

Dynamics and Impact of Land use/ land cover change of Mahanadi delta region, India

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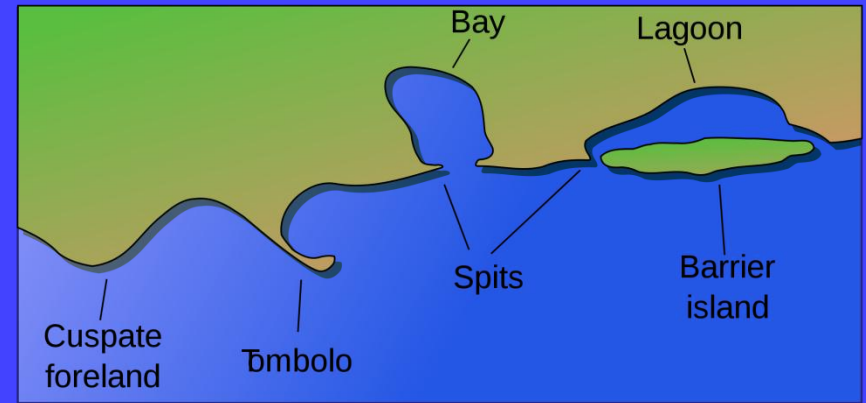
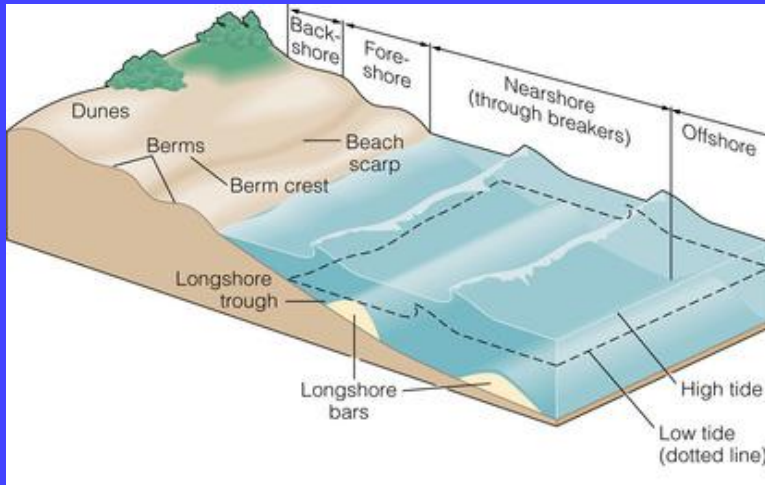
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Talk outline

- 1. Introduction**
- 2. Study area and data**
- 3. Need for the study**
- 4. Change detection analysis**
- 5. Summary**

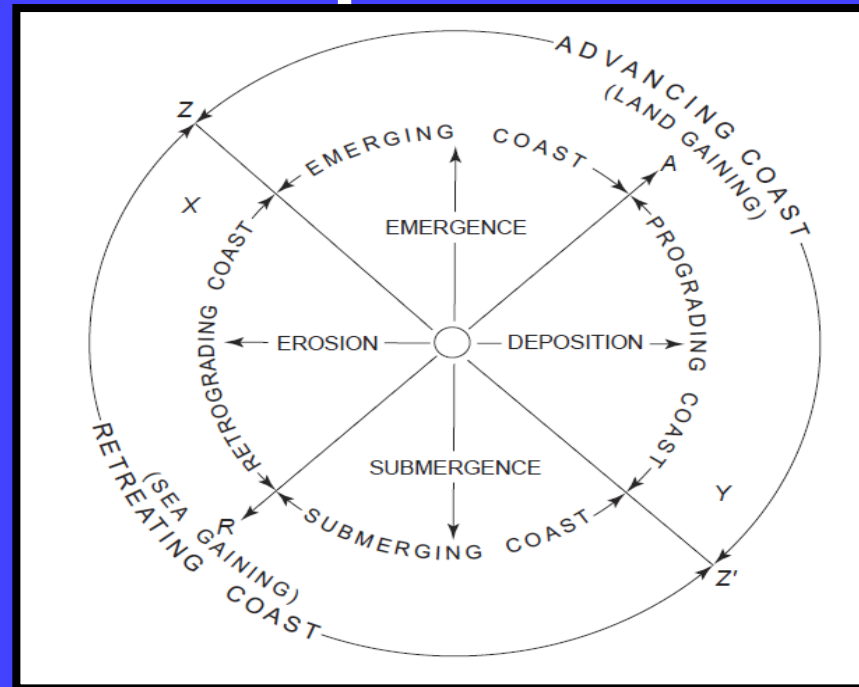
Introduction



- A zone between the land and sea is called coastal zone
- Coastal landforms - the result of the interactions of the physical processes, man-made influences, global tectonics, local underlying geology.
- Morphodynamics - the interaction of physical processes and geomorphic response

Introduction contd...

- It is important to explore the processes responsible for the coastal geomorphological changes
- The nearshore dynamics contributing to the erosion –accretion processes



Analysis of coastline changes in terms of emergence and submergence, progradation and retrogradation as proposed by Valentin (1952)

Factors controlling the coast (modified after Davies, 1972)

| | |
|-------------------------------------|---|
| Factors of the Land | |
| Geological structure | Plate tectonics, mountain ranges, continental shelf width, relief |
| Isostatic sea level change | tectonic isostasy, glacial isostasy |
| Local geology | Local structure, rock type |
| Geomorphic processes | River valleys, deltas, sediment supply |
| Eustatic sea level change | glacial eustasy, geoidal changes |
| Wave climate | Orientation of the coast, wind and storm climatology |
| Tides | Tidal range, tidal type, tidal currents |
| Ice effects | Shorefast ice, winter ice cover |
| Local erosion and deposition | coastal erosion, transport and deposition processes |
| Biological effects | mangroves, salt marshes, coral reefs, sea grass beds, coastal dune vegetation |

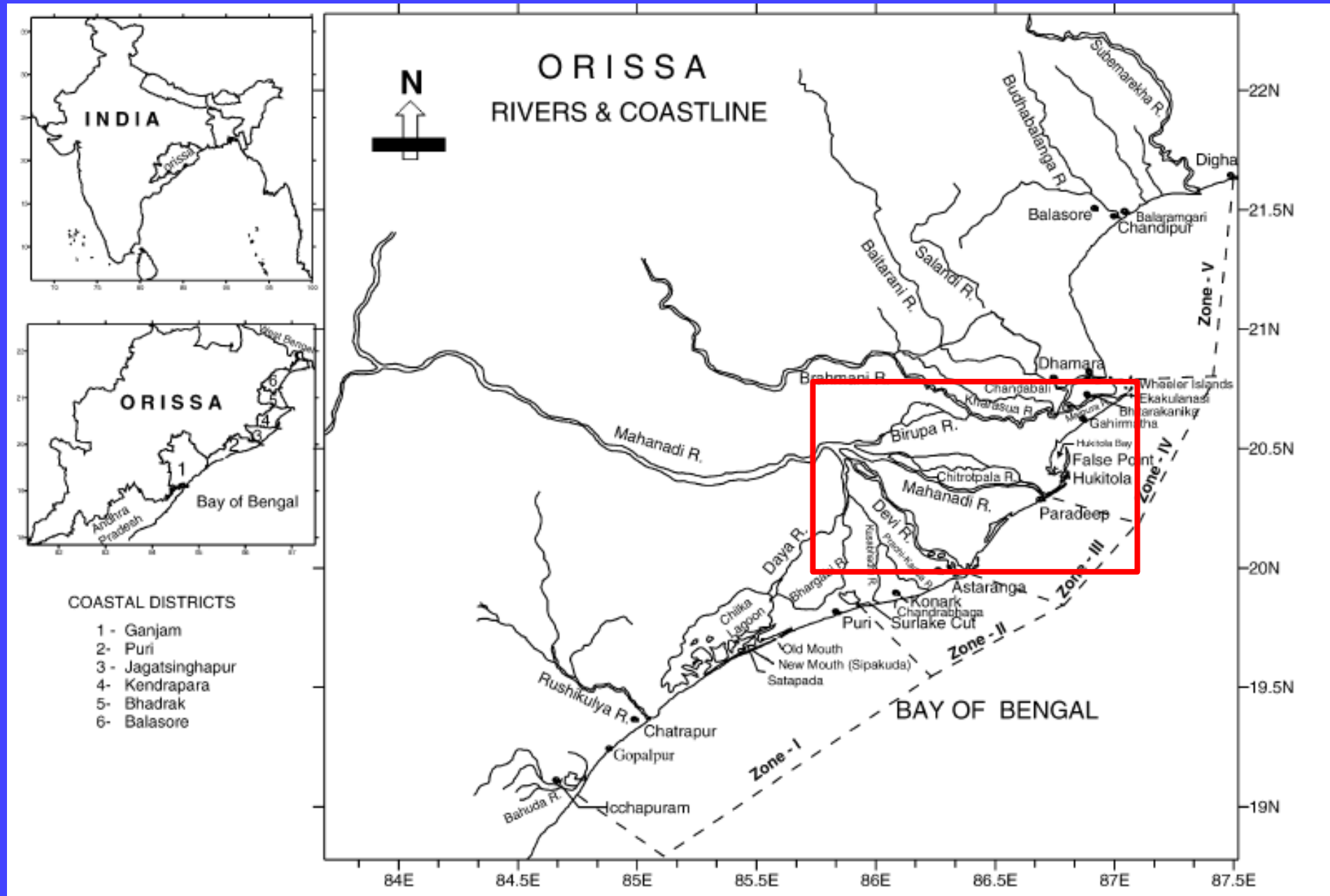
Significance of the proposed study

- ❖ The coastal environments are particularly vulnerable to global changes, whether these are caused by sea-level changes, **changes in sediment supply and human influence** or demographic changes.
- ❖ The interaction of all these simultaneous changes will cause different impacts on different types of coasts.



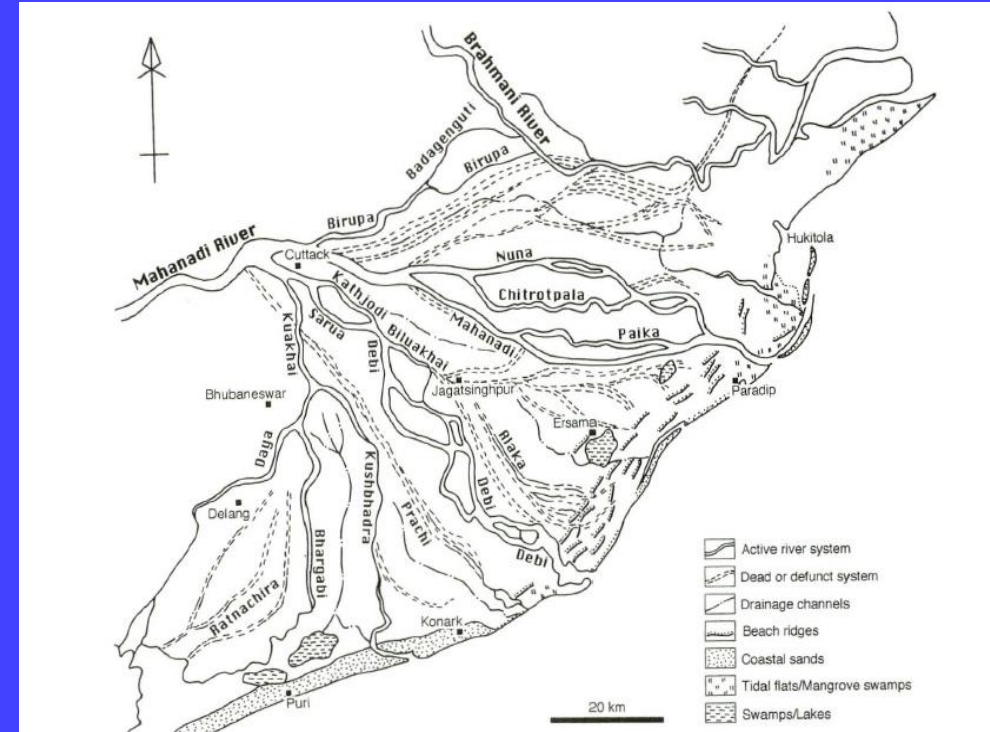
<https://collidecolumn.wordpress.com/>

Study area (Mahanadi Delta region)



Study area

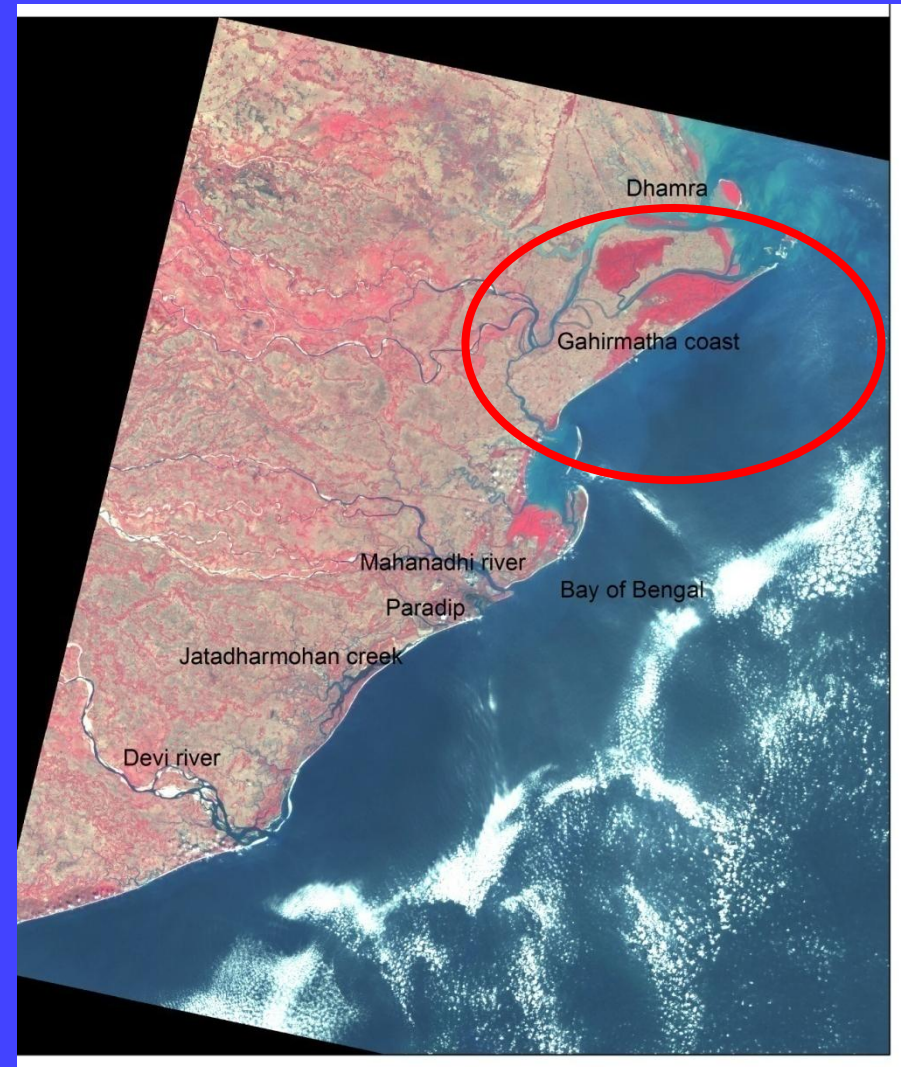
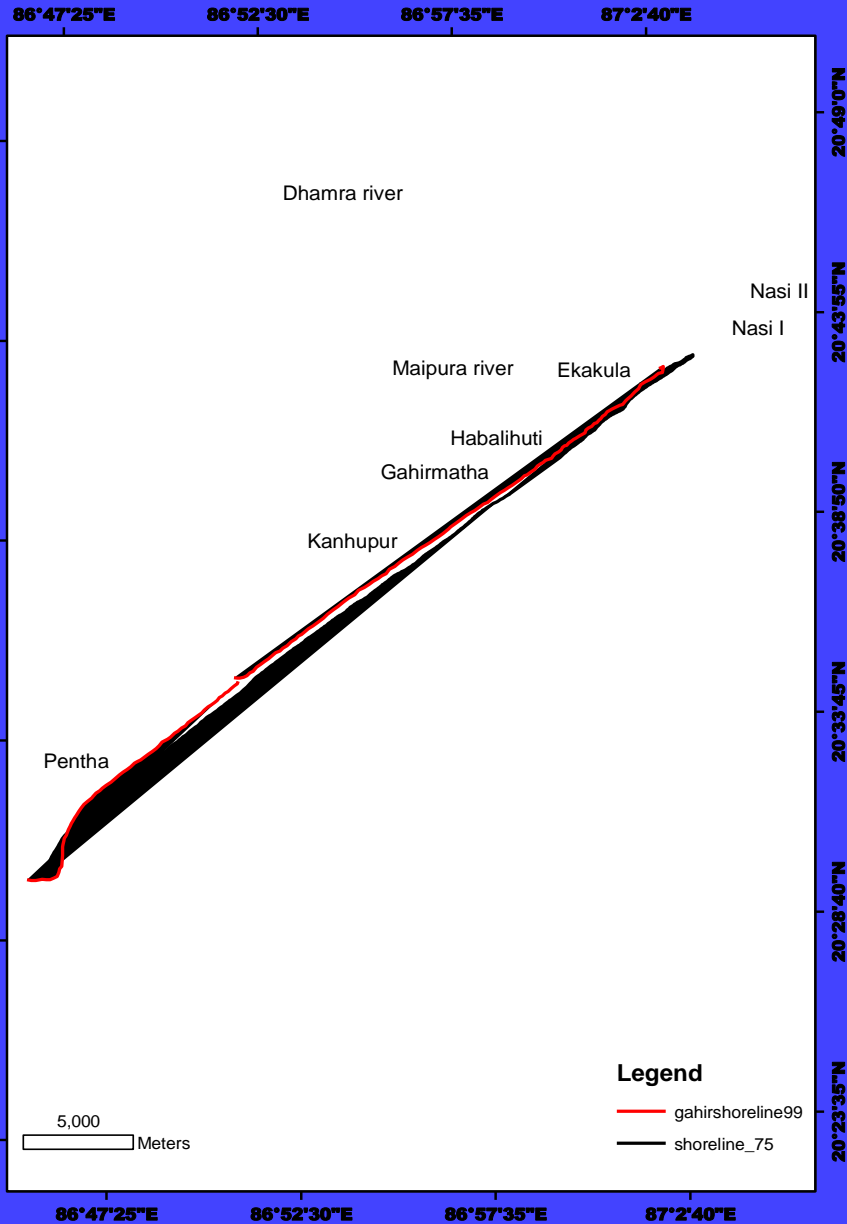
- It has 150 km long coastline
- The study area extends from Devi to Dhamra rivers
- Mahanadi delta region



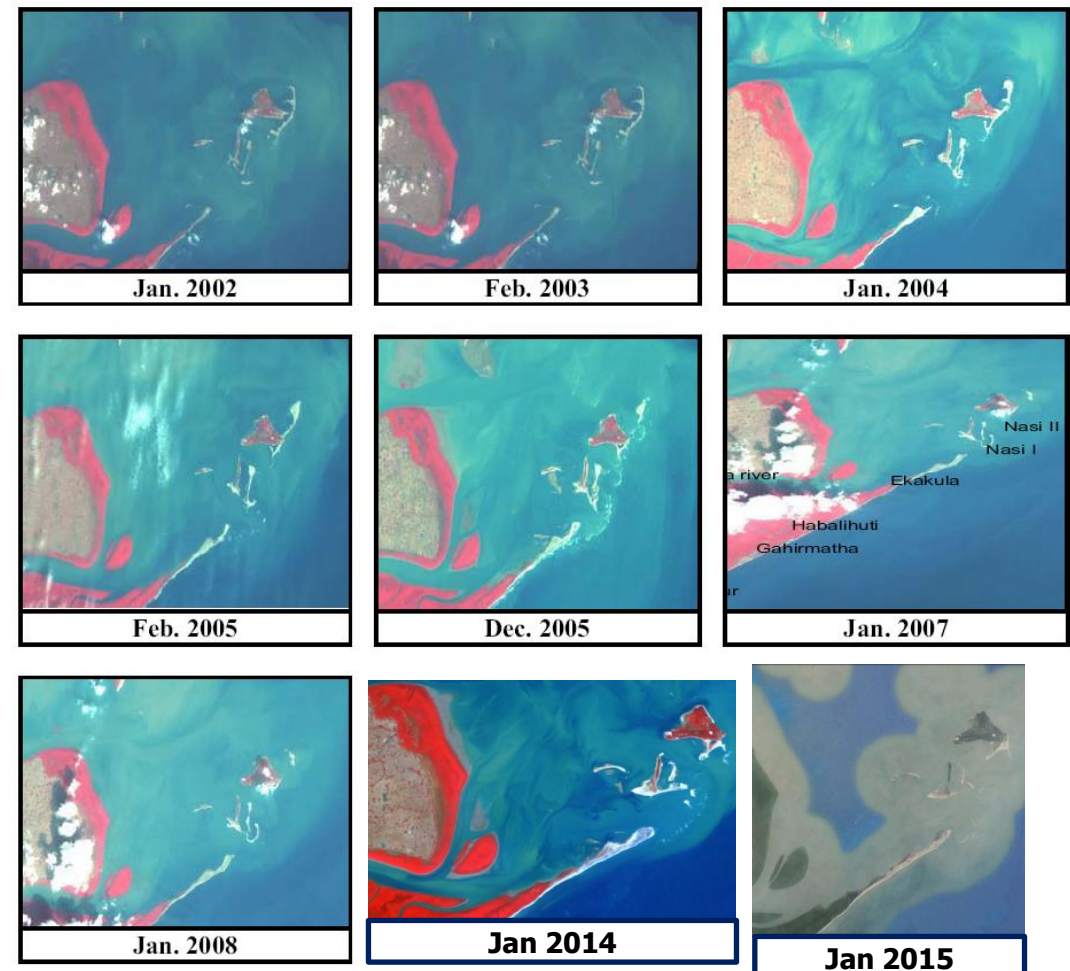
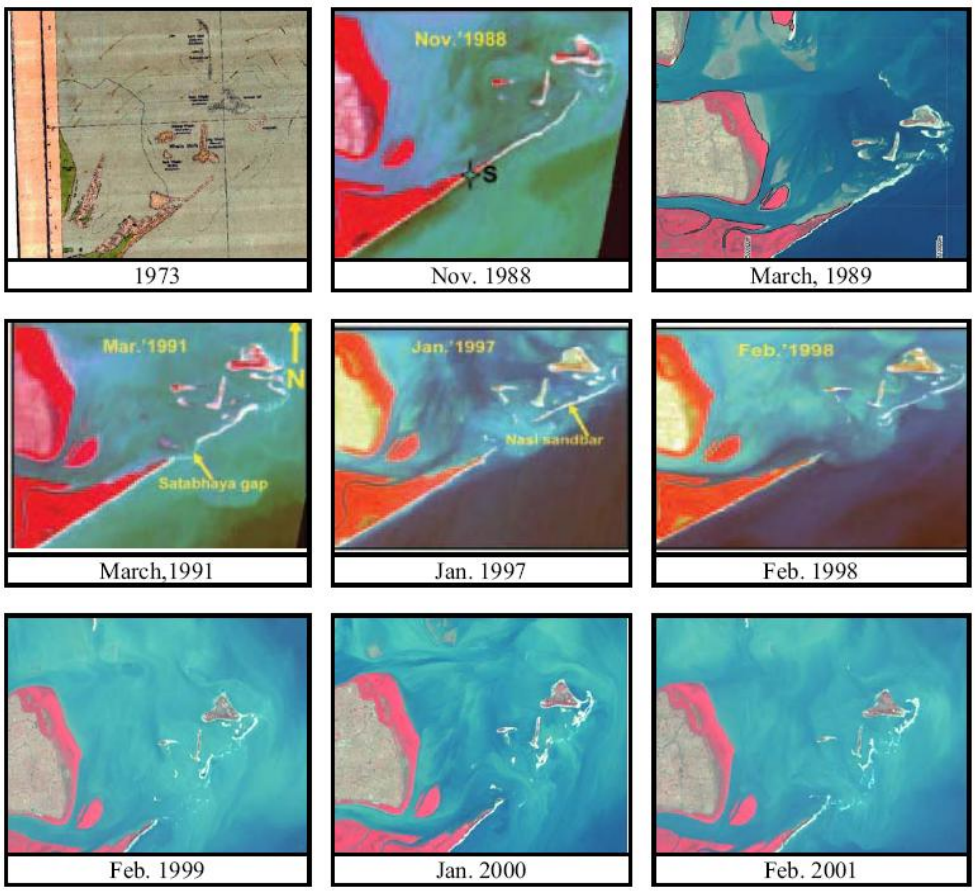
Geomorphic features of Mahanadi delta region
(Mahalik et al., 1996)



Inter-annual variability of the coastal geomorphology



Progressive changes of Ekakula spit



1973 – 1999 - 1.8 km

1999 – 2008 +2.7 km

1999 – 2015 + 4.0 km

1999 - 2015

1999



2015



4 km increase in the spit length

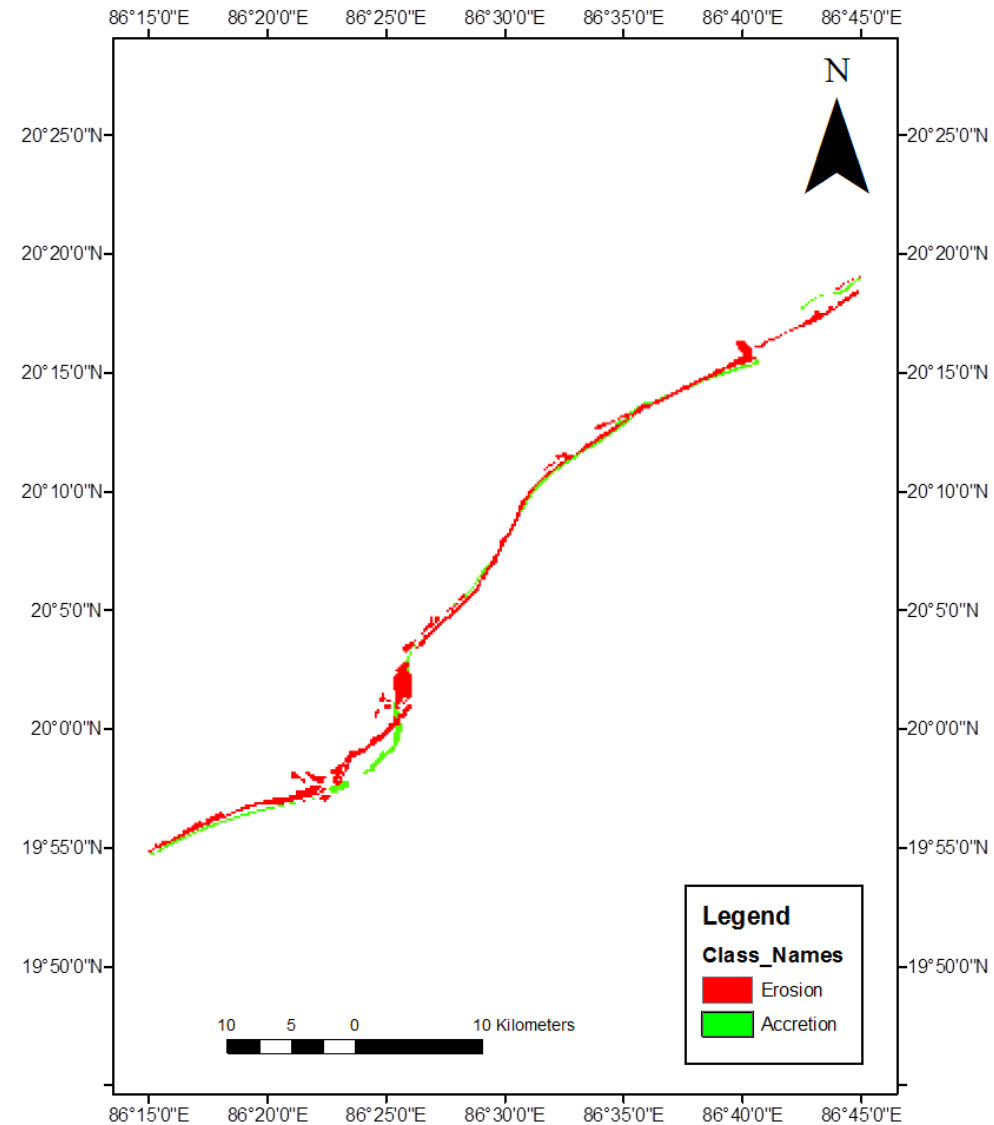
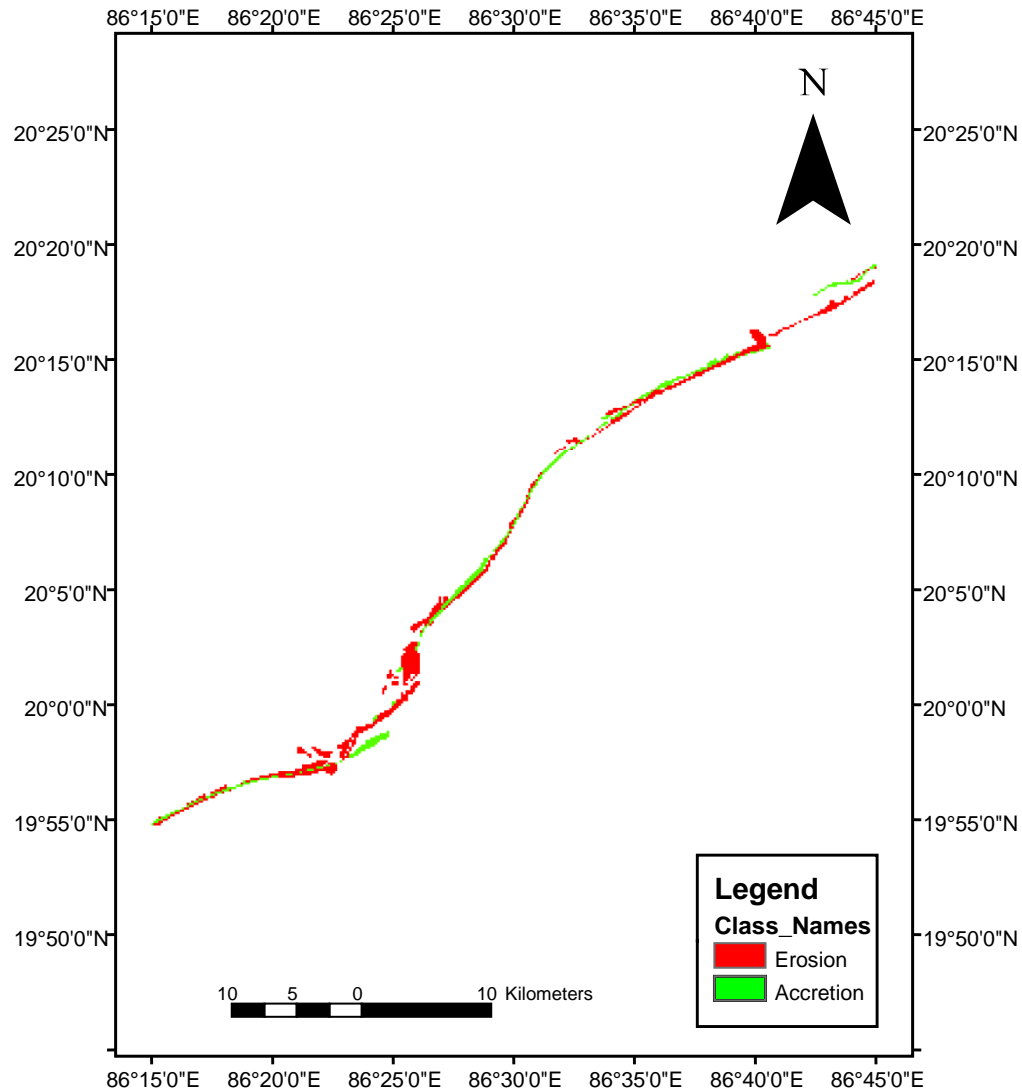




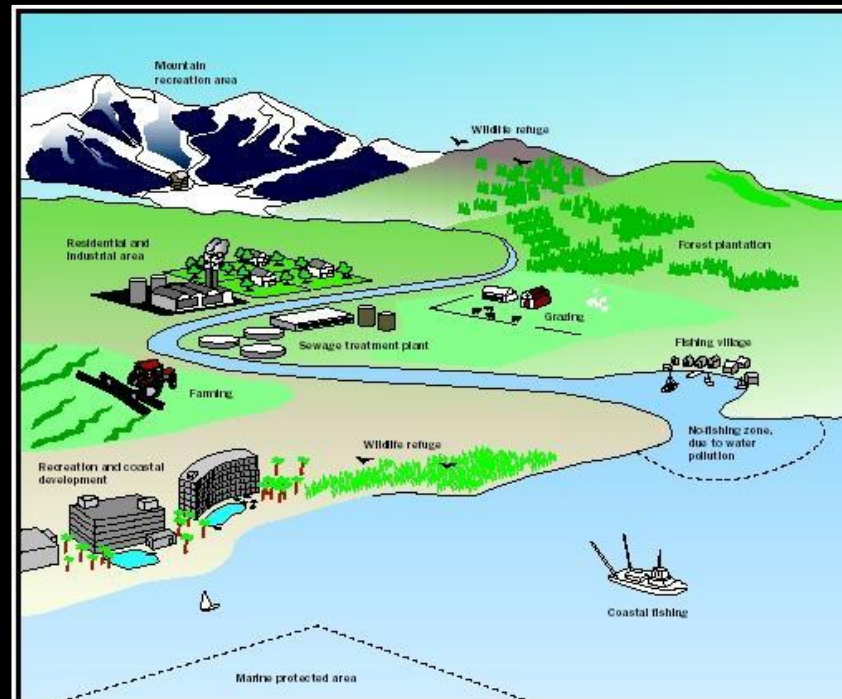
Coastal area changes map between the years 1973-1998, 1973-2005

Coastal area changes map of Jadadharmohan creek (1973-1998)

Coastal area changes map of Jadadharmohan creek (1973-Dec2005)



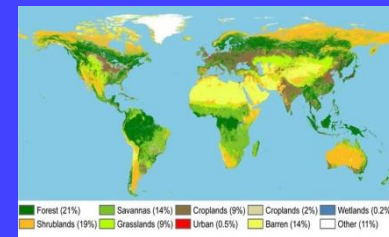
How human influence in hinterland affects the coasts?



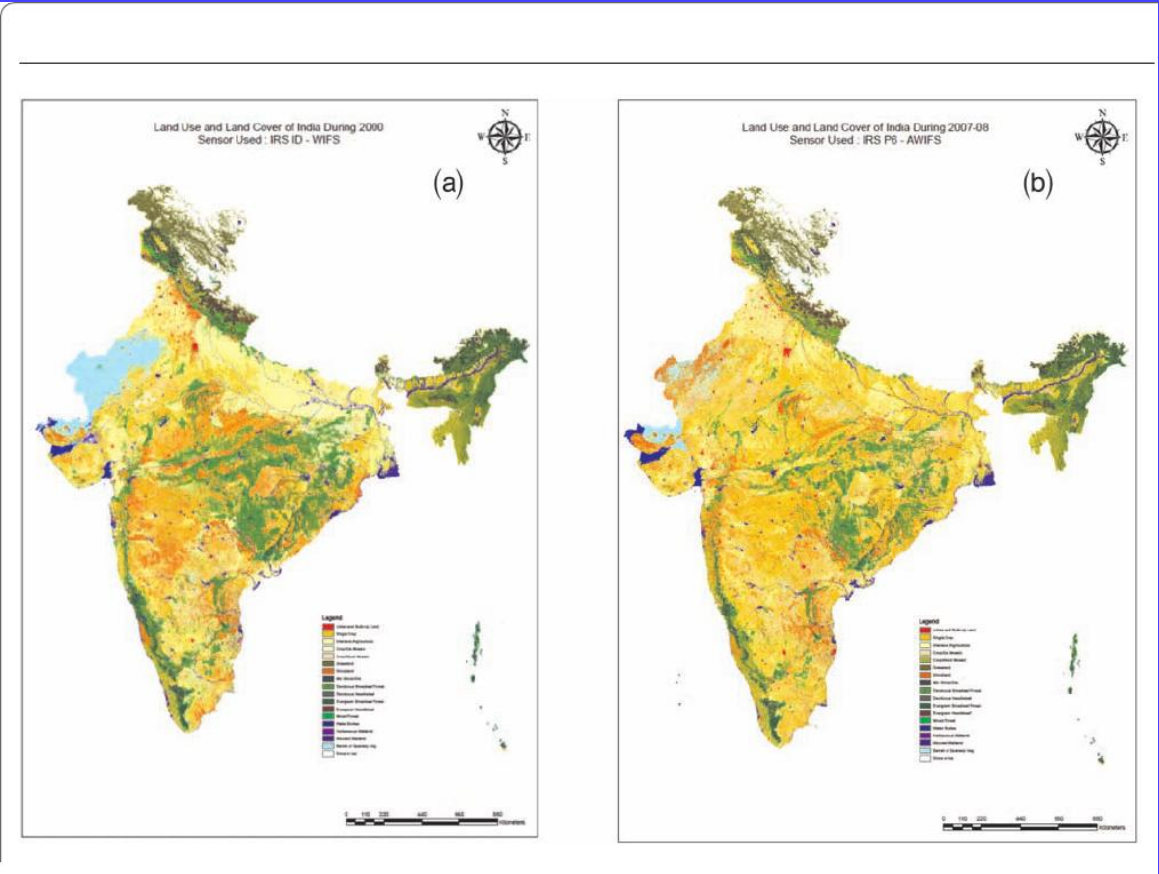
Courtesy: <http://www.waterencyclopedia.com>

Land use mapping

- Land cover refers to the vegetative or non-vegetative characteristics of a portion of the Earth's surface.
- Land use describes some human activity on the surface.
- Land use/ land cover plays an important role as the Nation plans to overcome the problems of uncontrolled development, deteriorating environmental quality etc.
- It clearly reflects the dimensions of anthropogenic activities on the environment.

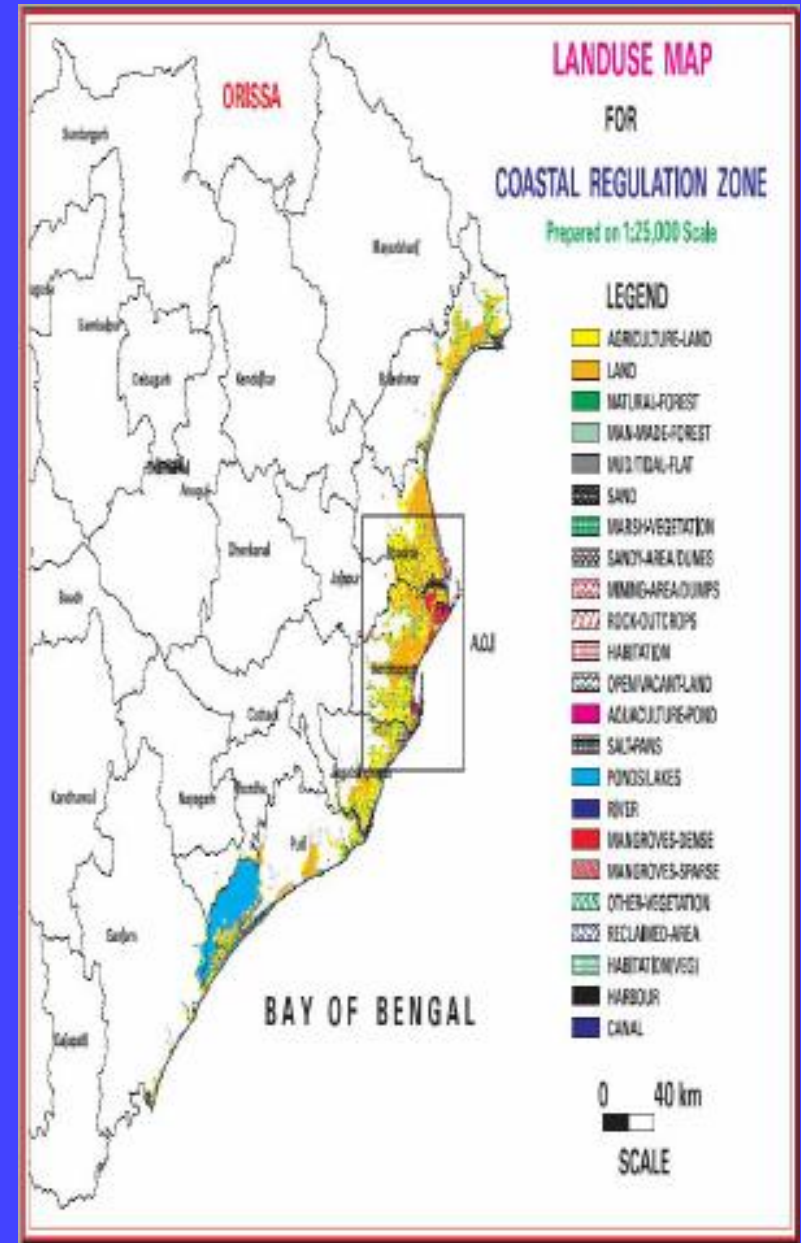


- **Human influences on river basin – coastal zone interactions change the coastal domain.**



Change detection

- One of the main uses of remote sensing is the detection of changes over an area on temporal scale
- Different time interval help in analysing the rate of changes as well as the causal factors or drivers of changes
- Post classification comparison



Data

- o **Survey of India (SOI) topography sheets**
- o **IRS 1D/P6, LANDSAT Satellite images**

| Date of Pass |
|--------------|
| 12/12/1972 |
| 28/02/1999 |
| 22/02/2001 |
| 13/01/2002 |
| 16/12/2002 |
| 13/01/2004 |
| 09/12/2005 |
| 28/12/2006 |
| 16/01/2008 |
| 29/01/2010 |
| 06/04/2011 |
| 24/02/2012 |
| 26/04/2013 |
| 24/02/2014 |

DESCRIPTIONS OF LAND USE AND LAND COVER CLASSES

LULC classification scheme and brief description of classes are as given hereunder:

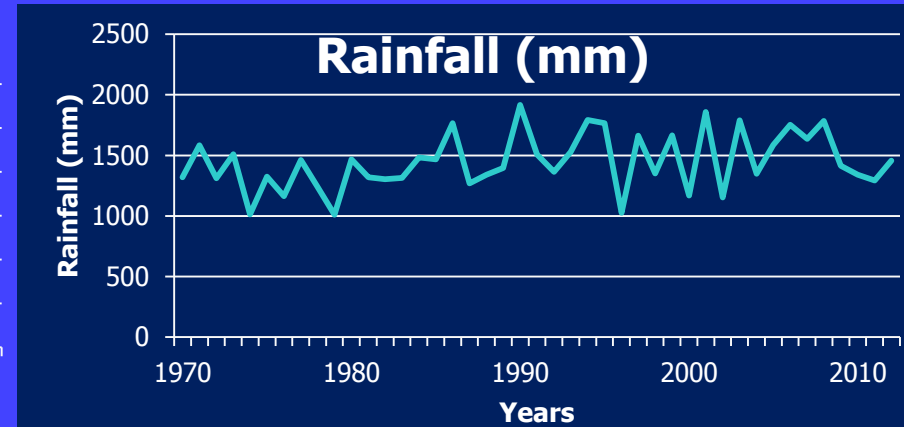
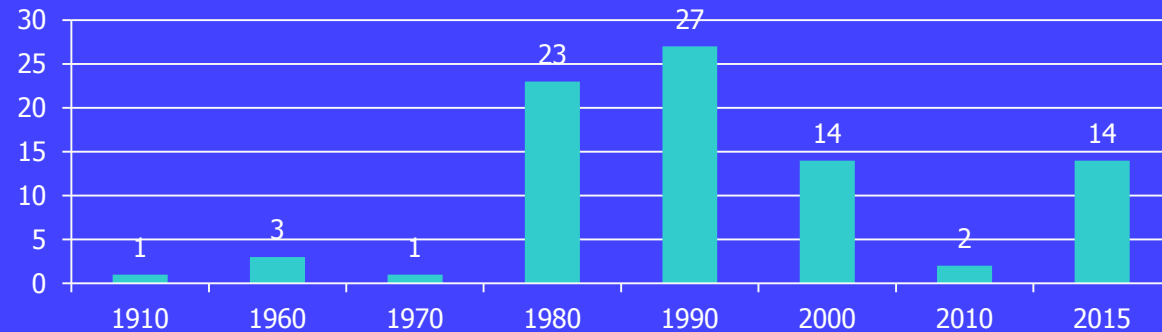
| Sl. | Description-1 | Description-2 | Classes from NRC LULC50K Mapping Project |
|-----|-------------------------------|------------------------------|--|
| 1 | Builtup | Urban | Residential, Mixed builtup, Public / Semi Public, Communication, Public utilities / facility, Commercial, Transportation, Reclaimed land, Vegetated Area, Recreational, Industrial, Industrial / Mine dump, Ash / Cooling pond |
| | | Rural | Rural |
| | | Mining | Mine / Quarry, Abandoned Mine Pit, Land fill area |
| 2 | Agriculture | Crop land | Kharif, Rabi, Zaid, Two cropped, More than two cropped |
| | | Plantation | Plantation - Agricultural, Horticultural, Agro Horticultural |
| | | Fallow | Current and Long Fallow |
| | | Current Shifting cultivation | Current Shifting cultivation |
| 3 | Forest | Evergreen / Semi evergreen | Dense / Closed and Open category of Evergreen / Semi evergreen |
| | | Deciduous | Dense / Closed and Open category of Deciduous and Tree Clad Area |
| | | Forest Plantation | Forest Plantation |
| | | Scrub Forest | Scrub Forest, Forest Blank, Current & Abandoned Shifting Cultivation |
| | | Swamp / Mangroves | Dense / Closed & Open Mangrove |
| 4 | Grass/ Grazing | Grass/ Grazing | Grassland: Alpine / Sub-Alpine, Temperate / Sub Tropical, Tropical / Desertic |
| 5 | Barren/unculturable/Watelands | Salt Affected Land | Slight, Moderate & Strong Salt Affected Land |
| | | Gullied / Ravinous Land | Gullied, Shallow ravine & Deep ravine area |
| | | Scrub land | Dense / Closed and Open category of scrub land |
| | | Sandy area | Desertic, Coastal, Riverine sandy area |
| | | Barren rocky | Barren rocky |
| | | Rann | Rann |
| 6 | Wetlands / Water Bodies | Inland Wetland | Inland Natural and Inland Manmade wetland |
| | | Coastal Wetland | Coastal Natural and Coastal Manmade wetland |
| | | River / Stream / canals | Perennial & Dry River/stream and line & unlined canal/drain |
| | | Water bodies | Perennial, Dry, Kharif, Rabi & Zaid extent of lake/pond and reservoir and tanks |
| 7 | Snow and Glacier | | Seasonal and Permanent snow |

Accuracy assessment

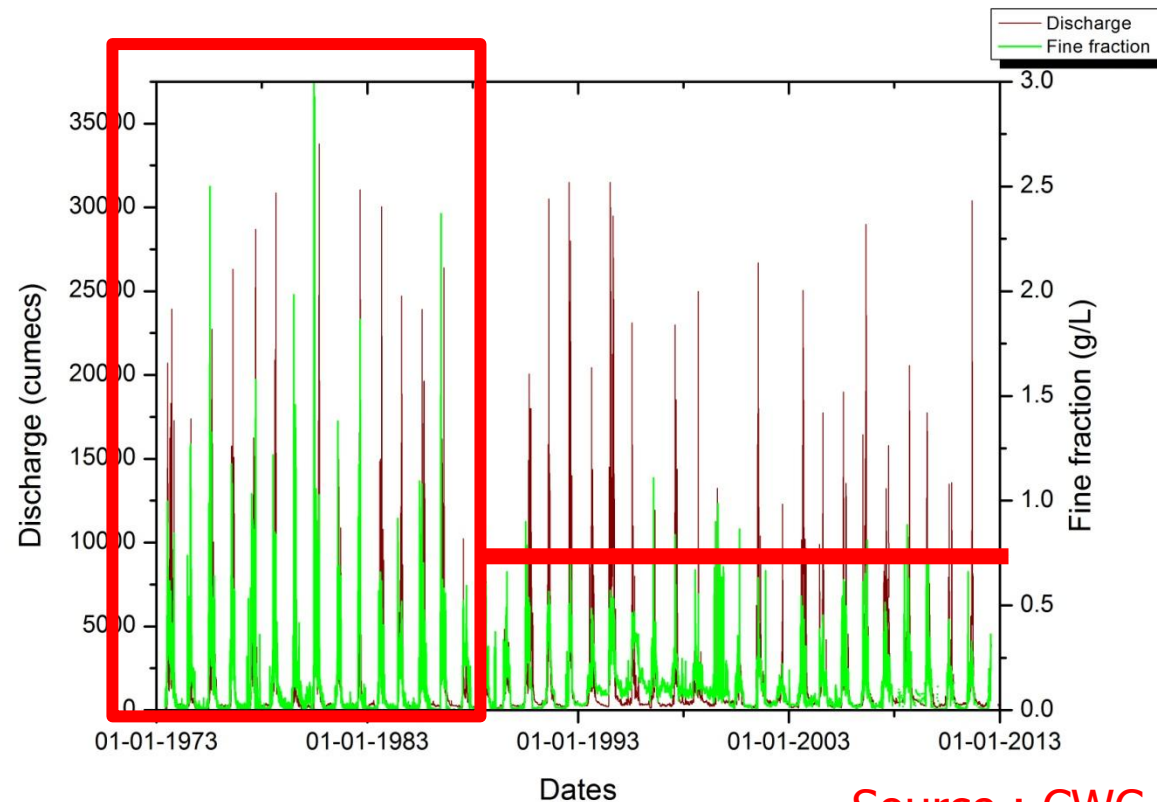
| Year | Overall accuracy(%) |
|-------------|----------------------------|
| | |
| 1972 | 82.86 |
| 1999 | 78.1 |
| 2001 | 80.0 |
| 2002 | 82.54 |
| 2003 | 84.0 |
| 2004 | 85.78 |
| 2006 | 89.78 |
| 2007 | 86.25 |
| 2008 | 89.33 |
| 2010 | 86.67 |
| 2011 | 87.11 |
| 2012 | 86.67 |
| 2013 | 88.44 |
| 2014 | 93.33 |

River discharge

No of Dams built



- ❖ Sediment load reduction due to upstream dams, increases coastal erosion which degrades coastal marine ecosystems (Syvitski, 2003).
- ❖ Reservoirs and irrigation channels can retain a large proportion of fluvial sediment discharge (Farnsworth and Milliman, 2003).



Source : CWC

Summary

- Increase in crop land, mangroves, built up
- Decrease in sandy area, fallow land, mudflats
- Effect of damming is observed and contributed for erosion

Summary

- ❖ Mahanadi delta is no more progressive delta region.
- ❖ Damming and sea level rise effect is observed along the coast and reducing the delta region.
- ❖ Increased agricultural activity has reduced the sediment flux.
- ❖ Floods and cyclones cause the severe geomorphologic changes.
- ❖ Human intervention in hinterland affects the coastal systems.
- ❖ Decreased sediment flux, cyclones and floods are the main causes of erosion in this region

Conclusion

- ❖ **The river basin and its coastal zone should be viewed as a single system.**
- ❖ **coastal zone issues are dependent on regional-local factors as well as on global climate change and sea-level rise.**
- ❖ **Human activities can either increase or decrease riverine loads.**
- ❖ **The land–ocean interface is highly dynamic at monthly–millennial time scales.**
- ❖ **Shoreline change is an overall indicator of the processes and disturbance of any coast.**



Thank You