


# Monitoring of Forest Cover Change in Sundarban mangrove forest using Remote sensing and GIS

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# Content

- 1: INTRODUCTION
  - 2: OBJECTIVES
  - 3: METHODOLOGY
  - 4: RESULTS & DISCUSSION
  - 6: CONCLUSION
  - 7: REFERENCES
- 

# Introduction

## General Background

- Mangrove forests are one of the most important coastal ecosystems in the world in terms of primary production and coastal environment protection.
- Mangroves are evergreen forests between the land and the sea occupying tracts along sheltered coasts, estuaries and deltas where they are influenced by tides, salinity and rainfall. Mangrove forest is found in the tropical and sub tropical region. They are possibly the simplest and best defined ecosystem among tropical forests (UNESCO 1981).
- The Sundarbans mangrove forest is the world's biggest unique chunk of mangrove forest, located at the south of the tropic of cancer, southwest part of Bangladesh, covering part of Khulna, Satkhira and Bagerhat district (Iftekhhar & Islam, 2004). Sundarbans covers approximately 10,000 km<sup>2</sup>, 40% of which is in India and the 60% is in Bangladesh (WCMC, 2005).

# Introduction (cont)

## Problem Statement

- As Bangladesh is a densely populated country, overexploitation of forest resources to meet the growing requirement of the people is one of the main problems in the SF. This has resulted in depletion of economically valuable species, growing stock and productivity of the forest. Other problems in this forest are geo-morphological changes, increased salinity, inadequate regeneration, top dying of *Heritiera fomes*, extended shrimp farming in the surrounding of the forest etc. These problems frequently shift the SRF towards a state of unsustainability.
- Increased salinity will change the habitat pattern of the forest. Sundari, the most dominating trees of the Sundarbans is thought to suffer from *Top dyeing disease* because of increased salinity (Kausher, 1993).

# Introduction (cont)

## Justification for the Study

- Remote sensing and Geographic Information Systems are providing new tools for advanced ecosystem management. (Wilkie and Finn, 1996).
- Remote sensing could play an important and effective role in the assessment and monitoring of mangrove forest cover dynamics. While remote-sensing data analysis does not replace field inventory, it provides supplementary information quickly and efficiently.
- The use of remotely sensed data offers many advantages including synoptic coverage, availability of low-cost or free satellite data, availability of historical satellite data, and repeated coverage. In addition, recent advances in the hardware and software used for processing a large volume of satellite data has helped increase the usefulness of remotely sensed data.

# Introduction (cont)

- Moreover, it is extremely difficult to get into vast swamps of mangrove forests, and conducting field inventory is time consuming and costly. (Islam et al., 1997; Dwivedi et al., 1999; Blasco et al., 2001; Nayak et al., 2001).
- Remote sensing offers an efficient and reliable means of collecting spatial information required for assessing forest cover. Satellite Remote sensing technology is a potentially fast and efficient approach to mangrove management, mapping and monitoring.

# Project Objectives

Some specific objectives such as

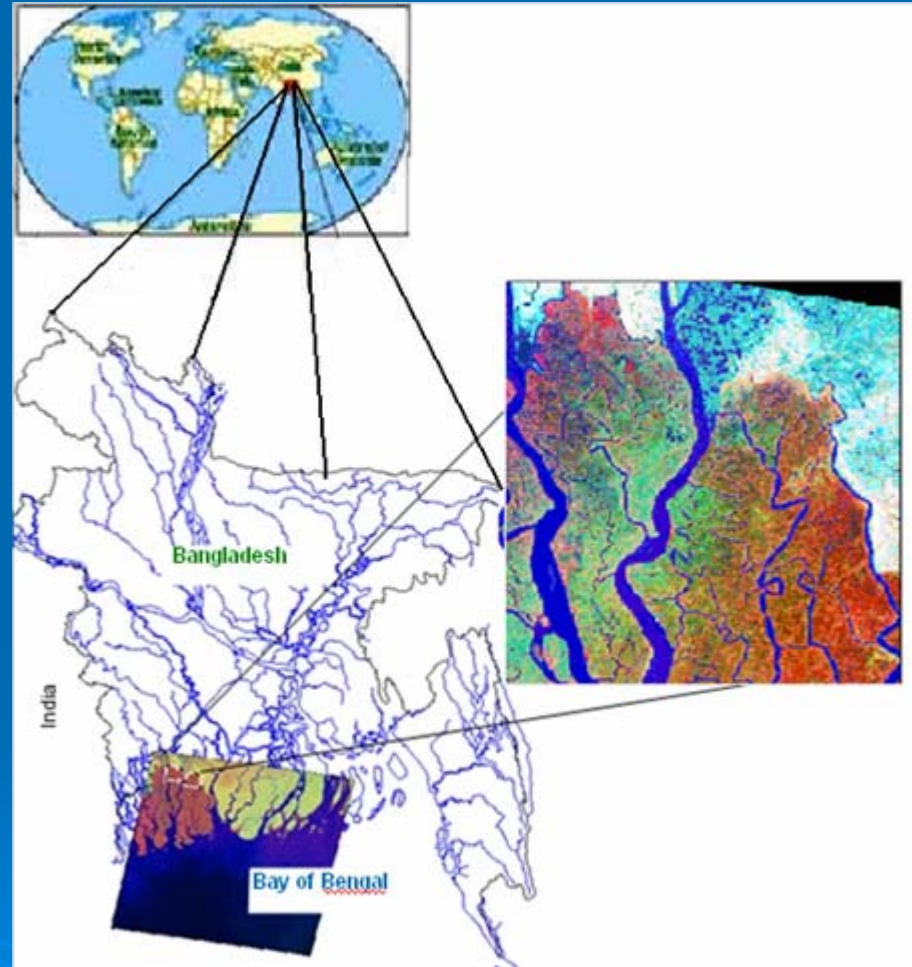
- a) to develop an appropriate classification map to represent the forest cover in this area
- b) to evaluate the forest cover change (sundori) in study area for the period of 1989 - 2000.
- c) to possibly assign reasons for these changes over the years.



# Methodology

## Location of the study area

- The study analyses the forest cover located in the southwest part of Bangladesh.
- The study area is located in the north east part of the Sundarbans, which stands between latitude  $22^{\circ}30'25''\text{N}$  and longitude  $22^{\circ}15'35''\text{N}$ .





# Methodology cont.

- The Sundarbans mangrove is divided into four management units called Forest Range that is Khulna, Chandpai, Sarankhola and Satkhira ranges.
- The study area is the part of management unit namely Khulna and Chandpai Forest Range and covered an area about 44.327 hectares of the SRF.
- The human communities, their agriculture, shrimp farming and commercial activities surround the north part of the study area. The other parts surrounded with forests and rivers.



# Methodology cont.

- **Data collection for study area**
- **Landsat Imagery**
- In this study Landsat ETM+ of 26th November of the year 2000 and Landsat TM data of 12th January of the year 1989 was used that is available freely through the Global Land Cover Facility (GLCF) (<http://glcf.umd.edu>).
- The images obtained for the study were rectified and geo-referenced to the World Geodetic System 1984 and projected to the Universal Transverse Mercator (UTM) map projection system (zone 46). Thermal band (band 6) was not used for both TM and ETM+.

# Methodology cont.

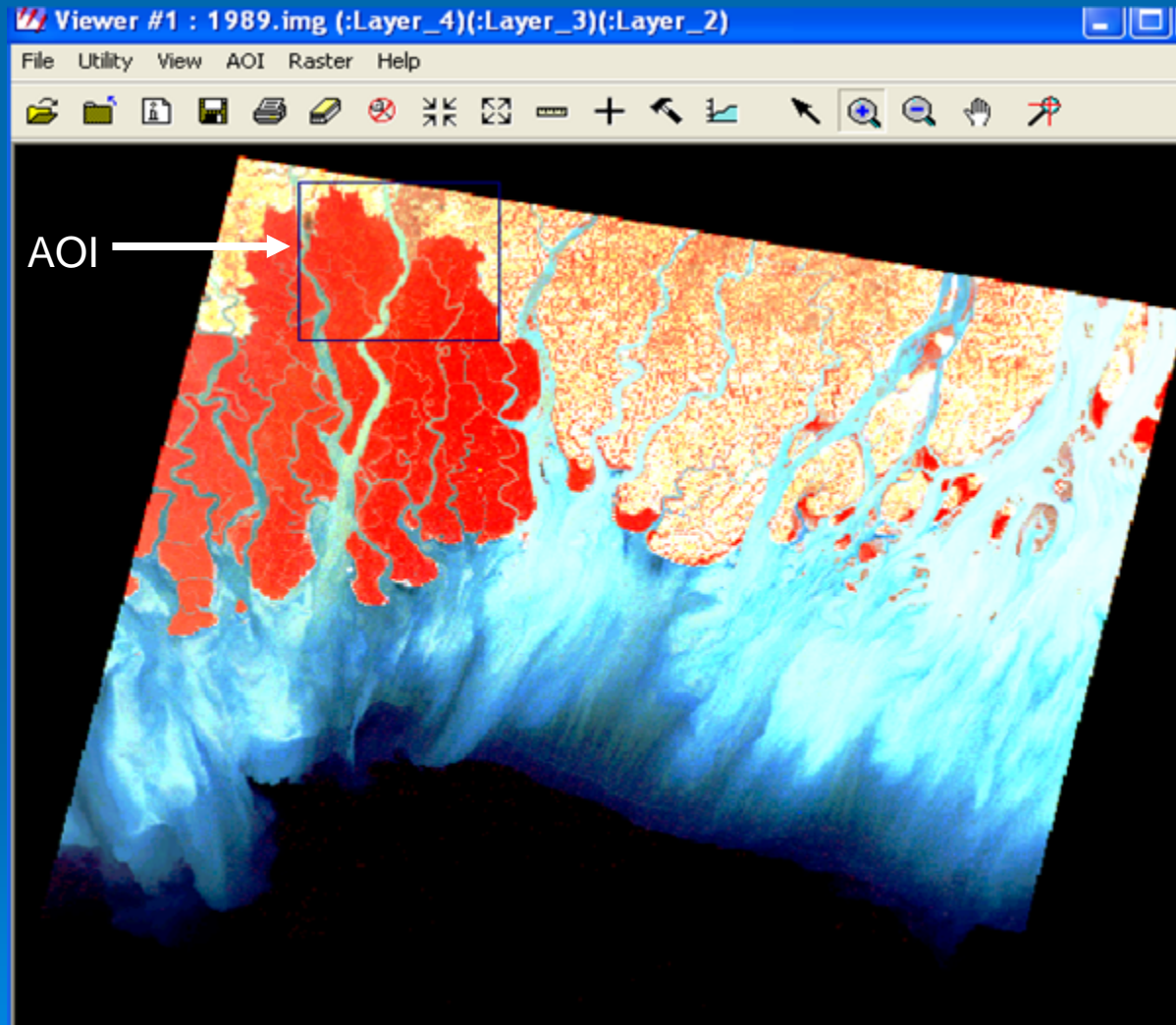
## Image preparation and analysis

- The image processing techniques employed in this study were conducted using Erdas Imagine 9.1 software, produced by Leica Geosystems. The reason for using this software was because, it was very simple to use and worked faster.
- The images were downloaded as individual bands 1, 2, 3, 4, 5, and 7 respectively and stored separately. However, band 6 was unavailable of 1989 year so I skip it for both images. The downloaded all band were compressed and had to be unzipped. The uncompressed bands were then stacked into single images for both 1989 and 2000 respectively. These were done by using Erdas imagine tools.



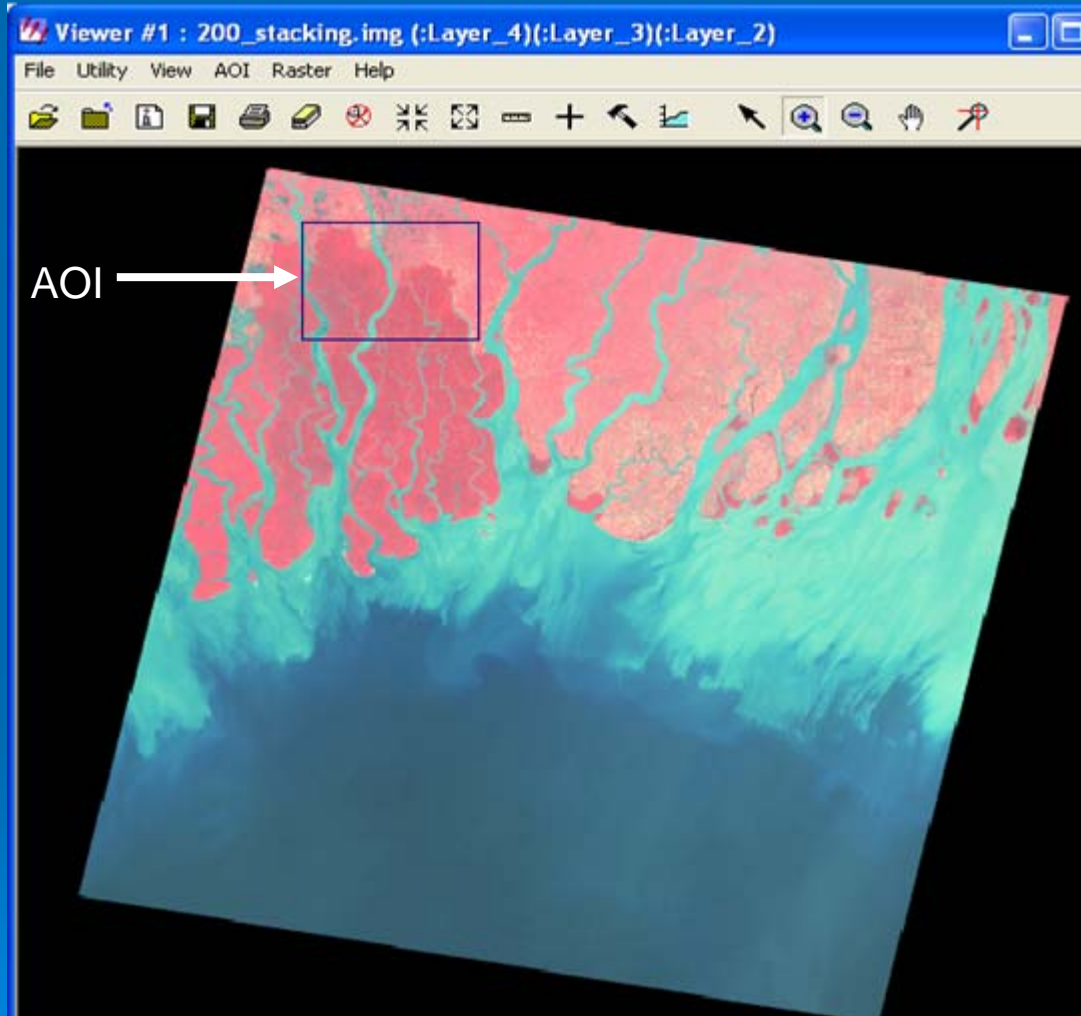
# Methodology cont.

## Stacked Bands into single Image for 1989



# Methodology cont.

Stacked Bands into single Image for 2000



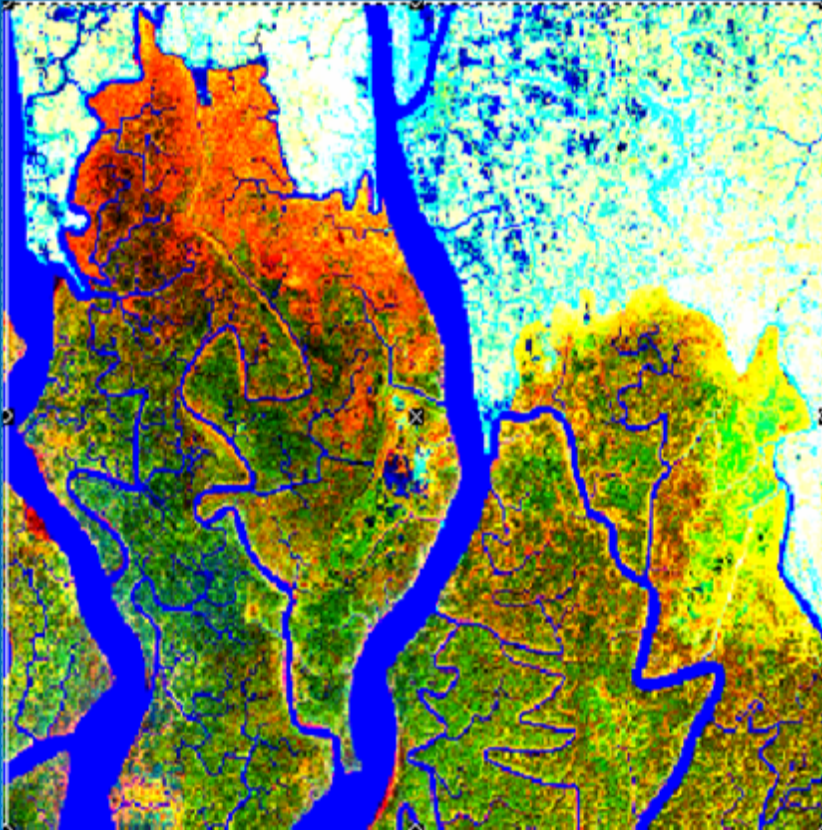
# Methodology cont.

## Image preparation, analysis and classification

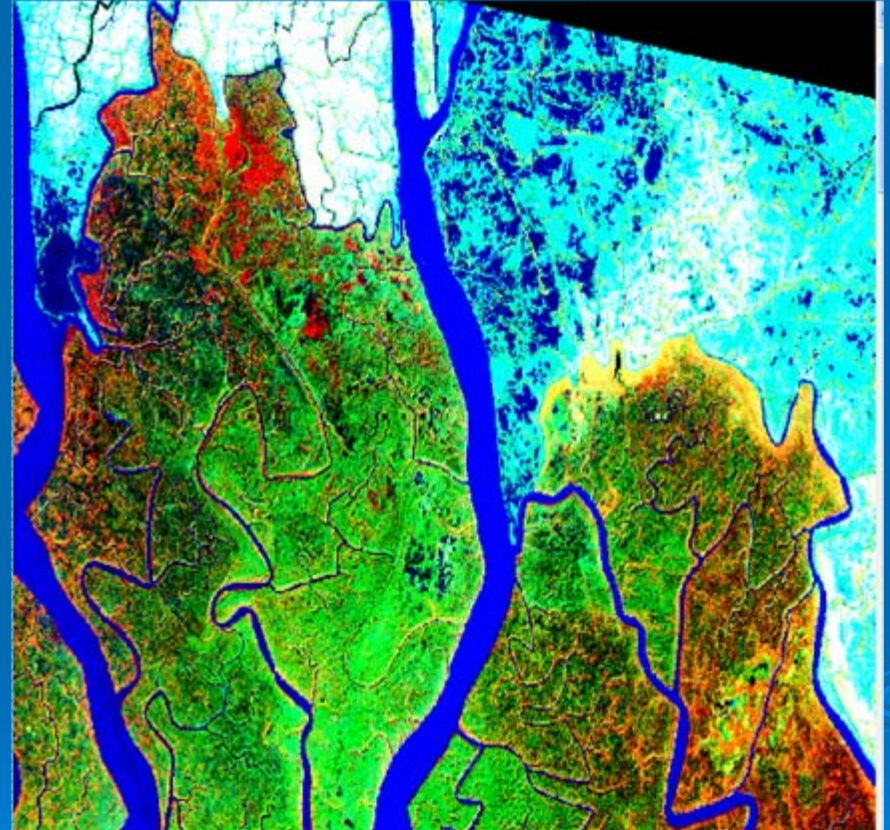
- For image processing, it requires several processing steps for better identification of the image features. Contrast stretching and formation of color composite were performed as an aid in identification of the cover classes.
- After applying the histogram stretch and appropriate brightness contrast, the both image was classified through supervised classification using "Maximum Likelihood classifier", on the basis of known ground truth points. The entire Landsat TM and Landsat ETM data have been classified into eight classes for the study area and analyzed to evaluate forest cover changes between the year of 1989 and 2000.



# Methodology cont.



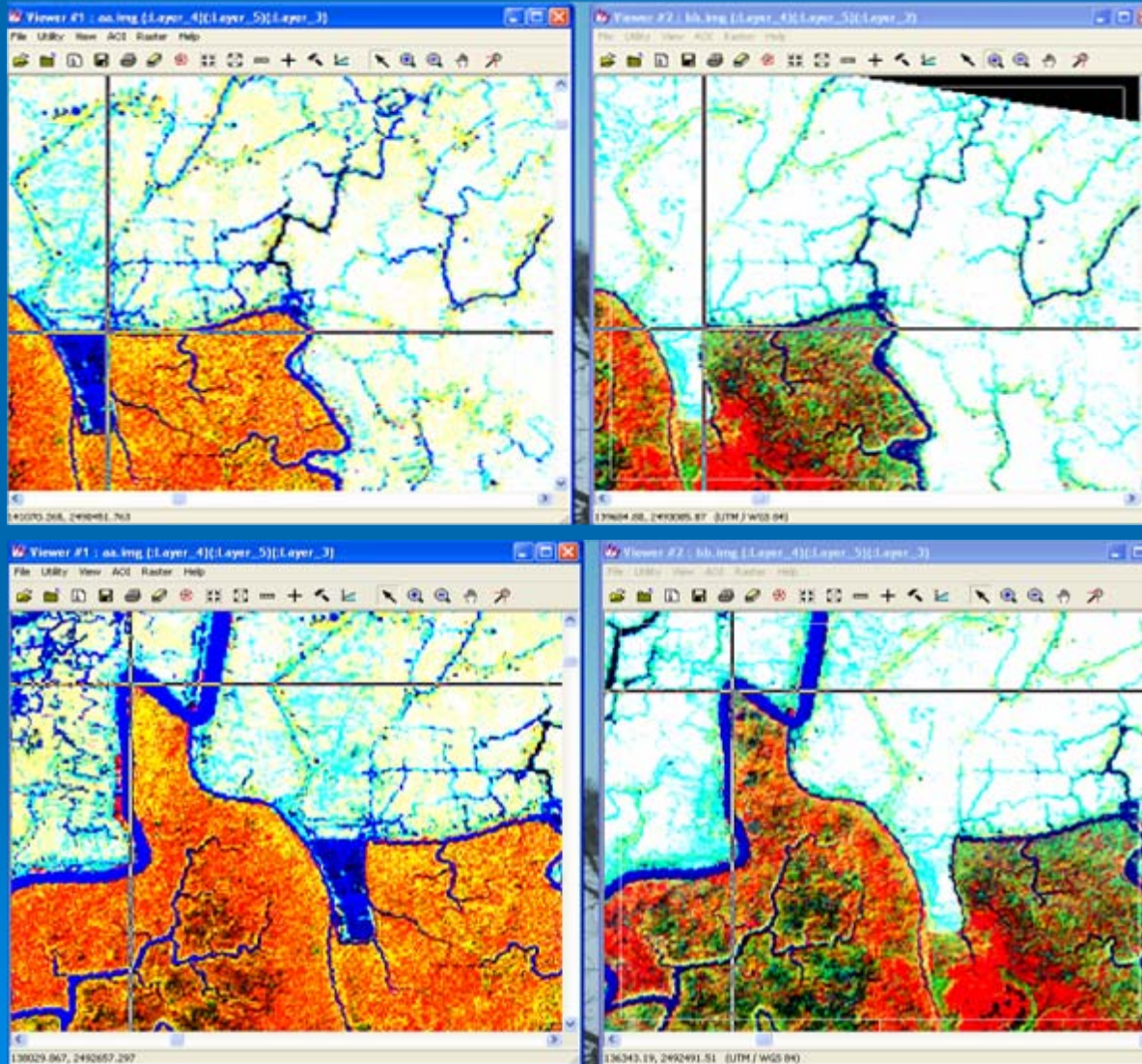
Colour Composite of the study area compiled from Landsat ETM 2000 image (bands 4,5,3)



Colour Composite of the study area compiled from Landsat TM 1989 image (bands 4,5,3)



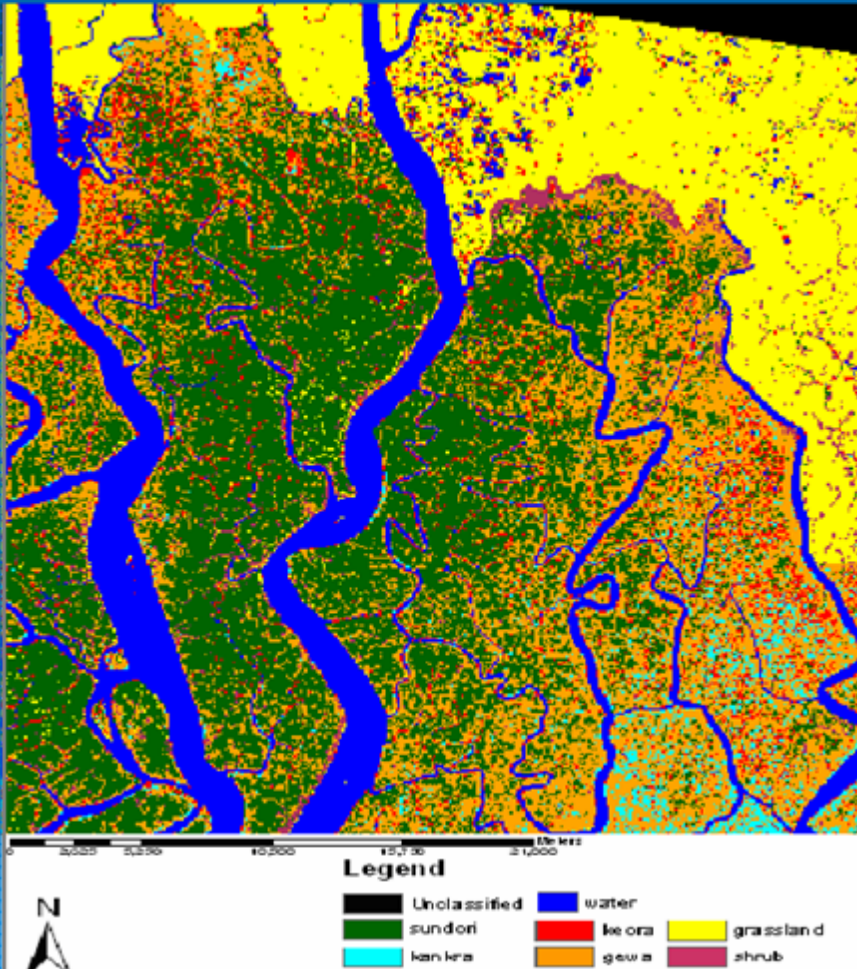
# Methodology cont.



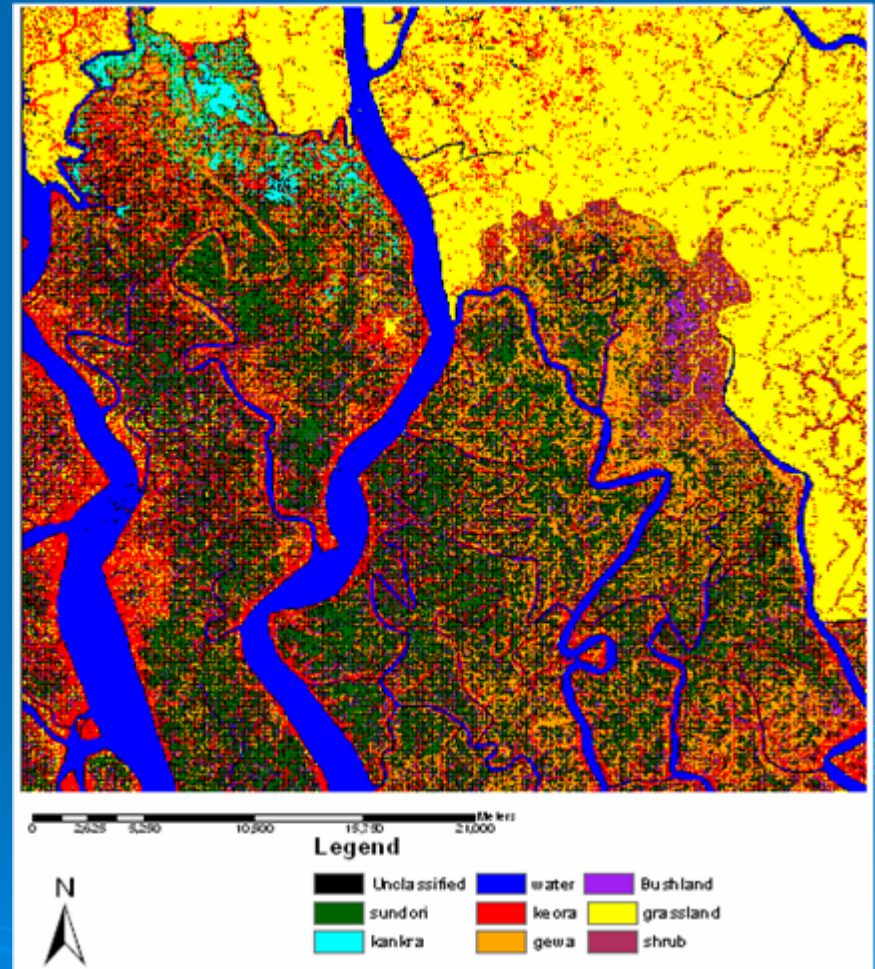


# Result & discussion

## Supervised clasifcation



Forest cover map of the study area in SF, derived from Landsat TM(1989)



Forest cover map of the study area in SF, derived from Landsat ETM+(2000)

# Result & discussion cont.

## Forest cover change

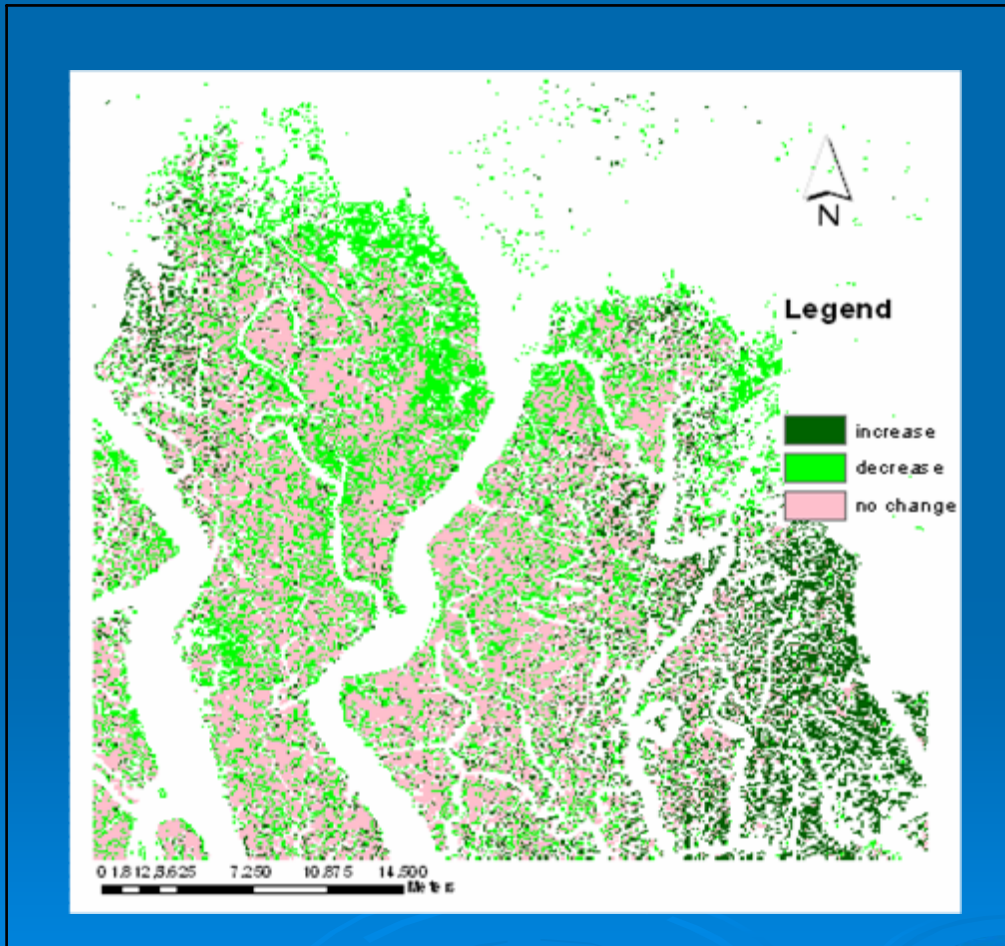
classes	1989		2000		change 1989-2000	
	Hectares	% Area	Hectares	% Area	Hectares	% Area
Sundri	25027.3	53.0	18308.4	41.02	3719.3	-11.98
Gewa	16184.4	34.2	16928.4	38	643.3	3.8
Kankra	196.4	0.5	1906.1	4.3	1715.5	3.8
Keora	43.8	0.1	81.7	0.2	37.9	0.1
Bush land			386.7	0.8	386.7	0.8
Shrub	569.5	1.2	463.3	1.02	-106.3	-0.18
grassland	558.7	1.18	872.2	2.0	213.6	0.2
Water	4726.6	10	5681.0	12.73	854.4	2.73

# Result & discussion cont.

- **Table** shows decreasing of 11.98% area of Sundri and 0.18% area of shrub during the period from 1989 to 2000.
- Area of Kankra, Gewa increased about 3.8%, 3.8% respectively and bush land was introduced within this 11 years period.
- Almost all the rivers in the study area have increased their width within the respective period.



# Result & discussion



shown the changed and unchanged areas for the one largest forest cover classes Sundri.

# Conclusion


- The causes identified as being responsible for changes of forest cover can be classified into two major groups - natural causes and man made causes. The natural causes are also affecting the study area during the whole year.
- Flooding causes erosion along the banks of the courses of the river almost every year.
- From the records it is proven that cyclones also destroy a considerable amount of forest periodically.
- The loss of considerable amount of Sundri trees has also been reported due to the die back disease in the study area.



# Conclusion cont.

- Man made causes is tremendously affecting the sustainability of the use of forest products.
- Most people living in the surrounding of the forest territory are mainly engaged with shrimp farming, collect regularly fuel wood, poles, posts for house construction and fencing, fish traps as well as boat building materials for their needs.

# Conclusion cont.

- The images from Landsat TM for 1989 and ETM+ 2002 showed the extensive changes in forest cover during this 11 year period.
  - However serious analysis could not be made as the both Landsat image was of low quality. This means a future research should be conducted using better images.
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# Reference

Iftekhar, M.S., Islam, M.R., 2004. *Managing mangroves in Bangladesh: A strategy analysis*, Journal of Coastal Conservation 10, pp.139-146.

UNESCO. 1981. Bibliography on Mangrove Research. 1600 - 1975, ISBN - 92 - 3 101819 - 10189 - 1.

WCMC (UNEP World Conservation Monitoring Centre), 2005. Protected Areas Database. Available from [http://www.wcmc.org.uk/data/database/un\\_combo.html](http://www.wcmc.org.uk/data/database/un_combo.html)

Wilkie, D.S., and Finn, J.T., 1986. Remote Sensing Imagery for Natural Resources Monitoring. Columbia University Press, New York. P. 295.

<http://glcf.umd.edu>

<http://www.mangrove.de/mangrove/english/index.php?id=wachstum&submenu=mangroven&le=1&re=0>

THANK YOU FOR YOUR ATTENTION

