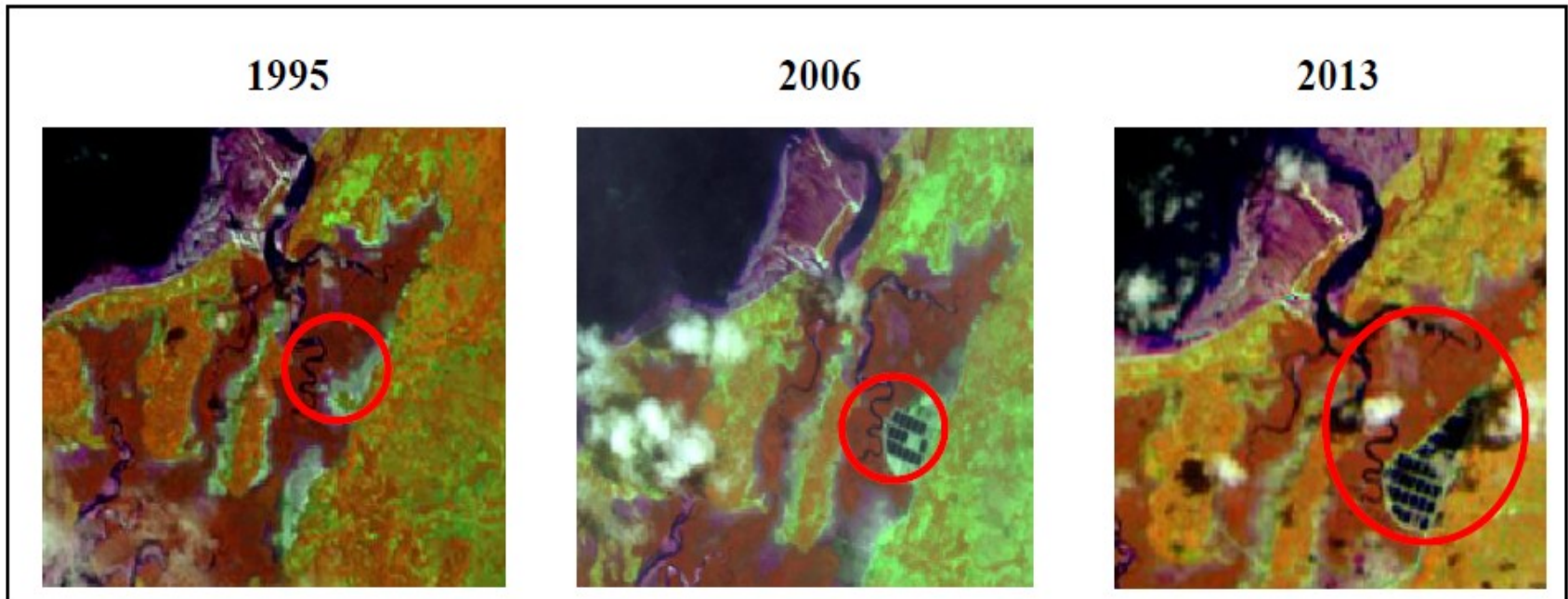
Estimated Mangroves Area(1985-2013)

Year	1985	1995	2006	2013
Estimated Mangroves Area (ha)	3,708.36	3,671.07	3,438.16	3,187.25

- The classification results show that overall mangroves in Mafia Island have been gradually decreasing over time.
- The trend suggests a loss of 521.11 ha of mangroves in the Island which is about 14% or 0.5% loss per year.

Causes of Mangroves Loss in Mafia Island

- One of the underlying factors for Mangrove loss in Mafia Island is Shrimp Farming



Mangrove Clearance for Shrimp Farming in Mafia Island



Conclusion

- This study contributes to our understanding on the status of mangroves coverage, mangrove losses and its underlying causes and the need to improve and strengthen the current policy, planning and management initiatives.
- The spatial information generated will help to improve the decision making processes for rehabilitation and conservation of mangroves in the Island.
- There is a great potential for developing countries such as Tanzania to utilize the freely available remote sensed data (e.g., LANDSAT) and GIS open source software (e.g., ILWIS) to monitor mangrove forests.

Future Studies

- Our results should be interpreted with caution as LANDSAT are low resolution satellite imagery which may underestimate the mangroves coverage.
- Further studies on mapping mangroves in the island should focus on the use of high resolution satellite imagery to improve the mangrove coverage estimation.

Recommendations for Policy Options

- Strengthen existing regulations to ensure effective mangroves planning and management.
- Change policy on utilization of mangroves to improve mangroves management.
- The existing policy and management plans could be improved by utilizing geospatial information.



THANK YOU