

SPACE TECHNOLOGY FOR POVERTY ALLEVIATION AND MANAGEMENT OF NATURAL RESOURCES

(LECTURE-3)

Prof. U.R. Rao
Chairman, PRL Council

(Former Chairman, ISRO & Secretary, DOS)

Department of Space, Antariksh Bhavan

New BEL Road, Bangalore – 560 094

(2006)

ECONOMIC DISPARITIES IN THE WORLD

	India	World	Developed Countries	Developing Countries	Sub-Saharan Africa
Total Land Area (M. ha.)	329	13,300	5,500	7,800	2,427
Population (Billions)	1.08	6.3	1.0	5.3	0.7
Per Capita GNP (Dollars)	620	6,300	32,000	1,280	600
Life Expectancy (Years)	64	67	78	65	46
Under 5 Mortality (Per 1,000)	90	81	7	88	150
Adult Illiteracy (%)	39	19	8	22	40
Foodgrain Area (M. ha.)	120	750	275	475	65
Net Irrigated Area (M. ha.)	57	250	66	184	10
Food production (M. ha.)	210	1,960	860	1,100	70
Productivity (Ton / ha.)	1.8	2.6	3.1	2.4	1.3
Per Capita Energy (TOE)	0.5	1.7	5.4	1.0	0.4
Sectorial Growth (%) Agri	21	8	2	12	13
Industry	25	32	30	33	28
Service	54	60	68	55	58

ROOT CAUSES OF POVERTY

- Non-optimal Exploitation of Natural Resources
 - Forestry, Wasteland, Water Harvesting, Agriculture
 - Fisheries, Environment, Bio-Diversity
- Non-Empowerment of Vulnerable People
 - Requires Education, Training
- Poor Disaster Management
 - Cyclones, Floods, Drought, Earthquake, Tsunami Landslide, Fire
- Unsustainable Development (Green Revolution)
 - Needs Improved Productivity – Doubling Food Production by 2040
 - New Ever Green Revolution
- Increasing Digital Divide
 - Initiate ICT Revolution, Knowledge Based Development
 - Rural Kiosks – Village Resource Centers

PLANNING OF R.S. PROGRAM

- Aerial Surveys Using Haselblad Camera, Early 1970's
 - Coconut Wilt disease – Sugarcane Plantation – Land Use Studies
- Setting-up LANDSAT Receive Station – Hyderabad 1979
- Experimental RS Satellite – BHASKARA-1 (1979), BHASKARA-2 (1981)
 - Slow Scan Videocon Cameras (1 Km. Res) – Land Survey
 - Passive Microwave Radiometers (19,22,31 GHz) – Ocean Survey
- National Inter-Ministerial Conf. On Remote Sensing 1978
- Establishment of Regional Remote Sensing Service Centers
 - Bangalore, Nagpur, Jodhpur, Dehradun, Kharagpur, Shillong

OPERATIONALISATION OF REMOTE SENSING

- IRS-1A (1988), IRS-1B (1991) on VOSTOK
 - 4 Band Multispectral CCD (Push Broom) Cameras
 - LISS-1 (73 m. Res), LISS-2 (36 m. Res)
- IRS-1C (1995) on MOLNIYA
 - IRS-1D (1997) on PSLV
 - LISS-3 (24 m.) and IR (70 m.) Swath 140 km.
 - High Resolution Panchromatic Camera (5.6 m.), 70 km.
 - 2 Band Wide Field Visible + IR (188 m.) Swath 860 km.
- Technology Experiment Satellite (TES in 2001) – 0.8 m. Res
- RESOURCESAT (2003), Improved IRS-1D + 5.8 m. Multi-Spectral
- CARTOSAT (2005) – Panchromatic 2.5 m. Stereo (30 km. Swath)

Indian Imaging Systems

Polar missions

Geo stationary missions

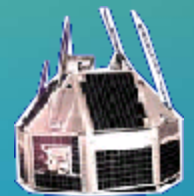
1979/81

BHASKARA
VIDICON,
SAMIR



1982

RS-D1
SMART
SENSOR



1988/91

IRS-1A & 1B

LISS-1&2 (72/36M)



1994

IRS-P2
LISS-2



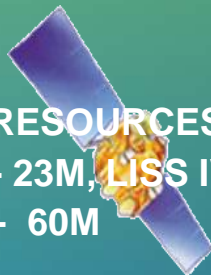
1995/1997

IRS-1C/1D LISS-3 (23/70M,
STEERABLE PAN (5.8 M);
WiFS (188M)



2003

IRS-P6(RESOURCESAT-1)
LISS III - 23M, LISS IV - 5.8M
AWIFS - 60M



1996

IRS-P3
WiFS, MOS X-Ray



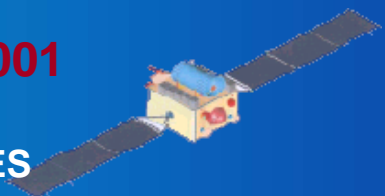
1999

IRS-P4 (OCEANSAT-1)
OCM, MSMR



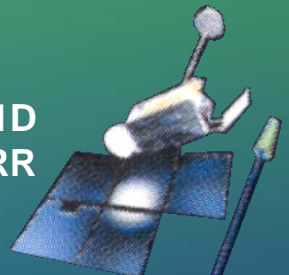
2001

TES
STEP & STARE



1990

INSAT-1D
VHRR



1992

INSAT-2A
VHRR



1993

INSAT-2B
VHRR



1999

INSAT-2E
VHRR, CCD (1 KM)



2002

METSAT-1
VHRR - 2 Km(VIS);
- 8 Km (IR & WV)



Earth Observation - Applications



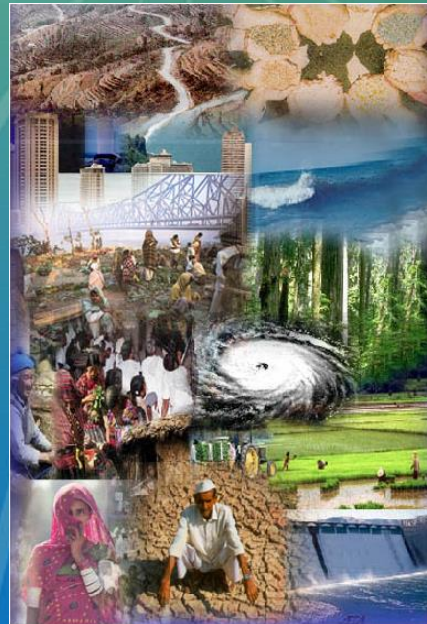
AGRICULTURE & SOIL

- Crop Acreage & Production Estimation
- Soil & Land Degradation Mapping
- Watershed Development
- Horticulture Mission for North-East



FOREST, ENVIRONMENT, BIO

- Forest Cover & Type Mapping
- Forest Fire and Risk Mapping
- Biodiversity Characterisation
- Environmental Impact Studies



LAND

- Landuse/Land Cover Mapping
- Wasteland Mapping
- Urban Sprawl Studies
- Large Scale Mapping



WEATHER & CLIMATE

- Extended Range Monsoon Forecasting
- Ocean State Forecasting
- Regional Climate Model



WATER

- Potential Drinking Water Zones
- Command Area Management
- Reservoir Sedimentation



DISASTER SUPPORT

- Flood Damage Assessment
- Drought Monitoring
- Land Slide Hazard Zonation



OCEAN

- Potential Fishing Zone (PFZ)
- Coastal Zone Mapping



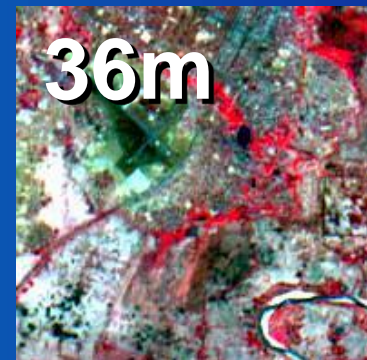
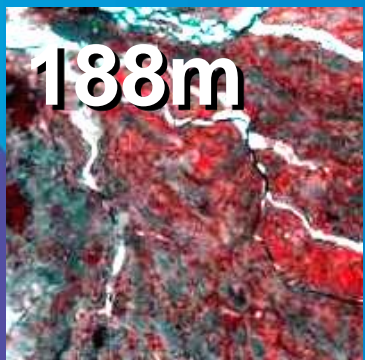
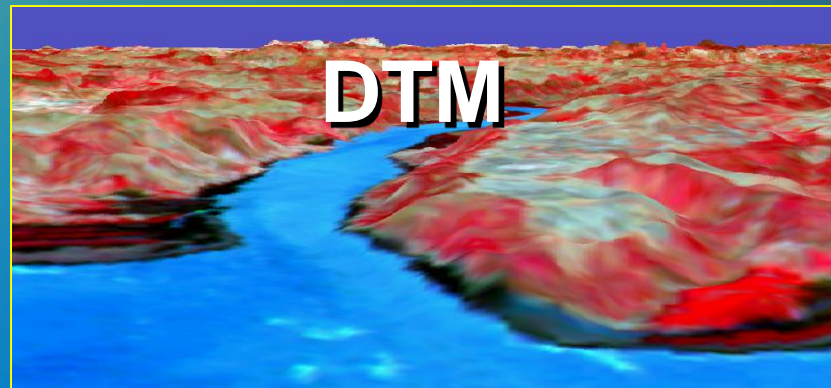
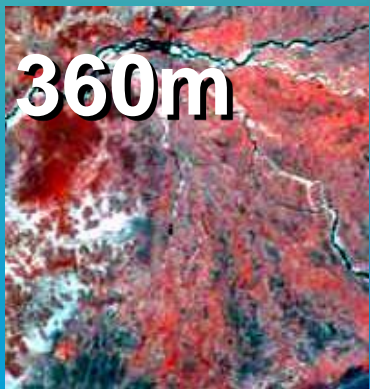
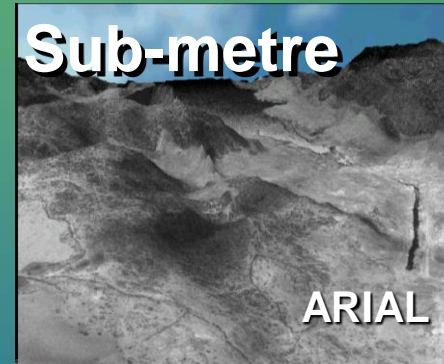
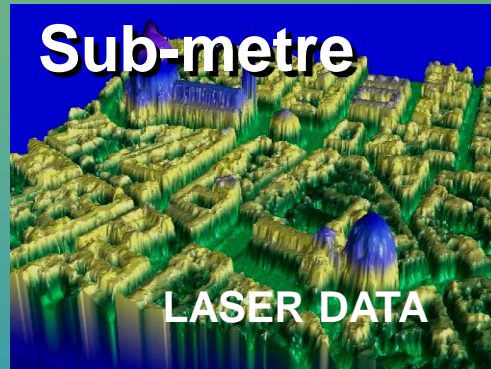
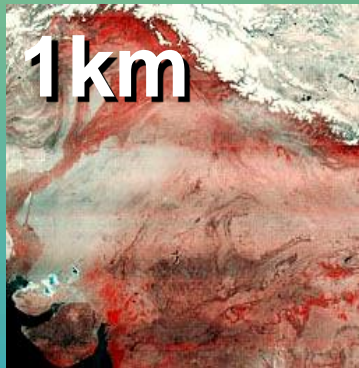
GEOLOGY & MINERALS

- Vasundara
- GEOISMM
- Coal Fire studies
- Mineral Exploration

PLANNING COMMISSION

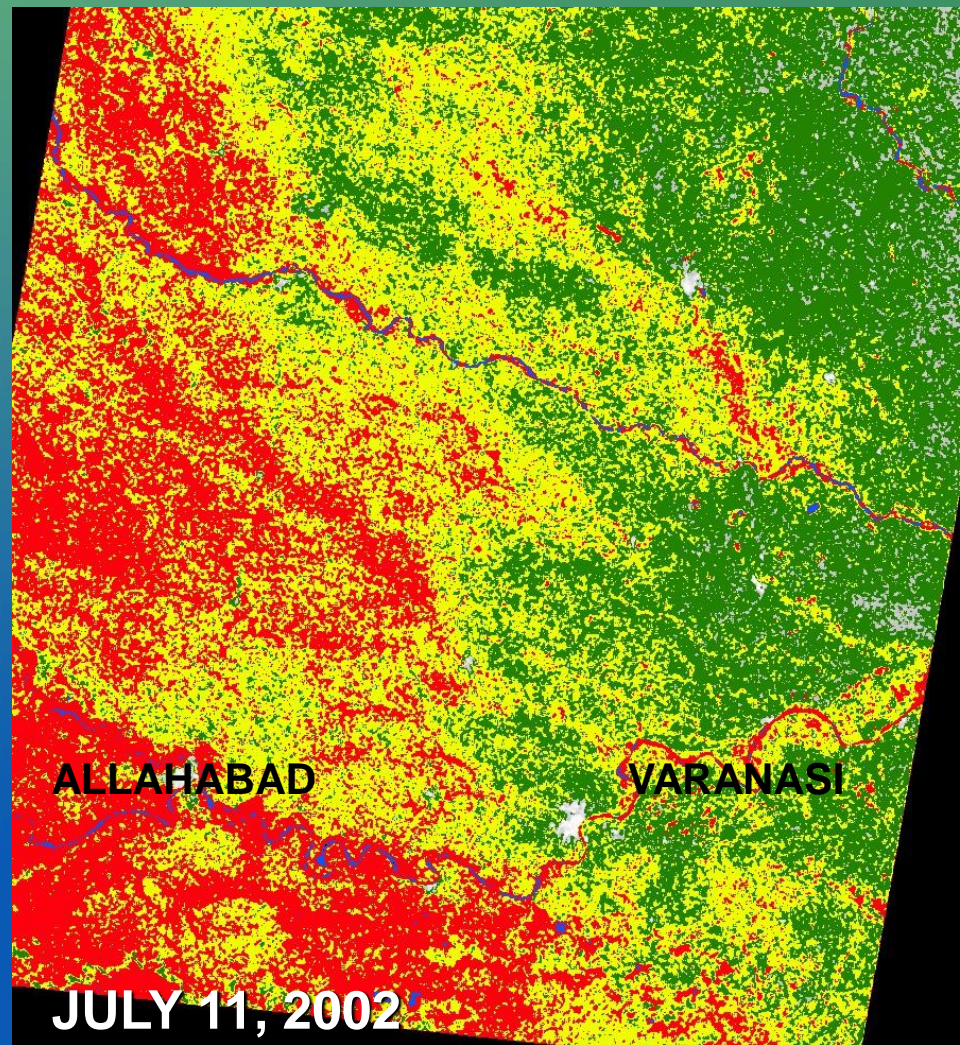
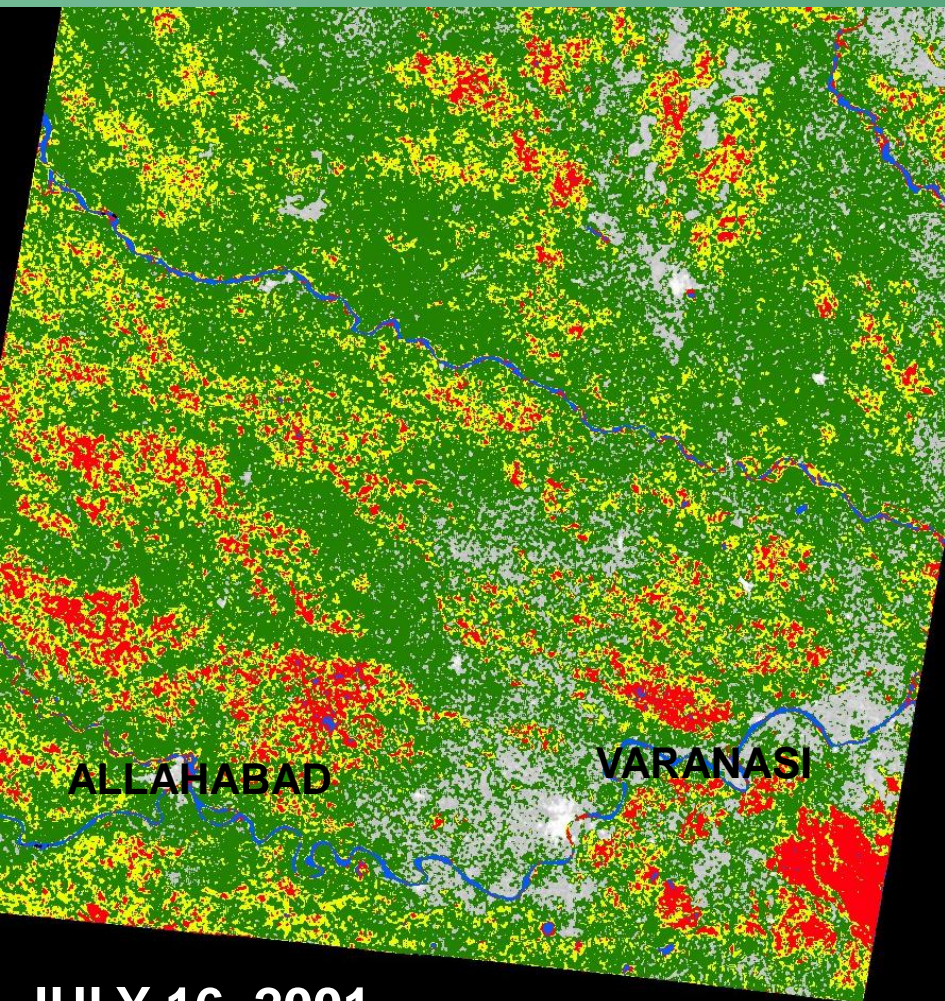
- Agro-Climatic Zone Based Planning (Land Use / Land Cover)
- Agroclimatic Planning Info. Bank-APIB

Imaging Capability: Km to Sub-metre



Soil Moisture Estimation Using SAR Data

Eastern UP



JULY 16, 2001

JULY 11, 2002

SOIL MOISTURE (Mass - Weight basis)
0-10%, 10-20%, 20% and above

Areas affected by Drought (2002 Image)
Red – Severe; Yellow - Moderate

WASTELAND INVENTORY

- Ecologically Degraded Land - 64 Mha
- 45 Mha culturable with interventions



Categorisation for development

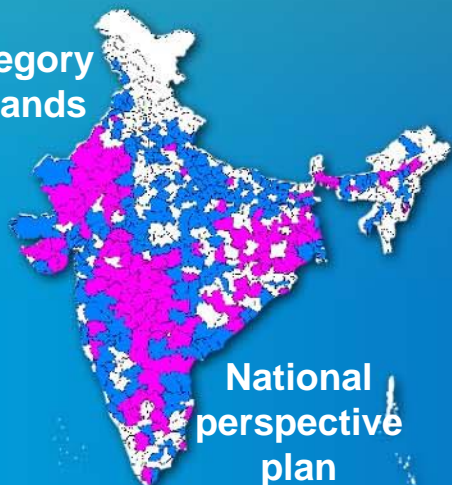
- A: Sands, Barren...(High capital investment)
- B: Marginal Agril. (Intervention needed)
- C: Saline, Aklaline.. (Second Generation Issues)

- Watershed Development Programme
- Creation of Rural Employment/Assets
- Targeting Poverty & Eco-degradation



Natural Resources Census (NRC) to monitor the changes

B2 Category Wastelands



- Districts having more than 30%
- Districts having 5% to 30%

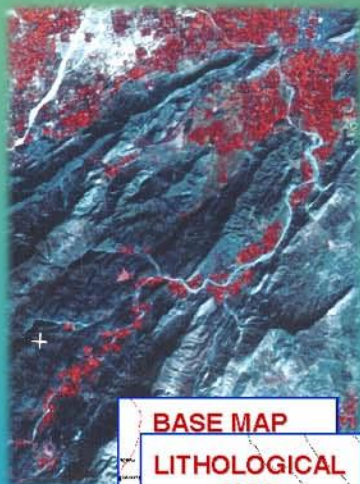
National perspective plan



Village & Watershed overlay

RAJIV GANDHI NATIONAL DRINKING WATER MISSION

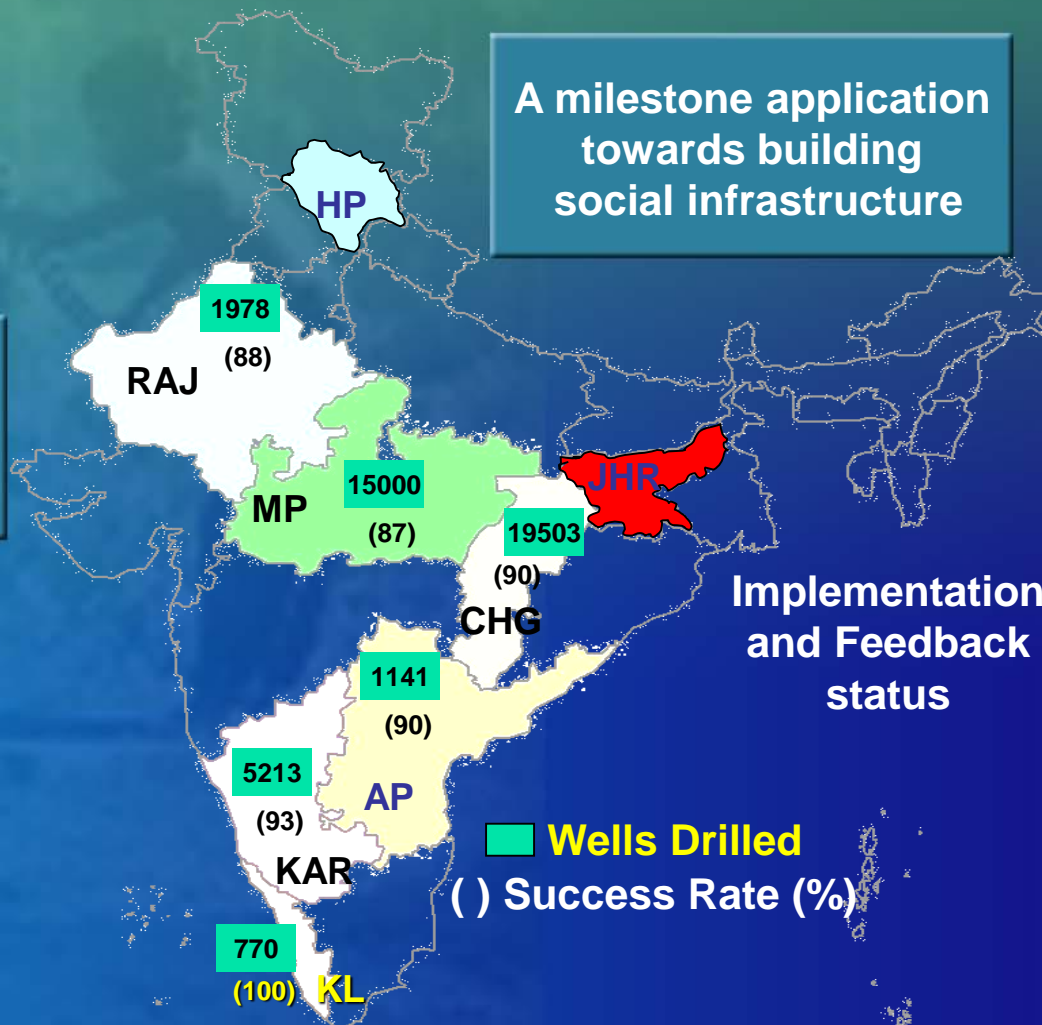
- Development of spatial information system on ground water covering problem states
- > 90% success rate in drilled sources (>65,000 in 7 states)



Ground Water Prospect Map with Sites for Recharge

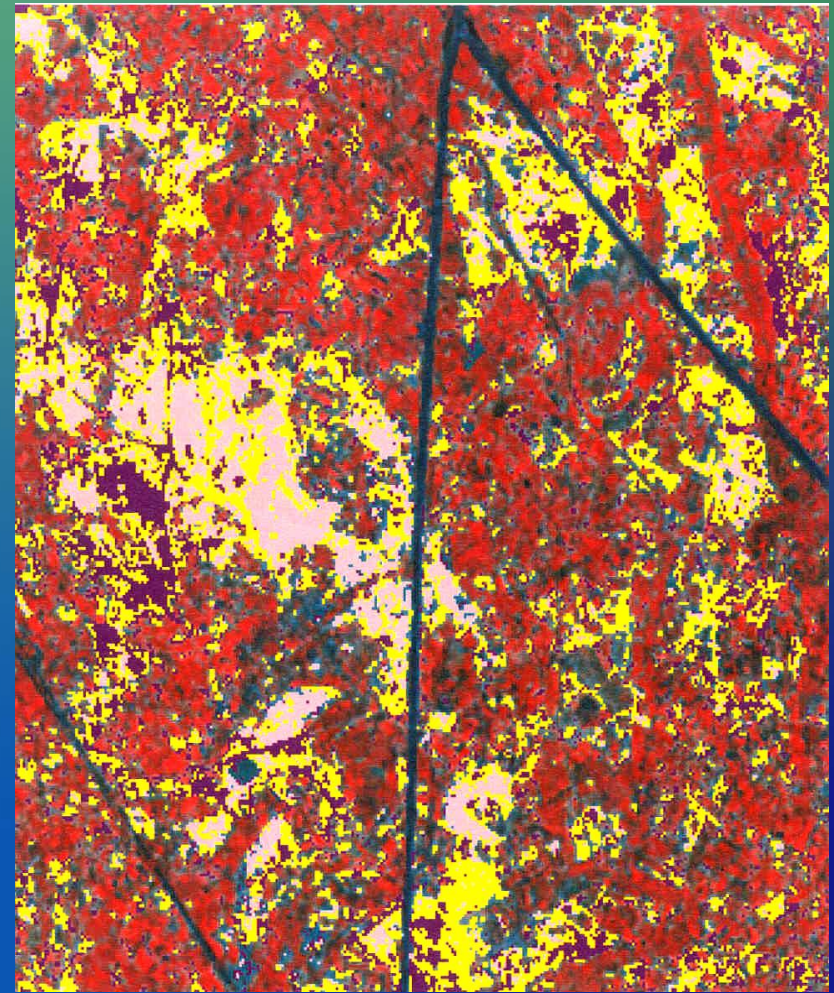
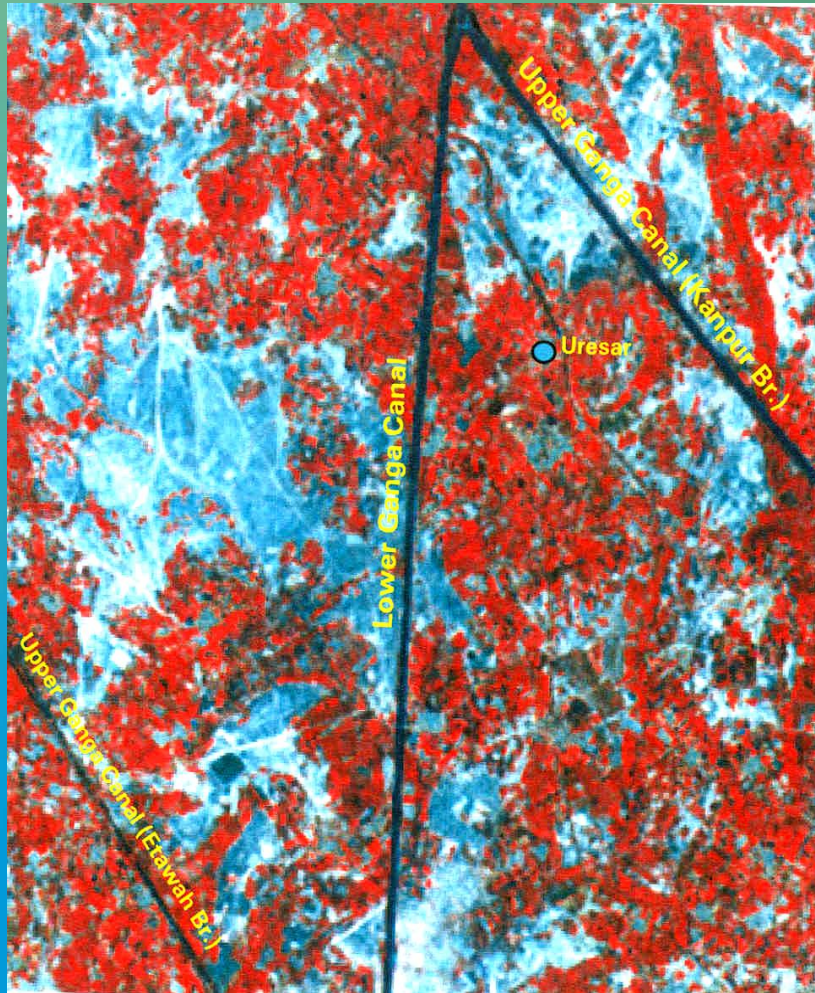


A milestone application towards building social infrastructure



Implementation and Feedback status

MAPPING LAND DEGRADATION (SOIL SALINITY/ALKALINITY) IN PARTS OF MAINPURI DISTRICT UP



IRS -1C LISS III MARCH 2000

CLASSIFIED OUTPUT



STRONGLY SALT-AFFECTED SOILS



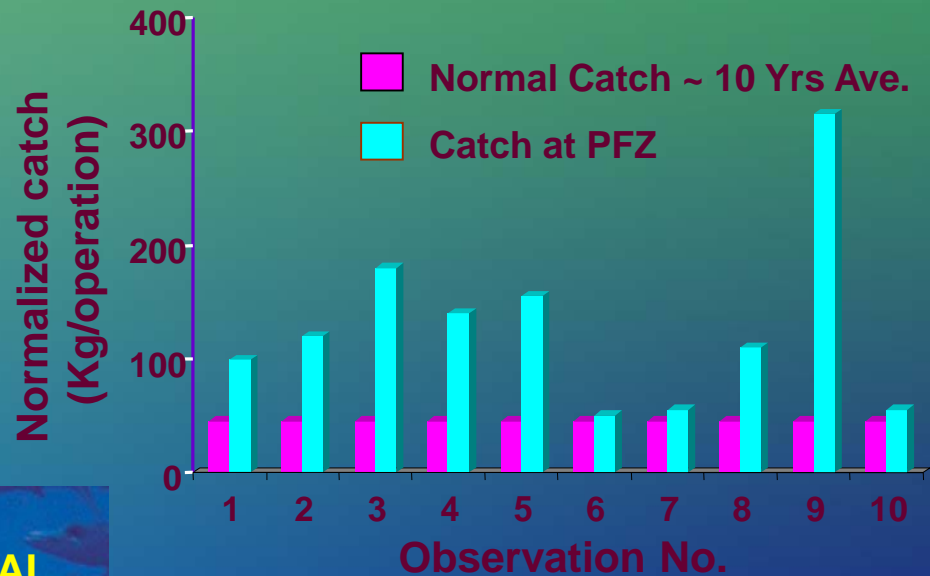
MODERATELY SALT-AFFECTED SOILS



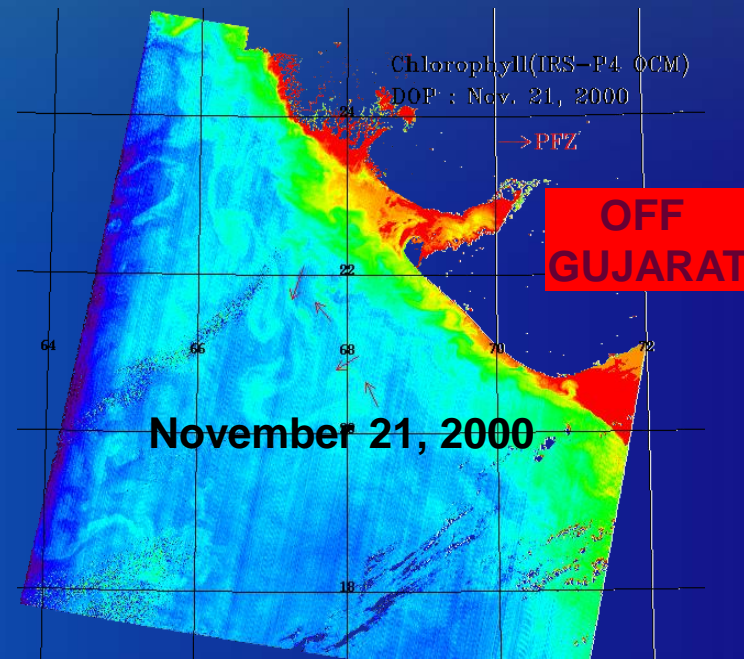
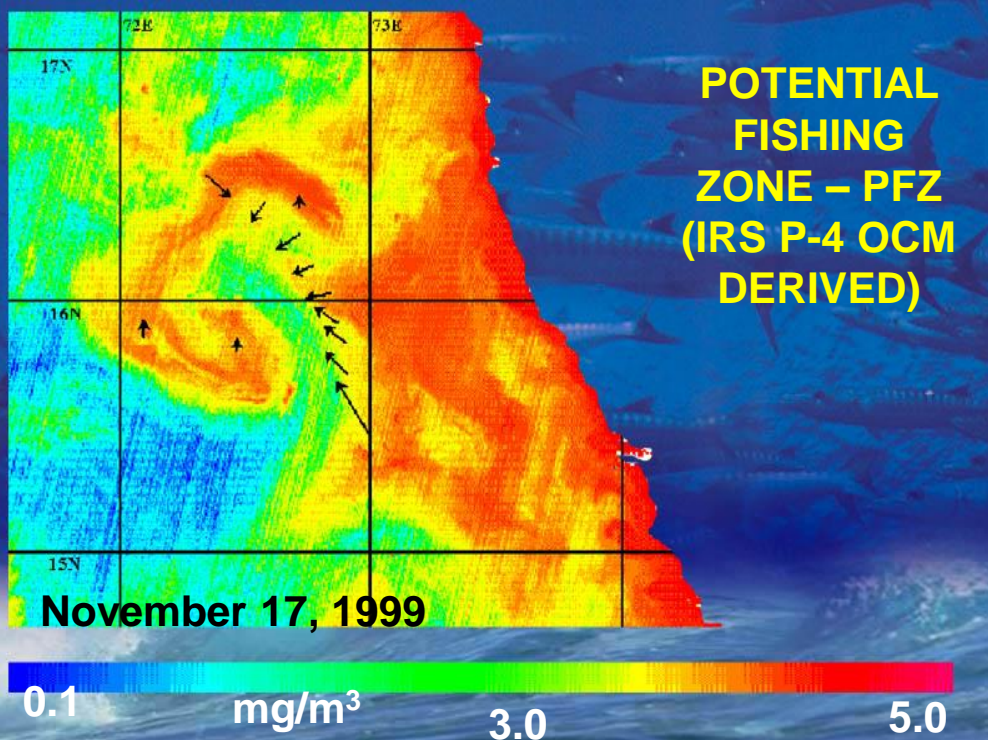
SLIGHTLY SALT-AFFECTED SOILS

Identifying Potential Fishing Zones

Information Dissemination through INCOIS, DoD



OFF GOA



FASAL: Nationwide Multiple Rice & Wheat Crop Forecasting

- In-season Crop Forecasts
- Impact of Drought & Flood Assessment
- Early Warning – Crop condition & Stress Scenario
- FASAL Centre /NCFC with Ministry of Agriculture

Forecasts

Year 2003-04	FASAL Estimate	BES/DOA Figures
*Wheat	71.95 MT	72.5 MT
**Rice Monsoon	1.80 MHa	1.69 MHa
Winter	0.84 MHa	0.81 MHa

* National

** A.P. Province

Final
Estimate



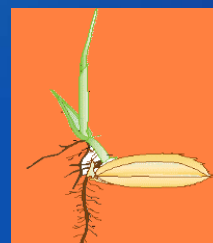
Third
Estimate



Second
Estimate



First
Estimate



Spectral, Agromet & Econometric Models

- Integrated Yield Models



Spectral – Agromet Models

- Space Images
- Meteorological data
- Ground data



Agromet Models

- Space Images
- Ground Data
- Temp./Rainfall



Econometric Models

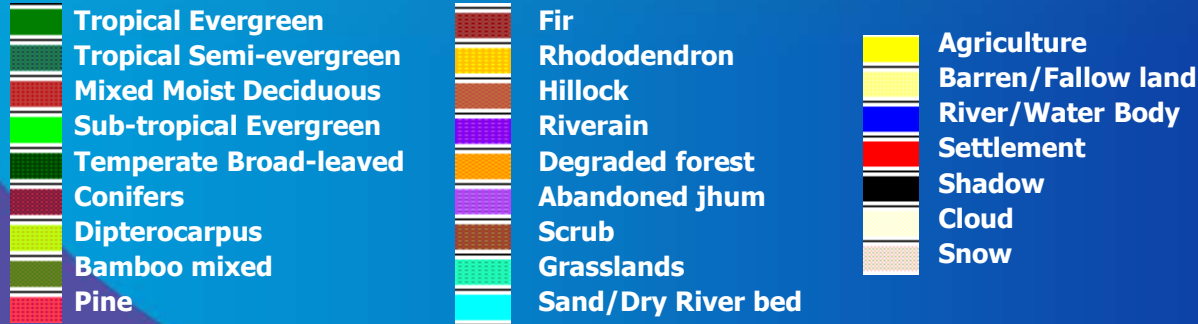
- Market Information

Forecast at National, State and District levels

Pre-harvest Production Forecast for Major Crops like Paddy, Wheat, Sorghum, Rapeseed, Mustard, ...

Biodiversity Characterization

VEGETATION TYPES/ COVER ARUNACHAL PRADESH

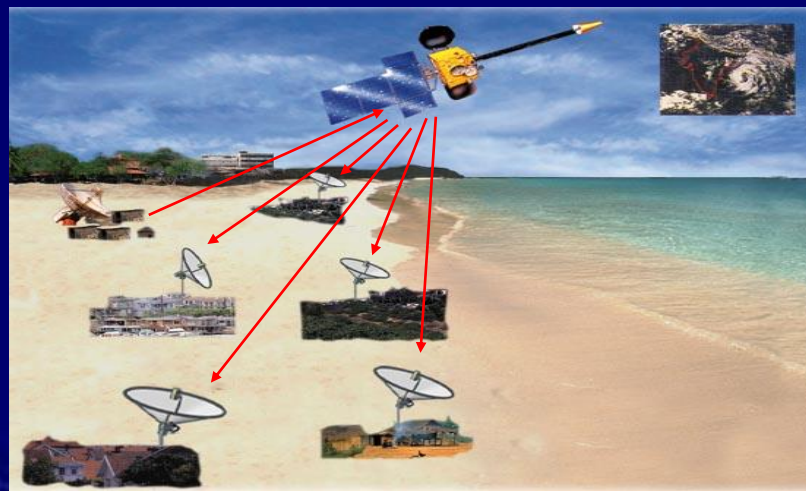


- Biome level ecological zone maps prepared using satellite data, topographical details, etc., for NE Himalaya, W.Himalaya, W.Ghats and A&N Islands
- Detailed assessment of biodiversity and its distribution pattern in 15 important biodiversity rich sites carried out
- Biodiversity Information System developed

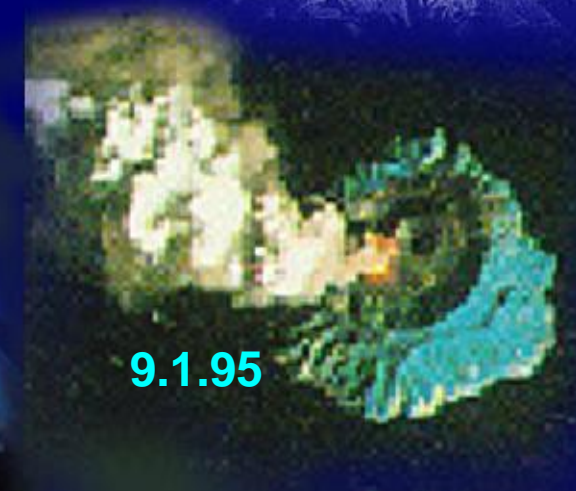
Volcanoes and Cyclones

- Monitoring / Warning
- Impact Assessment
- Landfall Prediction (Cyclone)

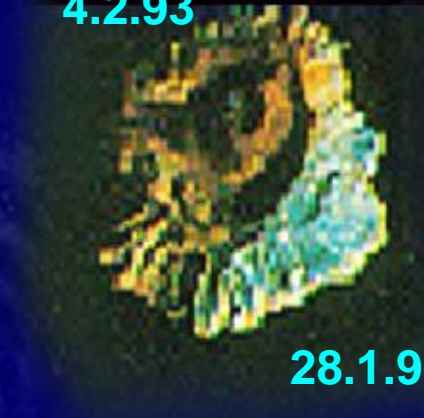
Baran Island
UT of Andaman & Nicobar



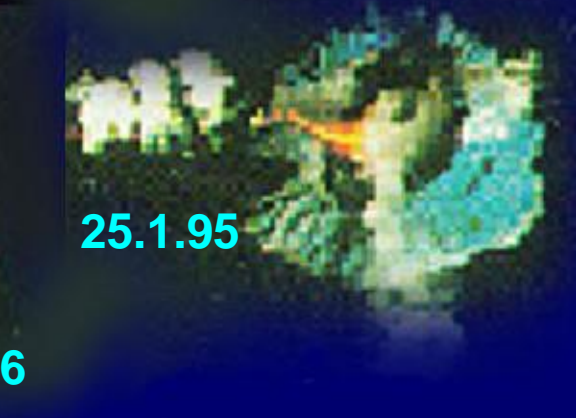
4.2.93



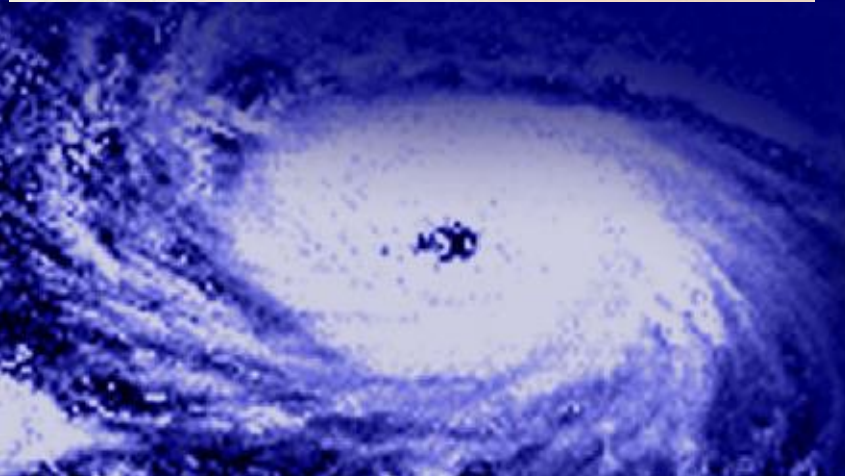
9.1.95



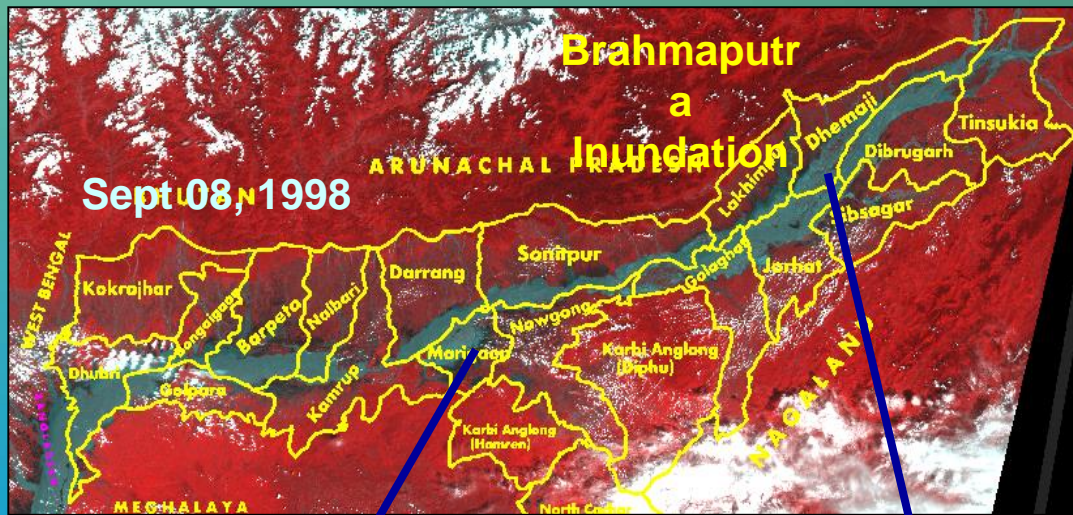
28.1.96



25.1.95



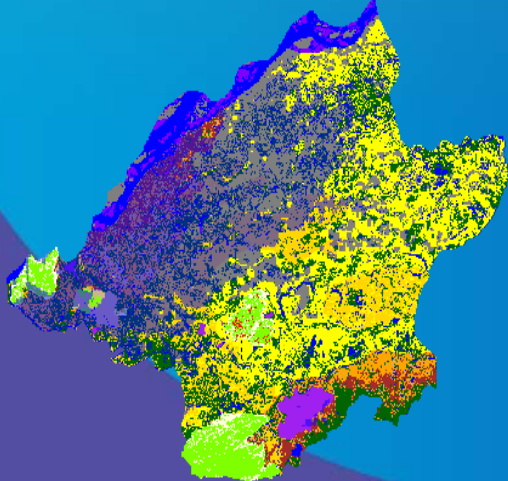
Flood Mapping



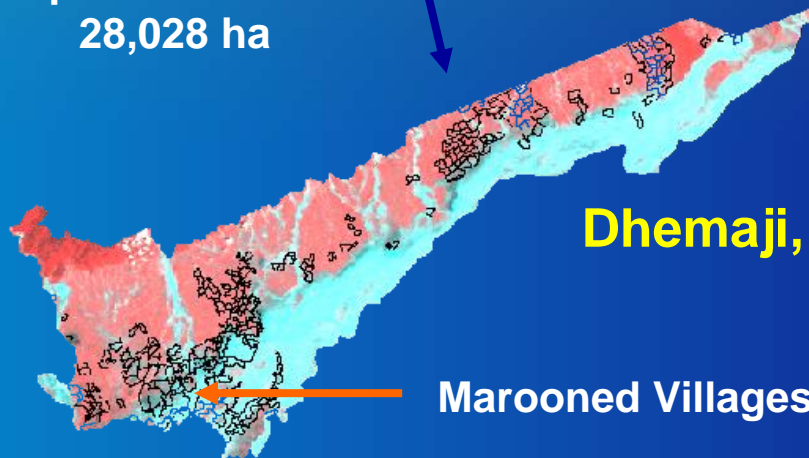
- Being carried out since 1987
- Flood prone river basins of Brahmaputra (Assam), Kosi/ Ganga (Bihar), Indus (J&K), Godavari (AP) and Mahanadi (Orissa) are covered

Morigaon, Assam

Crop Area Affected:
28,028 ha

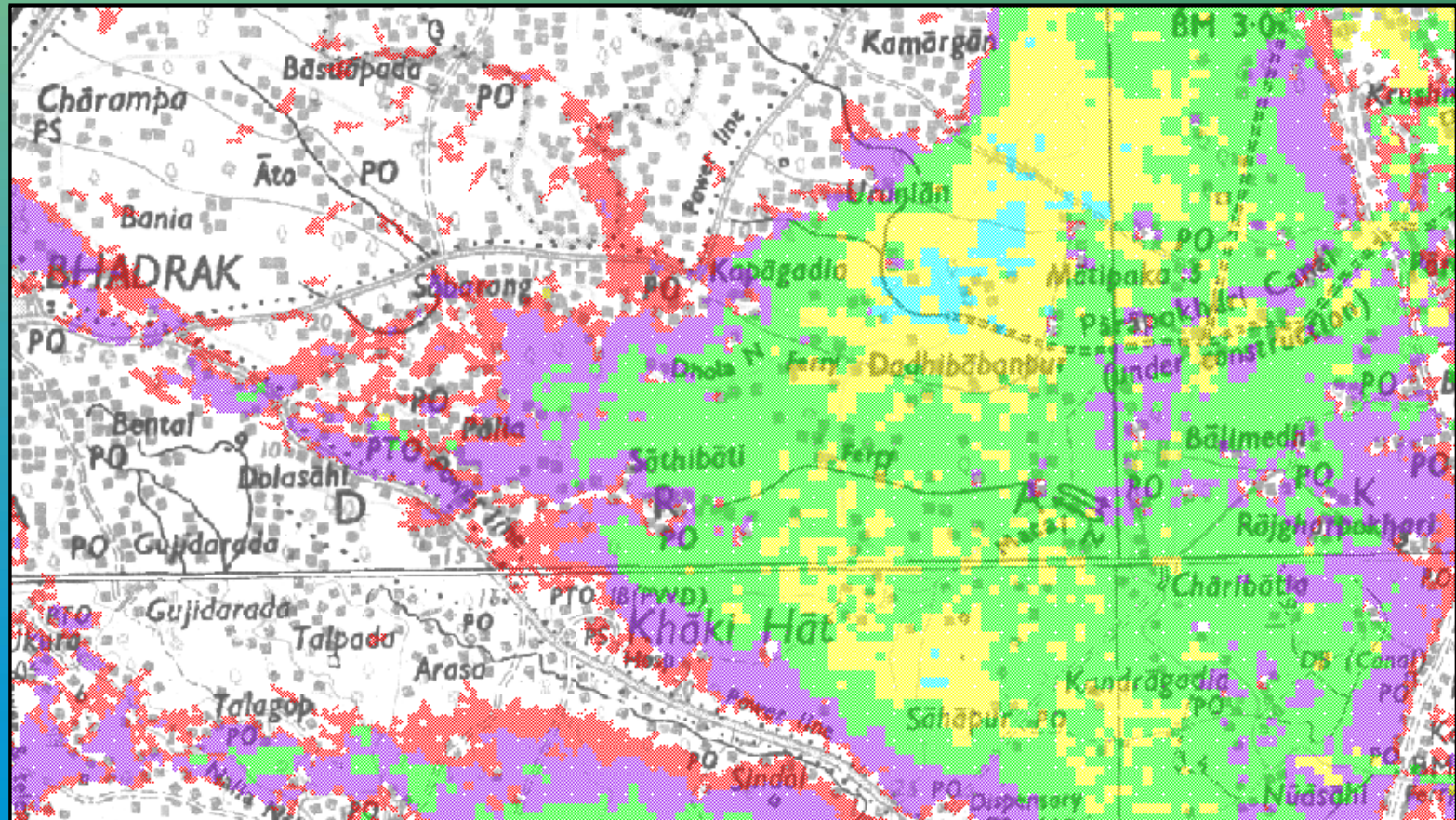


Dhemaji, Assam



Marooned Villages

ORISSA SUPER-CYCLONE - MONITORING



INUNDATION AS ON 13 NOV, 1999

INUNDATION RECESSON DURING 2-4 NOV,1999 - 2,46,428 HA

INUNDATION RECESSON DURING 2-8 NOV,1999 - 2,25,809 HA

INUNDATION RECESSON DURING 2-11 NOV,1999 – 94,076 HA

INUNDATION RECESSON DURING 2-13 NOV,1999 - 11,785 HA

Drought Monitoring

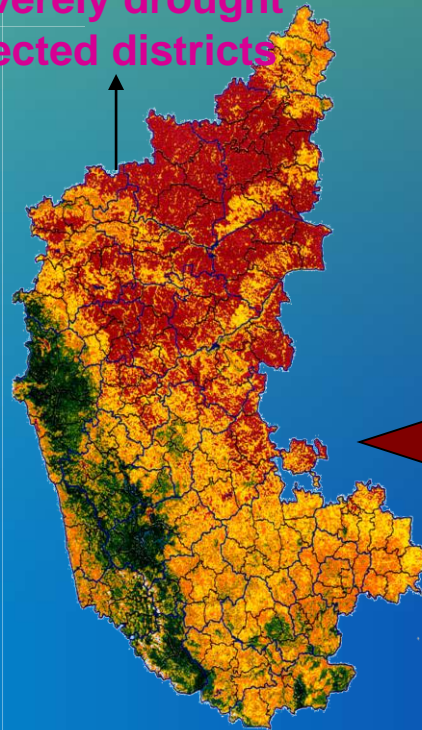
KARNATAKA

IRS WiFS based NDVI

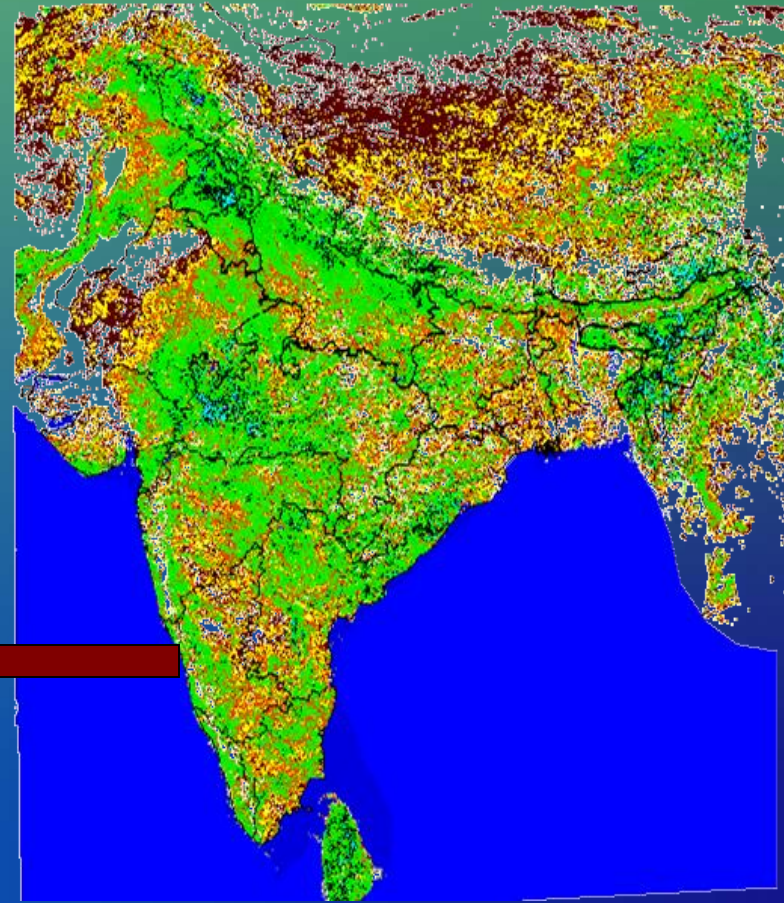
Severely drought affected districts



May-July 2000



May-July 2001



National Agricultural Drought Assessment and Monitoring (NADAMS)

Increasing NDVI

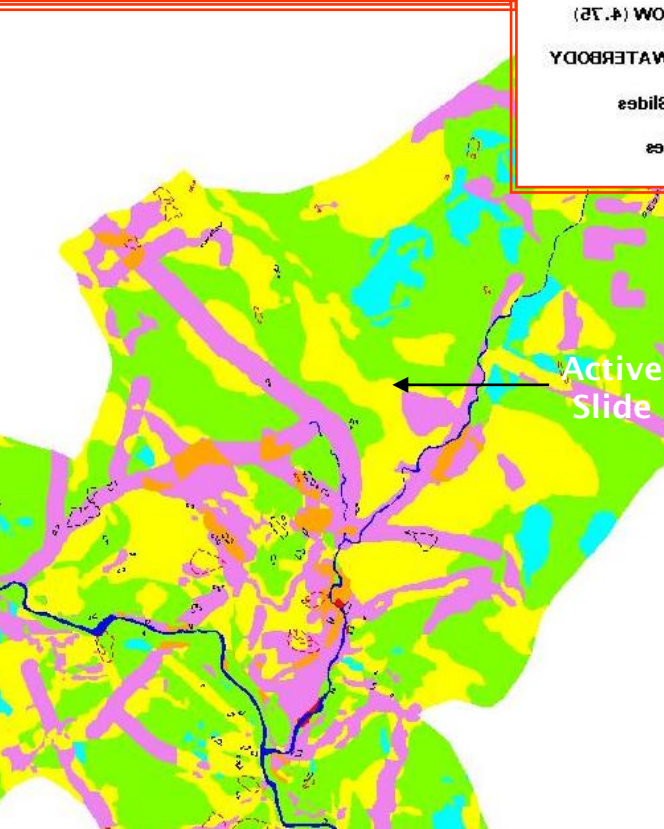




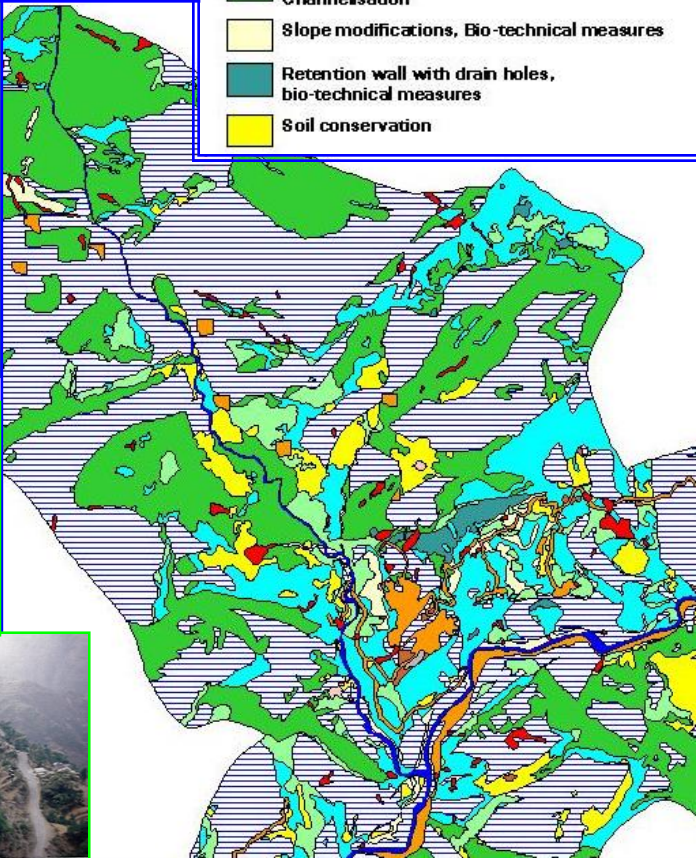
Landslide Hazard Zonation (LHZ) Mapping

2000 km length of major tourist and pilgrim routes in the Himalayas of Uttarakhand and Himachal Pradesh covered

Landslide Hazard Map - Chamoli



Landslide Hazard Management Map - Chamoli



- Retention wall with drain holes, Channelisation, Slope Modification, Bio-technical measures, River Training
- Retention wall with drain holes, Channelisation, Slope Modification, Bio-technical measures
- River training
- Retention wall with drain holes, Channelisation
- Planned Mining, Bio-technical measures
- Planned developmental activity
- Slope modifications as required, avoid further construction activity
- Retention wall with drain holes as required, avoid further construction activity
- Channelisation, Avoid further construction
- Bio-technical measures, Channelisation
- Forest conservation, Channelisation
- Afforestation, Forest conservation, Channelisation
- Slope modifications, Bio-technical measures
- Retention wall with drain holes, bio-technical measures
- Soil conservation

Landslide Hazard Management Measures



Active Slide

Gujarat Earthquake - 2001

Emergency Response

- Established communication link between Bhuj & Gandhinagar using SNG terminal for relief/rescue operations
- Aerial photography of affected towns by NRSA: Data used by Govt. of Gujarat for rehabilitation
- Damage assessment using pre and post earthquake data

Rebuilding BHUJ

- Info. support for Rehabilitation & Reconstruction
- Watershed Development

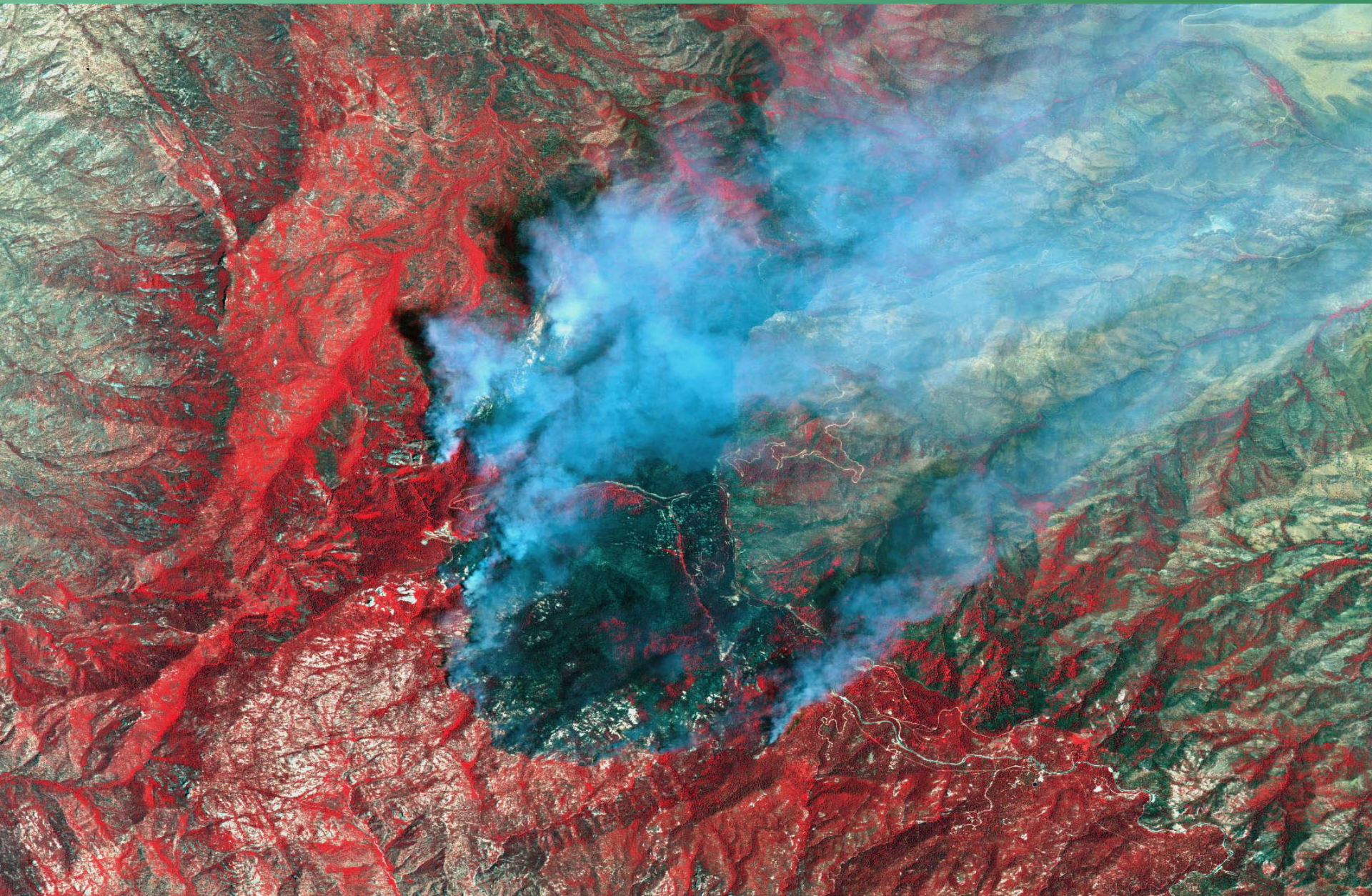
Damage

[Satellite Data of 1 M Resolution]



Arizona Forest Fires

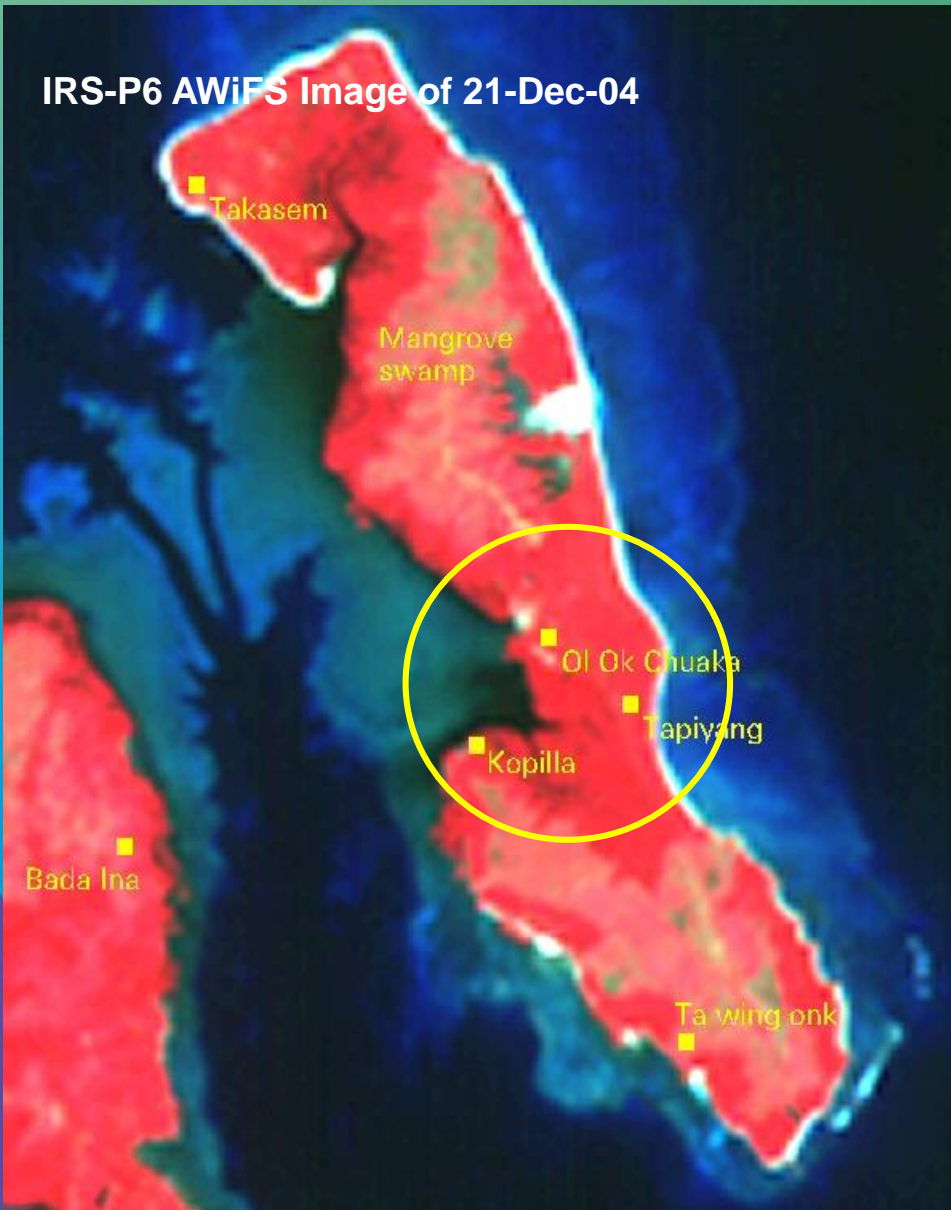
June 21, 2003



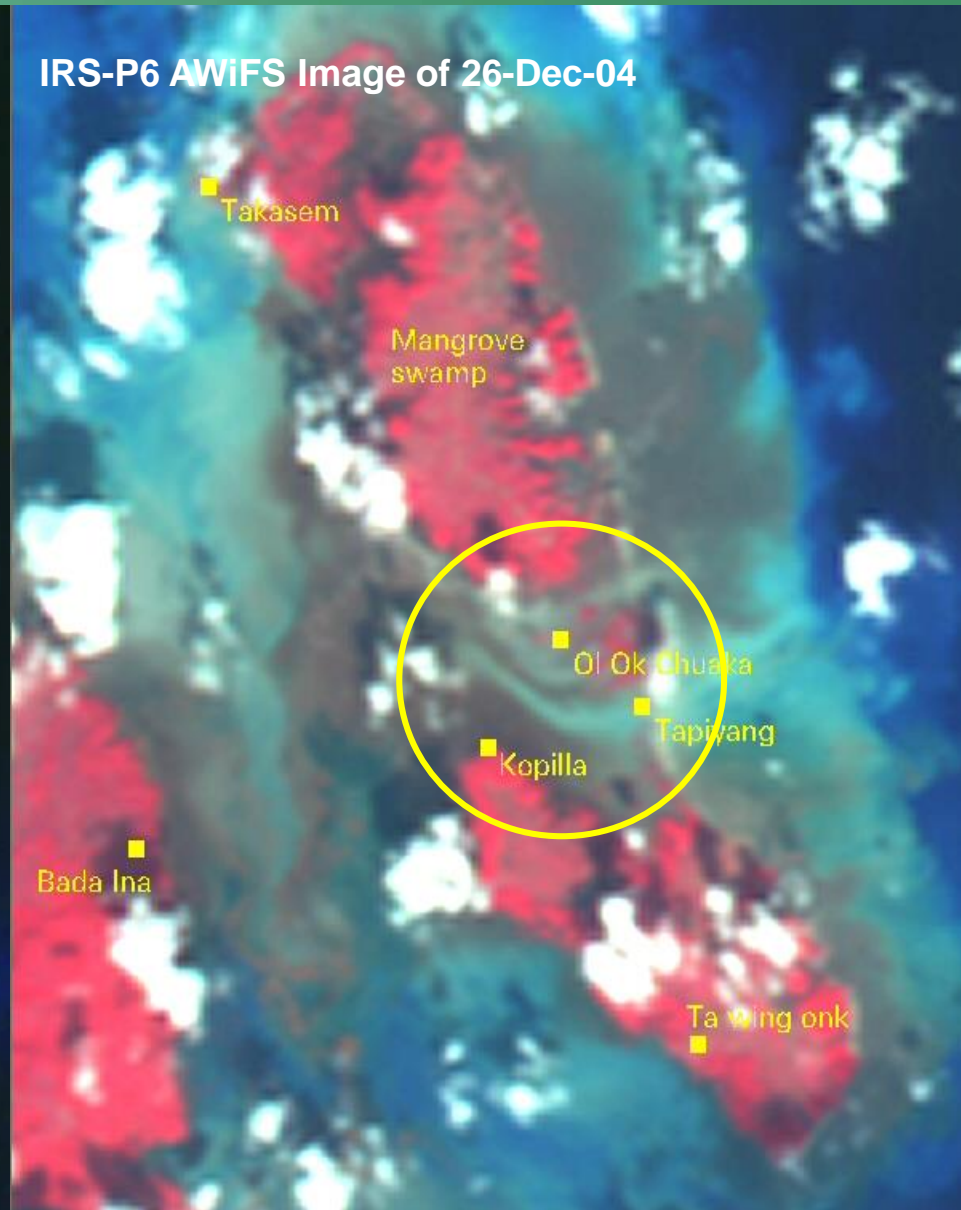
Tsunami - December 26, 2004

Trinkat Island, UT of Andaman & Nicobar

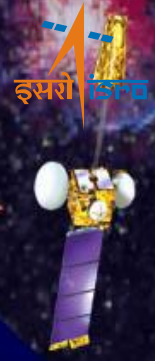
IRS-P6 AWiFS Image of 21-Dec-04



IRS-P6 AWiFS Image of 26-Dec-04



Integrated Mission for Sustainable Development Chandrapur- A Success Story



Action Plan for Micro-level Watershed Development



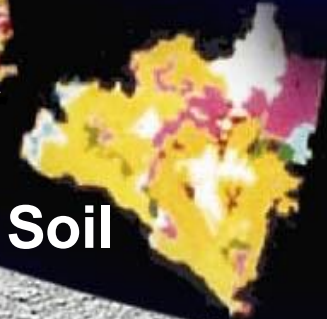
Drainage/
Ground water



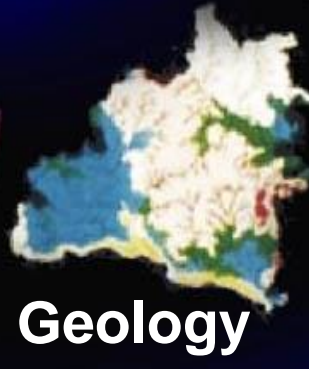
Slope



Land use/
Land cover



Soil



Geology



Landform



... Capacity building
Rural India

IMSD - Action Plans



Surface Water Harvesting, Ground Water Exploration and Recharge, Soil Conservation, Alternate Land use

Water Resources Development

- Check Dams
- Percolation Tanks
- Nala Bunds
- Dykes (Bandhara)
- Farm Ponds
- Vegetative Bunds
- Gully Plugs
- Tank Desiltation
- Dug/Tube Wells



Land Resources Development

- Agro-horticulture
- Agro-forestry
- Silvipasture
- Double cropping
- Intensive Agriculture
- Afforestation
- Forest Enrichment
- Pasture Development
- Fuel/Fodder Plantation



Village Resource Centre (VRC)



**Space-based Services for
Community Outreach**





Thanks