

# Rapid Assessment of damage to ecological resources due to Tsunami

## Background:

A tsunamii (Japanese word literally meaning 'harbour ware' which is triggered by undersea earthquake, landslide or volcanic eruption) measuring 9.0 on the Richter's scale with epicenter close to the northern tip of Indonesia's Sumatra hit South and South-East Asia on December 26, 2004, and caused heavy damage to life and property including ecological resources all along the Indian eastern coastline, Andaman & Nicobar Islands and Kerala. The Secretary to the Govt. of India, Ministry of Environment & Forests, convened an inter-agency meeting on January 5, 2005 in New Delhi, to initiate action on assessment of damage caused to the ecological resources of India. In the meeting it was decided that the assessment be carried out in two phases. In the first phase, a rapid assessment of the damage would be made using satellite imageries and thereafter, detailed assessment would follow involving ground information.

Accordingly, the task of rapid assessment of the damages caused to forests in both Islands and Mainland, and the mangroves in Mainland was assigned to the Forest Survey of India, Dehradun.

## Objectives

The objective of the study was to make rapid assessment (based on satellite data) of the damages caused to

- (i) The forest and mangrove cover of Orissa, Andhra Pradesh, Tamilnadu, Pondicherry and Kerala.
- (ii) The forest cover of Andaman & Nicobar Islands.

## Methodology

The methodology used in the study is based on digital interpretation of satellite data of pre-Tsunami and post-Tsunami period and comparing the two to detect changes. The satellite data for the purpose was procured from National Remote Sensing Agency (NRSA), Hyderabad and the details of data are given in Table 22.

**Table 22: Satellite data used for rapid assessment of damage to ecological resources**

Data characteristics	Pre-tsunami	Post- tsunami
Satellite	IRS- P6 (Resourcesat-1)	IRS-P6 (Resourcesat-1)
Sensor	AWiFS*	AWiFS
Resolution	56m x 56m	56m x 56m
Product /no. of scenes	Digital / 27 scenes	Digital / 27 scenes
Period	19 <sup>th</sup> Nov.04-23Dec. 04	5 <sup>th</sup> Jan 05 – 11 <sup>th</sup> Jan05

\*AWiFS- Advanced WideField Sensor

For digital interpretation of satellite data, ERDAS-Imagine 8.7 version was used as DIP (Digital Image Processing) software. After downloading all the data onto the computer, radiometric and stretch corrections were applied for removing radiometric defects and improving the visual impact of the False Colour Composite (FCC). Geometric rectification of the data was carried out with the help of Survey Of India (SOI) toposheets for assigning geographical coordinates to every pixel of the image. The pre- and post- scenes were geo-linked and scanned simultaneously. Based on tone and texture, forest and mangrove areas were compared on both the scenes, change areas were delineated and area figures were computed for the area under study.

### Results:

Changes in forest cover and mangroves in the coastal states and A&N Islands due to Tsunami are given in Table 23.

**Table 23: Loss of Forest and Mangrove cover due to Tsunami (Area in Hectare)**

S. No.	States/ UT's	Loss of Forest Cover			Loss of Mangrove cover			Remarks
		Dense	Open	Total	Dense	Open	Total	
1.	Andhra Pradesh	-	-	-	-	-	-	No detectable damage observed
2.	Orissa	-	-	-	-	-	-	No detectable damage observed
3.	Tamilnadu	10	30	40	10	25	35	In Cuddalore District of Tamil Nadu
4.	Pondicherry	-	-	-	-	-	-	
5.	Kerala	-	-	-	6	2	8	In Ernakulam District
6.	Andaman & Nicobar island							In Little Andamans and Nicobar group of islands
	(i) Andaman District	175	83	258	Not mandated	Not mandated	Not mandated	
	(ii) Nicobar District	11,670	554	12,224	-do-	-do-	-do-	
	Total of A&N islands	11,845	637	12,482	-do-	-do-	-do-	
<b>TOTAL</b>		<b>11,855</b>	<b>667</b>	<b>12,522</b>	<b>16</b>	<b>27</b>	<b>43</b>	

Forest cover does not include mangrove

Dense Forest/Mangrove - Areas with more than 40% tree canopy density

Open Forest/Mangrove - Areas with tree canopy density between 10% and 40%

State/UT-wise changes in forest and mangrove cover are as follows:

#### 1. Andhra Pradesh

No detectable damage to forest and mangrove cover were observed in coastal areas of Andhra Pradesh

2. **Orissa**  
No detectable damage to forest and mangrove cover were observed in coastal areas of Orissa
3. **Pondicherry**  
No detectable damage to forest and mangrove cover were observed in coastal areas of Pondicherry
4. **Tamil Nadu**  
In Cuddalore district of Tamil Nadu, it was observed that a total of 76 ha of forest cover has changed to non-forest due to Tsunami (SOI sheet no. 58M). Of this, 20 ha belong to dense forest and 56 ha to open forest category. There was no change in the mangrove cover in this area. Fig 14 shows FCCs of pre-Tsunami and post-Tsunami period of coastal area of Cuddalore district and area showing changes are marked. In other coastal districts of Tamil Nadu, no loss of forest or mangrove cover was observed.

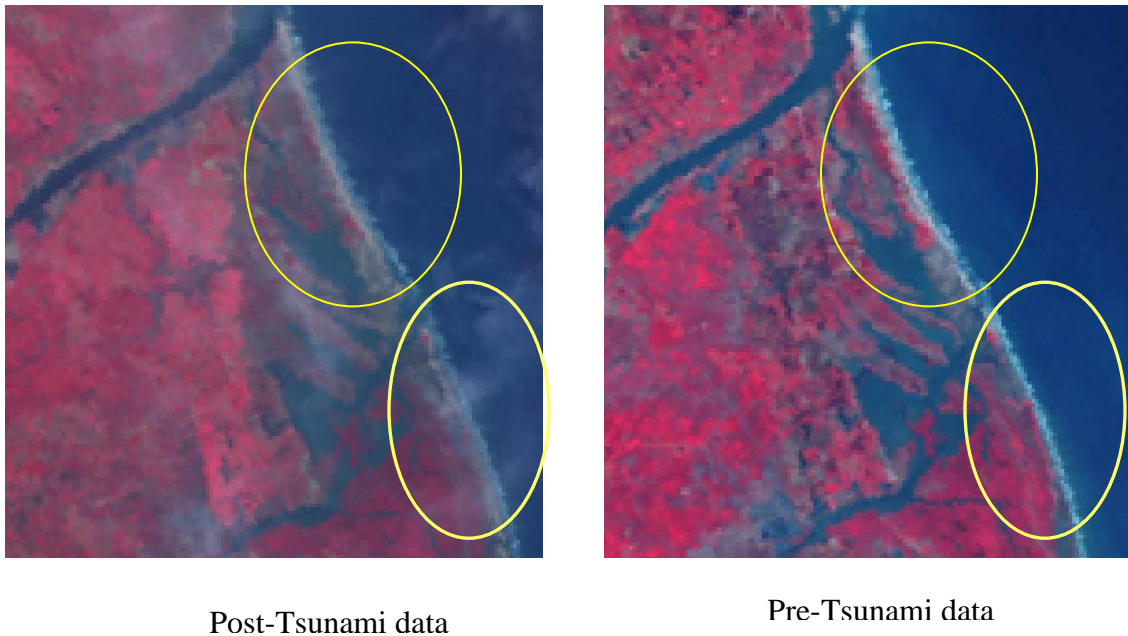
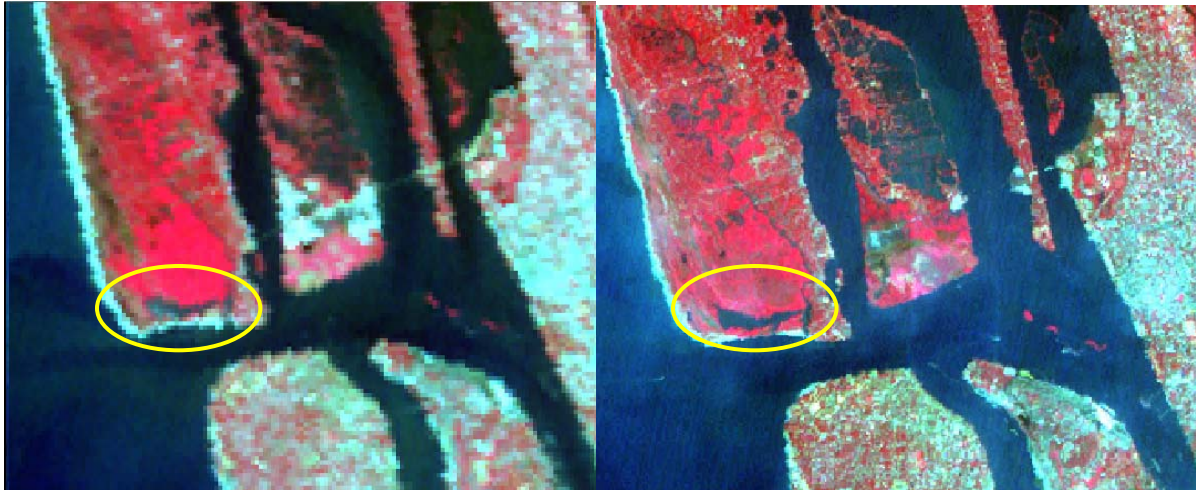


Fig. 14: Changes in forest cover in Cuddalore District of Tamil Nadu

5. **Kerala**  
In Kerala, no major changes in forest and mangrove cover were observed except in Ernakulum district where 8 ha of mangrove cover have been lost in post-Tsunami period. Of this, 6ha is dense and 2 ha is open mangrove. Fig 15 shows FCCs of pre-Tsunami and post-Tsunami period of coastal area of Ernakulum district and area showing changes are marked.



Post-Tsunami data

Pre-Tsunami data

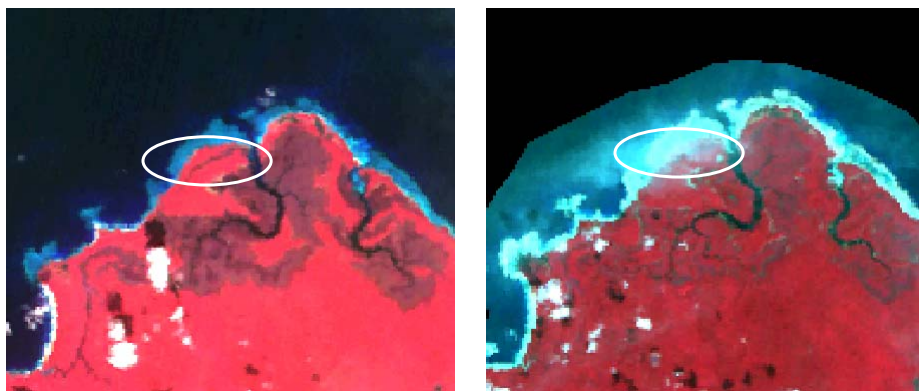
Fig. 15: Change in Mangrove cover in Ernakulum District of Kerala

## 6. Andaman & Nicobar Islands

### a. Andaman Group of Islands:

In Andaman group of islands (Andaman District), no detectable change in forest cover was observed as a result of damage caused by Tsunami except in Little Andaman Island where loss of 258 ha of forest cover has been assessed. This includes 175 ha of dense forest and 83 ha of open forest. Fig. 16 shows pre and post Tsunami images of parts of Little Andamns where loss is detected.

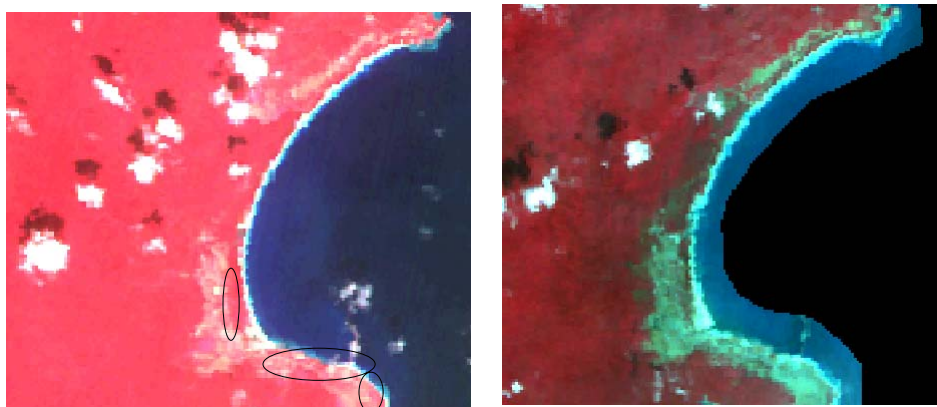
#### NORTHERN PART OF LITTLE ANDAMAN



PRE TSUNAMI

POST TSUNAMI

## SOUTH EASTERN PART OF LITTLE ANDAMAN



PRE TSUNAMI

POST TSUNAMI

Fig. 16: Forest Cover Changes in Little Andaman

### b. Nicobar Group of Islands:

Due to non availability of cloud free AWiFS data of post-tsunami period, FSI used data LISS-III data also for this period. FSI even downloaded satellite data of some of these islands from different websites through Internet and assessed damage. Details of the Tsunami images downloaded from Internet and Pre-Tsunami satellite data used for assessment are given in the Table 24.

**Table 24: Details of images and satellite data of Nicobar Islands**

S. No.	Island Name	Pre-Tsunami Satellite Data Details	Post-Tsunami Satellite Data Details
1.	Bompoka	IRS-P6-AWiFS, 118-67-C dated 21-12-2004	IRS-P6-AWiFS, 115-67-D dated 16-2-2005
2.	Car Nicobar	IRS-P6 118-67-C dated 21 <sup>st</sup> December 2004	IRS-P6-WiFS, 115-67-D dated 16-2-2005
3.	Camorta	IRS-1D-LISS III, 117-68 dated 28-4-2003 IRS-P6-WiFS, 118-67-C dated 21-12-2004	IRS-P6-LISS III dated 4-1-2005
4.	Chowra	IRS-P6-AWiFS, 118-67-C dated 21-12-2004	IRS-P6-AWiFS, 115-67-D dated 16-2-2005
5.	Katchall	Landsat-5 TM, 133-54 dated 30 <sup>th</sup> March, 2001 IRS-P6-AwiFS, 118-67-C dated 21-12-2004	Spot-5 28 <sup>th</sup> December, 2004
6.	Tarasa	IRS-P6-AWiFS, 118-67-C dated 21-12-2004	IRS-P6-AWiFS, 115-67-D dated 16-2-2005
7.	Trinket	IRS-1D-LISS III, 117-68 dated 28-4-2003 IRS-P6-AWiFS, 118-67-C dated 21-12-2004	IRS-P6-LISS III dated 4-1-2005
8.	Little Nicobar	IRS-1D-LISS III, 117-69 dated 15-9-2002 Landsat-5 TM, 132-55 dated 3-2-2001 IRS-P6-AWiFS, 118-67-C dated 21-12-2004	IRS-P6-AWiFS, 117-67 dated 2-2-2005 IRS-P6-AWiFS, 117-67 dated 18-1-2005

9.	Great Nicobar	IRS-1D-LISS III, 117-69 dated 15-9-2002 Landsat-5 TM, 132-55 dated 3-2-2001 IRS-P6-AWiFS, 118-67-C dated 21-12-2004	IRS-P6-AWiFS, 117-67 dated 2-2-2005
10.	Trak, Treis & Pulo Milo	IRS-P6-AWiFS, 118-67-C dated 21-12-2004	IRS-P6-AWiFS, 117-67 dated 18-1-2005

The results of the assessment are given in Table 25.

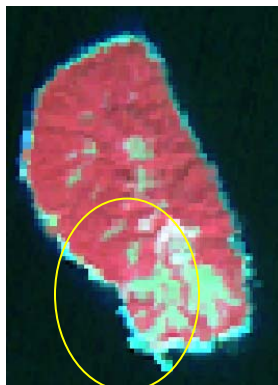
**Table 25: Loss of forest cover due to Tsunami in Nicobar group of Islands (Area in Hectare)**

S. No.	Island Name	Loss in Dense Forest	Loss in Open Forests	Total Loss in Forest Cover
1.	Bompoka	43	-	43
2.	Car Nicobar	136	170	306
3.	Camorta	735	4	739
4.	Chowra	73	79	152
5.	Katchal	2,567	22	2,589
6.	Tarasa	499	52	551
7.	Trinket	285	2	287
8.	Little Nicobar	594	-	594
9.	Great Nicobar	6,690	225	6,915
10.	Trak, Treis & Pulo Milo	48	-	48
	<b>Total</b>	<b>11,670</b>	<b>554</b>	<b>12,224</b>

Dense Forest - Areas with more than 40% tree canopy density

Open Forest - Areas with canopy density between 10% and 40%

Figures of Table 25 show that overall 12,670 ha of forest cover including 11,670 ha of dense forests, and 554 ha of open forests has been lost in different islands of Nicobar. Maximum damage to forest cover has been observed in Great Nicobar island (6,915 ha), followed by Katchall island (2589 ha), Camorta (739 ha), Tarasa (551 ha) and Little Nicobar (594). An interesting observation made during the study was that changes in forest cover were more pronounced on western side of most of the islands than on eastern side which faced Tsunami waves directly. Fig.17 – Fig.23 show change in forest cover in some of the islands due to Tsunami.



IRS-P6-AWiFS Dec.21, 2004

IRS-P6-AWiFS Feb. 16, 2005

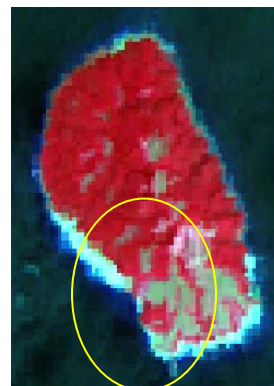
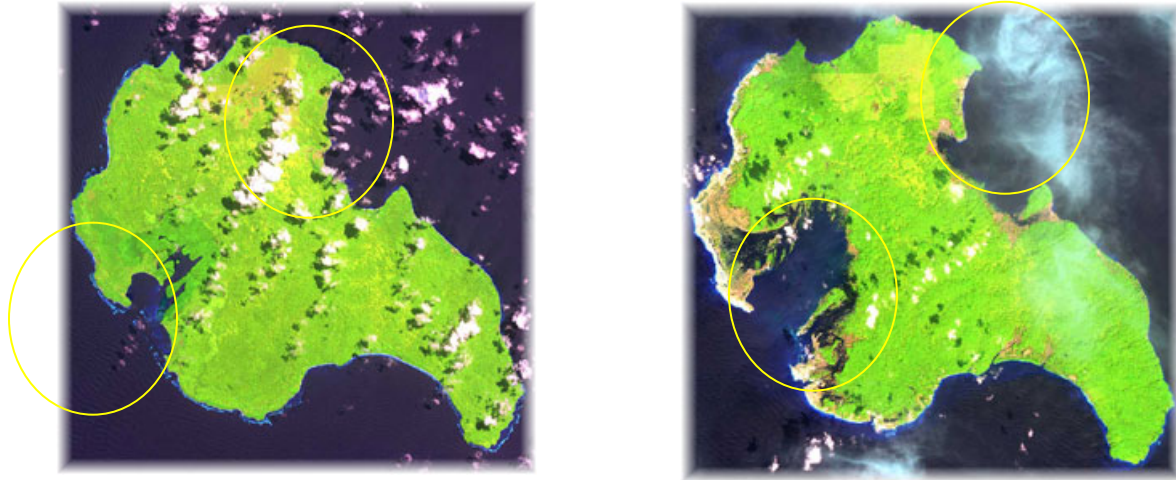




Fig. 20: Changes in forest cover in Chowra Island of Nicobar Group

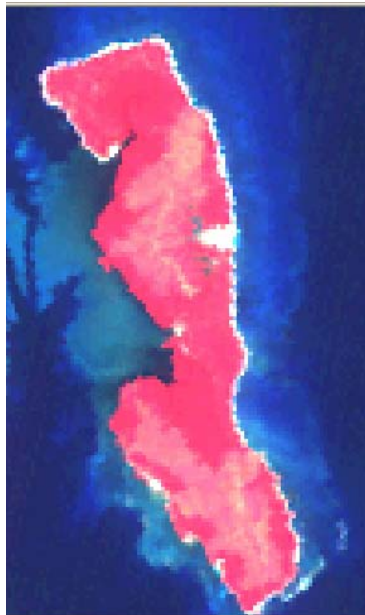


SPOT 5 : 10.07.2004

SPOT 5 : 28.12.2004

Fig. 21: Forest cover changes in Katchal Island of Nicobar group

IRS-P6-AWiFS DEC.21, 04



IRS-P6-LISS III JAN.4, 05



Fig. 22: Forest cover changes in Trinkat Island of Nicobar group

PRE-TSUNAMI

POST-TSUNAMI



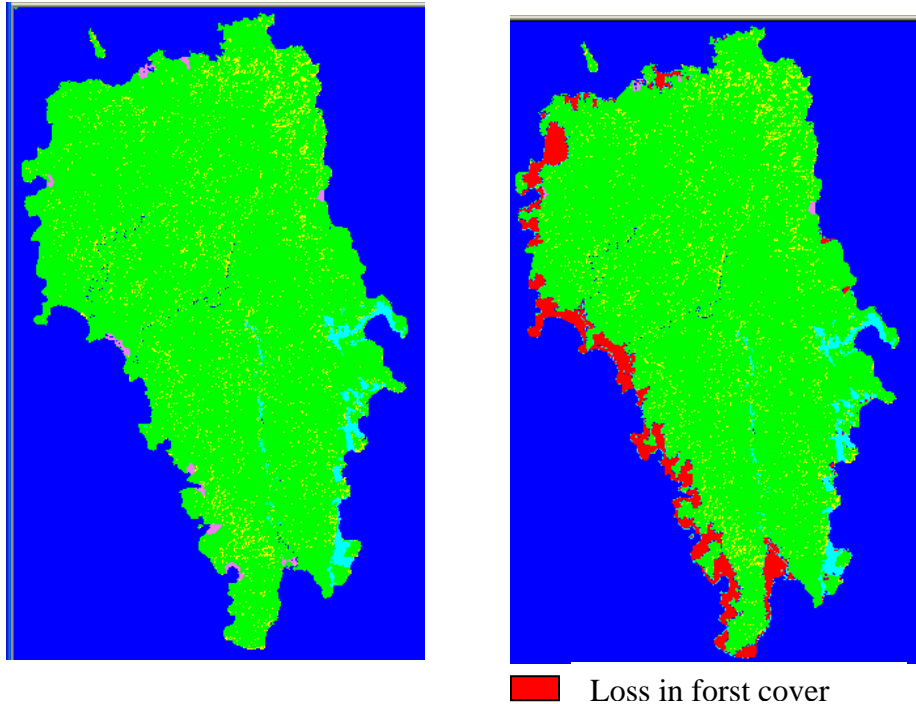


Fig 23: Forest Cover Changes in Great Nicobar

#### Findings in brief:

- No damage has been detected in the forest and mangrove cover in Andhra Pradesh, Orissa and Pondicherry due to Tsunami.
- In Cuddalore District of Tamil Nadu 40 ha of forest cover (10 ha of Dense and 30 ha of open forest) has been lost. In the same area of Cuddalore District about 35 ha of Mangrove cover (10 ha of dense mangrove and 25 ha of open mangrove) has been lost due to Tsunami.
- In Ernakulam District of Kerala, 8 ha of mangrove cover comprising 6 ha of dense and 2 ha of open mangrove cover is lost after Tsunami.
- In Andaman group of Islands, loss of forest cover was found only in Little Andaman island where 258 ha of forest cover comprising 175 ha of dense and 83 ha of open forest was lost.
- In Nicobar group of Islands, maximum damage to forest cover was observed. Total loss of forest cover in Nicobar group of islands was assessed to be 12,224 ha, of which loss in dense forest cover was 11,670 ha and in open forest it was 554 ha. Great Nicobar had maximum loss of forest cover (6,915 ha), followed by Katchal (2,589 ha), Camorta (739 ha), Tarasa (551 ha) and Little Nicobar (594 ha).