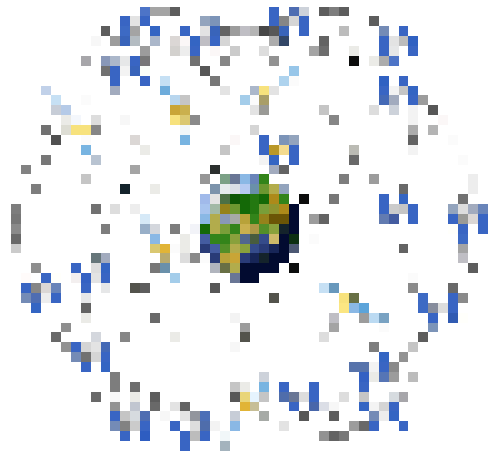
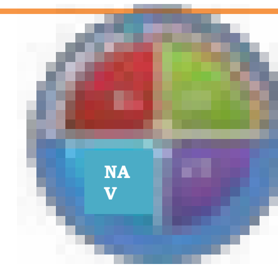
Geospatial Technology and its application for Disaster Management Support





Know the Atmosphere we Live in , 20th Dec 2019

Dr. Y.V.N. Krishna Murthy

Registrar & Senior Professor, IIST, Dept. Of Space, Govt. Of India, yvnkrishna@iist.ac.in

Formerly Distinguished Scientist ISRO, Director NRSC, Scientific Secretary ISRO, Director IIRS, Director CSSTEAP (UN affiliated Centre), Director NARL, Director RRSC's, Director Antrix Board

DISASTER

Significant physical damage or destruction, loss of life, drastic change to the environment, catastrophic, tragic

NATURAL DISASTERS

Earthquake
Flood
Hurricane
Tornado
Tsunami
Thunderstorm
Drought

Volcano
Wildfires
Landslides
Death/Epidemic
Cyclones
Avalanches
Blizzards

MAN-MADE DISASTERS

Wars
Massacre
Mass murder
Fire
Explosions
Riots and Civil Disorders
Accidents

FACTORS leading to Disasters

- Increasing population
- Construction on ecologically sensitive sites
- Improper management of resources
- Deforestation
- Depletion of resources
- Climate Change
- Ignorance and lack of responsible behavior
- Non conformity to bye-laws and standards (Eg. Rainwater Harvesting and Seismic Proof building norms)
- Changing minds- from societal cause to economic and monetary benefits
- Political interference

DISASTER

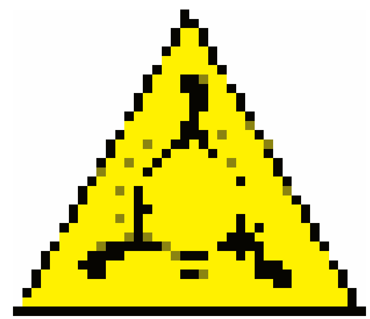
Destroys the economic, social and cultural life of people

Occurrence of **Hazard**

High **Vulnerability**

Inappropriately managed **Risk**

Disaster



Disaster Risk Management and Reduction

Disaster risk Management

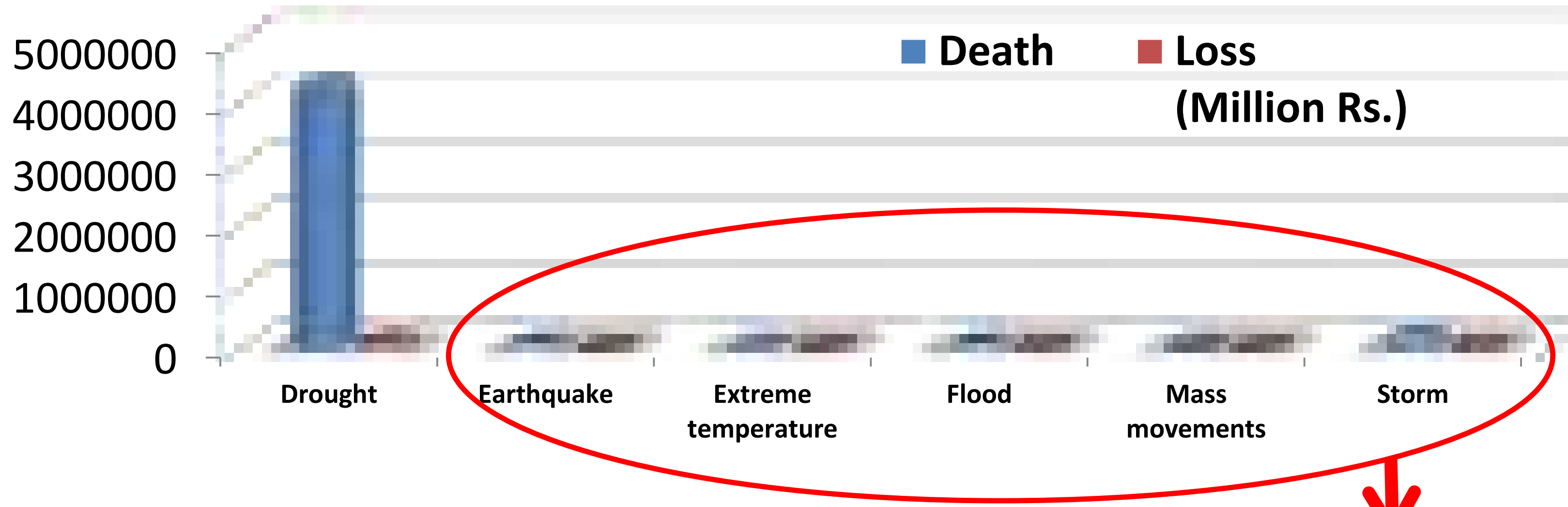
- The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster
- Aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for Prevention, Mitigation and Preparedness

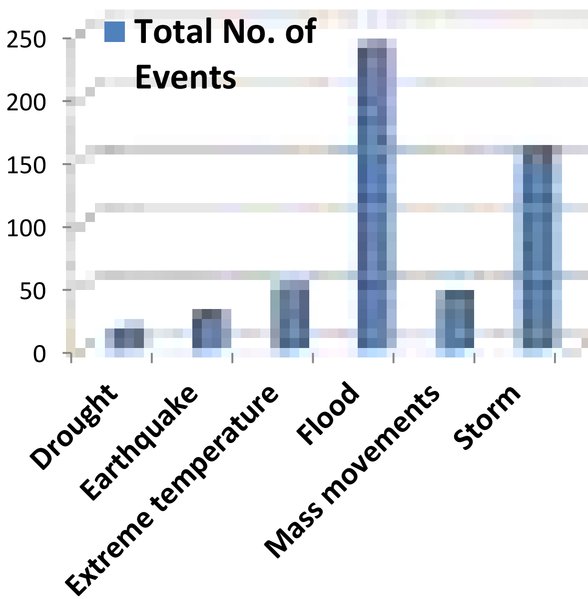
Disaster risk Reduction

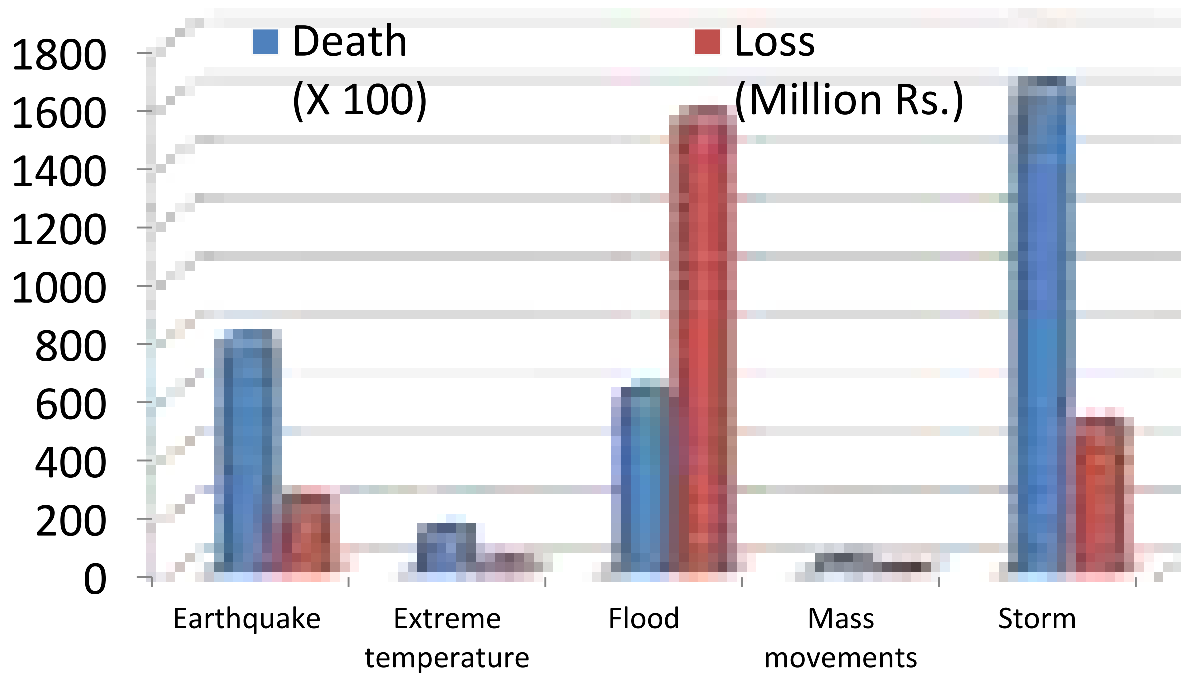
- The concept and practice of reducing disaster risks through
  - systematic efforts to analyse and manage the causal factors of disasters
  - reduced exposure to hazards
  - lessened vulnerability of people and property
  - wise management of land and the environment
  - improved preparedness for adverse events
- Subset of Disaster Risk Management

Disaster Status in India during 1900-2011

(Source: Centre for Research on the Epidemiology of Disasters (CRED) Emergency Events Database EM-DAT)







INDIA-Disaster Statistics

Indian sub-continent is one of the world's most Disaster-prone areas.

50 million people affected annually due to disaster

Affected Area:

Floods: **~40 M ha** of total area

Cyclones: **~8%** of total area
(7500 km long coastline)

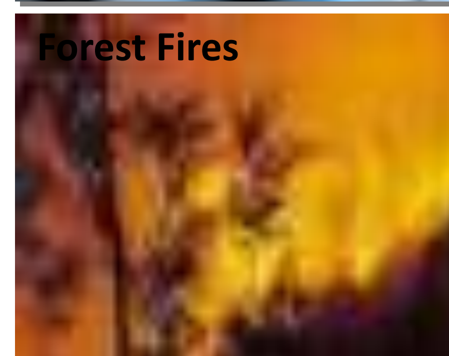
Drought: **~68%** of total area (116 districts)

Landslides: **~8%** of total area
(Himalayan/ Western Ghats)

Earthquakes:**~55%** of area in Seismic
Zone III- & IV

Forest Fires: **~65%** of total forests under
potential threat

Tsunami: East Coast, part of West Coast,
A & N Islands



Pre-Disaster Phase

DISASTER MITIGATION, PREDICTIONS, WARNING & PREPAREDNESS

- Engineering measures
- Physical planning measures
- Economic measures
- Management & institutional measures
- Social measures

- Disaster Preparedness aims to reduce the loss from future disasters
- Involve mock drills

During the Disaster

RESPONSE

- Implementation of planning or measures put in place in the preparedness phase

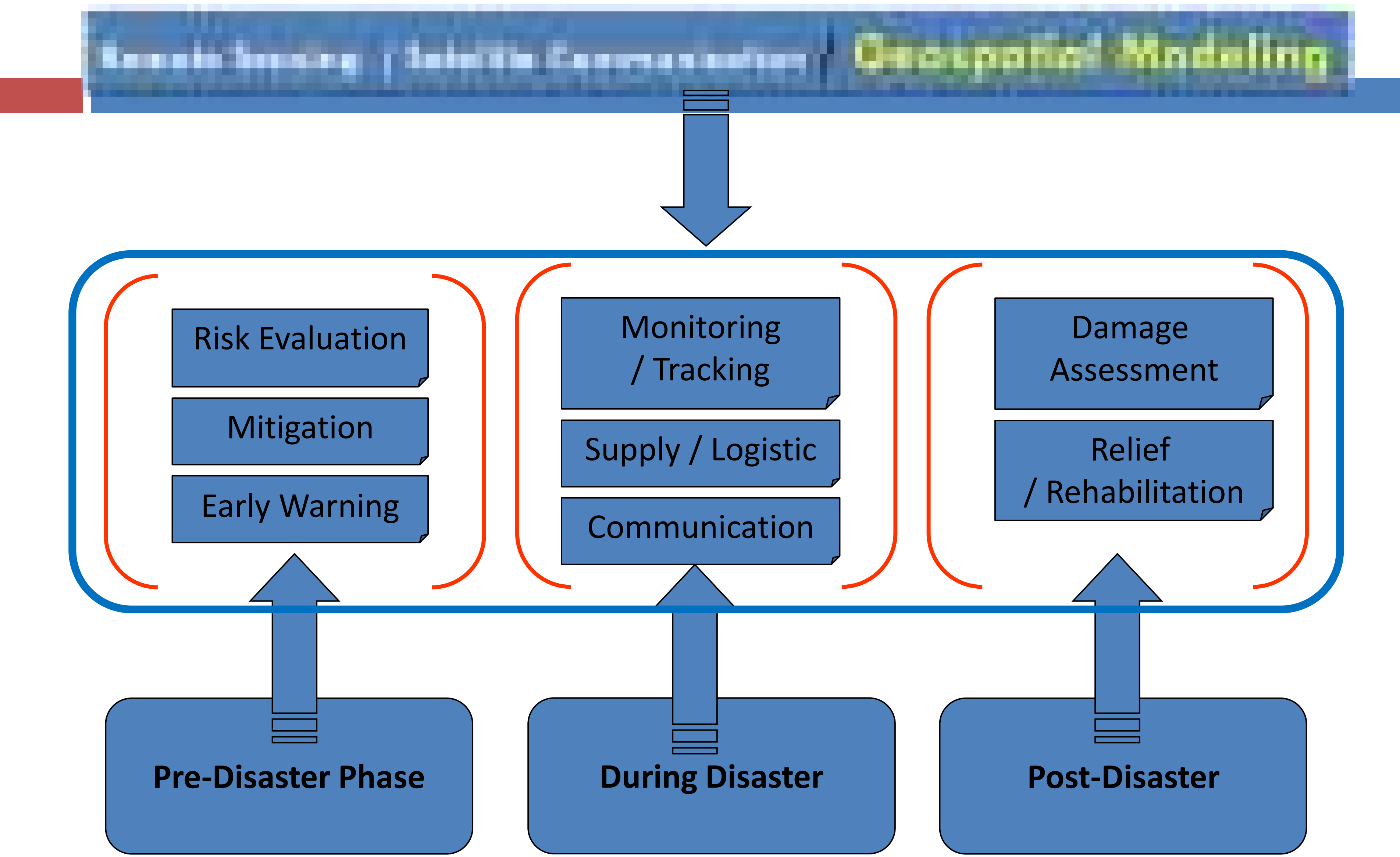
- Saving life – priority
- Evacuation
- Assessment and emergency relief
- Logistics and supply
- Communication and information management

Post - Disaster

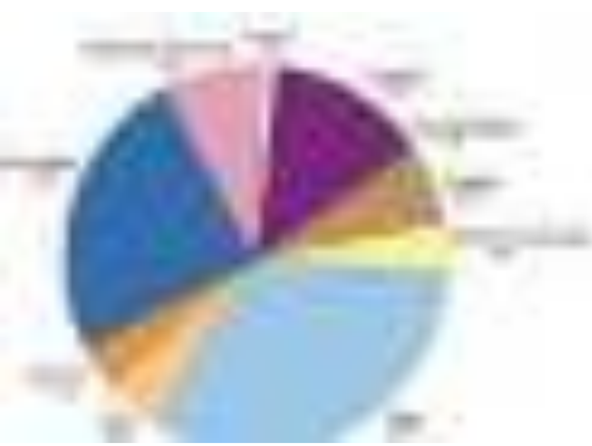
RECONSTRUCTION

- Restoring normalcy
- Rescue-relief-rehabilitation

Space Technology in Disaster Management



Disaster Management

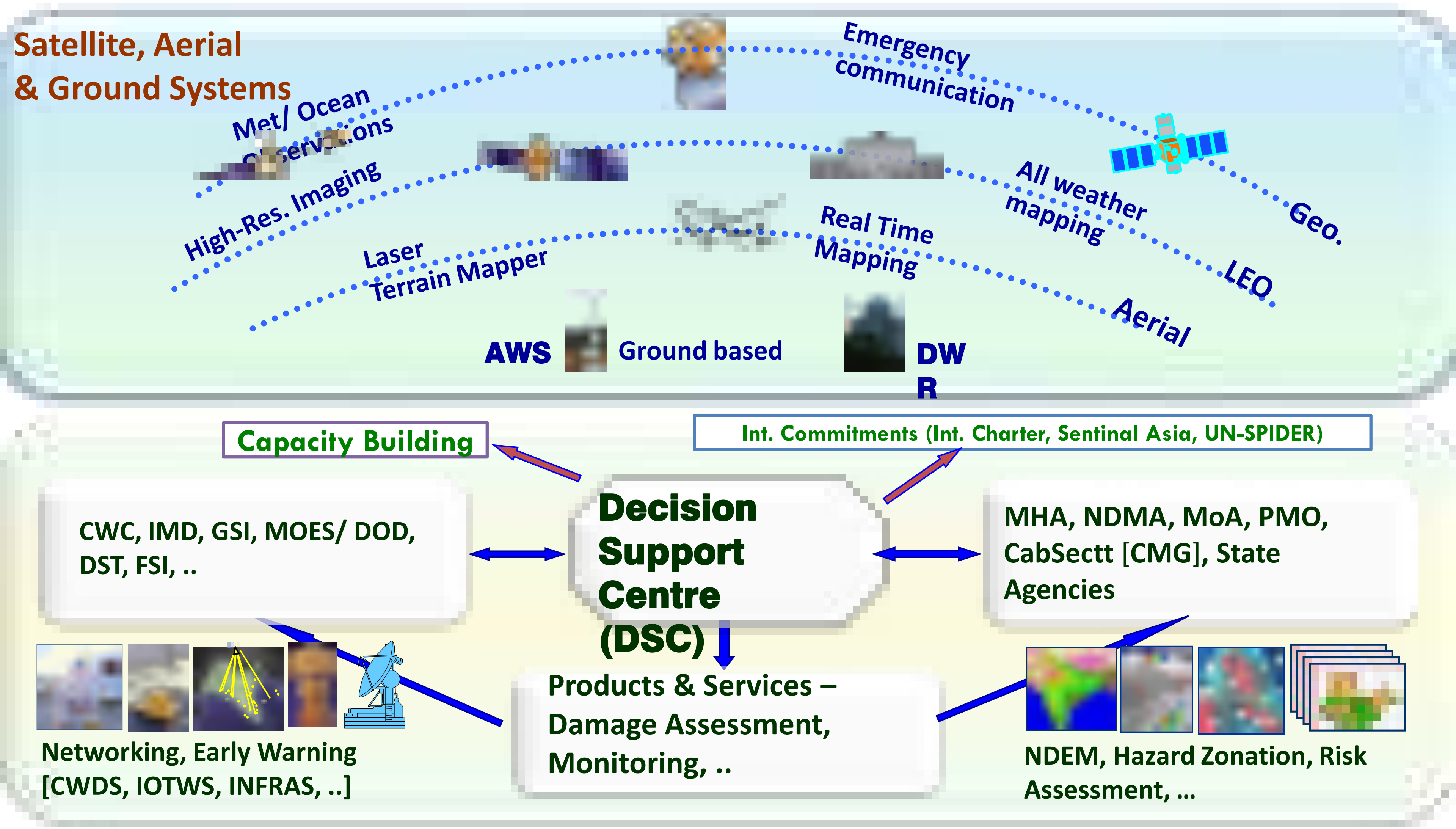


GAPS

- **Functionaries**
  - Administrators & Policy/Decision makers
  - Organizations & Academia
  - NGOs & Self help groups
- **Technological**
  - 'Last Mile' Outreach
  - New Tools & Methods
  - Seamless Integration
- **Operational**
  - Real Time Issues
  - Database Constraints
  - Institutional Constraints
- **Policies**
  - Regulation
  - Restriction
  - Accountability
- **International Cooperation**

CAPACITY BUILDING

Disaster Management Support (DMS) Programme of ISRO: Assets and Infrastructure



Technology Development & Research - ASAR, Forecasting/ Simulation Models, ..

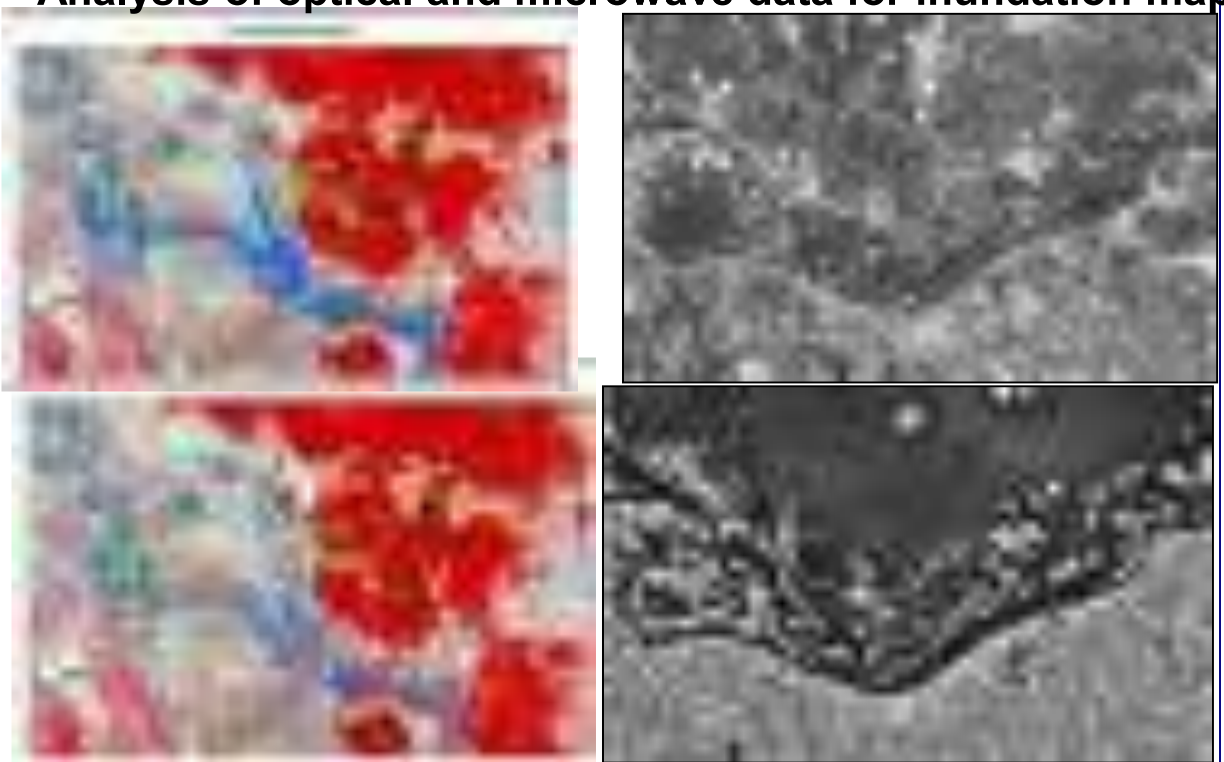
Emergency Communication Network - VPN; Support - MSS Type-D, WLL VSAT, ...

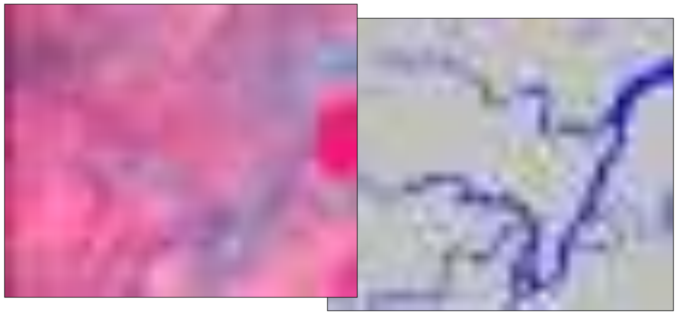
Operational services for flood & related disaster management

- Database generation at 1:50,000 scale & periodic updation.
- Hazard zonation for capturing the vulnerability (Preparedness)
- Near real time flood inundation mapping (Response)
- Scientific assessment of flood damages (Mitigation)
- Mapping of river configuration, flood control works
- River bank erosion & chronic flood prone area
- Improved forecasting and warning models
- Decision Support Software Tools

Decision Support Software Tools

Analysis of optical and microwave data for inundation mapping





Semi-automated tools for water layer extraction

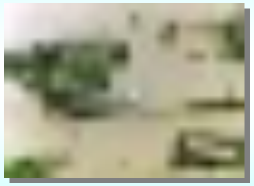
Disaster Management Support

Institutional Mechanism
Decision Support Centre (DSC)

→

in association with Nodal Agencies
MHA, MOA, NDMA, State Agencies

Floods



- Hazard Zonation
- Flood Inundation Maps
- Damage Assessment
- Bank Erosion Studies

Earthquake

- Damage Assessment

Weather & Cyclone

- Intensity & track prediction
- Damage Assessment
- Heavy Rainfall alerts
- Heat wave alerts

Landslide

- Damage Assessment
- Hazard zonation
- Rainfall induced landslide forecast

Drought

- Monthly Agril. Drought Report
- End-of-the-Season Agril. Drought Report
- Carried out by MNCFC

Forest Fire

- Active Fire Detection
- Damage Assessment

SUPPORT TO INTERNATIONAL INITIATIVES: Charter, Sentinel Asia, UN Spider…

Disaster Management Support Services

- **Cyclone Tracking & Landfall Prediction**
  - ✓Significant improvement due to availability of HRI, SST and SSW
  - ✓Accurate Track intensity change and rainfall prediction still challenging.

- **Flood Management**
  - ✓ Flood Hazard Zonation Maps using historical datasets for preparedness.
  - ✓ Real Time Flood Inundation & Rapid Damage Assessment
  - ✓ Forecasting & Inundation Modeling (Experimental)

- **Drought Monitoring & Assessment**
  - ✓ Operationally carried out by MNCFC for 14 states.
  - ✓ Monthly Bulletins on seasonal crop condition and Agril. Drought situation
- **Forest Fire Alerts**
  - ✓ Near real time (within 30 minutes from acquisition) fire alerts during Dec-June fire season.

- **Landslides**
  - ✓ Landslide Hazard zonation
  - ✓ Rain triggered landslides early warning (Experimental)

Agricultural Drought

- Agricultural vegetation condition Images maps at state/district level
- Agricultural drought assessment maps
- Products on drought related parameters - rainfall, crop areas, etc.

Satellite data: NOAA-AVHRR, Resourcesat-1 AWiFS,
MODIS, AMSR-E

Parameters: Vegetation indices, Soil moisture, Sown area

Field parameters: Rainfall, Sown area

Reporting: @ monthly, end of season : June to October

Special Reporting: @ fortnightly

Dissemination: Surface mail, e-mail, Web posting

Thrust Areas

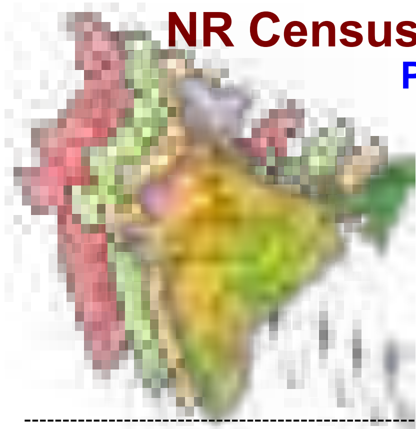
- Drought impact assessment on crop production
- Drought early warning system

Agricultural Drought Assessment
Kharif 2009

Agricultural Drought Assessment
A.P. (Kharif 2009)

Space Applications in Diversified Areas(Contd...)

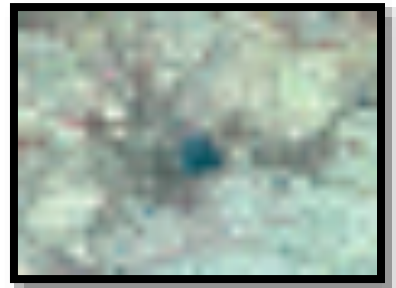
NR Census



Periodic Inventory of Natural Resources

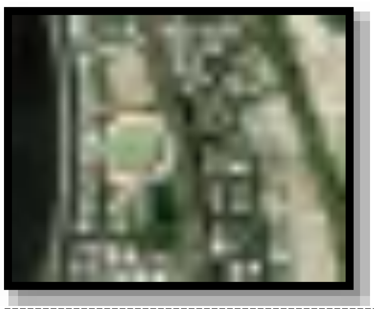
Land use , Soil, Geomorphology Wetland, Land degradation , Snow & Glaciers , Vegetation

Decentralized Planning at Panchayat



- Geospatial database
- Asset mapping & Activity Planning
- Implementation & Monitoring
- Decision Making at local level

National Urban Info. System



Multi scale (10K, 2K) hierarchical Urban Geospatial database

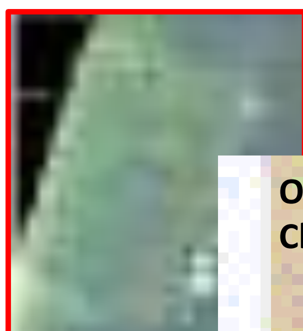
- In support of Urban Planning, Infrastructure development, e-governance.

Close Contour Flood Plains Mapping

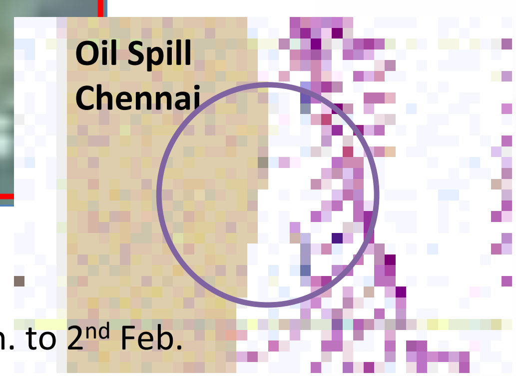
- DEM with with 25 cm height accuracy, Contours at 0.5 m interval, Ortho images for 1:5000 scale topographic maps.
- Used in flood inundation modeling, depth estimation and flood forecasting

Weather & Climate

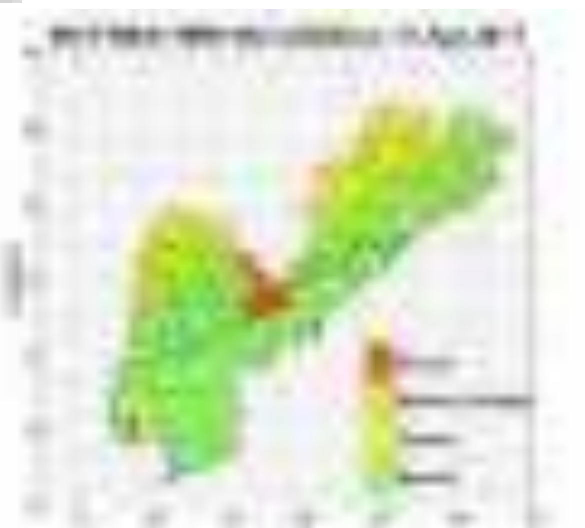
- Space based Weather parameters & Essential Climate Variables (13 / 51)
- Assimilation into model for improved weather prediction.
- Ocean State forecast
- Sea Surface Temperature
- Sea Surface Heights
- Heat wave predictions



Post-Event Sentinel-2 data of 31-Jan-2017



28^{th} Jan. to 2^{nd} Feb.



Remote Sensing Inputs for Flood Management

During Response Phase

Flood Mapping

Post Disaster Phase

Flood Control works

Mitigation Phase

Hazard Zonation

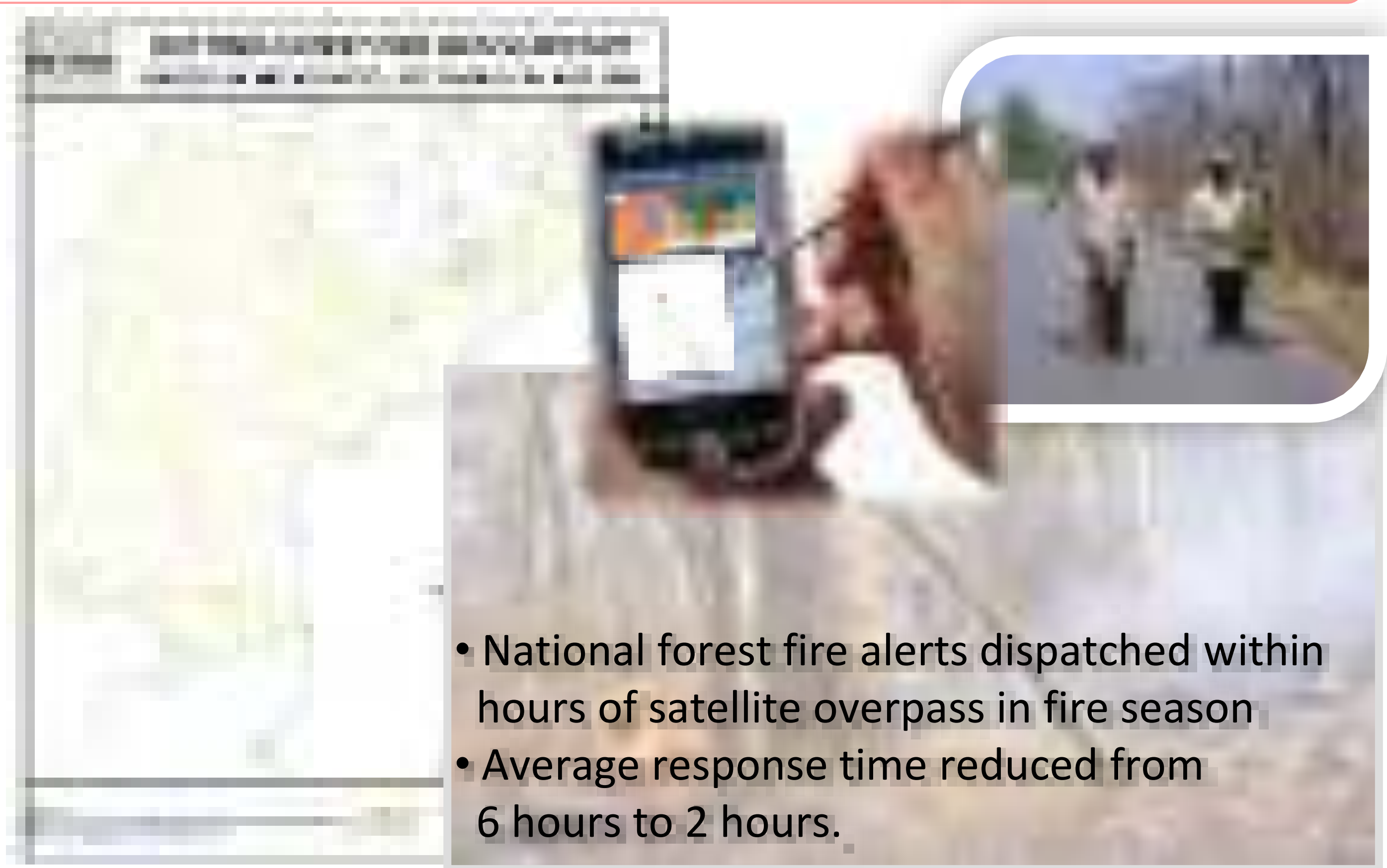
Warning Phase

Inundation Simulation

Forest Fires

Indian Forest Fire Response and Assessment System

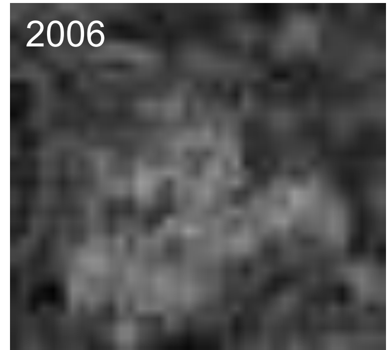
inffras

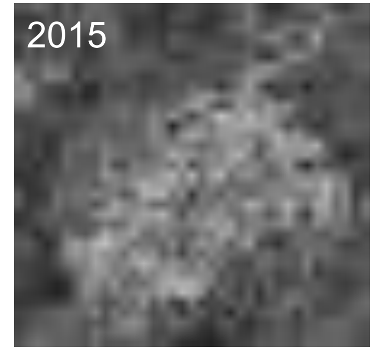


- Daily, near-realtime, day- & night-time, active fire locations via web site
- Fire locations overlaid with forest organization layers
- Communicated to state forest departments.


Cartosat 2 Series (Merged) : Part of Nellore District on 20-02-2017

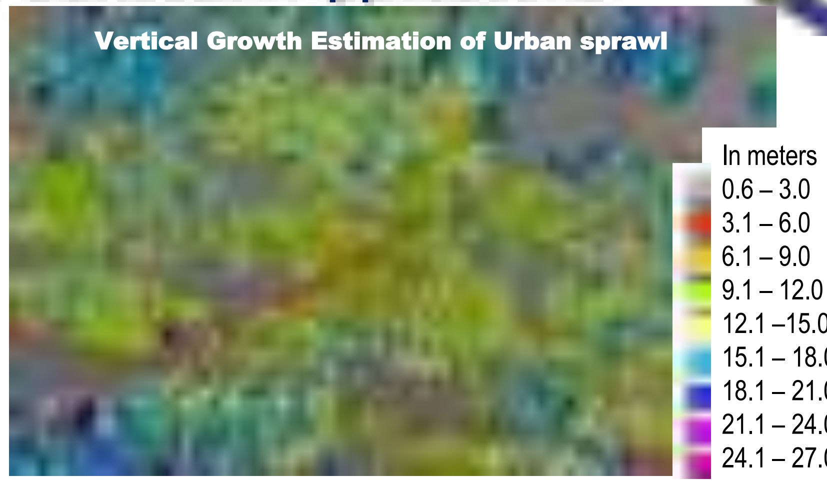
Volume Estimation of a quarry site near Bengaluru Airport





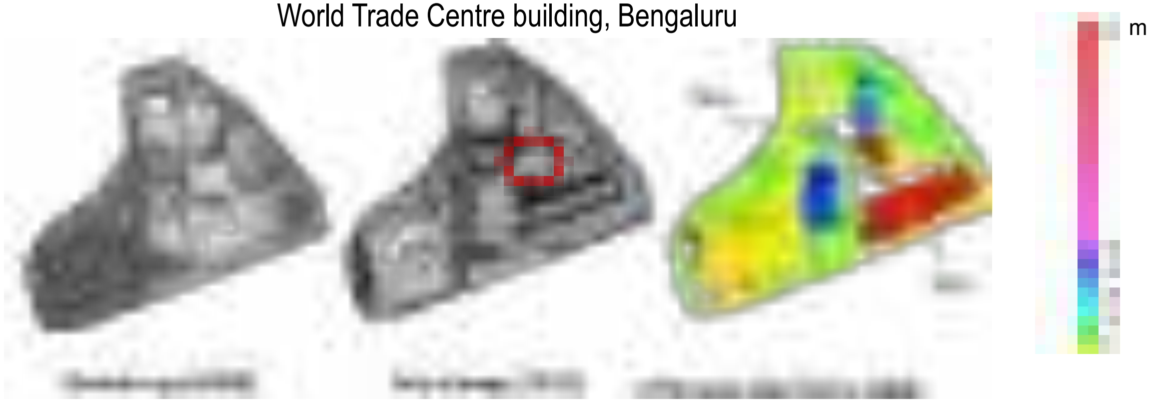
Glimpses of Cartosat-1 Applications

Perspective view of a Terrain with 10m Contour Interval Tawang Mountains Arunachal Pradesh



Delhi Rajouri Garden – Building heights from CartoDSM

World Trade Centre building, Bengaluru



The Height of WTC building is validated with Airborne LFDC stereo (20 cm). The difference in height is less than 2 m.

3D Perspectives from C2S - EVM

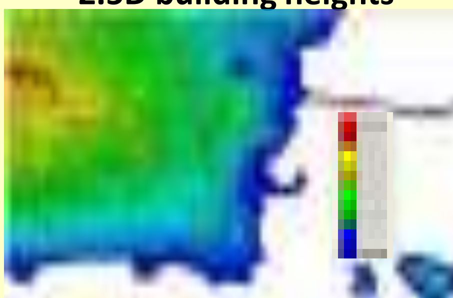
Stream

2.5D visualization – Raipur

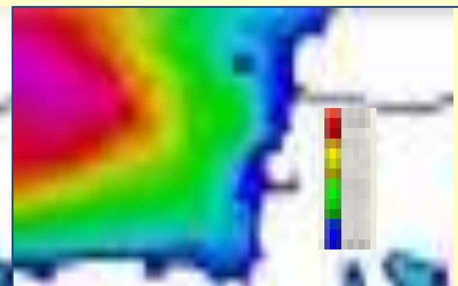
Floor wise
(1 floor=3m)

Coastal DEM for Tsunami Warning Centre (INCOIS)

- 4m DEM with 10 m spacing for 1,50,000 sq km using Cartosat 1 for entire coast
- LiDAR DEM for 22400 sq.km area (Indian Coast with 2km inland buffer) covered
    - Deliverables
        - – Contours with 1.0 m in Mean Sea Level
        - – 1:5000 scale Topographic maps
        - – 2.5D building heights



DSM (Kanyakumari)



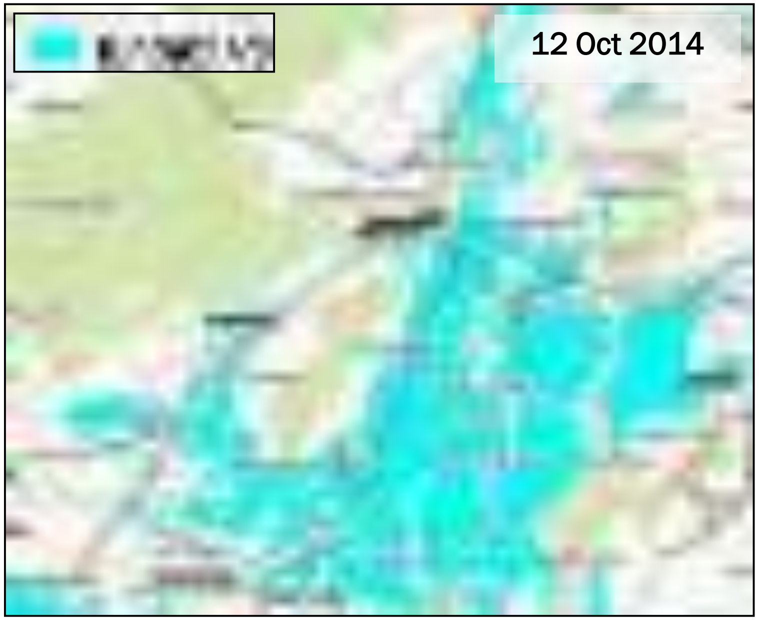
DTM (Kanyakumari)

3D Building Models - Chennai

Topographic Map - Kanyakumari

Cyclone HUDHUD – October 2014

Inundation in Parts of Yelmanchalli District



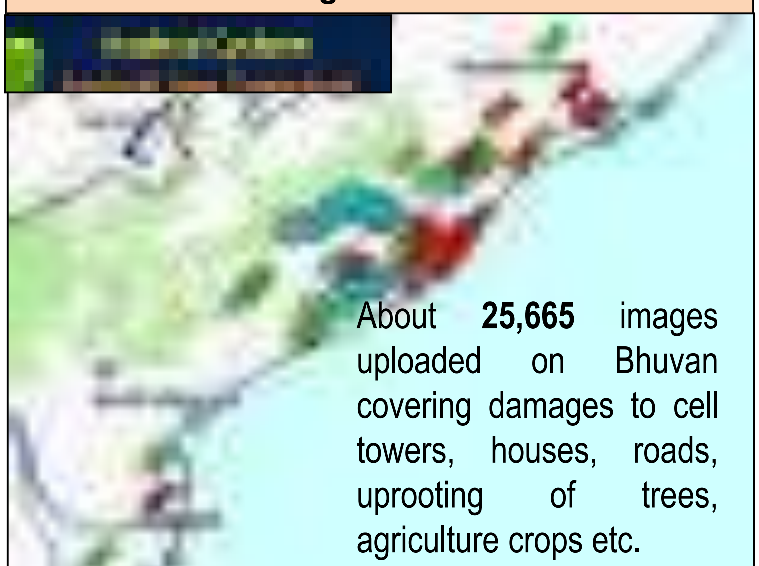
Cyclone Track

severe damage in Vishakhapatnam, Srikakulam, Vizainagaram & East Godavari districts.

IMPROVED DATABSE SUPPORT THROUGH COMMUNITY PARTICIPATION

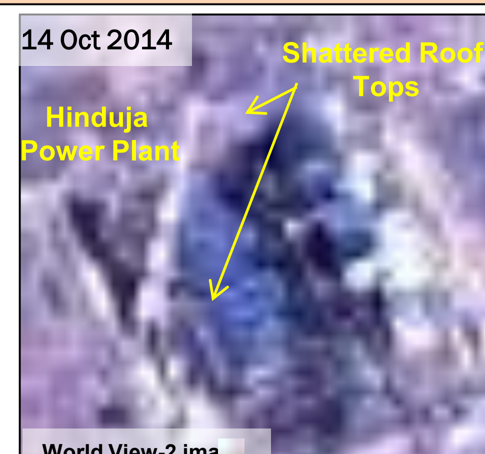
- Very Severe Cyclonic Storm "HUDHUD" on 12 Oct 2014 hit Vishakhapatnam, Andhra Pradesh
- 22 Inundation maps were provided in near real time
- Aerial survey was carried out for damage analysis.
- Crowd sourcing was enabled

Crowd sourcing of data on to Bhuvan



About **25,665** images uploaded on Bhuvan covering damages to cell towers, houses, roads, uprooting of trees, agriculture crops etc.

Structural Damages (Shattered Roof Tops) Observed in Part of Vishakhapatnam District



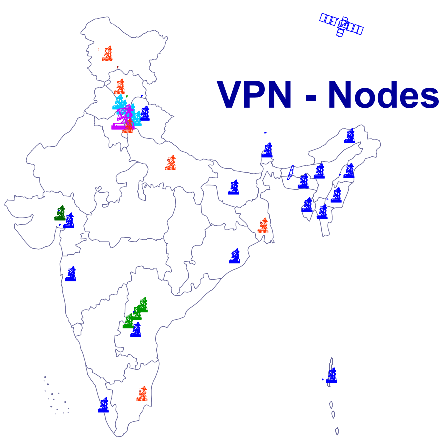
National Database for Emergency Management

- ✓ **Database generation - 1:50 K for entire country; 1:10 K for 169 multi-hazard prone districts; 1:2 K for mega-cities**

- ✓ **Mirroring/ replica of Databases at MHA - with suitable access/ security mechanisms**

- ✓ **Decision Support Systems - Response and rehabilitation**

Satellite based VPN for Disaster Management:



✓42 Nodes Active - Linking Nat'l EOCs with State EOCs, Knowledge Institutions, & Key Offices of Govt.

✓ **Expansion to Multi-Hazard-prone Dists (350+), DM Authorities / NDRF Units (50+)**

Mobile PDA for Collection & Dissemination of RT Field Information

Real time data collection on GPS coordinates, Digital Photos & user specified parameters and transmission from field to central processing server

Field techniques - Map Technologies

Mobile application : Interactive Data* Reporting : WebGIS

Field data /Sensor : GIS database

Current activities in Agriculture for Odisha

- Crop insurance (CIDSS project MoU with Dept. of Agriculture)
- Crop intensification
- Agriculture Drought Vulnerability
- Flood mapping
- Flood hazard zonation
- Crop simulation modelling (R&D intiative)
- Support for Drought Monitoring Cell
- Mobile Apps for crop assessment
- Training to the State officials in drought/crop insurance

Identification of technology intervention areas in the crop insurance value chain

Technologies – IT, Mobile, GIS, Remote Sensing, Data Analytics ..

Timely settlement of claims — Cadastral database, IT tools …

Post harvest damage — Weather indices, Mobile Apps, Field enumeration …

Localised crop damages
Hailstorms — Weather indices, Mobile Apps, Field enumeration …

Crop damages:
Natural calamities
Abnormal events — Satellite indices, weather indices, Mobile Apps, Field enumeration …

Crop assessment
- CCE mechanism

— Moderate resolution satellite data, Mobile Apps, Field enumeration …

Crop Monitoring
- Prevented sowing risk
- Mid-season adversity

— Moderate resolution satellite data, weather data, Mobile Apps, Field enumeration, data analytics …

Enrollment, Expansion & Compliance — High resolution satellite Images, cadastral maps …

Rate making — Agriculture risk info maps, past insurance data …

Agriculture | Land Resources | Forest | Urban | Geology | Water | Rural | Disasters

Crop Insurance Decision Support System (CIDSS) – a web-enabled integrated package for Odisha state

Rate making

Insurance coverage

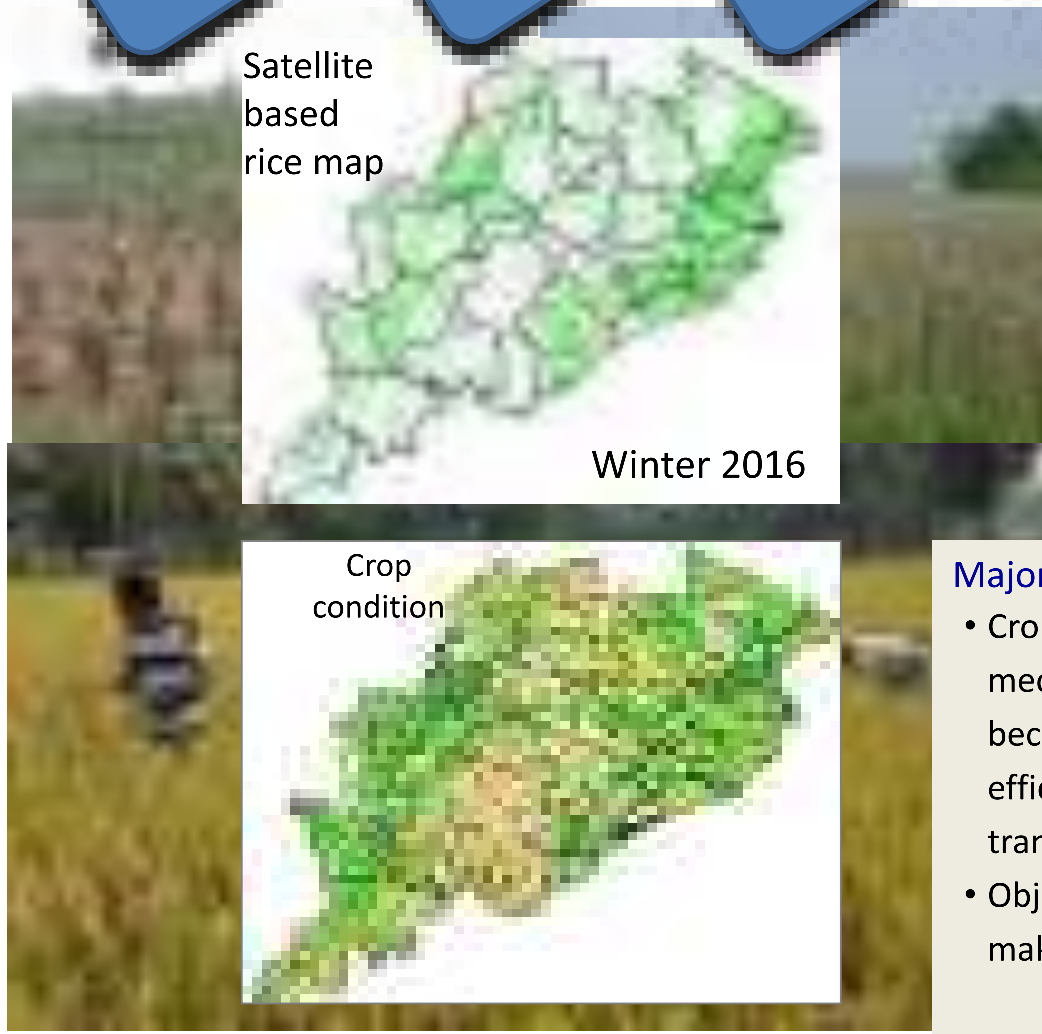
Agriculture outlook

Area discrepancy

Crop performance

CCE verification

Input data sets
Geo referenced cadastral layers
Weather
Soil
Irrigation
Crop & seasonal reports
Satellite based crop area
Satellite based crop condition
In-season flood maps
In-season drought information
Flood hazard area
Drought vulnerability area
Mobile based field data
Mobile based CCE data data
Mobile based crop damage data
Crop area and yield data

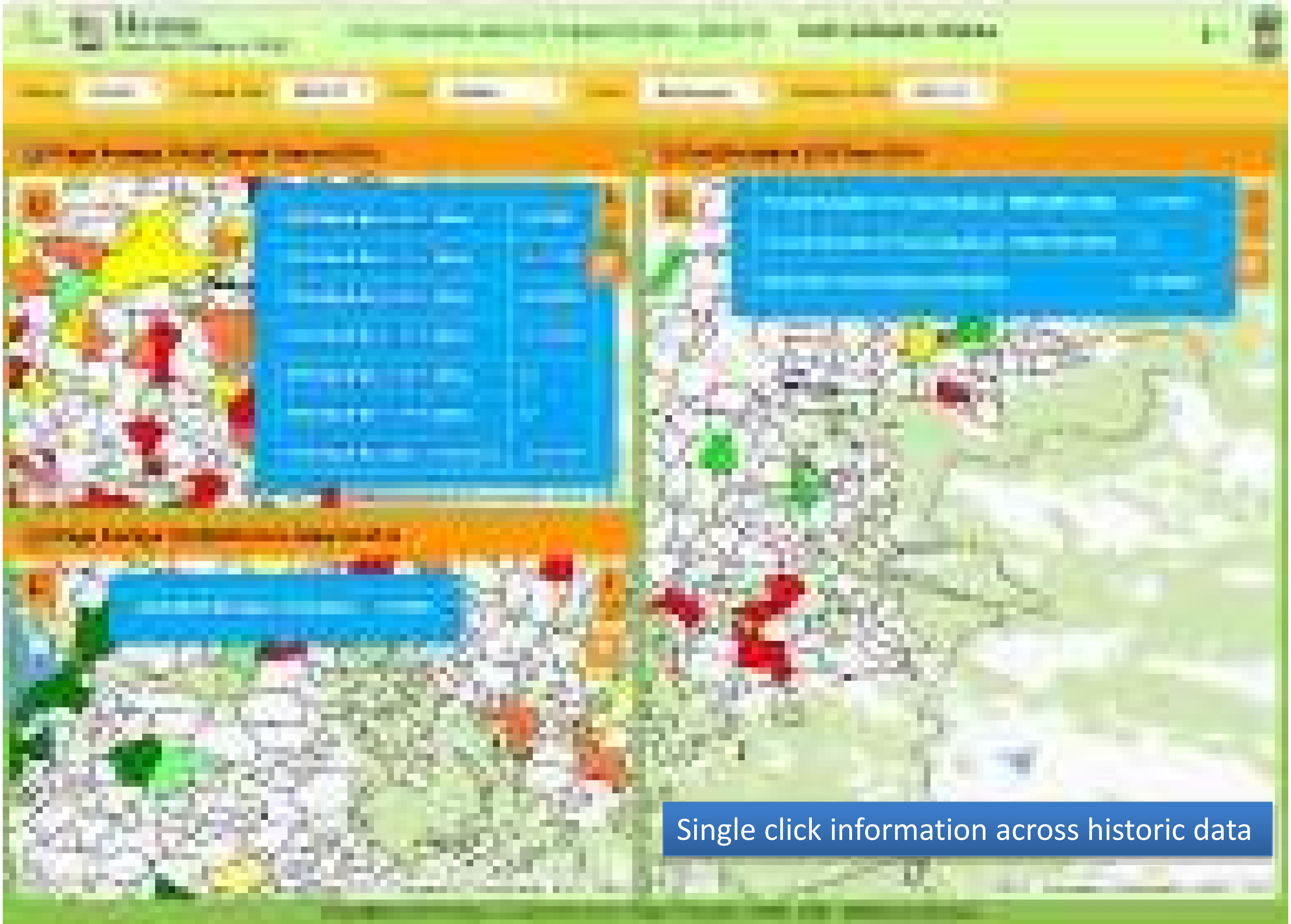


Major Benefits

- Crop insurance mechanism will become more efficient and transparent
- Objective decision making

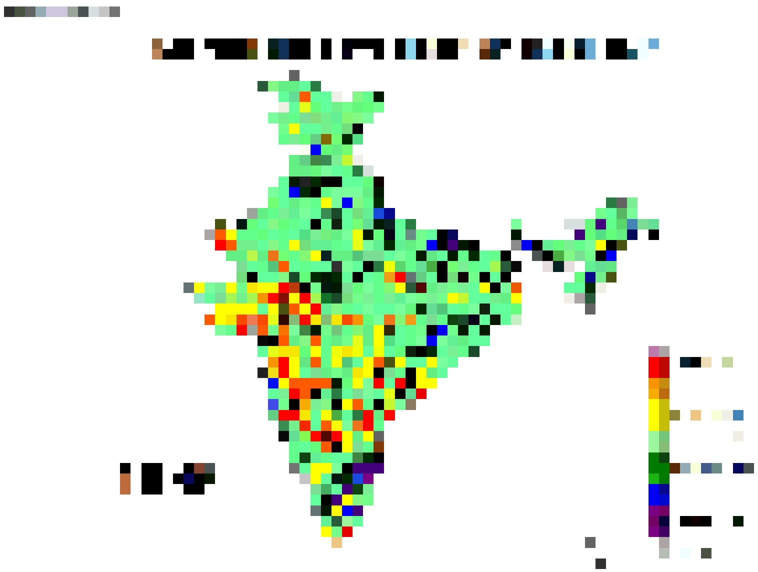

bhuvan
CIDSS

Dedicated DSS modules : CCE Verification and Purification – Tire I (Village level Yield)

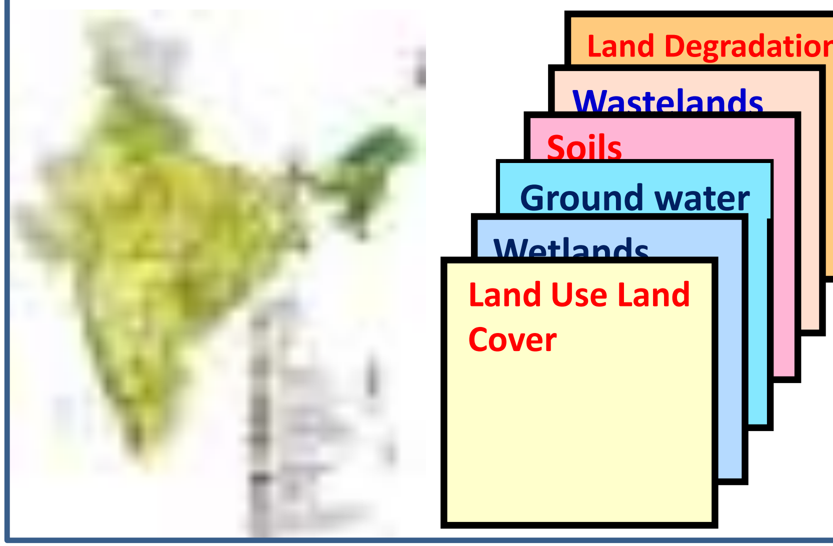


Geospatial products for insurance rate making

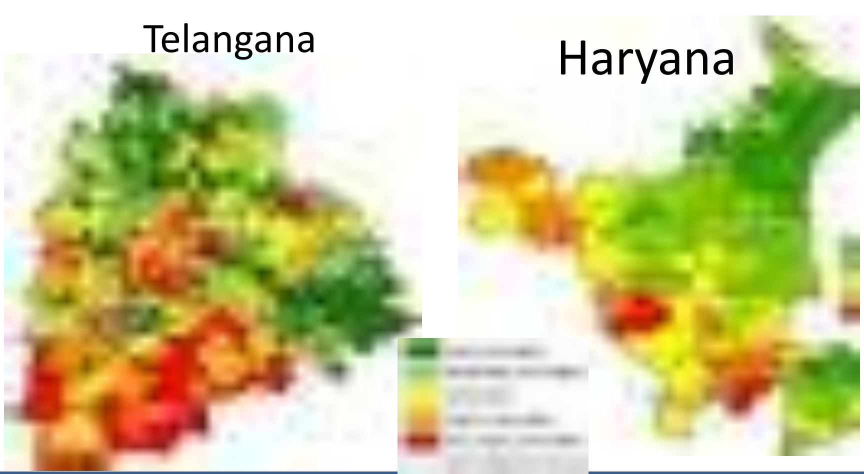
Meteorological drought hazard



Satellite based thematic layers



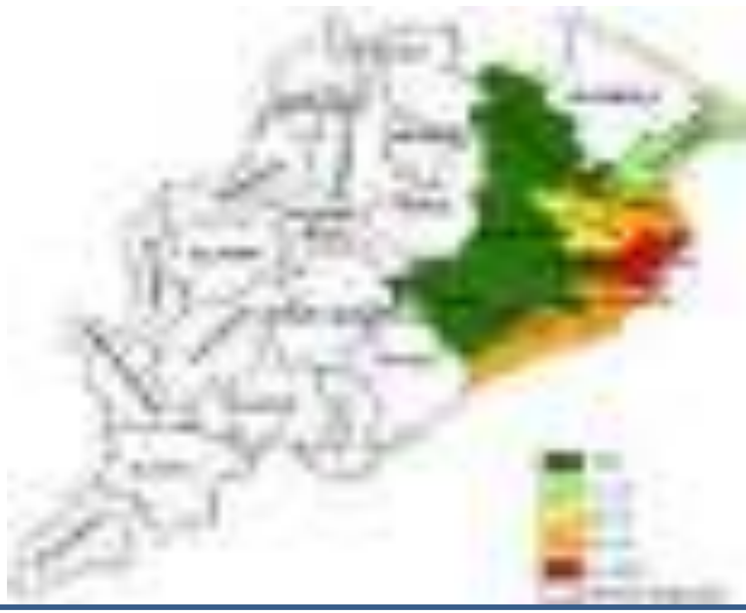
Agricultural drought vulnerability mapping



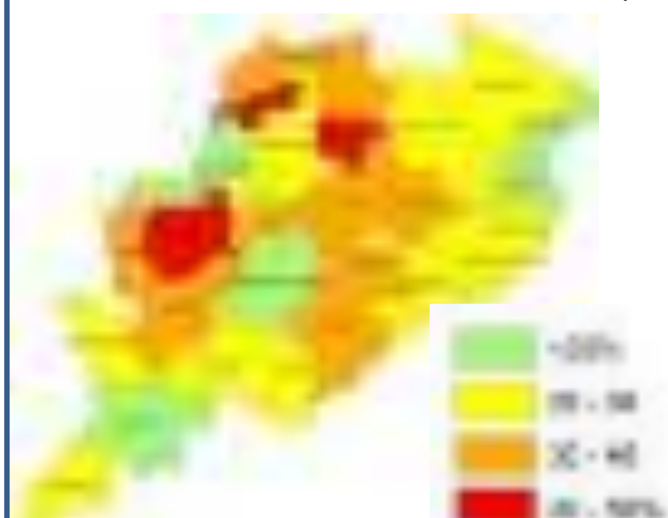
Flood hazard mapping Bihar

Agriculture risk information products for insurance rate making

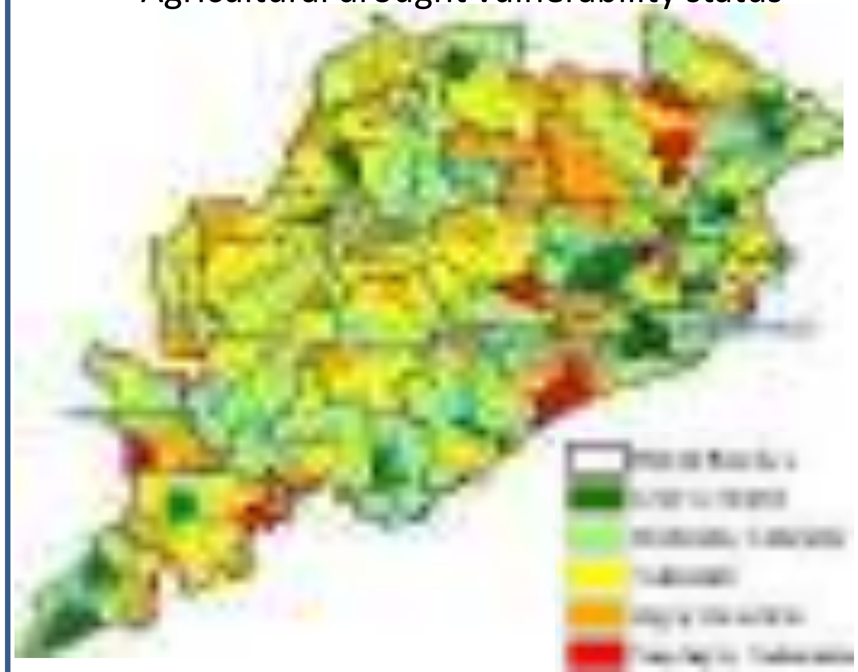
% agriculture area under flood hazard

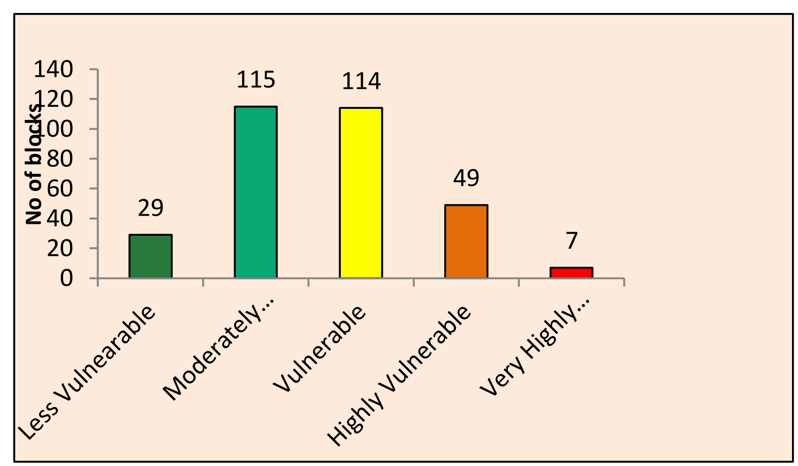


Weather/environmental risks on kharif paddy yield



Agricultural drought vulnerability status

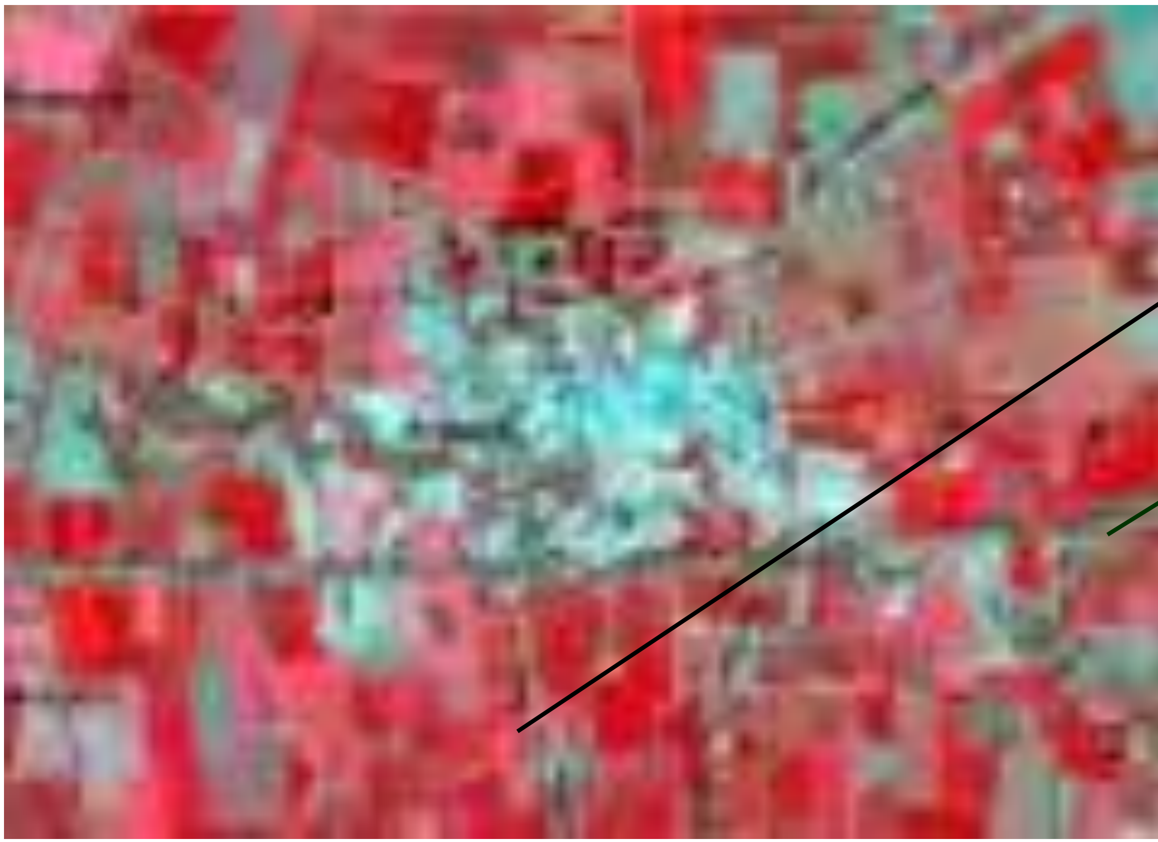


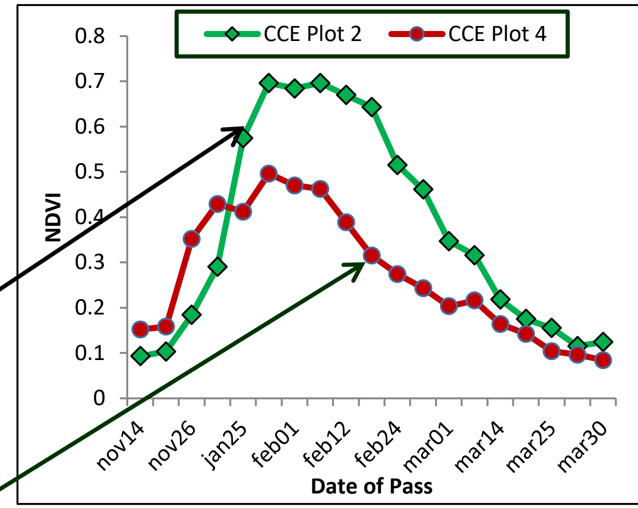


Crop yield variability within the insurance units

NDVI profile vs. Grain yield of Wheat

Village: Baghera
Number of CCE plots: 10



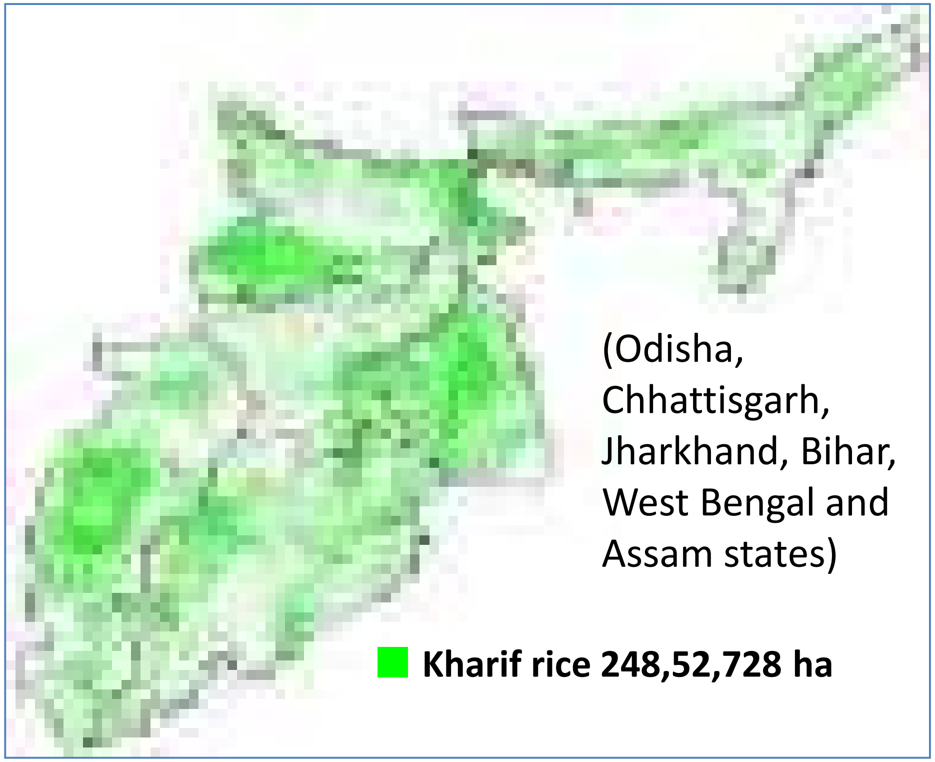


Yield of Plot 2: 44 Q ha^{-1}
Yield of Plot 4: 28 Q ha^{-1}

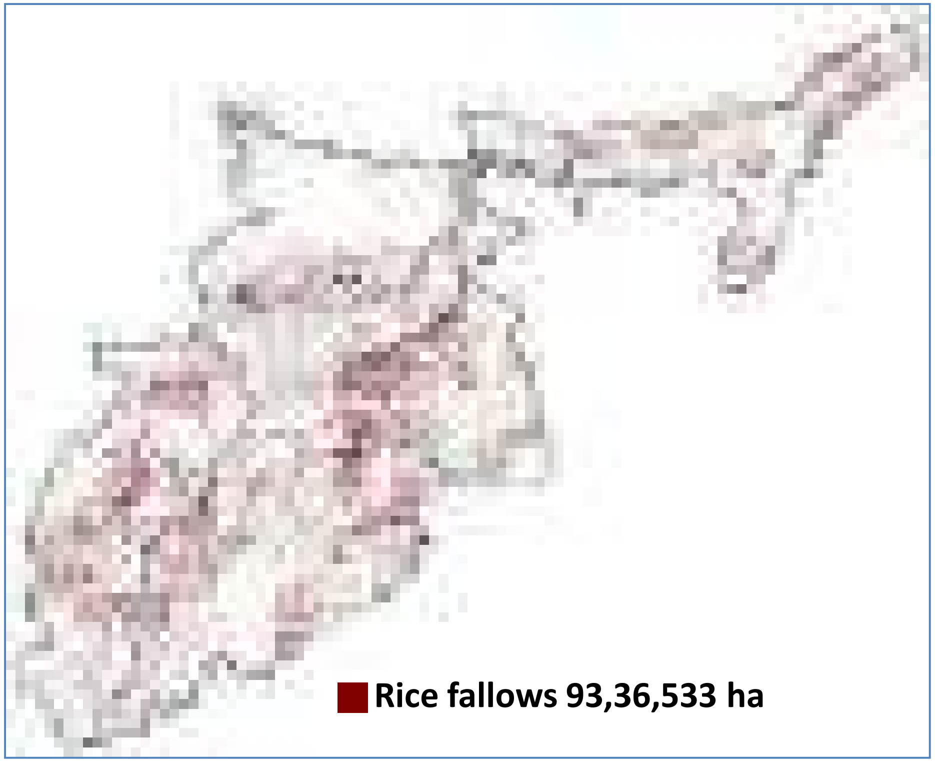
Group of Secretaries Project
Bringing Green Revolution to East India (BGREI)

Satellite based mapping and assessment

Kharif Rice Cropped Areas (2015-16)



Post Kharif Rice Fallow Areas



These 9.3 m ha of kharif rice fallow lands are potential areas for cultivation of pulses and oilseeds in rabi season, thereby bringing green revolution in all these states

Crop intensification

Post kharif rice fallow lands for growing pulse crops in rabi season

A. Kharif Rice (2015) B. Rabi Cropped Area C. Kharif Rice + Rabi Crop

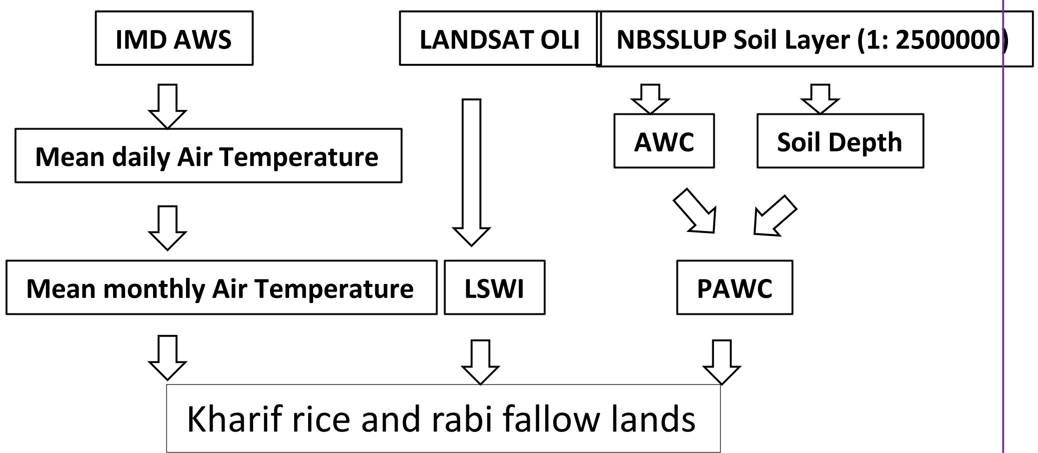
Post Kharif Rice Fallow Areas

District	Kharif Rice
Bhadrak	154613
Kendraparha	130510
Total Kharif Rice(ha)	285123

District	Rabi Cropped Area
Bhadrak	49955
Kendraparha	108039
Total Kharif Rice(ha)	157993

District	Kharif Rice + Rabi Crop	Post Kharif Rice Fallow Areas	Post kharif rice fallows as % of kharif rice area
Bhadrak	31736	122870	79 %
Kendraparha	73251	57247	43 %
Total (ha)	**104987**	**180117**	

Multicriteria approach for suitability for rabi pulses

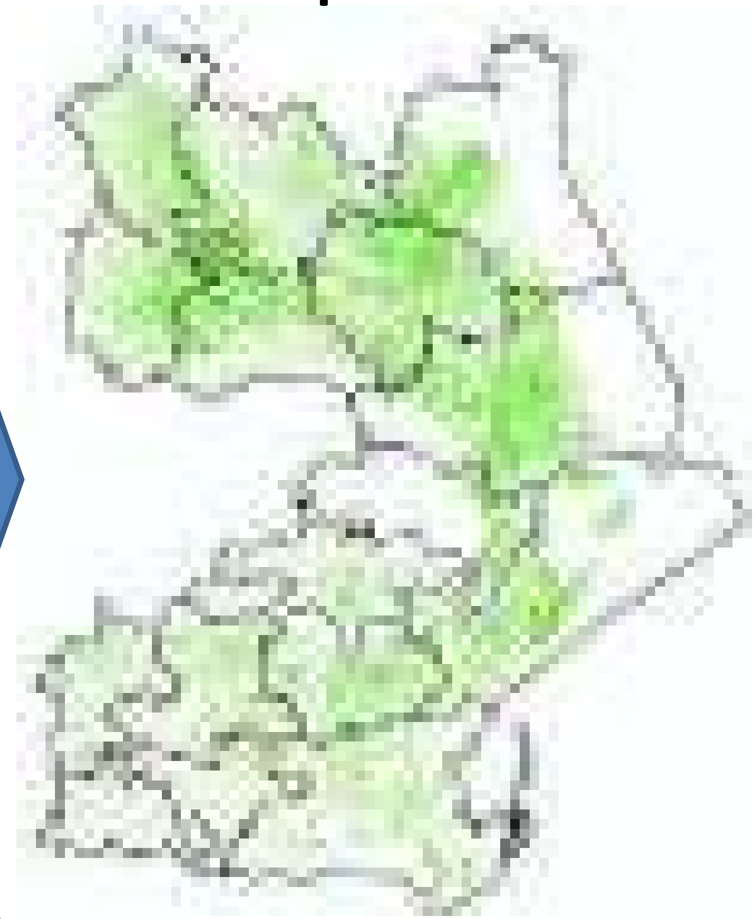


Criteria:

- **Mean monthly air temp ≤ 24**
- **LSWI first fortnight Jan 16 ≥ 0.1**
- **LSWI second fortnight Jan 16 ≥ 0.1**
- **PAWC ≥ 75**

Area favourable for *rabi* crop sowing

Final product



Kh rice fallow area suitable for *rabi* crop growing

Districts	Estimated *kharif* *rice-Fallow (ha)*	Area favourable for *rabi* crop sowing (ha)	% area of *kharif* rice fallow
Bhadrak	122870	58201	47
Kendrapada	57247	31837	56

Crowdsourcing / VGI for Disaster Management - MANU

Crowdsourcing/VGI basically allows the public to create and contribute geospatial facts of the field which specify both spatial and non spatial properties of particular location. This is made feasible with the help of field – based mobile GIS which uses mobile communication networks and the internet as the communication medium for mobile spatial information service framework.

Map the Neighbourhood in Uttarakhand

MANU

A DST Initiative

Indian Institute of Remote Sensing (IIRS)

&

National Remote Sensing Centre (NRSC)

&

Survey of India (SOI)

Map the Neighborhood in Uttarakhand (MANU)

- Development of appropriate tools for field data collection & integration with Bhuvan geoportal.

- Capacity Building for field data collection in disaster affected areas of Uttarakhand (Char-Dham & Pinder Valley) by student and teacher community.

Team IIRS
Team NRSC
Team SOI

Primary Mode of Field Data Collection

- Multi-sensor time-series satellite data;
- Satellite data Download;
- Thematic Services;
- User response and discussions;
- VGI data and information;
- Terrain profile and other data and information services

Visualisation on Bhuvan @ Client end

Structure of Field Data Collection Proforma through Mobile App

- Damage to buildings and infrastructure
  - 1a. Damage to Buildings
  - 1b. Damage to Infrastructure
    - 1b1. Roads
    - 1b2. Bridges and Culverts
    - 1b3. Other Infrastructure
- Landslides
- River Bank Erosion
- Damage to Land-cover and Natural Resources
- Points of Interest

<u>Disclaimer</u>*: This proforma has been designed to collect data for the scientific analysis of damage caused due to disaster and is not intended to be used for making claims or for any legal purpose, whatsoever.*

Participants Trained

1st Batch of Training Prog. : 27-29 September, 2013
(Collaborators: WIHG + KU)

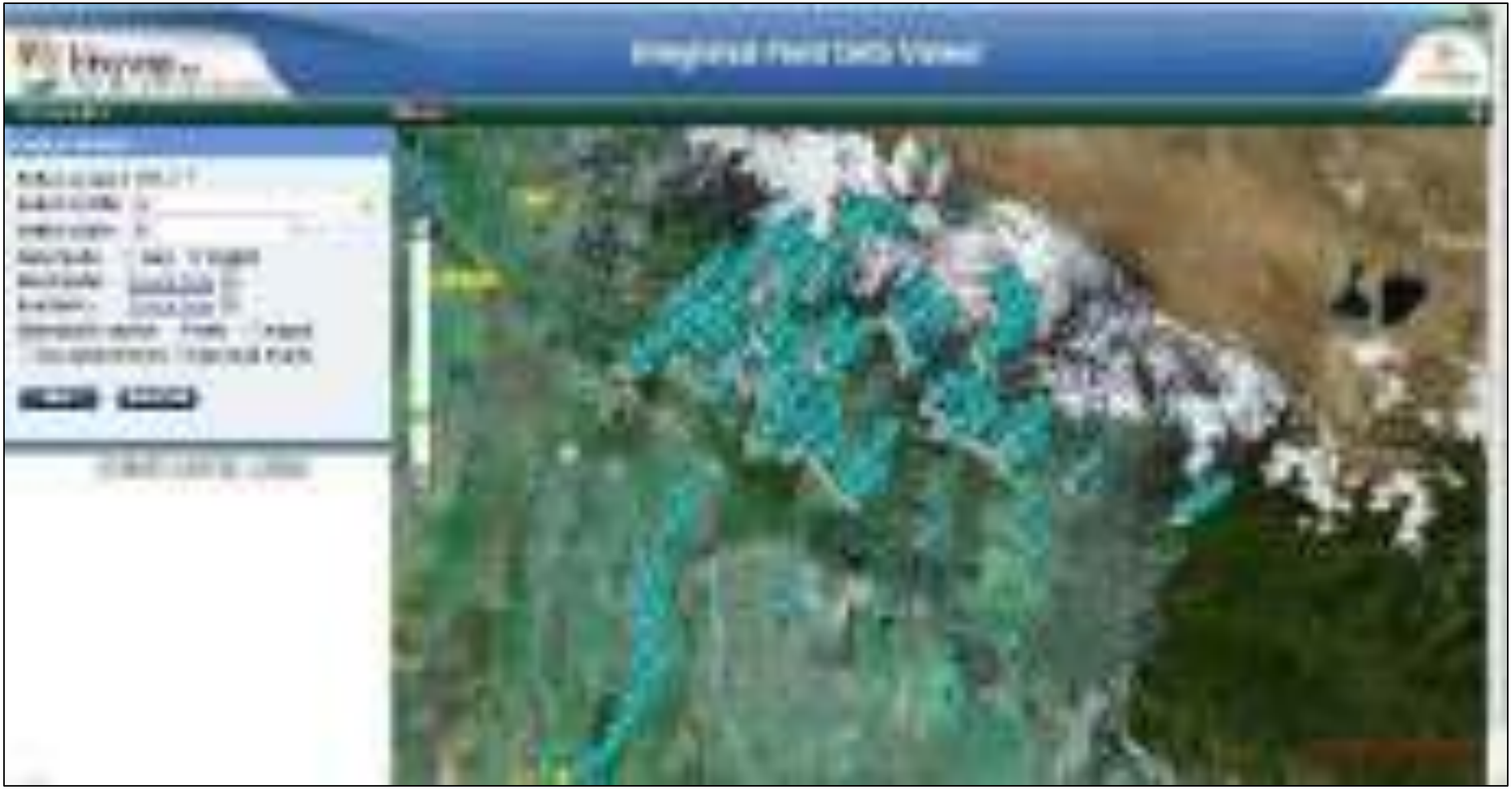
2nd Batch of Training Prog. : 3-5 October, 2013
(Collaborators: WIHG + HNBGU)

	Students
HNB Garhwal University	**65**
Kumaun University	**35**
Wadia Institute of Himalayan Geology	**49**
Total	**149**

1st Batch of Training Prog. : 27-29 September, 2013

2nd Bath of Training Prog. : 3-5 October, 2013

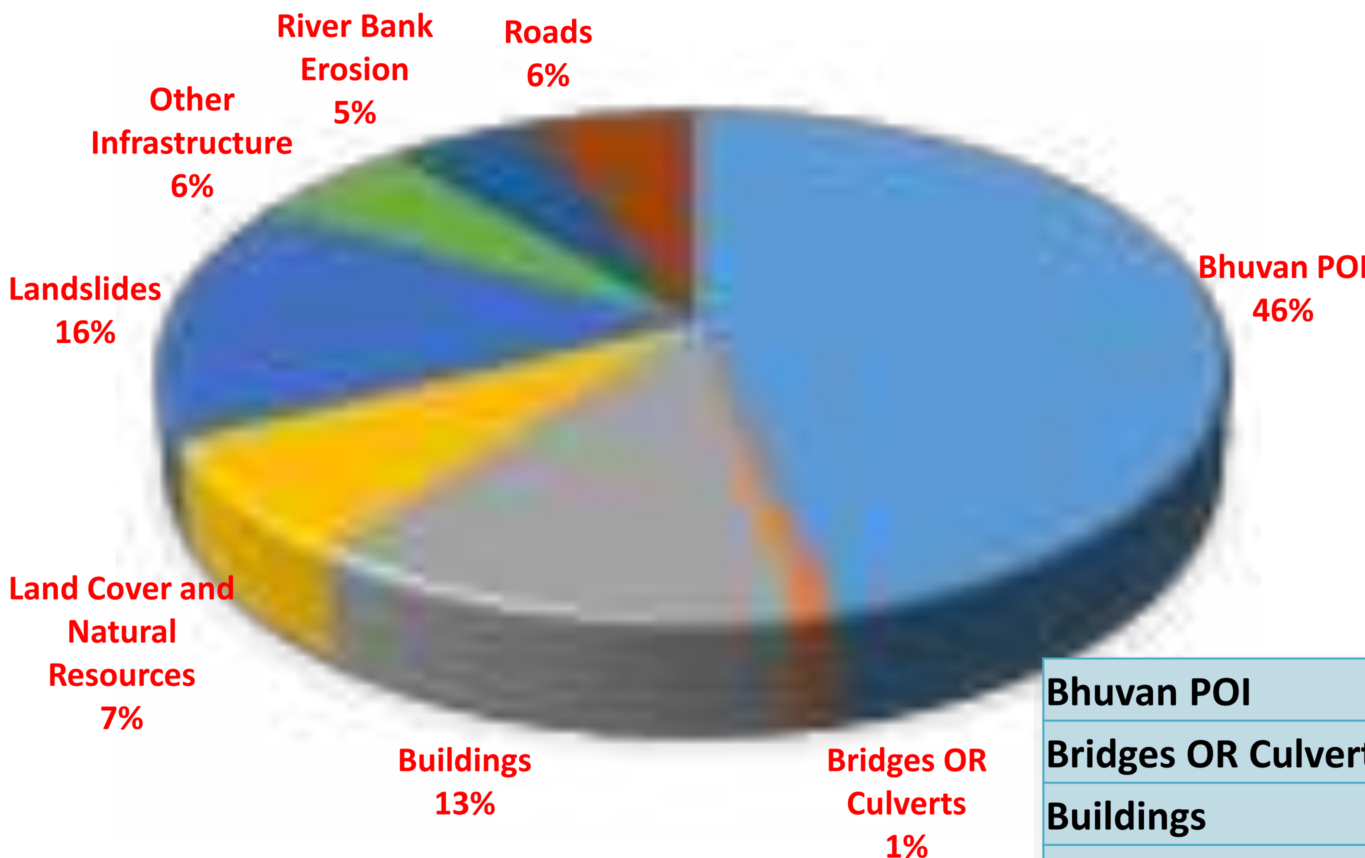
Visualization in Bhuvan



Total points – 19,613 (till 19th February 2014)

Feature-wise data collected in field

(11th Oct. 2013 to 19th Feb. 2014)

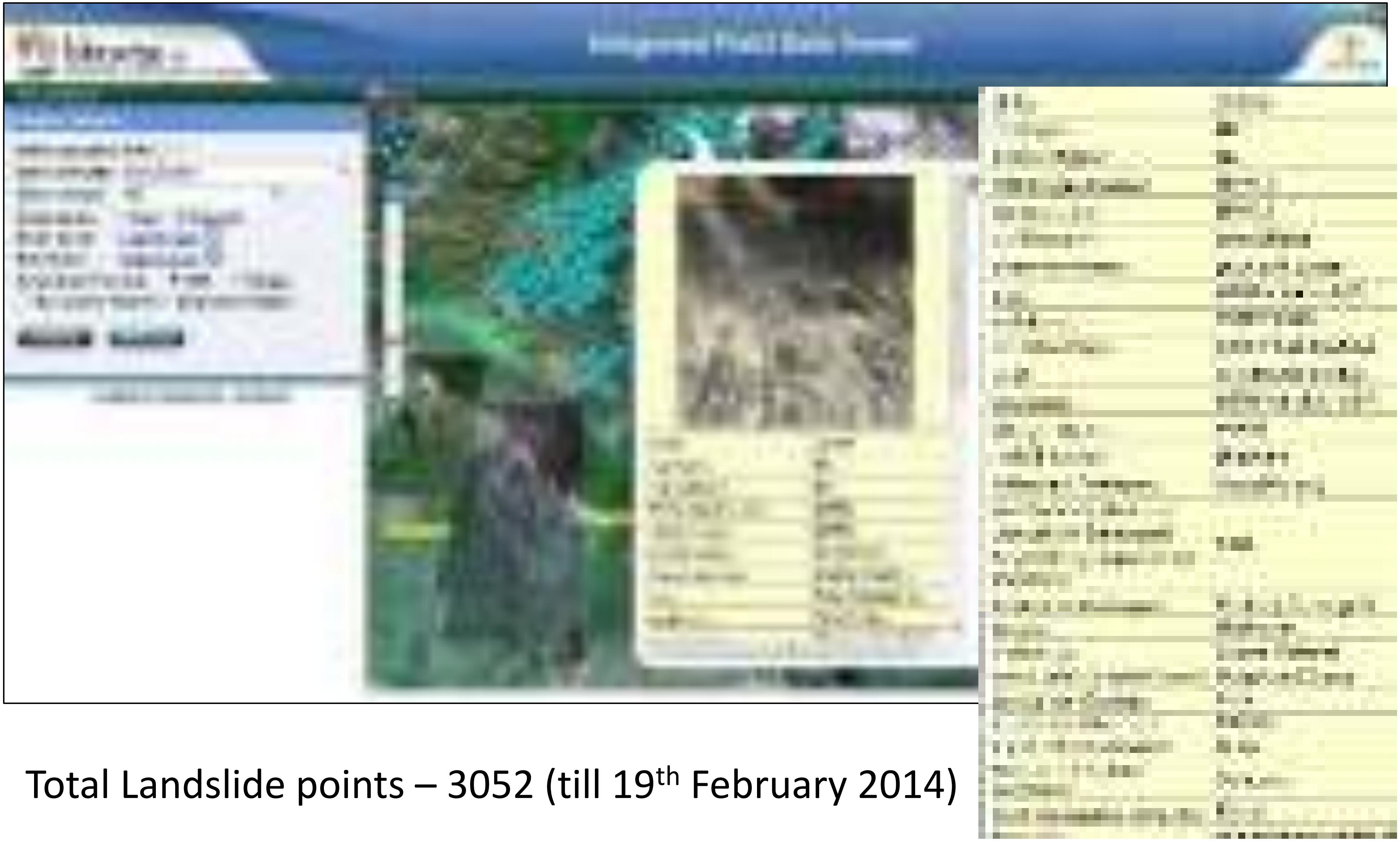


Bhuvan POI	9084
Bridges OR Culverts	179
Buildings	2588
Land Cover and Natural Resources	1442
Landslides	3052
Other Infrastructure	1100
River Bank Erosion	1018
Roads	1150

Valley	**Points Received**
Pinder, Kali	7960
Yamuna/Bhagirathi	7677
Alaknanda/Mandakini	3900

Total points – 19,613 (till 19th February 2014)

Reported Landslide Locations (2)



Total Landslide points – 3052 (till 19th February 2014)

Potential and Problems of Jharkhand

Land & the People

Potential:	Total population ~26.9 Millions
	Geographical area ~7.9 Mha
Problem:	Land degradation
	ST/SC Population ~39%
	Literacy ~54%
	Population below poverty line ~50%
Prospects:	Improving land productivity

Water

Potential:	Annual Rainfall 1200 mm
	16 river sub basins
Problem:	Severe drinking water problems
	Water quality
Prospects:	Improving surface and subsurface storage

Forest

Potential:	29.3% of TGA is under forest
Problem:	Forest degradation
	Forest fire
Prospects:	Improving forest productivity

Industrial Base

Potential:	Home to major iron, coal, mica, …. based industries TELCO, TISCO, HEC, SAIL, BCCL….
Problem:	Lack of infrastructure for Roads (communication)

Mineral Wealth

Potential :	One of richest mineral zones
	40% of total minerals of India
	coal, copper,Iron and Rare earth minerals
Problem:	Unauthorised mining

Agriculture

Potential:	Livelihood for 80% population
	Net sown area 1.8 Mha
Problem:	Irrigated area 0.16 Mha (8%)
	Productivity 1 t/ha – very poor
	Food production less than half of total requirement

INPUTS USED FOR GIS MODELLING

Data bases Generated under NNRMS Program (Year 2006-09 -- 1:50,000 Scale)

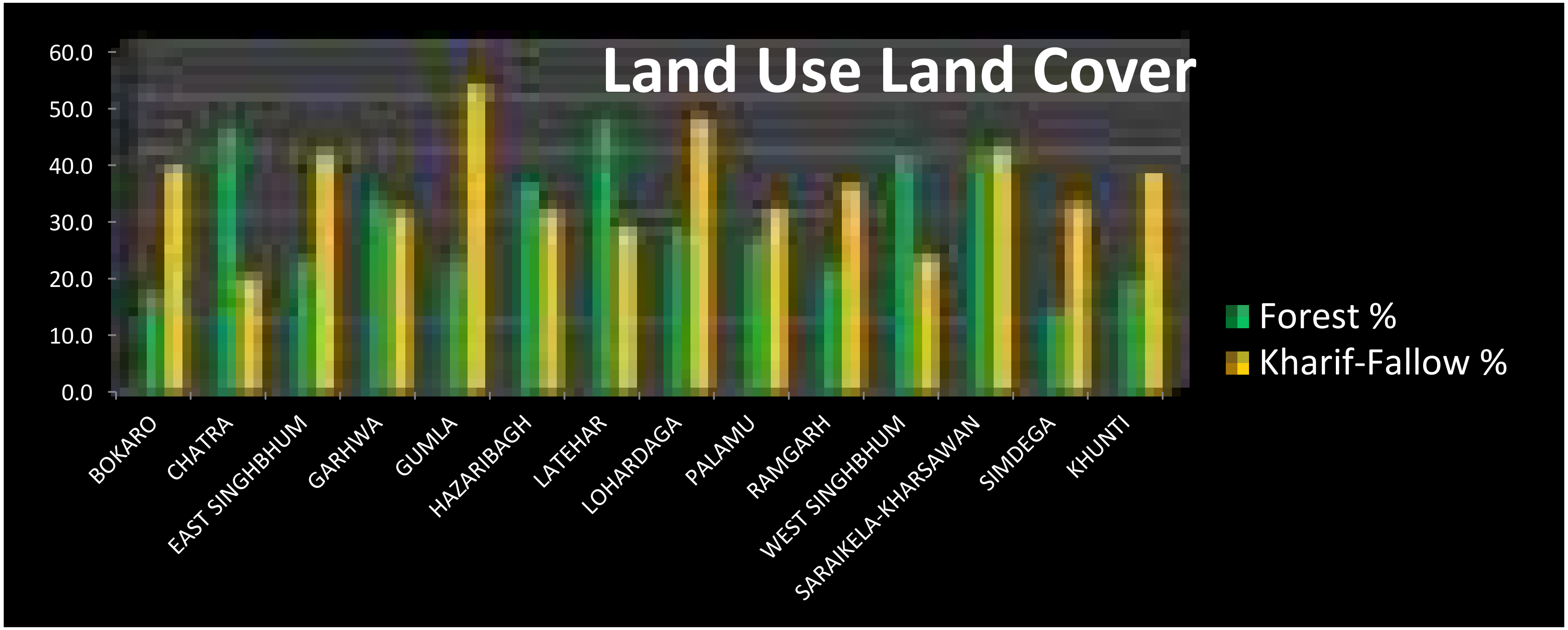
- Land use land cover
- Waste land
- Land degradation
- Wet land
- Rajiv Gandhi National Drinking Water Mission

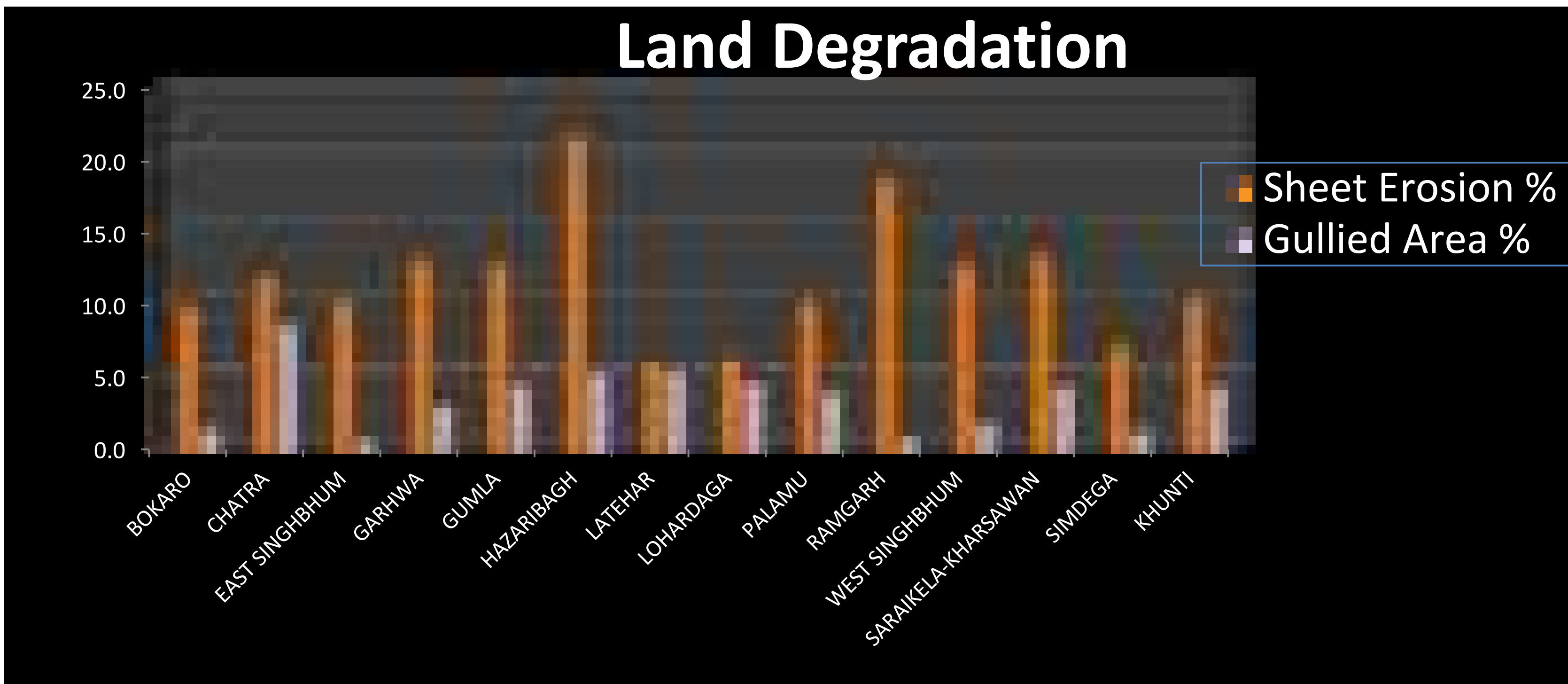
State Remote sensing Centre with state line Departments

- Soil Map **(Year 2009- 1:50,000 Scale)**
- Road and communication network **(Year 2006- 1:50,000 Scale)**
- Watershed maps **(Year 2006- 1:50,000 Scale)**
- GIS layers of socio economic data (census, schools, Health Administrative boundaries (**Source: 2001 Census**)
- GIS layers of land records (Cadastral and Record of Rights) **(Source-DLR, 1:4000**)
- Incidence of social disturbance (Home Department, Jharkhand, 2003-10)

Satellite Data

- IRS-AWIFS,LISS-III, LISS-IV, CARTOSAT,
- Carto DEM


Land Use Land Cover
60.0
50.0
40.0
30.0
20.0
10.0
0.0
BOKARO
CHATRA
EAST SINGHBHUM
GARHWA
GUMLA
HAZARIBAGH
LATEHAR
LOHARDAGA
PALAMU
RAMGARH
WEST SINGHBHUM
SARAIKELA-KHARSAWAN
SIMDEGA
KHUNTI
Forest %
Kharif-Fallow %


Land Degradation
25.0
20.0
15.0
10.0
5.0
0.0
BOKARO
CHATRA
EAST SINGHBHUM
GARHWA
GUMLA
HAZARIBAGH
LATEHAR
LOHARDAGA
PALAMU
RAMGARH
WEST SINGHBHUM
SARAIKELA-KHARSAWAN
SIMDEGA
KHUNTI
Sheet Erosion %
Gullied Area %

Water Resource Development Plan, Lohardaga district

Legend

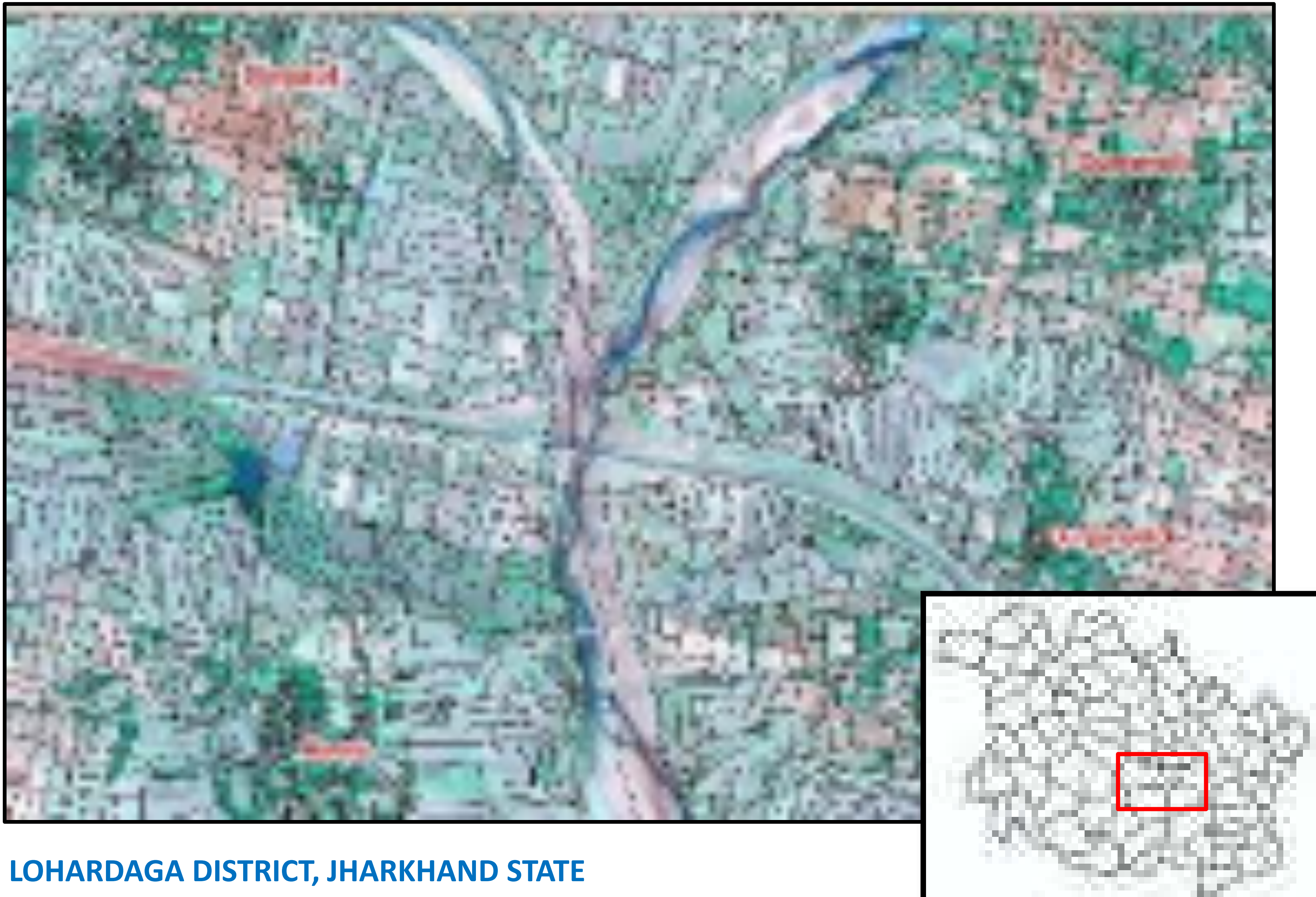
Inputs: 1. Soil 2. Land Cover 3. Slope 4. Drainage
5. Geomorphology 6. Runoff

Land Resource Development Plan, Lohardaga district

Legend

Inputs: 1. Soil 2. Land Cover 3. Slope 4. Drainage
5. Groundwater potential 6. Land capability

NCC OF MERGED IRS P6 LISS IV AND CARTOSAT 1 DATA WITH CADASTRAL OVERLAY



LOHARDAGA DISTRICT, JHARKHAND STATE

Flood Simulation

(Daya River, Odisha)

Sisumatha

RS Input
- LULC
- DEM
- Slope
- Cross-Section
- Flow Direction
- Flow Accumulation

Software
- HEC HMS
- HEC RAS

Output
- Flow wave progression
- Inundation Area

Cross section at Sisumatha Gauge Station

Kushabhadra River Profile

Understanding LULC Dynamics & Environmental Consequences at River-basin scale

Science Questions

- Where LULC changes have taken place in the past and what are the drivers or determinants of land-use change?
- How information on these drivers can be used to project future LULC patterns?
- What will be the consequences of change in LULC on hydrological regime?

***Linkage*:**

Land-Use/Cover Change Project (LUCC)/ Global Land Change Project of IGBP and IHDP

Objectives

Short-Term

To prepare the LULC database at decadal interval (1985, 1995, 2005).

To prepare database on socio-economic and physical drivers of LULC change.

Long-Term

To analyze the socio-economic and physical and drivers for land use change and study the impact of human dimensions on LULC dynamics.

To project the future LULC scenario.

To analyze and project the impact of LULCC on hydrological regime.

Modeling LULC Dynamics

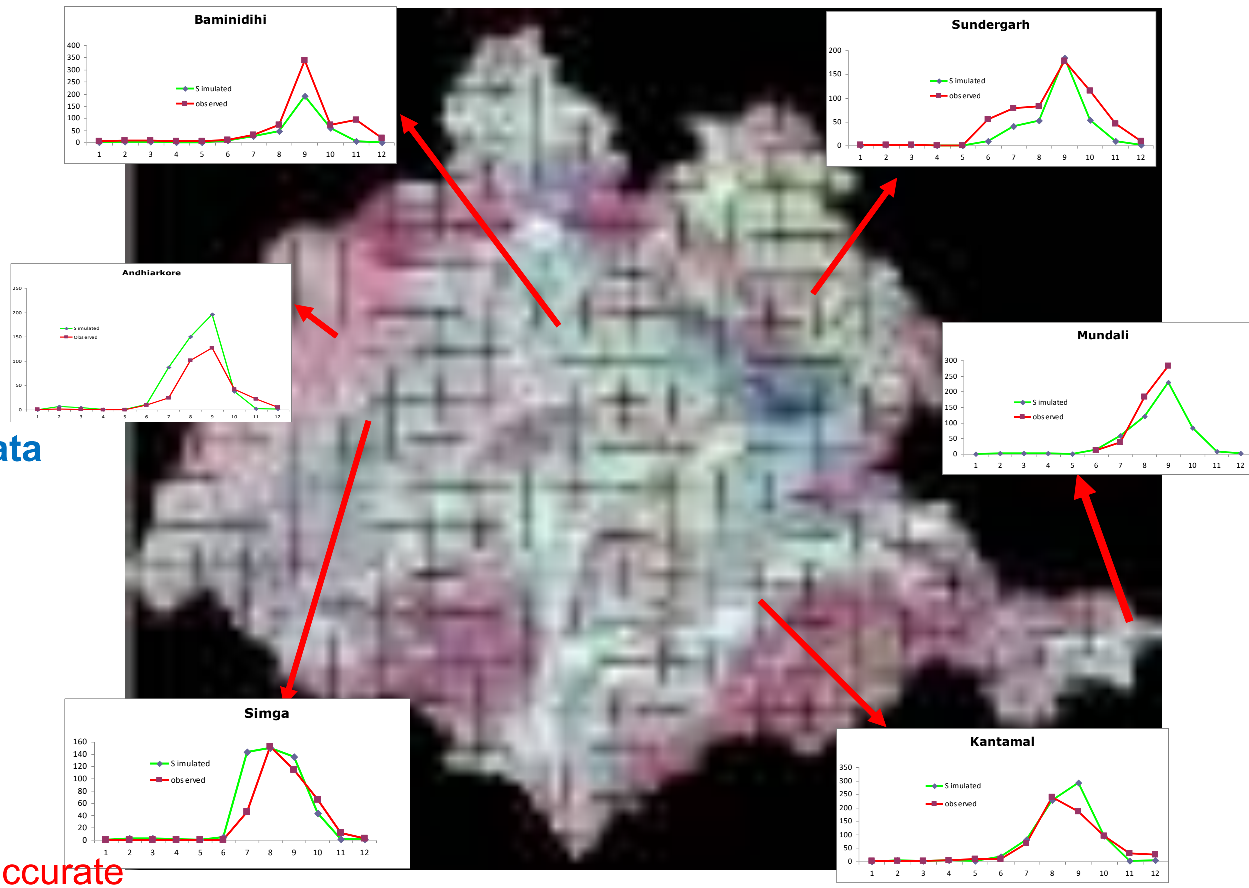
Basin scale hydrological modeling
(Mahanadi Basin: Area=1.41 lakh sq.km.)

Objectives:

1. Calibrate VIC model at outlet of Mahanadi river for the observed flow data of 2003
2. Validate the model on other five sub-basins of Mahanadi river basin
3. Simulate the runoff at six sites for 1972 (based on LULC of 1972)
4. Assess the impact of landuse change on runoff during 1972 to 2003

Model Inputs:

1. Resourcesat Awifs
2. Landsat MSS
3. Modis LAI
4. Modis albedo
5. GTOPO 30 DEM
6. NBSSLUP soil map
7. Daily Rainfall IMD gridded data
8. NCDC temperature data
9. Discharge from CWC



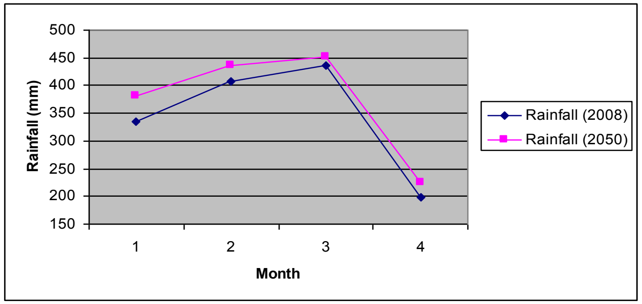
Results:

1.Simulation found to be reasonably accurate
With R^2 :0.836, Ns:0.821 and RE:8.5%

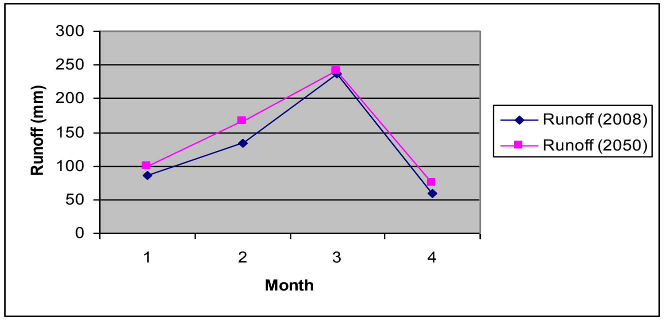
2.An increase of surface runoff by 4.53% (24.44 mm) in 2003 compared with 1972 (351.4 million m3).
This may be attributed to loss of forest by 5.71%.

THE RESPONSE OF HYDROLOGICAL PROCESSES TO CLIMATE CHANGE IN *MAHANADI BASIN* OF INDIA USING A MACROSACLE VIC MODEL

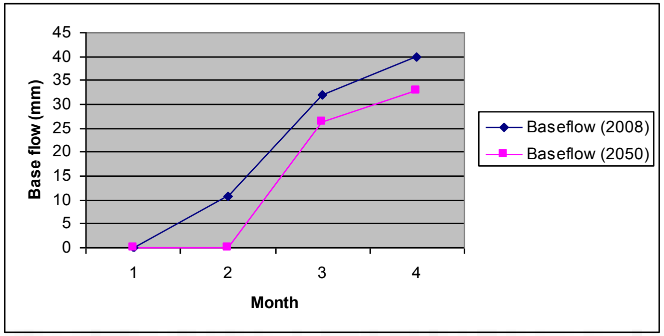
Precipitation Change



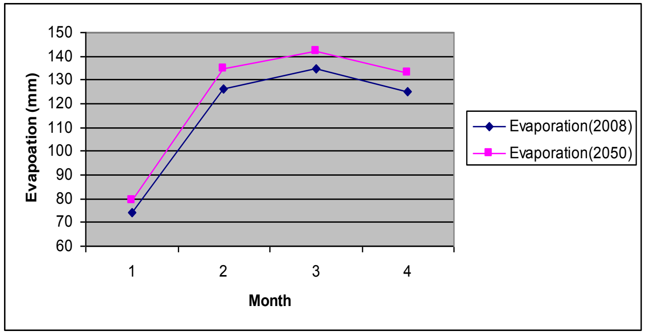
Runoff Change



Baseflow Cange



Evaporation Chane



- Climate change: based on IPCC 4th report 2007 on climate change
- Temperature; (2050 year): Winter; 3 .25˚C, Summer; 2.19˚C
- Precipitation: (2050 year) : Winter; -2.1% , Summer; 6.6%

Results: Surface runoff and ET will increase as predicted rainfall and temperature is high in 2050. However, base flow will decrease. This is attributed to increased ET.

DMS: International Commitments

International Charter on Space and Major Disasters

- ISRO - a Charter Signatory
- Services of Resourcesat and RISAT Satellites

Support to UN Agencies

- ESCAP - RESAP implementation (Disaster Management)
- UN OOSA - Action Team VII, UN-SPIDER

Support to Sentinel-Asia (SA), CEOS, GEOSS Initiatives

Capacity Building

- Centre for Space Science & Technology Education for Asia and the Pacific (CSSTE-AP)
- Specialized course on Geo-informatics for Disaster Management (700 International trainees in past 10 years)

Sharing of 'Best Practices'

- Sharing experiences & knowledge on disaster management as part of International Cooperation

BHUVAN – Indian Geo-Platform of ISRO

Visualization (23 TB) and Free Download (110 GB)

Maps & OGC Services (~7000+)

Applications (200+)

State Portals (30)

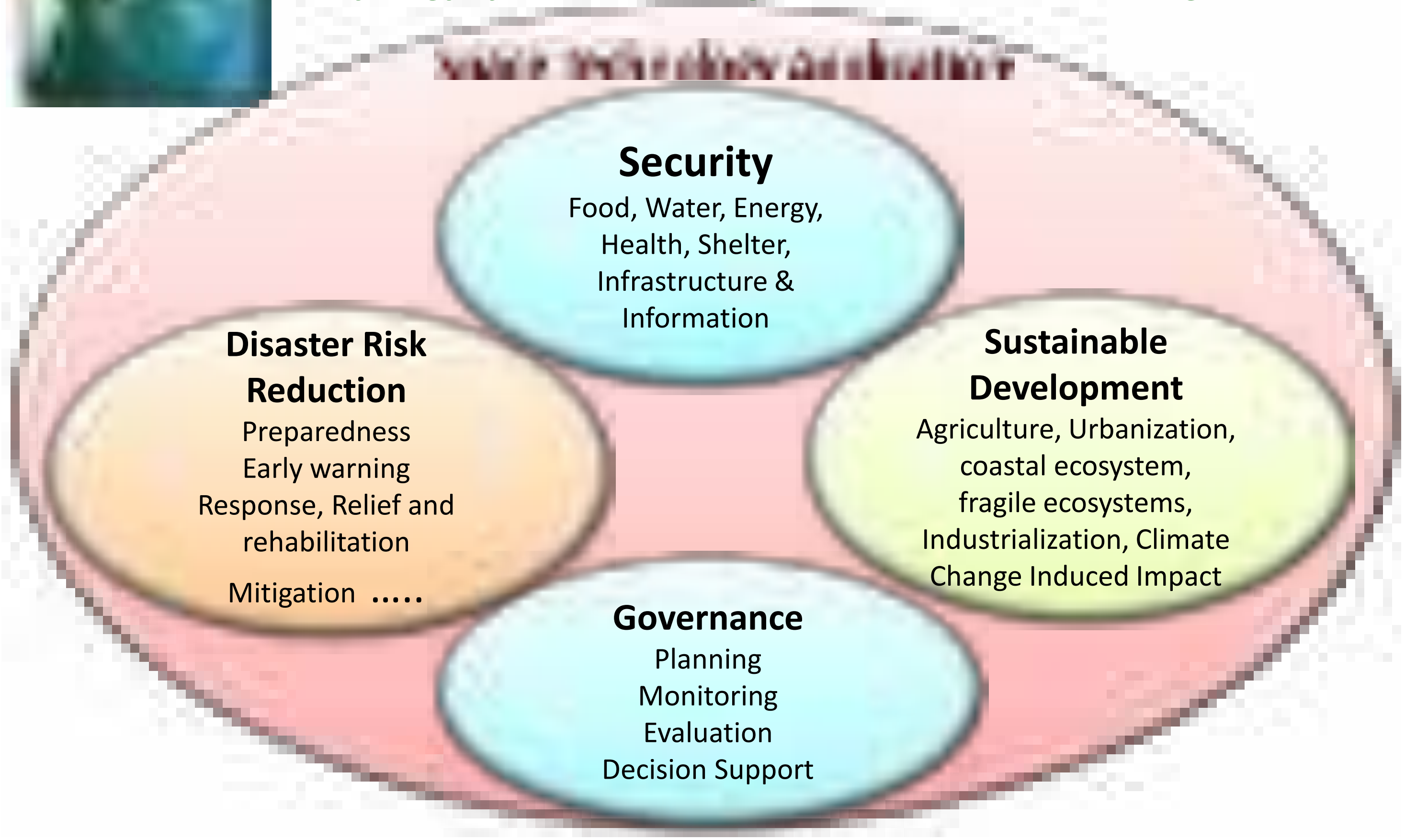
Crowd Sourcing (14 M)

- More than 1 lakh Registered users
- 36K unique visitors/day
- 6.38 lakhs free download

2009 Visualisation → 2012 Mashups → 2015 onwards G-Governance Applications

*……. we must be second to none in the application of advanced technologies to the real problems of man and society. – **Vikram Sarabhai***

Synergy of Remote Sensing, Communication and Navigation



Space Technology Inputs for G-Governance

Where *is* What?

Mapping

Descriptive

Why *and* So What?

Modeling

Prescriptive

Dr. Y.V.N. Krishna Murthy
Registrar & Senior Professor, IIST, Dept. Of Space, Govt. Of India,
yvnkrishna@iist.ac.in