GIS and Applications

Dr. V. Raghavaswamy
Former , Deputy Director, NRSC / ISRO, Hyderabad
vraghavswamy@yahoo.com
raghavaswamy53@gmail.com
Mob: 9440407060

(Expert Lecture at MCRHRD Institute , Hyderabad, dated : 31st,March 2016)

SATELLITES

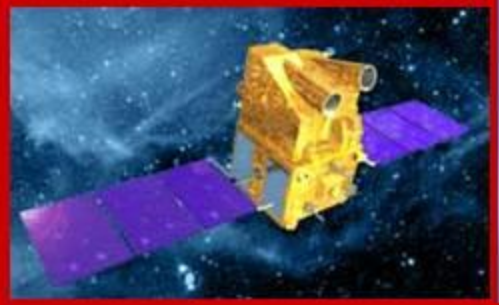
Modern Satellites

1. Communication
2. Remote Sensing
3. Weather Satellites
4. Global Positioning Satellites
5. Navigational Satellites
6. Rescue Satellites
7. Military Satellites
8. Scientific Satellites
9. Space Telescopes
10. Space Stations

Based on the functions satellites are classified

INSAT Series
(Communication)

CARTOSAT
(Remote Sensing)



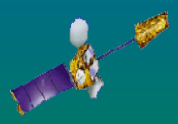
Indian Earth Observation/ Imaging Capabilities

Geo stationary

1990
INSAT-1D
VHRR

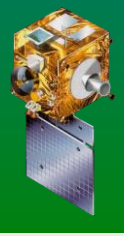
1992
INSAT-2A
VHRR

1993
INSAT-2B
VHRR



1999
INSAT-2E
VHRR, CCD

2002
KALPANA-1
VHRR



2003,2013
INSAT-3A, 3D
VHRR,CCD

Sun Synchronous

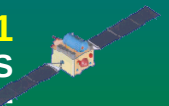
1988/91
IRS-1A & 1B
LISS 1- 72m
LISS 2- 36m

1995/1997
IRS-1C/1D
LISS3 23m, PAN-5.8 & WiFS-188m

1996
IRS-P3
WiFS-188m,
MOS X-Ray

1999
OCEANSAT
OCM-360m &
MSMR

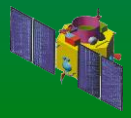
2001
TES
Step& Stare
PAN, 1m



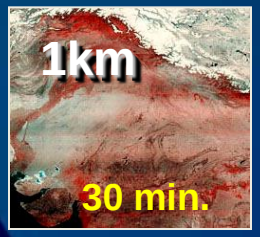
2003, 2011
RESOURCESAT 1 & 2
LISS3-23m; LISS4-5.8m;
AWiFS-55m

RISAT 1 **2012**

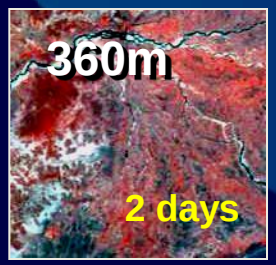
2005
CARTOSAT-1
PAN- 2.5m, F/A
24 days

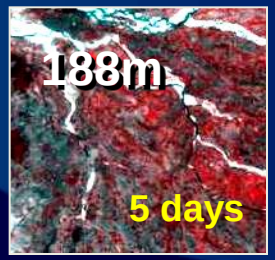


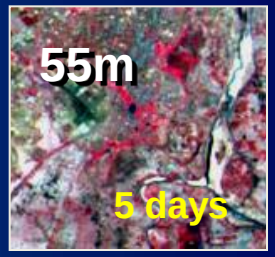
2007
CARTOSAT-2
PAN - <1m



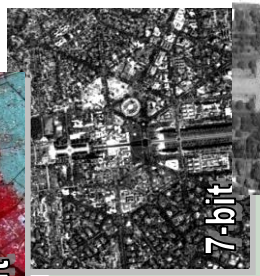
Aerial Laser Terrain Mapper
Digital Camera
Synthetic Aperture Radar (SAR)

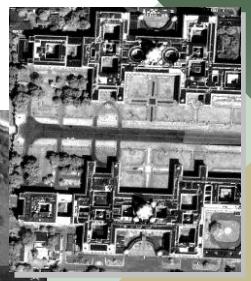






Evolution of Indian Remote Sensing





Submeter & high geometry

Data & radiometry

General sensor models (RPCs)

Along the track

Physical sensor parameters

Across track

(+/– 26deg)

Sensor geometry

propertiery Geometry parameters

Applications

LULC Mapping

Geology

Hydrology

Agriculture & Forest Resources

Discriminating of land cover features

Map updating

Urban growth, regional planning

Land-water, floods and flood plain

Hazards zonation

Transportation networks

Transmission routes

Solid waste disposal sites, power plants

Disaster monitoring , Emergency services

Urban planning, Large-scale topography (1:10k)

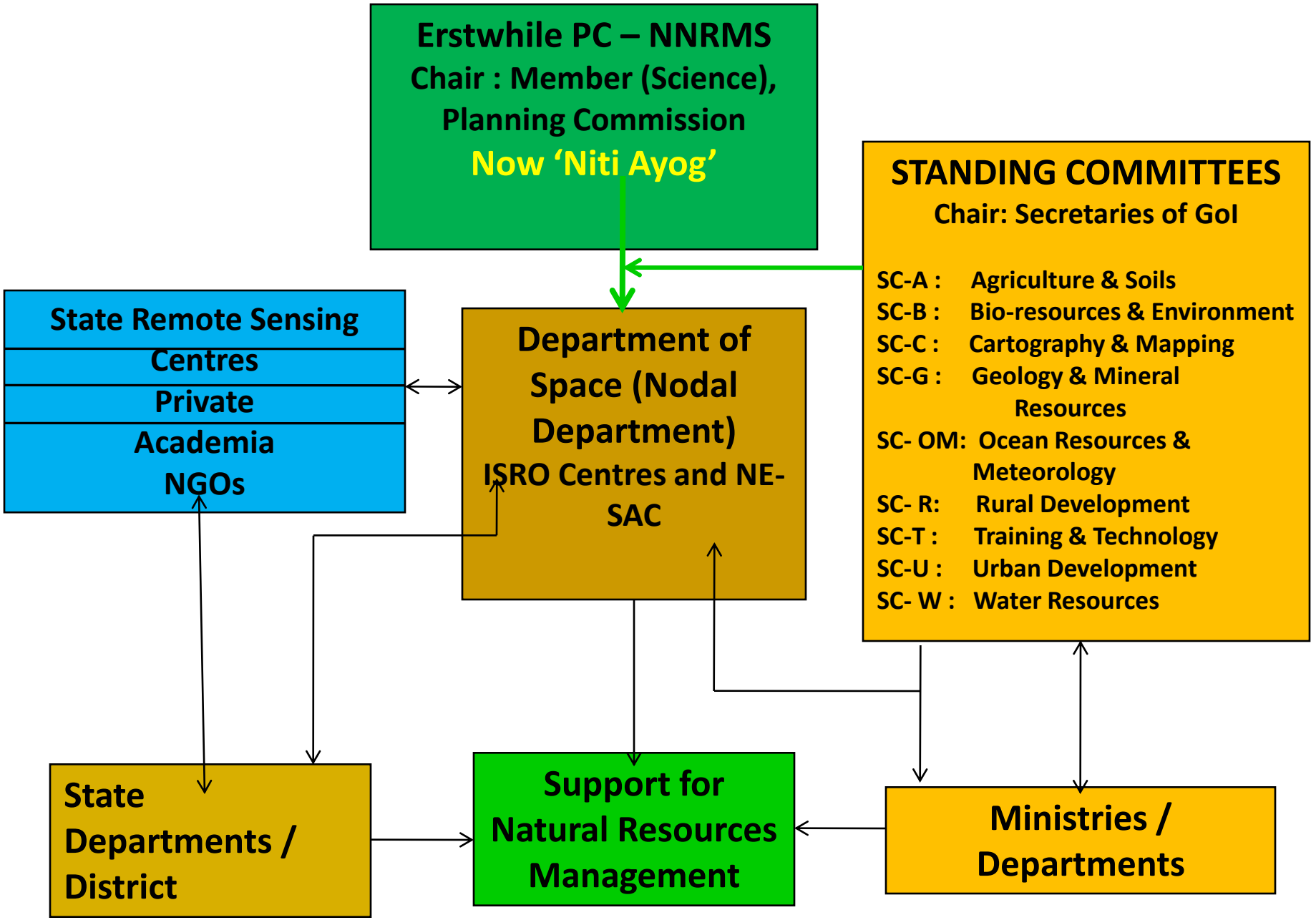
Financial, Retail

Facilities placement

Climate Change: Energy Savings, Carbon Credits

70 m | 36 m | 24 m | 5 m | 2.5 m | 1 m | < 0.5 m

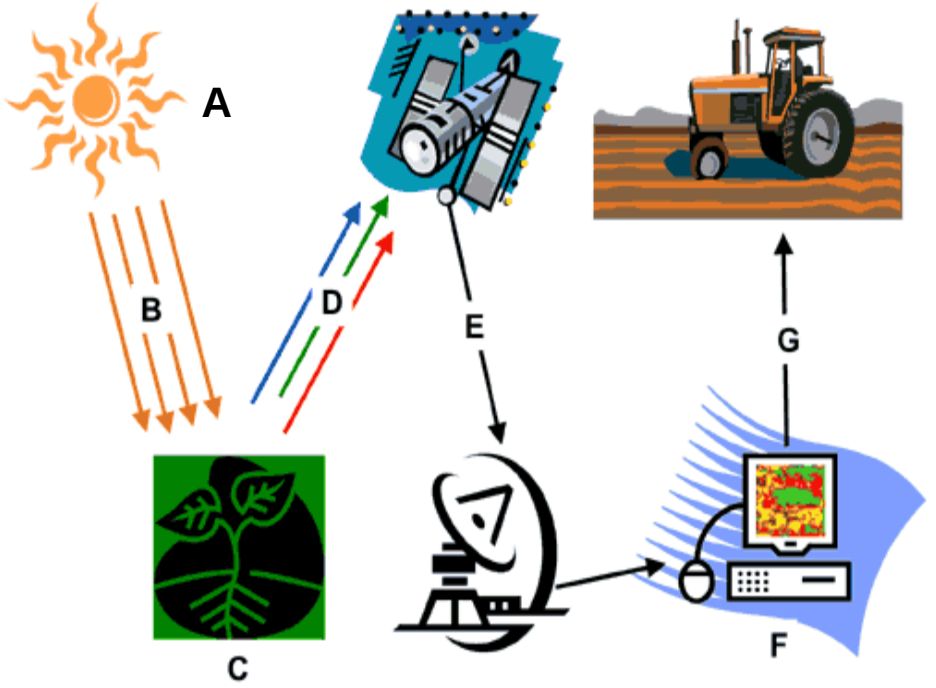
ISRO's Applications – Mandate



REMOTE SENSING

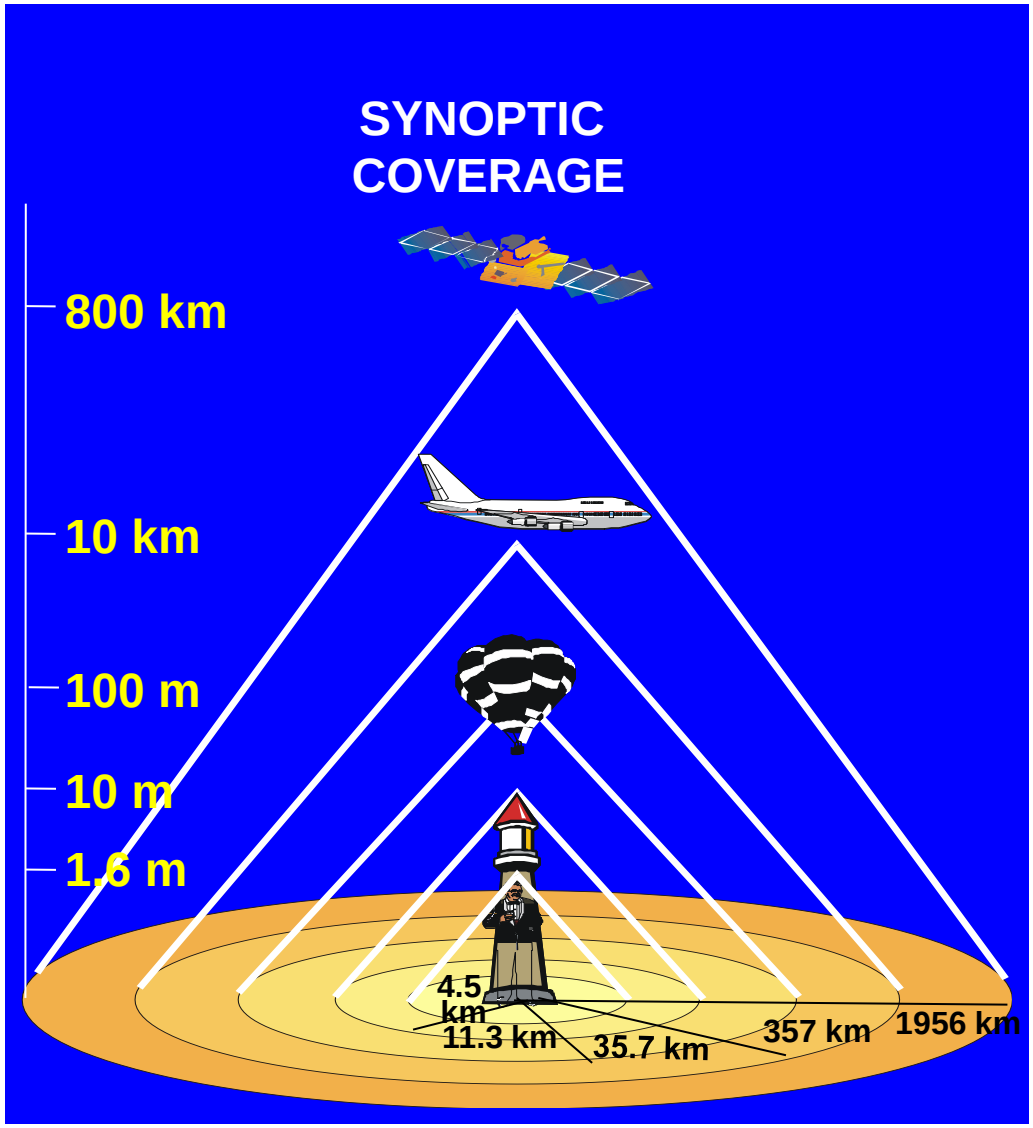
Remote Sensing

- Source of Light (EMR) - A
- Illumination - B
- Interaction - C
- Reflection & Collection – D
- Compression
- Transmission - E
- Acquisition
- De-compression
- Product Preparation - F
- Application - G

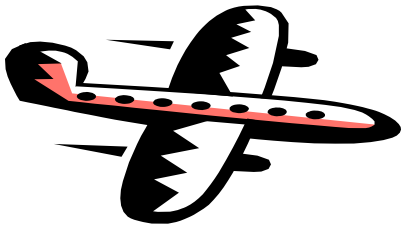


Remote sensing

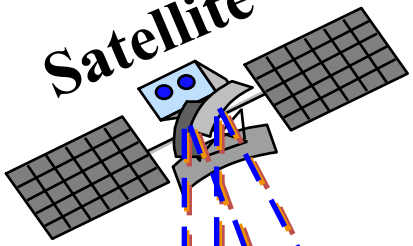
(Airborne, Satellite and Ground Based)

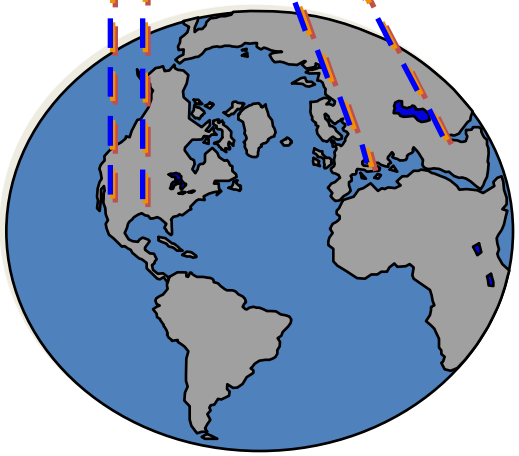


Airplane



Satellite





Total Station

Space Observations

High temporal resolution
Large swath

Low spatial resolution
Global level information

Medium temporal resolution
Large swath

Coarse spatial resolution
Regional level information

Low temporal resolution
Limited swath

Medium spatial resolution
Local level information

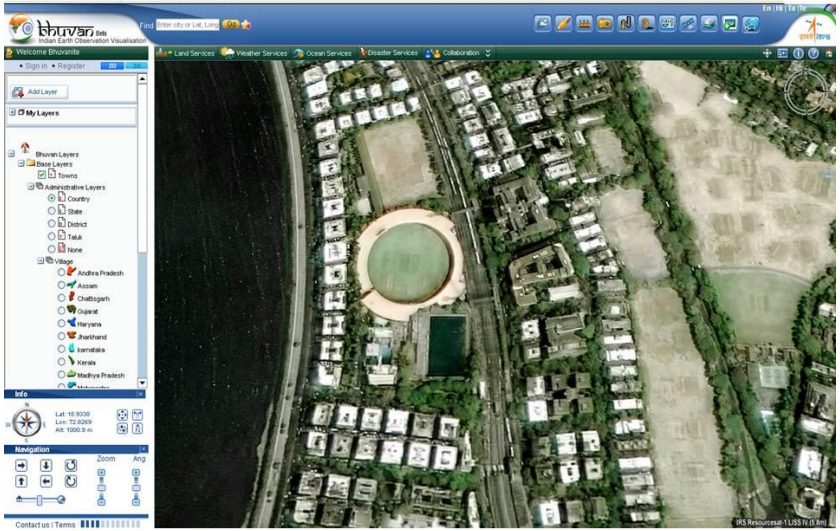
Low temporal resolution
Very limited swath

High spatial resolution
Location specific information

Global to Local

nrsc/ISRO

High Resolution Images on Bhuvan



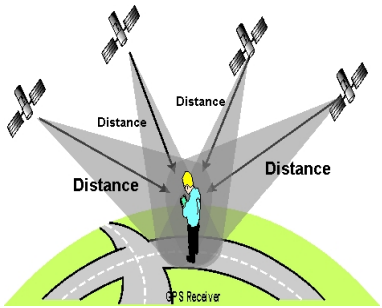
High Resolution Aerial Imagery Hyderabad

Conventional Data Gathering Sources / Techniques

Conventional & Geospatial Technologies for Surveying, Mapping and Spatial Database Collection / Capturing

- **Conventional**
  - Tapes & Chain
  - Compass
  - Plane-Table
  - Spirit Levelling
  - Theodilites

- **Aerial Photogrammetry**
  - Analog
  - Digital
  - DEM/DTM/DSM
  - LIDAR

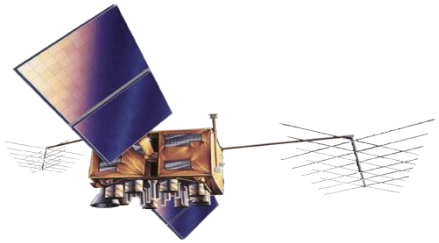


- **Global Positioning Systems : GPS/DGPS**
- **Digital Levelling / EDMs**
- **Total Station**
- **Satellite Remote Sensing (BW,MX,TIR etc)**
- **GIS / SDSS**
- **Mobile Devices (LBS)**
- **GPRs/Terrain Laser Scanners / Terrestrial Photography**
- **UAVs**

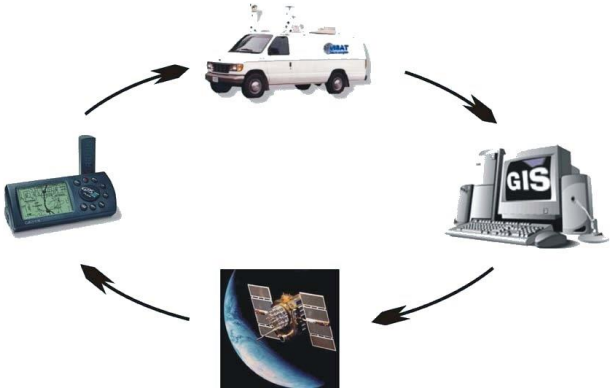
DATA ANALYTICS

Multi-Level Data Collection

Land Surveying

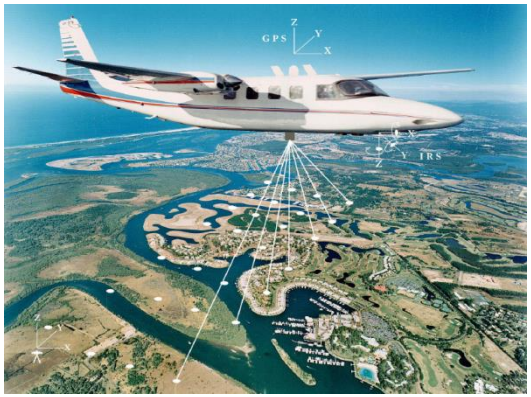


Remote Sensing



Mobile Mapping

Mobile Surveying

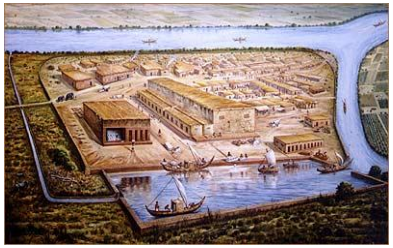


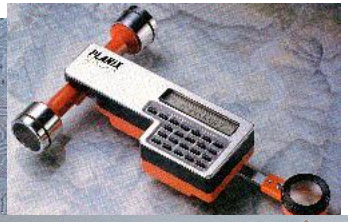
Aerial Surveying

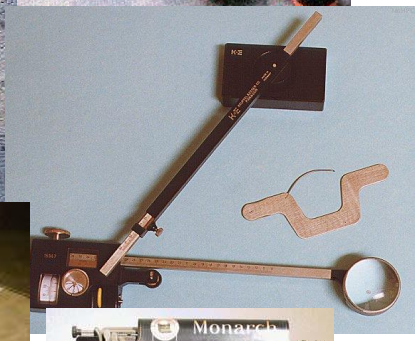
Hydrographic Surveying

Data Processing

Then





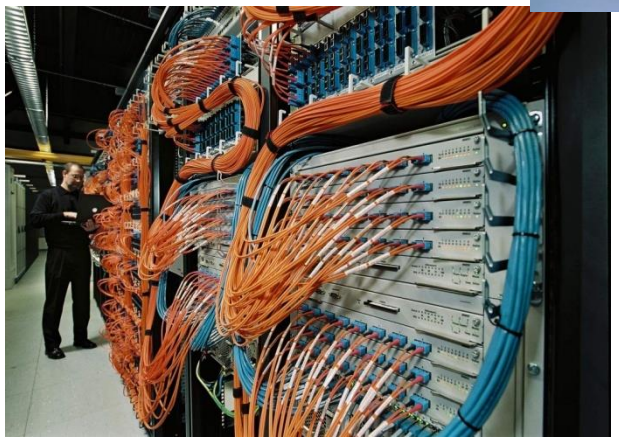


Now

Data Management

Then

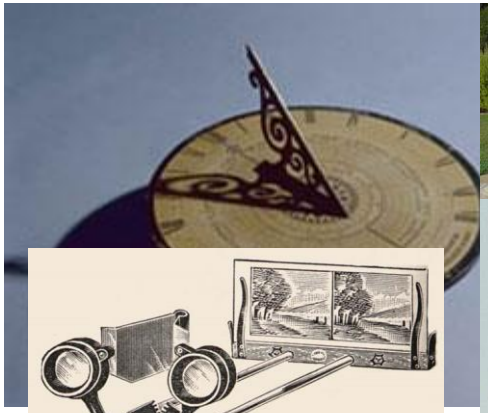
Now

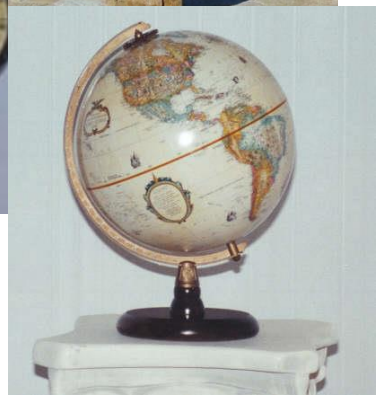


Cluster Servers

Data Visualizing

Then





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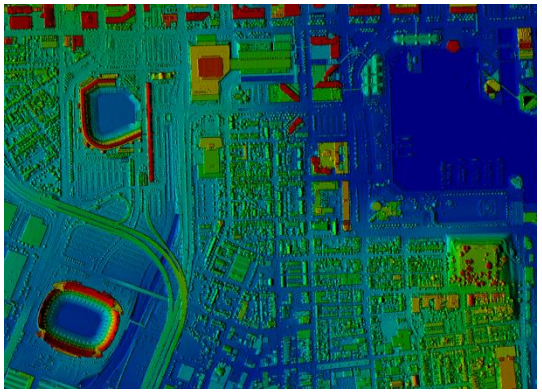
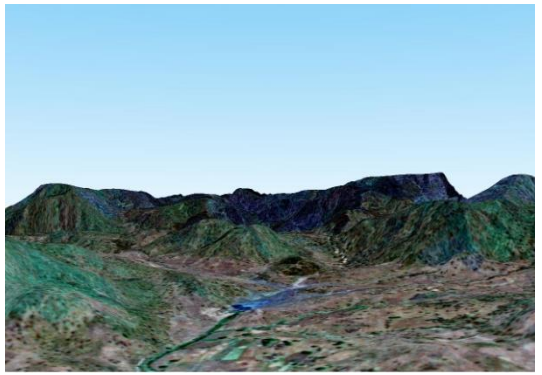
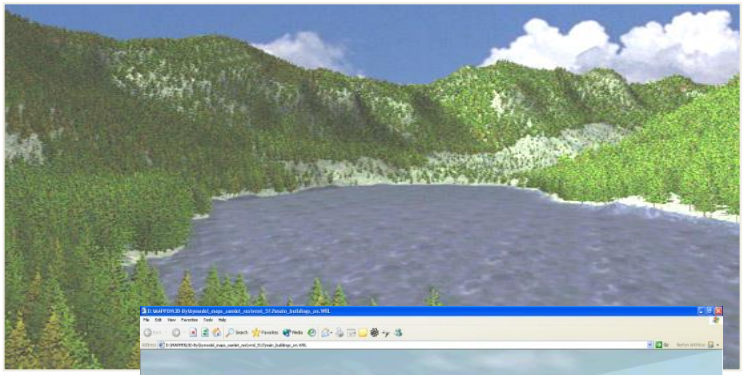
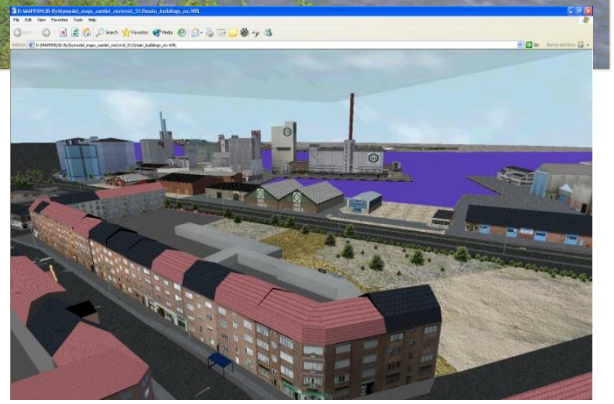
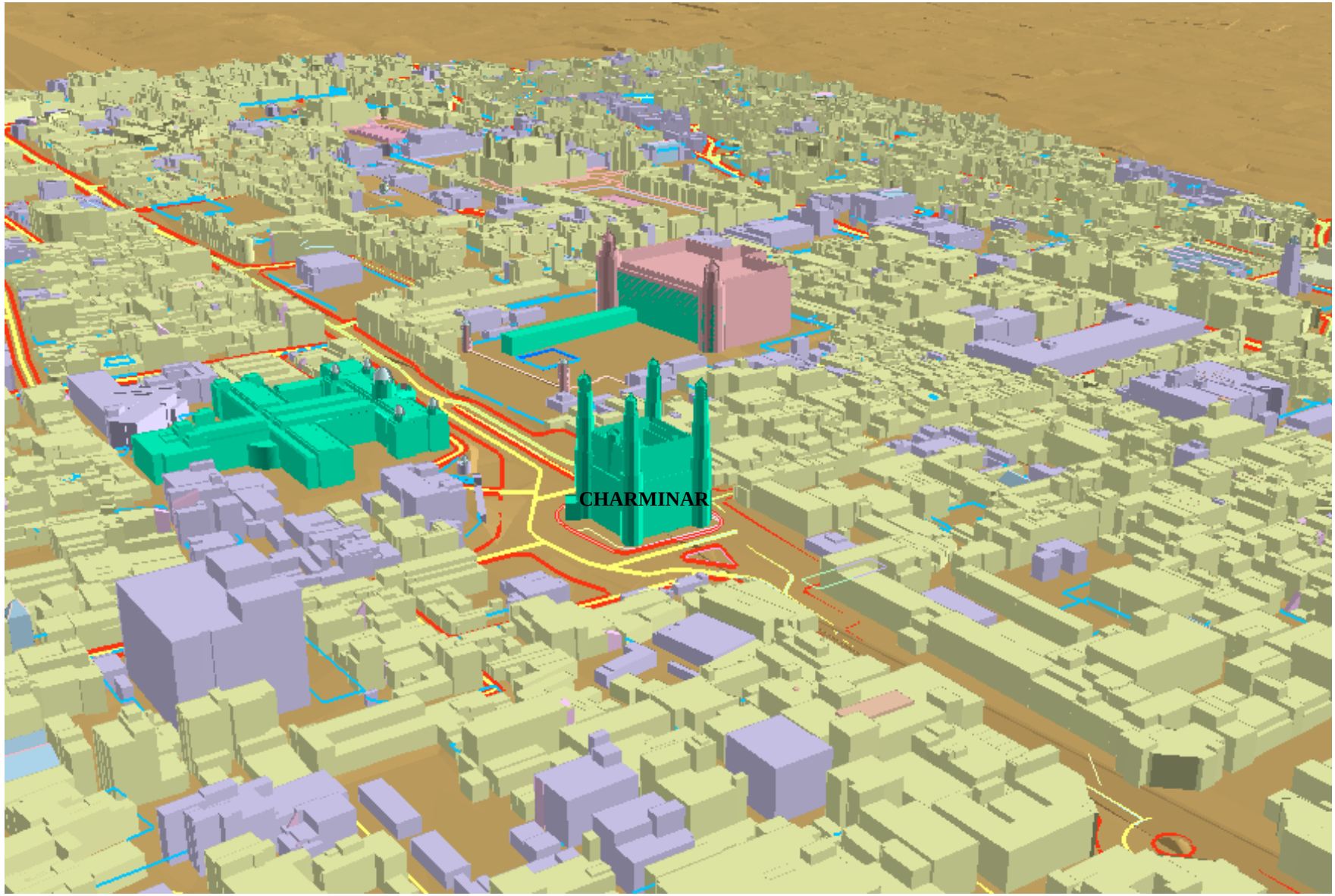








HYDERABAD OLD CITY : Charminar Area
3D City Geospatial Data on 1:1000 scale from 1:4000 Aerial Photography



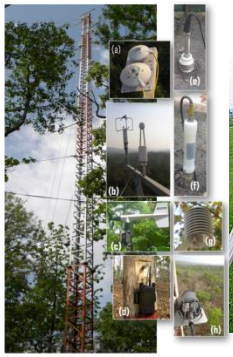
Ground Instrumentation

Synergy of Satellite Observations with Ground Instrumentation
(Inputs for Modelling, Validation & Calibration)

- Spectral Radiometers
- Flux Towers in different environs
- Ground Penetrating Radar (GPR)
- Scintillometers
- Terrestrial Laser Scanner
- Mobile Devices
- GPS Compass Camera
- Automatic weather stations (AWS)
- Water Quality Kits
- Continuous Operating Reference Stations (CORS)

AWS

Terrain Laser Scanner

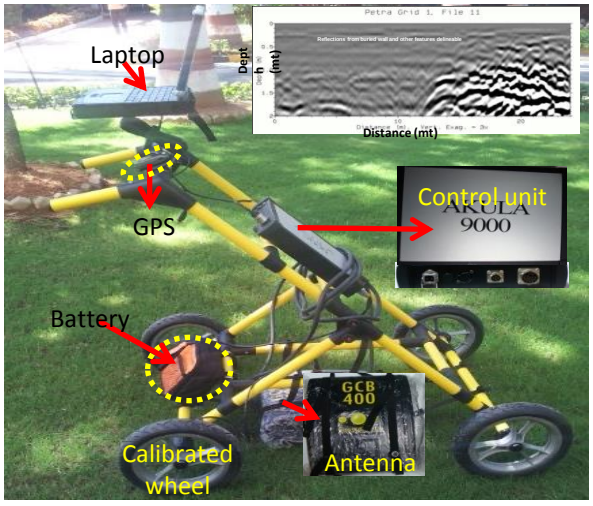


Flux Tower

Scintillometer

GPS Compass Camera

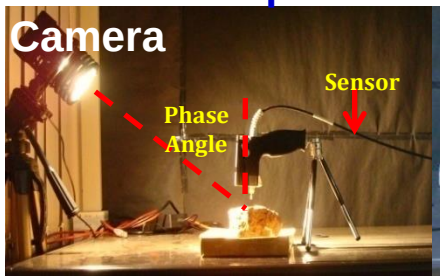
CORS

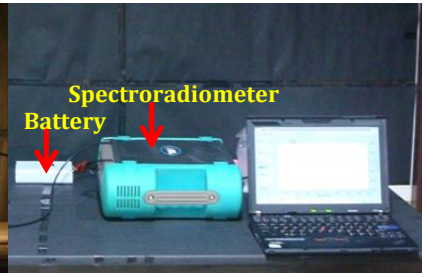


GPR

Mobile

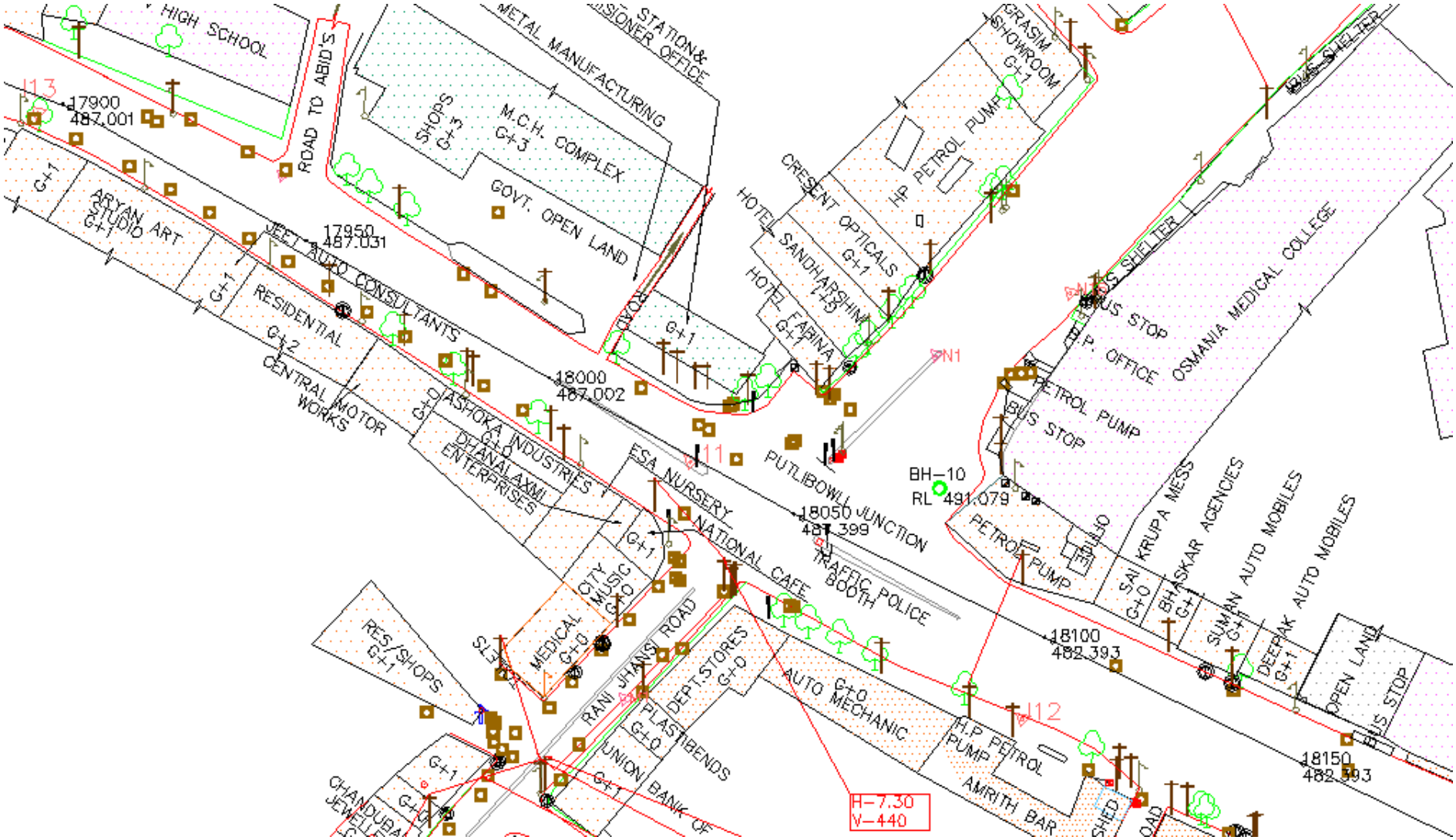
GPS Compass





Spectral radiometer (400-2500nm)

Minerals, rocks, veg. conditions, soils, ….

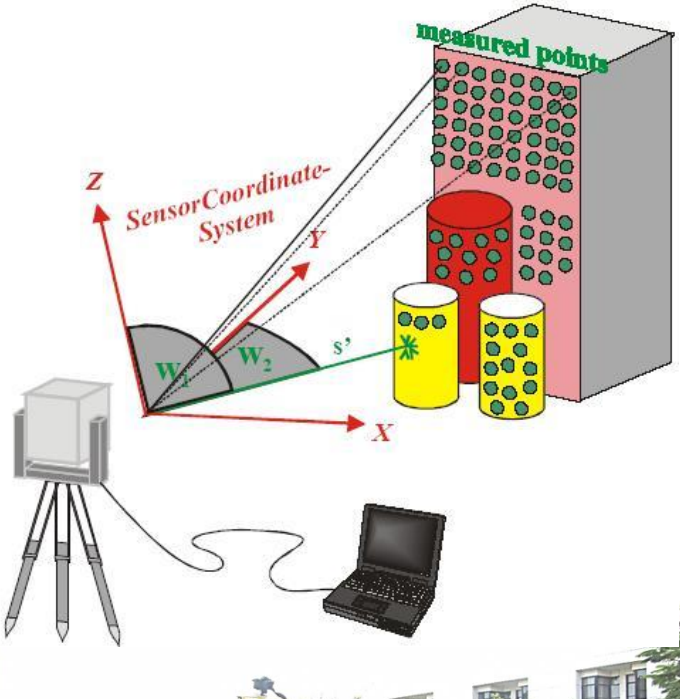


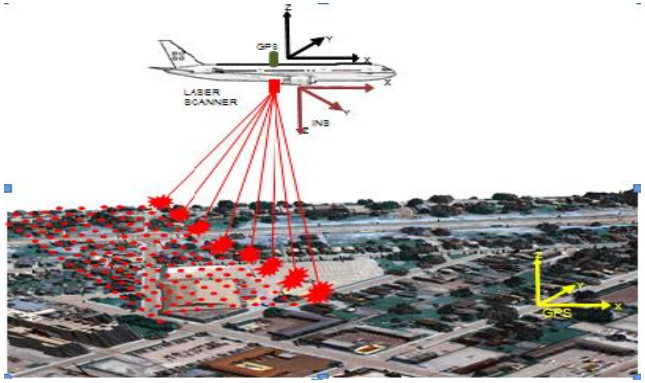
Detailed Map for Metro Railway Project – Hyderabad

(Total Station Survey)

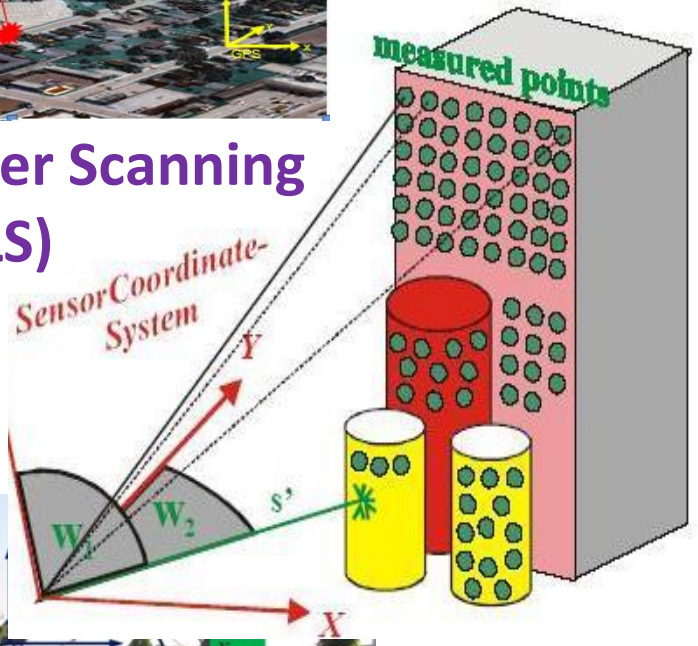
Mobile Laser Scanning (MLS)

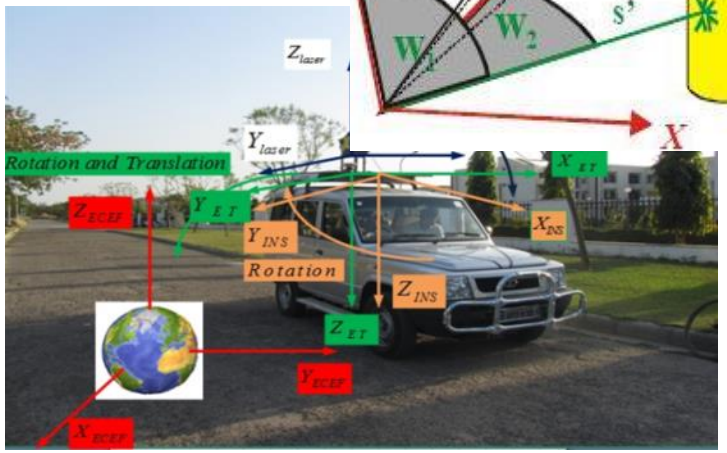
Terrestrial Laser Scanning (TLS)





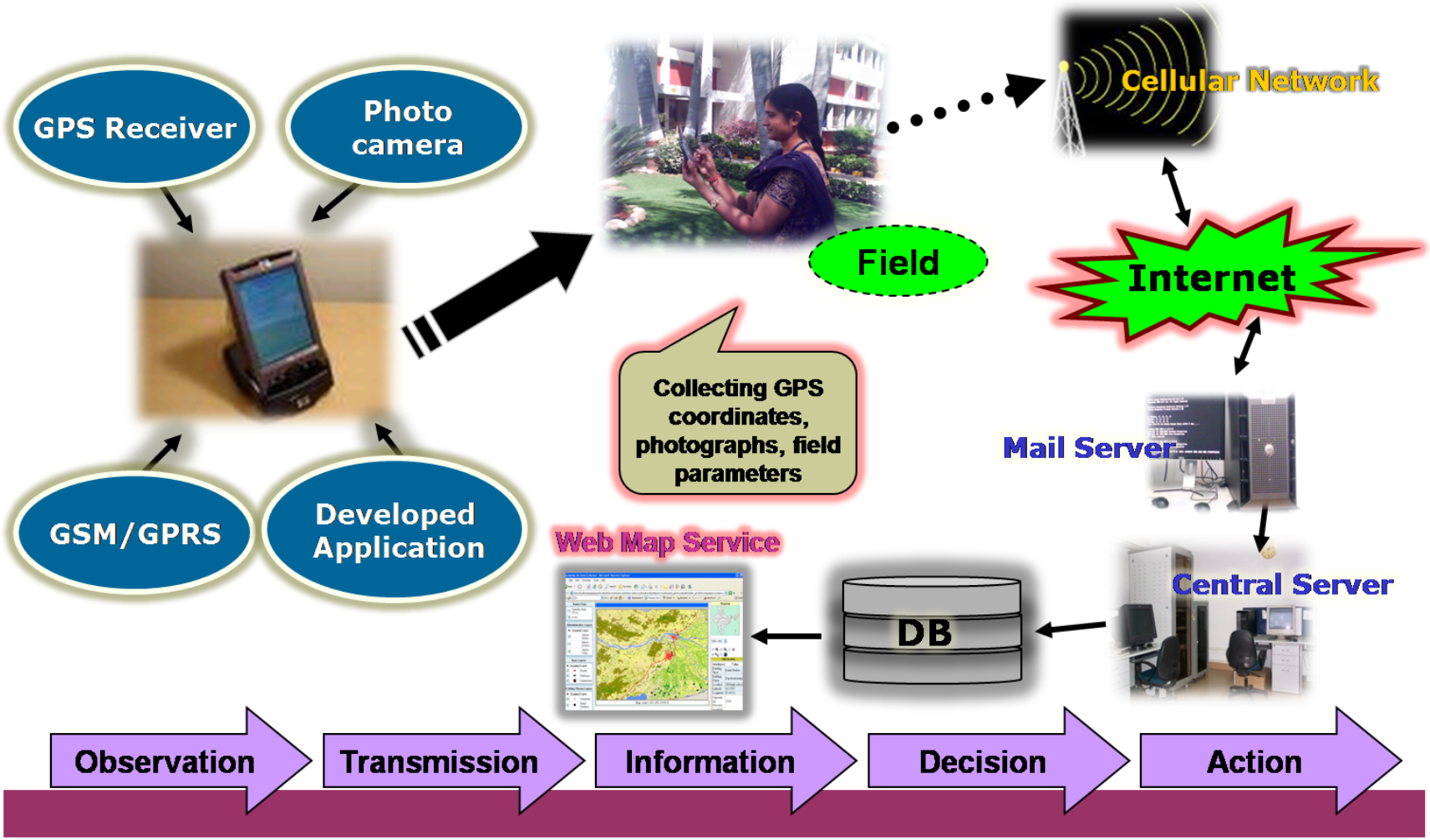
Airborne Laser Scanning (ALS)



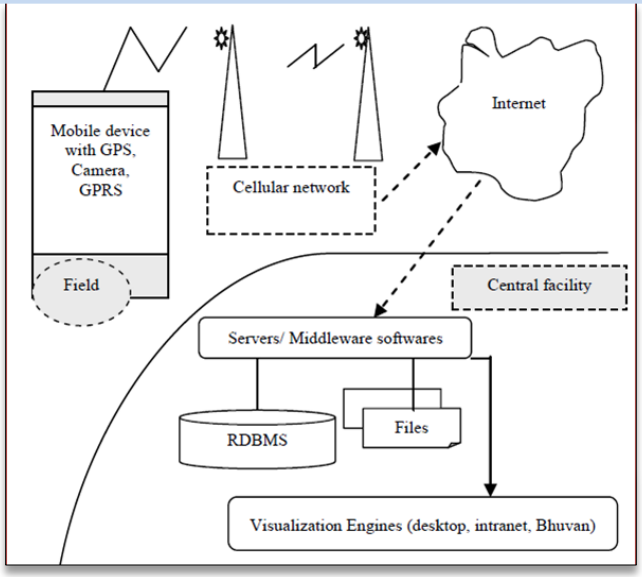


TECHNOLOGY AND ARCHITECTURE DESIGN of MOBILE GIS

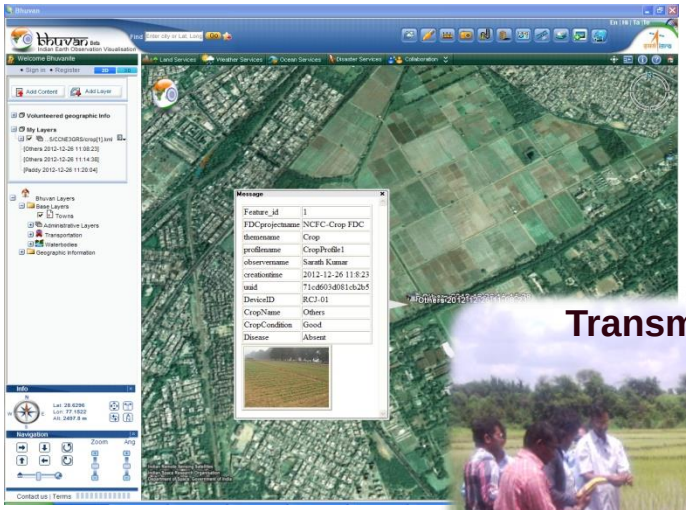
COMPLETE PROCESSING OF THE FIELD DATA COLLECTION USING MOBILE DEVICE



Mobile Applications



Geotagging of Field data

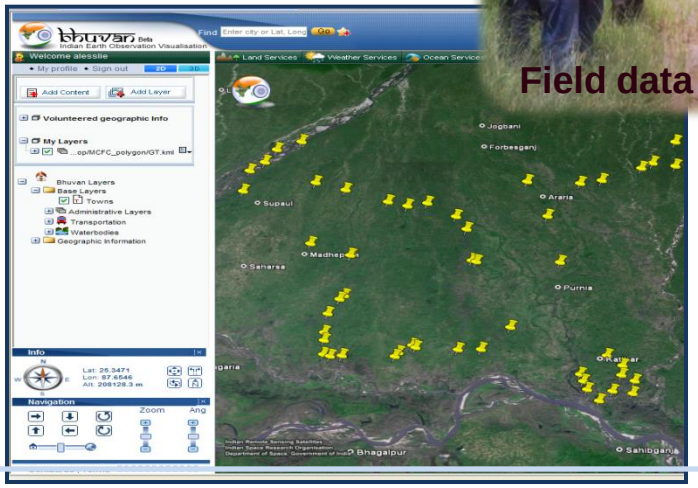


Transmission

Field data collection

Developed for Disasters, Urban, irrigation infrastructure, crops, …

Mobile Application Activity	Open Source Technologies
Mobile device based application development	Apache Cordova API, HTML5, CSS3, JavaScript,Java, Android & XML
IDE	Eclipse
Server/ middleware applications	Apache WebServer, PHP, Apache Tomcat, JSP/ Servlets, XML
Database/ GIS DB	PostgreSQL, PostGIS
Spatial Visualization	Open Layers, Geo-Server, Bhuvan
Analysis	Quantum GIS, GRASS, ILWIS, GeoR



bhuvan Beta
Indian Earth Observation Visualisation

Find Enter city or Lat, Long Go

En | Hi | Ta | Te

Welcome Bhuvanite

Sign in Register 2D 3D

Add Content Add Layer

Volunteered geographic Info

My Layers

C:/fakepath/google.kml

C:/fakepath/dtcp.kml

KHAMMAM

Bhuvan Layers

Base Layers

Towns

Administrative Layers

Transportation

Waterbodies

Geographic Information

Info

Lat: 17.2176
Lon: 80.148
Alt: 8429.9 m

Navigation

Zoom Ang

Contact us | Terms

Land Services Weather Services Ocean Services Disaster Services Collaboration

KHAMMAM_2

Khammam

Indian Remote Sensing Satellites
Indian Space Research Organisation
Department of Space, Government of India

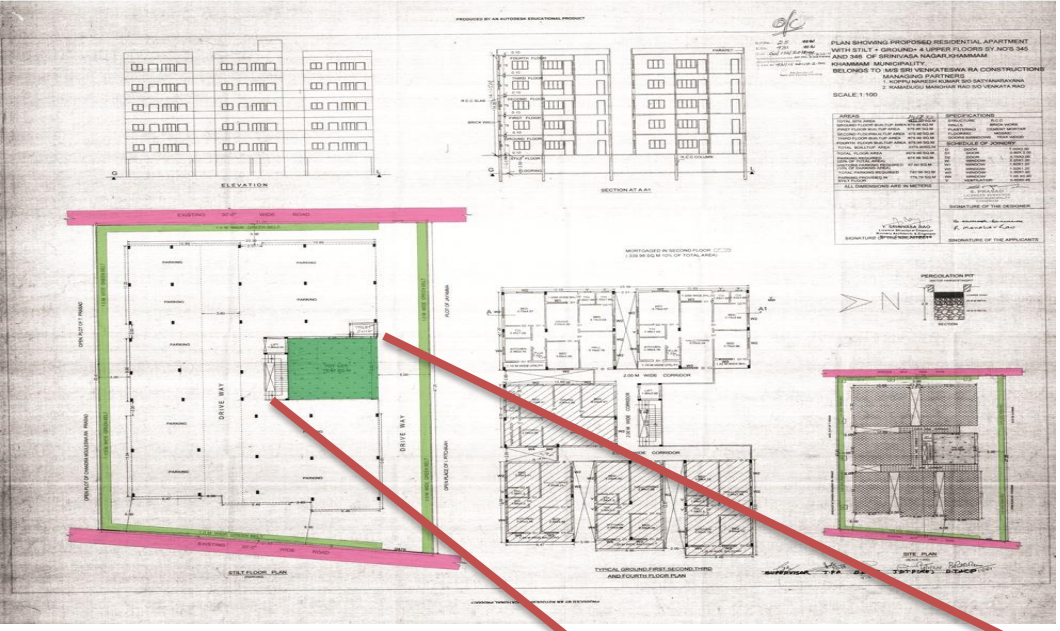
Message

KHAMMAM_6

Khammam Municipality

- Revenue Ward No-4
- Survey No- 345&346
- Building Plan –BP-25
- Plan Approved -2011
- Property -Private
- Locality Name-Srinivas Nagar
- Master Plan –Land Use (Residenatial Area)

IRS Resourcesat-1 LISS IV (5.8m)



Khammam Municipality

- Revenue Ward No-4
- Survey No- 345&346
- Building Plan –BP-25
- Plan Approved -2011
- Property -Private
- Locality Name-Srinivas Nagar
- Master Plan (Draft Approved 2008) Land Use – (Residenatial Area)

Field Photo : 25.07.2012
(Confirmed According to the Master Plan)

Geographical Information System (GIS)

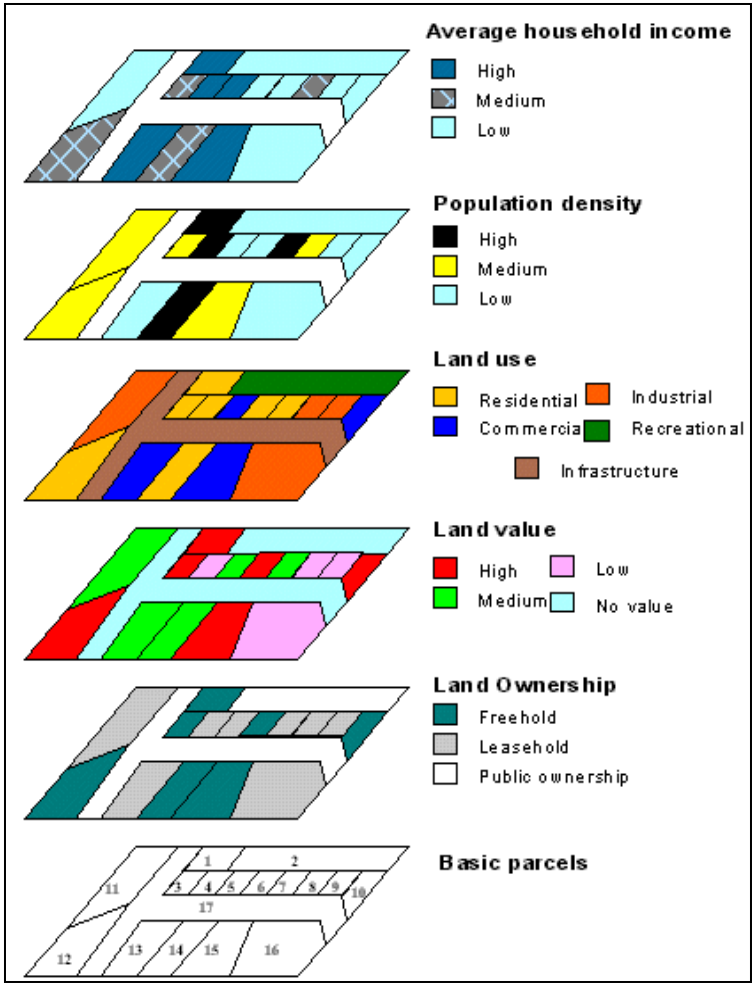
Geographical Information System

Organized collection of computer Hardware, Software, Geographic Data (Spatial & non-spatial) and People designed to efficiently *Capture, Store, Update, Manipulate, Analyze and Display* all forms of geographically referenced information.

Power of GIS…?

A GIS combines layers of information about a place. What layers of information to be combined depends on the purpose.

It is not an automated decision making system. But a tool to query, analyze, and map data in support of the decision making process.

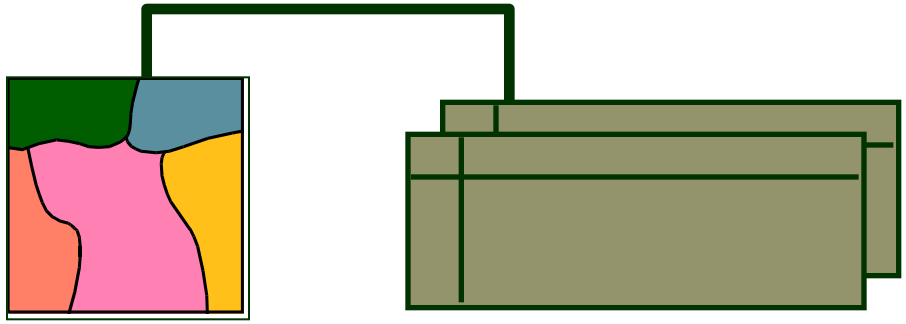


Why GIS…?

- **Improves Integration of data within Organization**
- **Make share data between the departments.**
- **Allow better Decisions with spatial data-with better information**
- **Gives visualization to analyze and represent data effectively**
- **….**

GIS - Technology

- Spatial (Location) Data
- Non Spatial (Attribute) Data
- Linkage
- Query
- Analysis
- Modeling
- Decision Making



Spatial Data

Attribute Data

Open source for Geospatial Enterprise

Advantages

- Cost effective
- Flexibility
- Editable
- Full control of developer
- Open to all….

FOSS4G Sydney 2009 20 - 23 October — Free and Open Source Software for Geospatial

FOSS4G:
Free and Open Source Software for Geospatial

OSGeo — Your Open Source Compass

OSGEO:
The Open Source Geospatial Foundation

GDAL

PostgreSQL

PostGIS — Spatial PostgreSQL

The New OSSIM — Awesome Remote Sensing

uDig

GRASS GIS

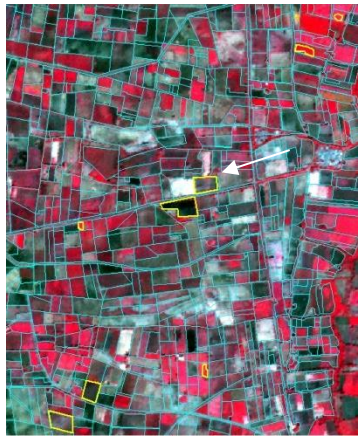
GeoServer

MapServer

Best way to create geo-spatial enterprise at grassroots level. Very effective to enhance the range and application of geo-spatial data…

GIS based Applications

Agriculture



Precision Agriculture

Horticulture Studies

Land Degradation Mapping & Monitoring

State Level

Soil Mapping

Forecasting Agriculture output using Space, Agro-Meteorology and Land-based observations (FASAL)

District Level

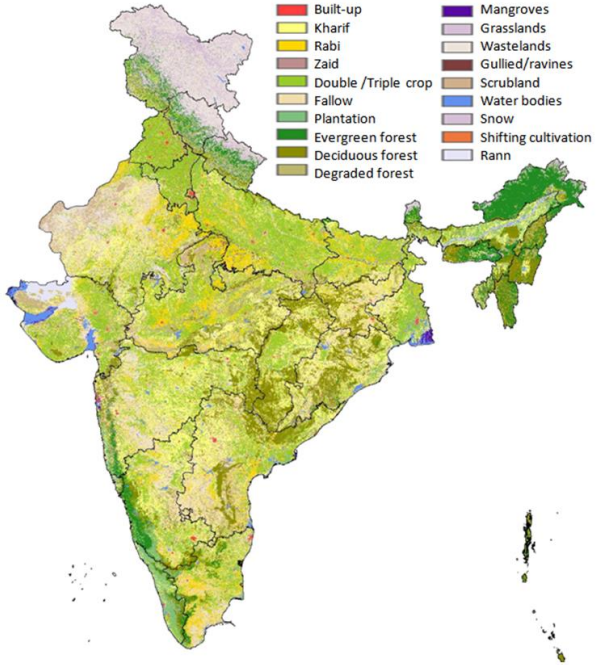
Crop Area and Production Estimation

District Level

1985 1990 1995 2000 2005 2012

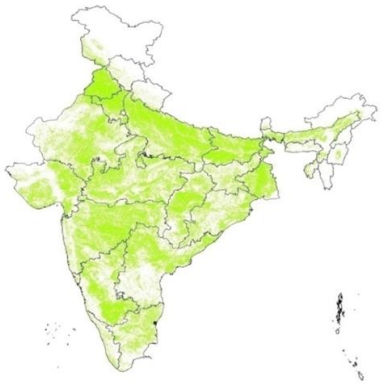
National

Land Use & Land Cover (1:250k)

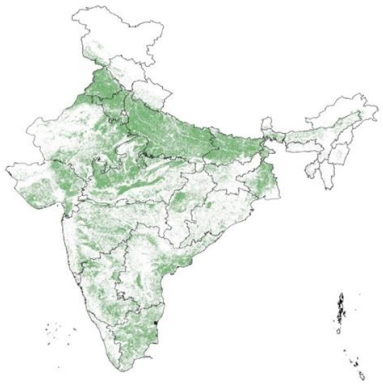


LULC Class (2010-11)	Area (M Ha)	% to TGA
Kharif crop land	49.55	15.07
Rabi crop land	21.47	6.53
Zaid crop land	1.17	0.35
Double / Triple crop land	72.47	22.04
Plantation / orchard	4.40	1.34
Net Sown Area	**149.05**	**45.34**
Current fallow	33.43	10.17
Evergreen / Semi-evergreen	17.34	5.27
Deciduous Forest	34.39	10.46
Shrub / degraded forest	14.33	4.36
Littoral / Swamp / Mangrove	0.47	0.14
Forest cover	**66.54**	**20.24**
Grassland & grazing land	7.48	2.28
Other wasteland	29.46	8.96
Gullied / Ravines	1.04	0.32
Scrubland	18.84	5.73
Water bodies	8.35	2.54
Snow covered / Glacial	6.41	1.95
Shifting cultivation	0.58	0.18
Built up land	2.34	0.71
Rann	1.96	0.60

Extent of Kharif crop during 2011-12 (**122 Mha**)



Extent of Rabi crop during 2011-12 (**94 Mha**)

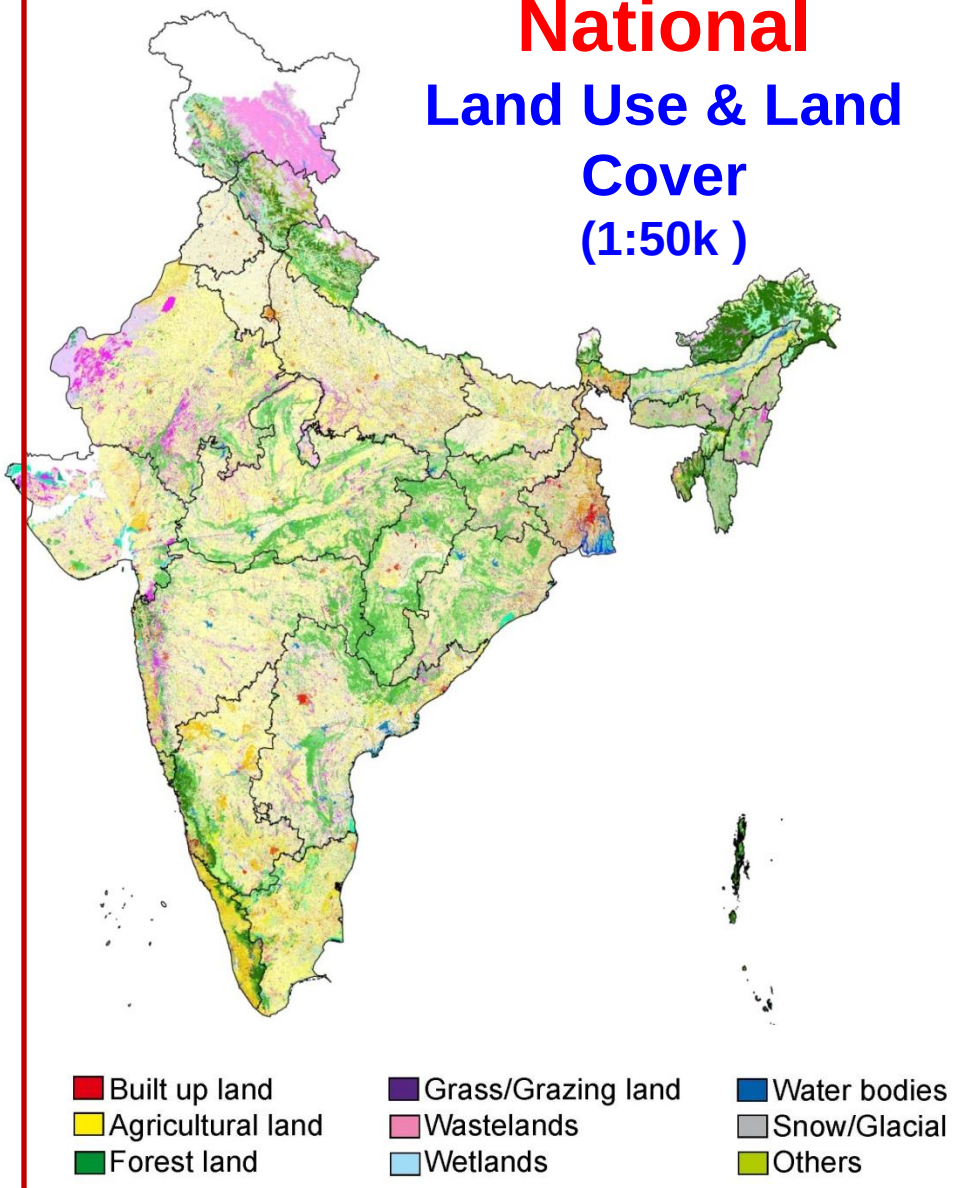


(a) Year summary, : e.g. max & min Water spread; max & min Snow cover etc

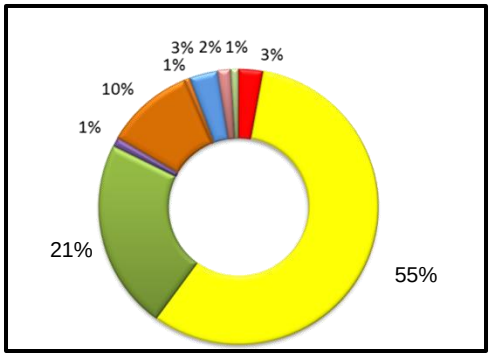
(b) Within Year summary : e.g. Total kharif, Total Rabi crops etc

(c) Across Year Summary : Deforestation, Urbanization, Wetland change; Cropping Frequency etc

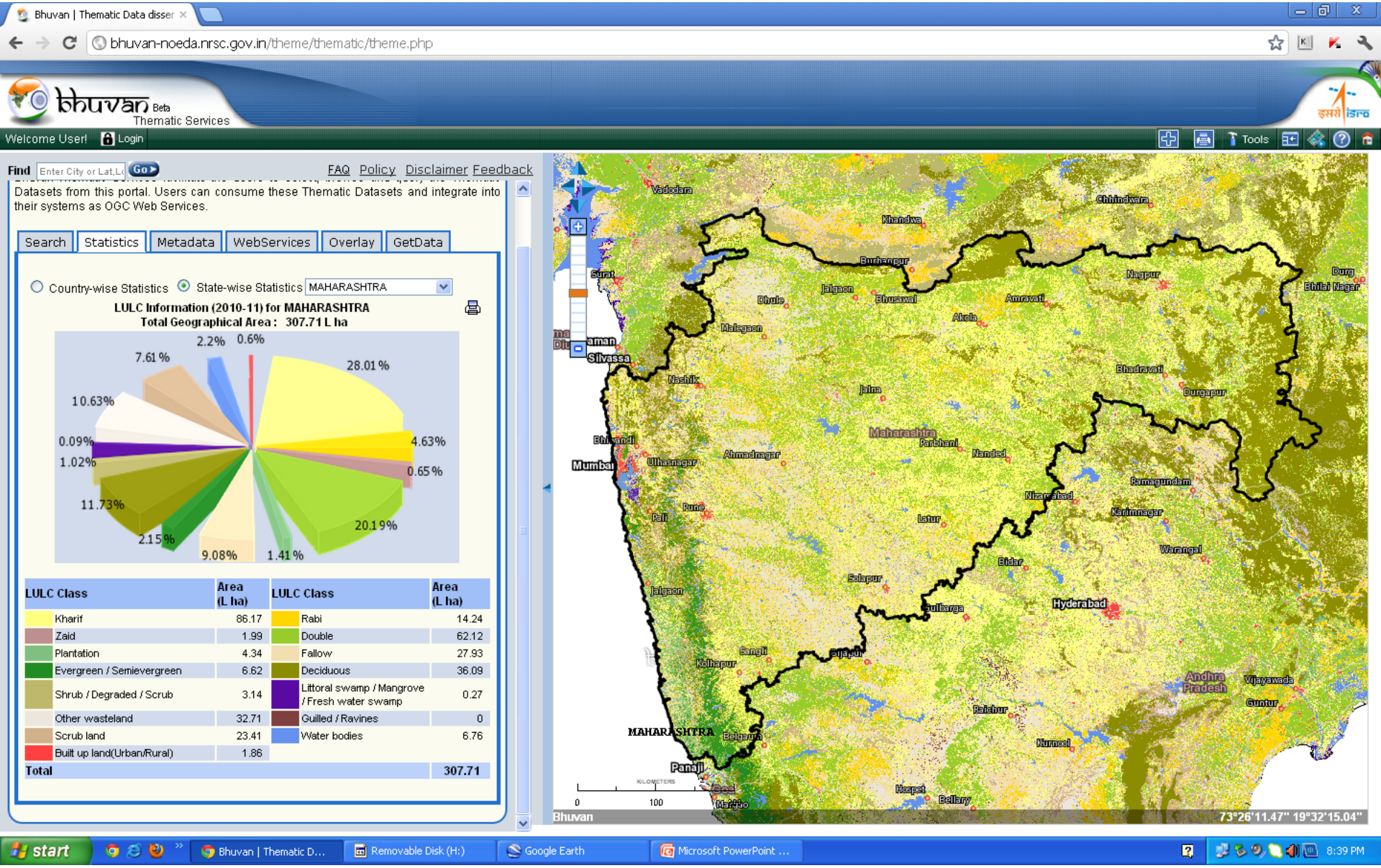
National
Land Use & Land Cover
(1:50k)



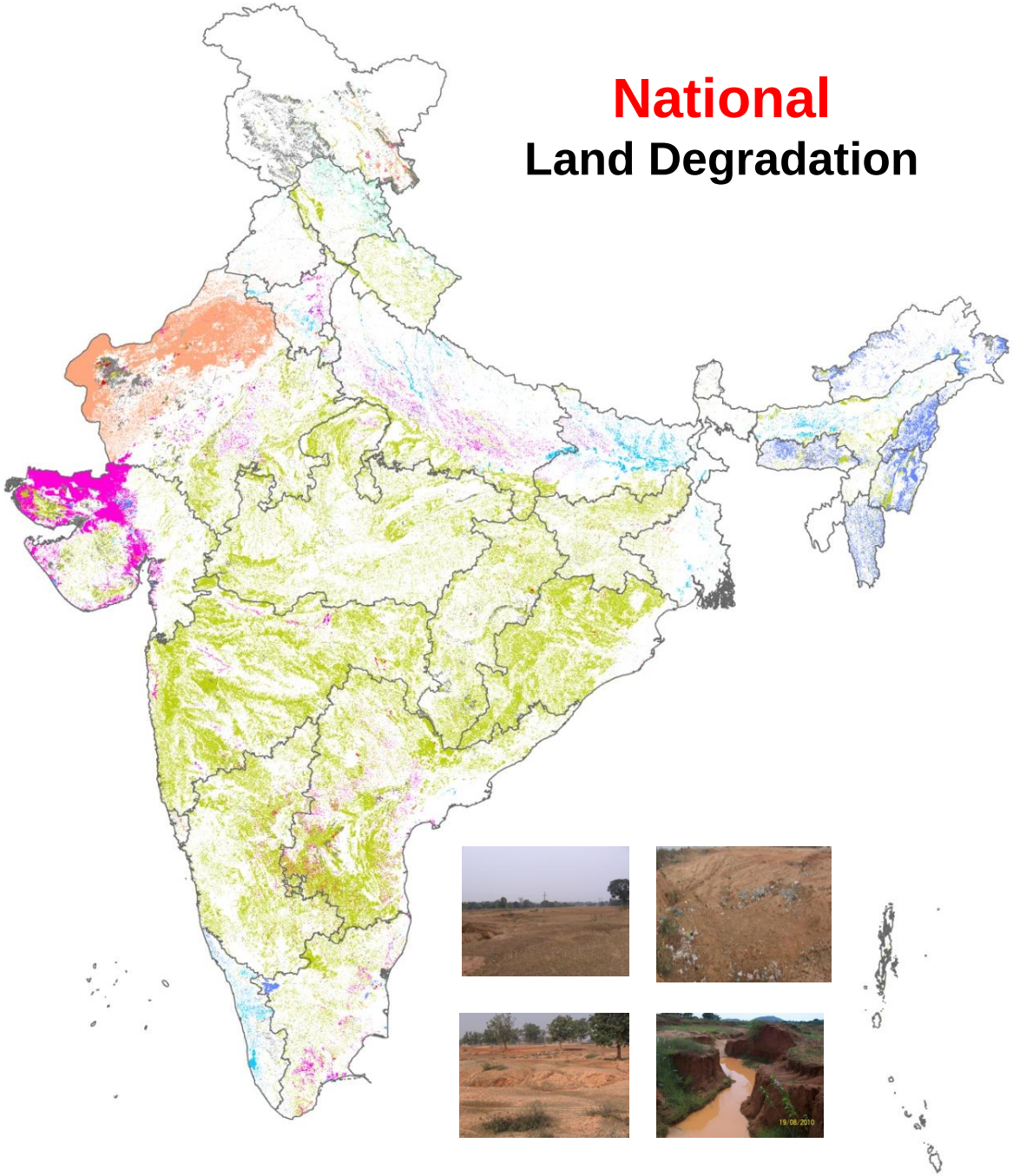
S.No	Category	Area in M Ha	% to TGA
1	Built-Up	8.94	2.72
2	Agriculture	181.04	55.07
3	Forest	70.62	21.48
4	Grass/ Grazing lands	3.37	1.03
5	Wastelands	32.71	9.94
6	Wetlands	2.02	0.61
7	Waterbodies	10.29	3.13
8	Snow/ Glacial Area	4.78	1.45
9	Shifting Cultivation	0.88	0.27
10	Rann (Kutch)	1.98	0.60
11	Area not Mapped in J & K	12.09	3.68
Net Sown Area		144.33	43.91
Cropping Intensity		143.45%	

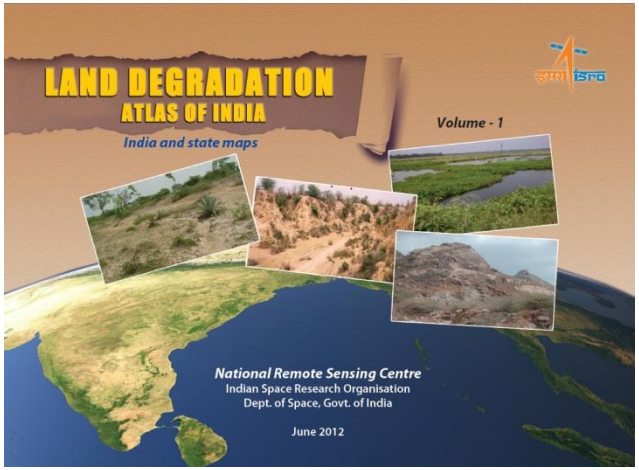


State Level Land Use & Land Cover ~ View



National
Land Degradation





Process	Area in sq.km	% TGA
Water Erosion	504468	15.93
Wind erosion	86649	2.74
Water logging	21383	0.68
Salinisation / Alkalisation	65454	2.07
Acidification	34467	1.09
Glacial	10903	0.34
Anthropogenic	4633	0.15
Others	63518	2.01
Total	791475	25.00

Bio-Resources Management

Information Systems
Process Models

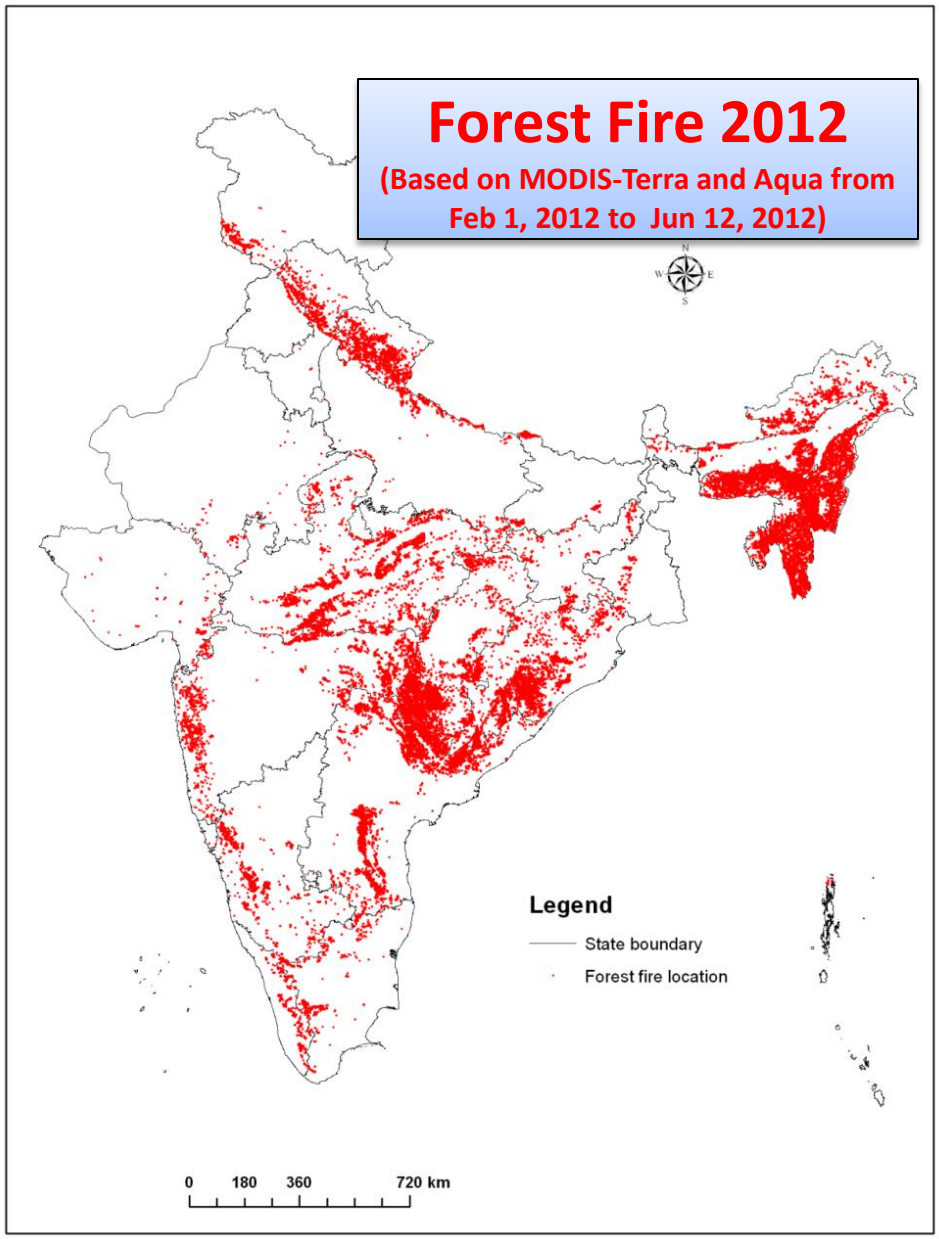
Fire detection, Trees outside Forest,
Growth Models, Species Prediction

Biodiversity studies, Management Plans

Quantitative Assessments, Bioprospecting

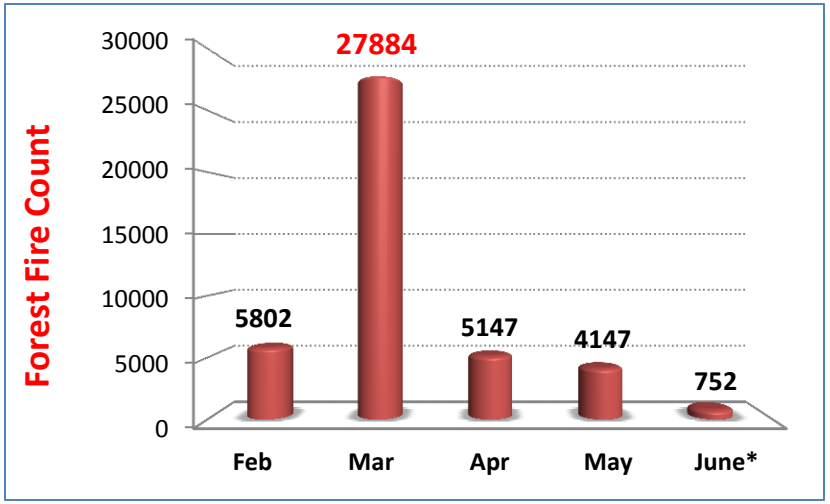
Mapping, Monitoring and Change Assessments

1985 1990 1995 2000 2005 2012

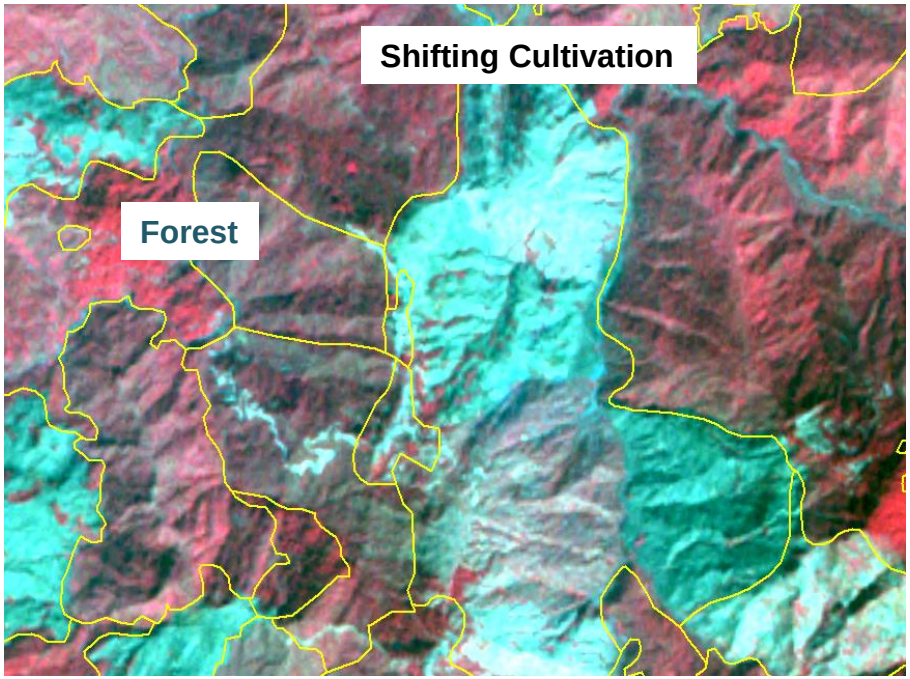


Year 2012	
Month	Forest Fire Counts
Feb	5802
Mar	27884
Apr	5147
May	4147
June*	752
Total	43732

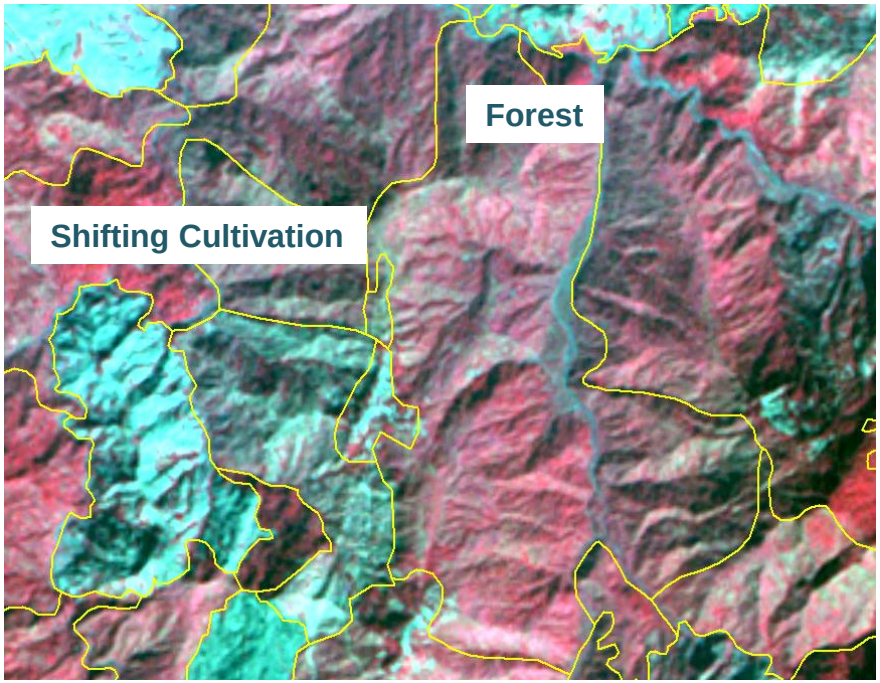
** Fire till 12-June-2012*



Forest (Open/Dense) to Shifting Cultivation
Tirap District, Arunachal Pradesh



Feb 2006



Feb 2012

Water Resources Management

Irrigation Infra-structure : Monitoring Irrigation Potential creation

Feasibility Assessment River link Projects

National Drinking Water Mission

Reservoir Sedimentation

Waterlogging & Soil Salinity Mapping

Command Area Water Management

Snow & Glacier lake inventory

Snow melt Runoff

Groundwater Potential zones

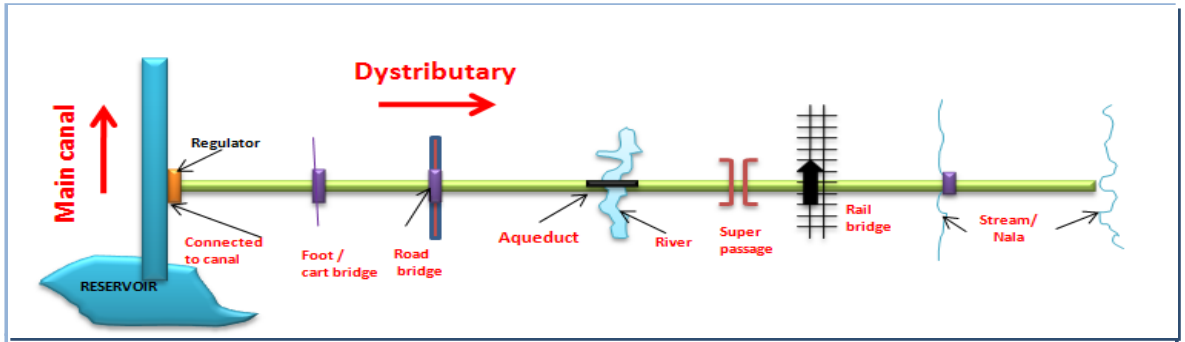
Irrigation & Drainage maps

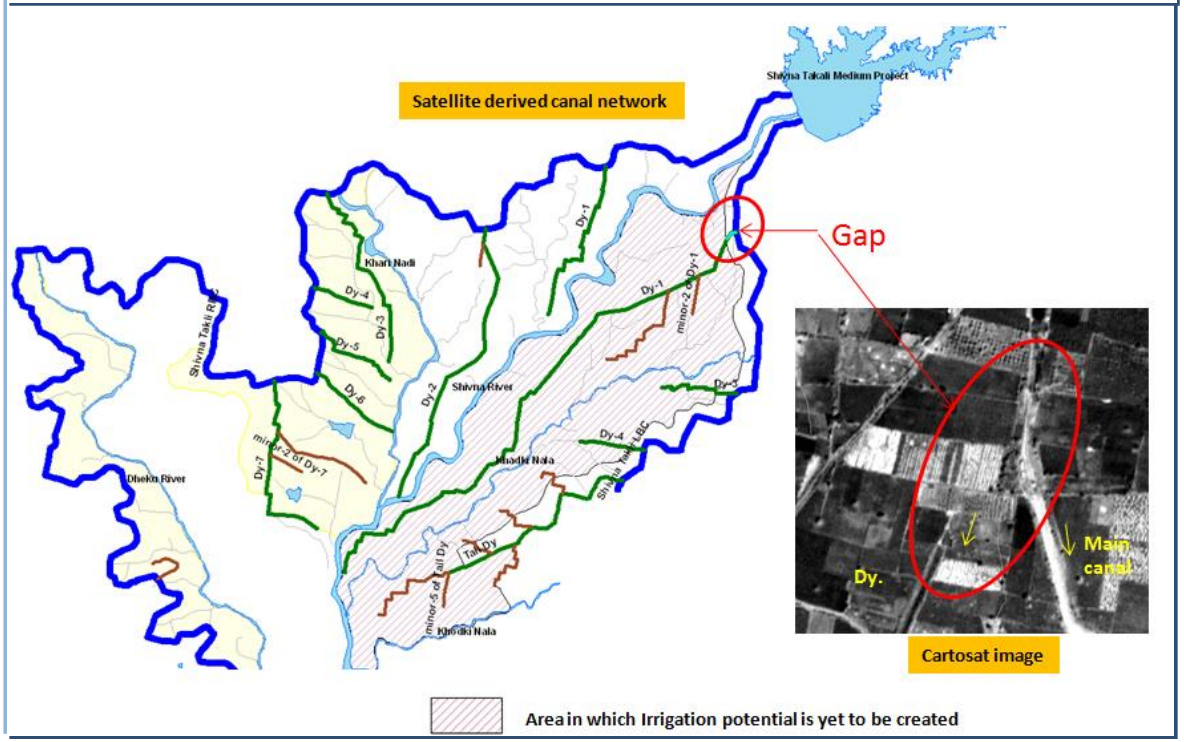
Surface Water Inventory

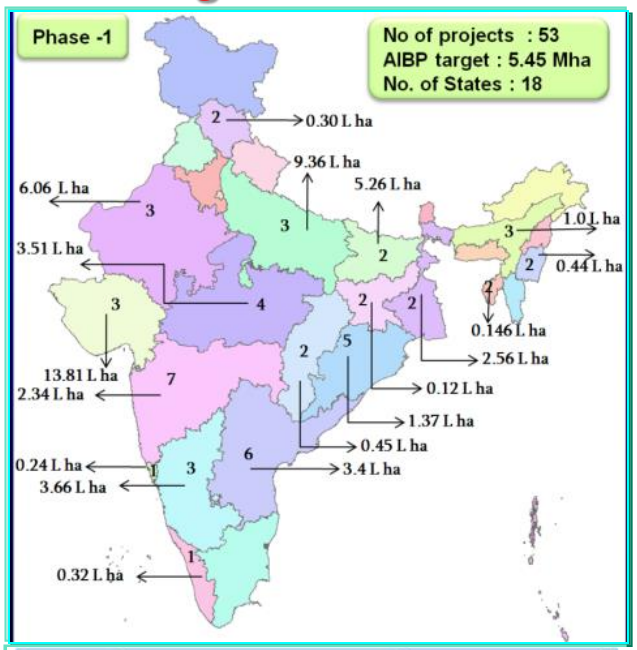
1975 1980 1985 1990 1995 2005 2012

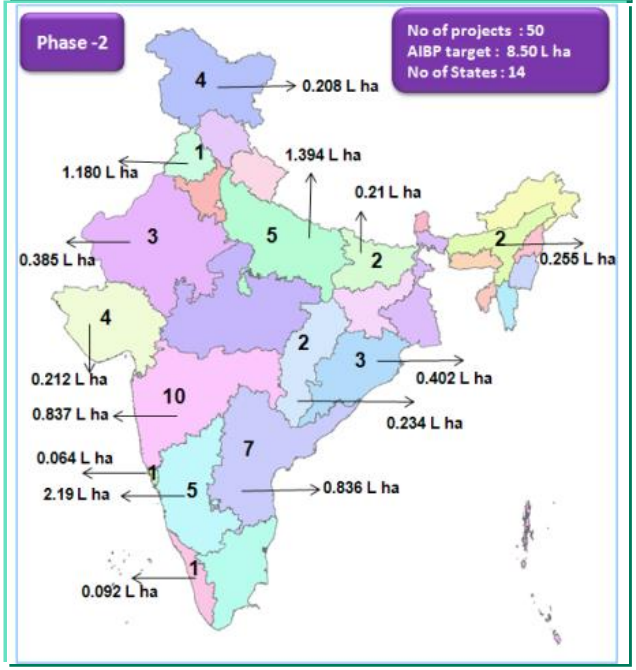
Assessment of Irrigation Potential created in Accelerated Irrigation Benefit Programme (AIBP) funded Irrigation Projects in India using Cartosat data

- Completed the study of 103 AIBP
- Technology Transfer / Capacity building is being carried out in 15 selected Partner Institutions through AIBP Phase-II
- Decision taken for Institutionalization of the technology in CWC / MoWR
- Working Group constituted to workout modalities for institutionalization





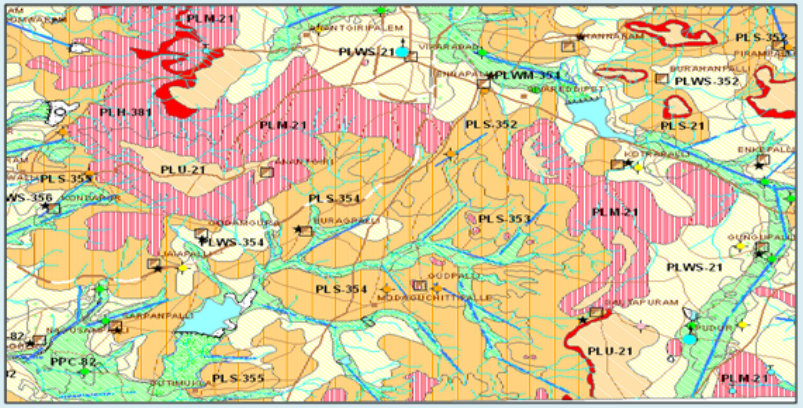




Integration of Thematic Maps

- Geological sequence / Rock type
- Geomorphic unit / Landform
- Depth to water table / No. of wells observed
- Recharge conditions (rainfall & other sources)
- Nature of aquifer material
- Type of wells suitable
- Depth range of wells (suggested)
- Yield range of wells (expected)
- Aquifer homogeneity & Success rate of wells
- Quality of water (potable/non-potable)
- Ground water irrig. area (exploitation status)
- Recharge structures suitable & Priority
- Remarks (problems / limitations)

VIBGYOR colour scheme i.e. violet to red, is used for depicting different yield ranges from excellent to poor. Within each yield range, three hatching patterns are used for depicting the depth range of wells.



GROUND WATER PROSPECTS INFORMATION

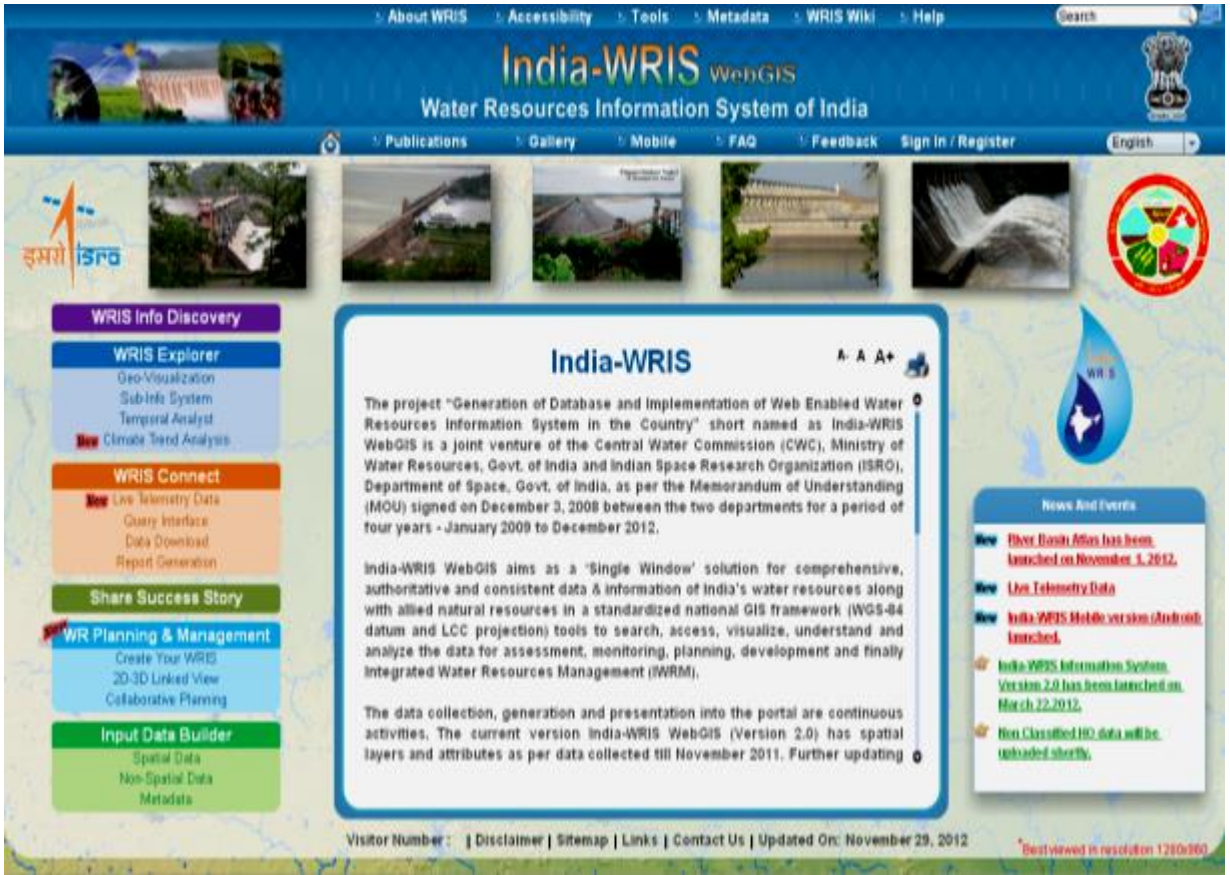
YIELD RANGE OF WELLS	COLOUR CODE	DEPTH RANGE OF WELLS		
		SHALLOW (< 30 METERS)	MODERATE (30 - 60 METERS)	DEEP (> 60 METERS)
> 800 LPM	VIOLET			
400 - 800 LPM	INDIGO			
200 - 400 LPM	BLUE			
100 - 200 LPM	GREEN			
50 - 100 LPM	YELLOW			
30 - 50 LPM	ORANGE			
20 - 30 LPM	BROWN			
10 - 20 LPM	PINK			
Prospects limited to valley portions only (Hills, Plateaus etc.)	RED			
Run-off zone/ Barrier for G.W. movement			(Inselberg / Ridge / Dyke etc.)	

India - Water Resource Information System

Joint Project of Central Water Commission and ISRO

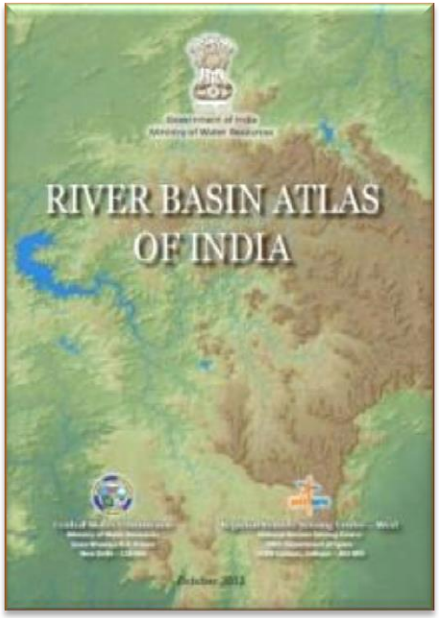
Objectives:

- Generate database of water resources and design an information system.
- Access to water resources data to all water resources departments.
- Tools to create value added maps for integrated water resources scenarios.
- Provide foundation for Spatial Decision Support Systems and modeling.



Main Information System – 12
Sub information System – 35

Layers – 108
Attributes - 4500+



Watershed Management

Planning & Prioritisation Inputs

Implementation Outputs

NREGS & VRC

IRISDA

NATP

IMSD-Special

Integrated Mission for Sustainable Development (IMSD-I&II)

Wasteland mapping

1985 1990 1995 2000 2005 2012

VRC : Village Resource Center

NREGS : National Rural Employment Guarantee Scheme

IRISDA : Integrated Resource Information System

Desert Area Development

NATP : National Agriculture Technology Programme

Space Inputs for Watershed Development

Natural Resources Databases

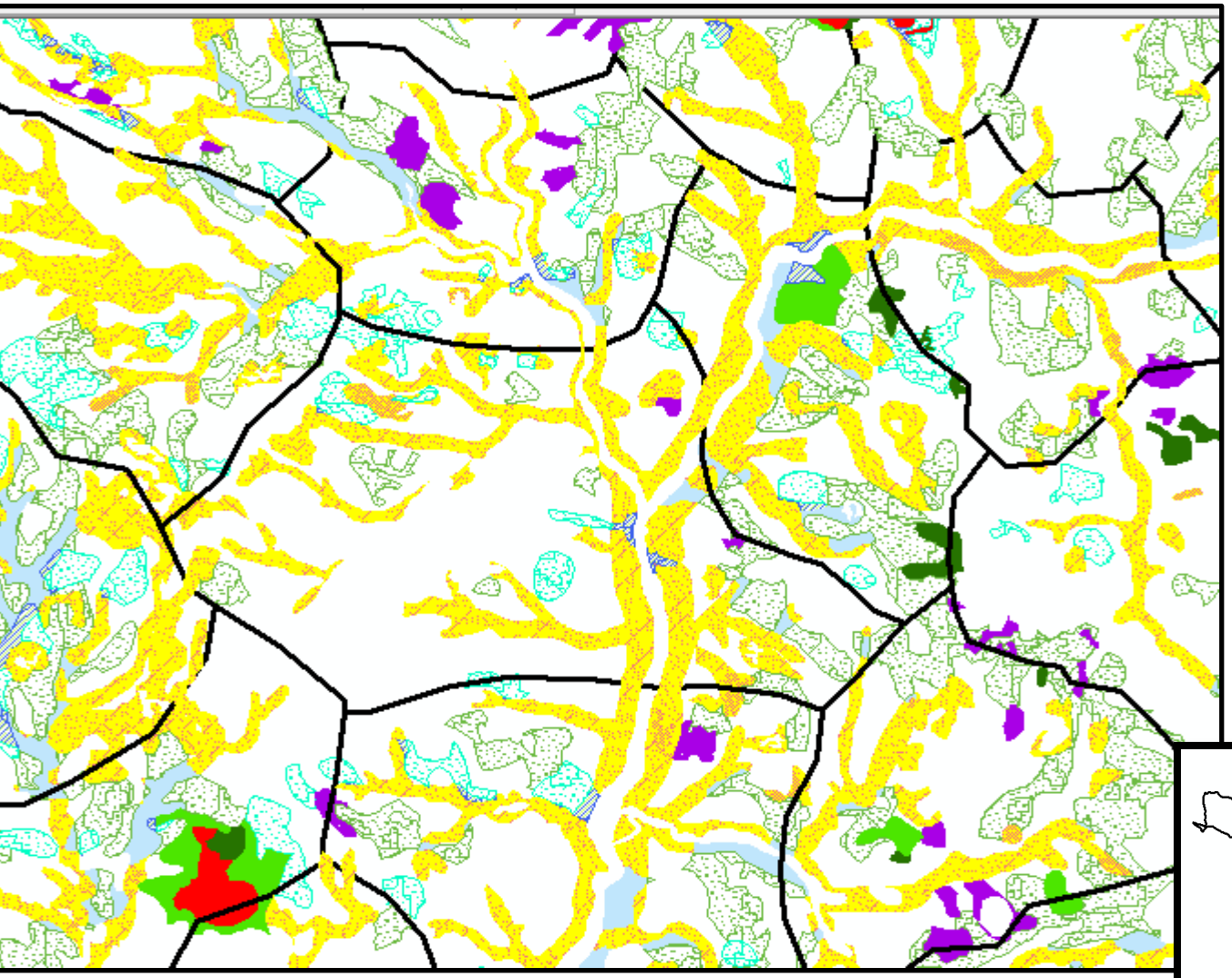
- Land use & land cover
- Wasteland
- Land degradation
- Wetland
- Rajiv Gandhi National Drinking Water Mission (21States)
- Soil Map (15 States + others by SLUSI ;1:250,000 entire country by NBSS&LUP)
- Drainage and Watershed maps
- Administrative boundaries (Census)
- Cadastral maps overlaid on satellite data (for 1 Lakh villages)
- Digital Surface Models – from Cartosat : 1 Stereo

Satellite Data

- IRS-AWIFS,LISS-III, LISS-IV, CARTOSAT
- Satellite Ortho image database at 1:10,000 scale for the entire country – SIS-DP

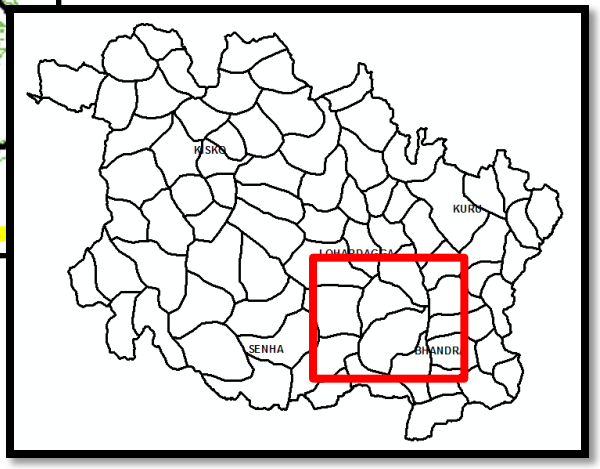
AWiFS | LISS III | LISS IV | Carto + LISS IV

Land Resource Development Plan, Lohardaga District, Jharkhand



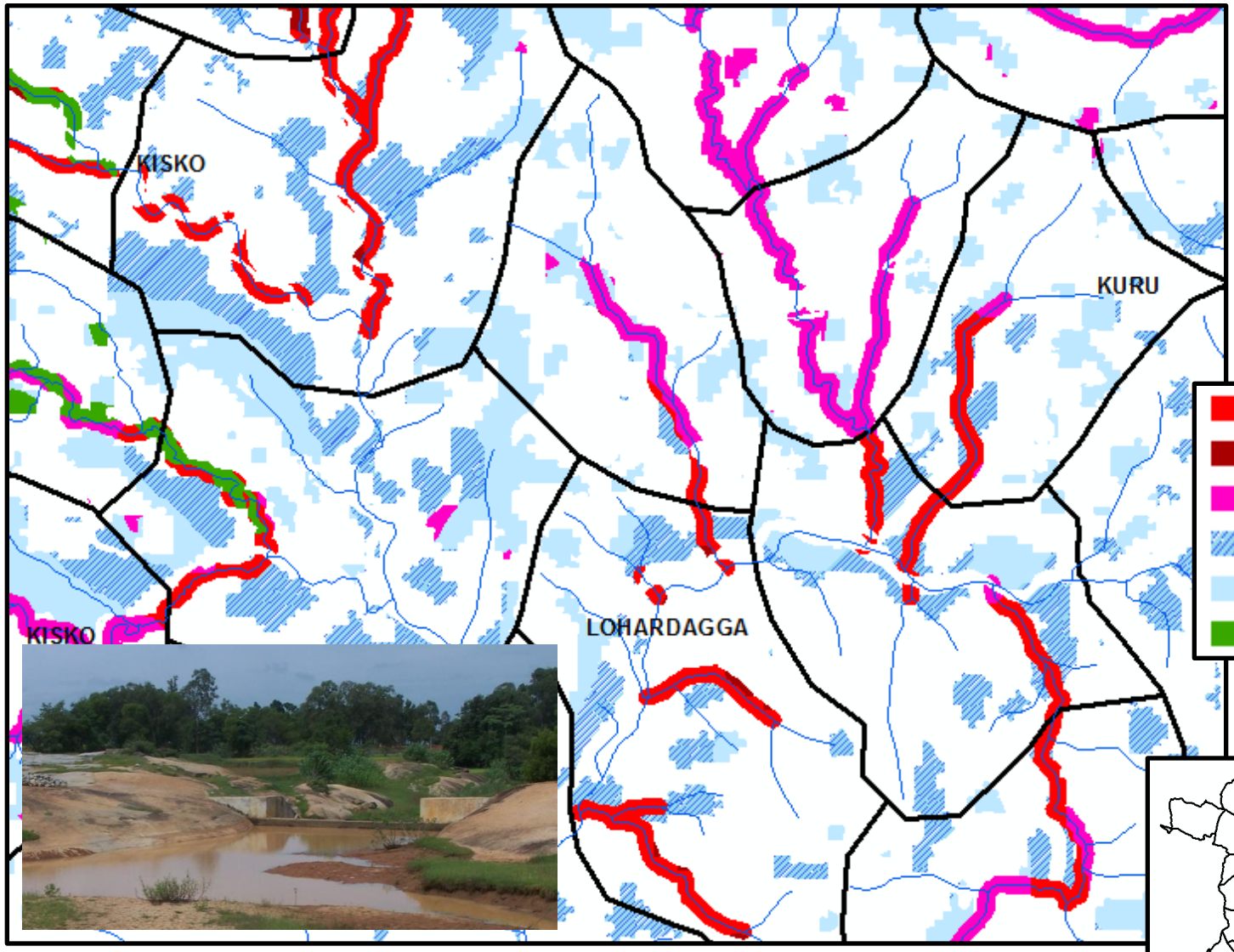
Details

- Intensive Agriculture
- Agro Horticulture I (Mango, Litchi,
- Agro Horticulture II (Ber, Jamun, M
- Agro Forestry I
- Horticulture
- Social Forestry
- Silvipasture
- Management
- Fuel _Fodder plantation
- Gap filling with forest species

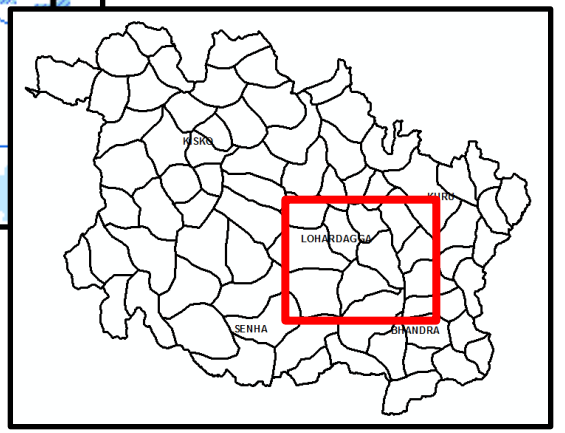


Inputs: 1. Soil 2. Land Cover 3. Slope 4. Drainage
5. Groundwater potential 6. Land capability

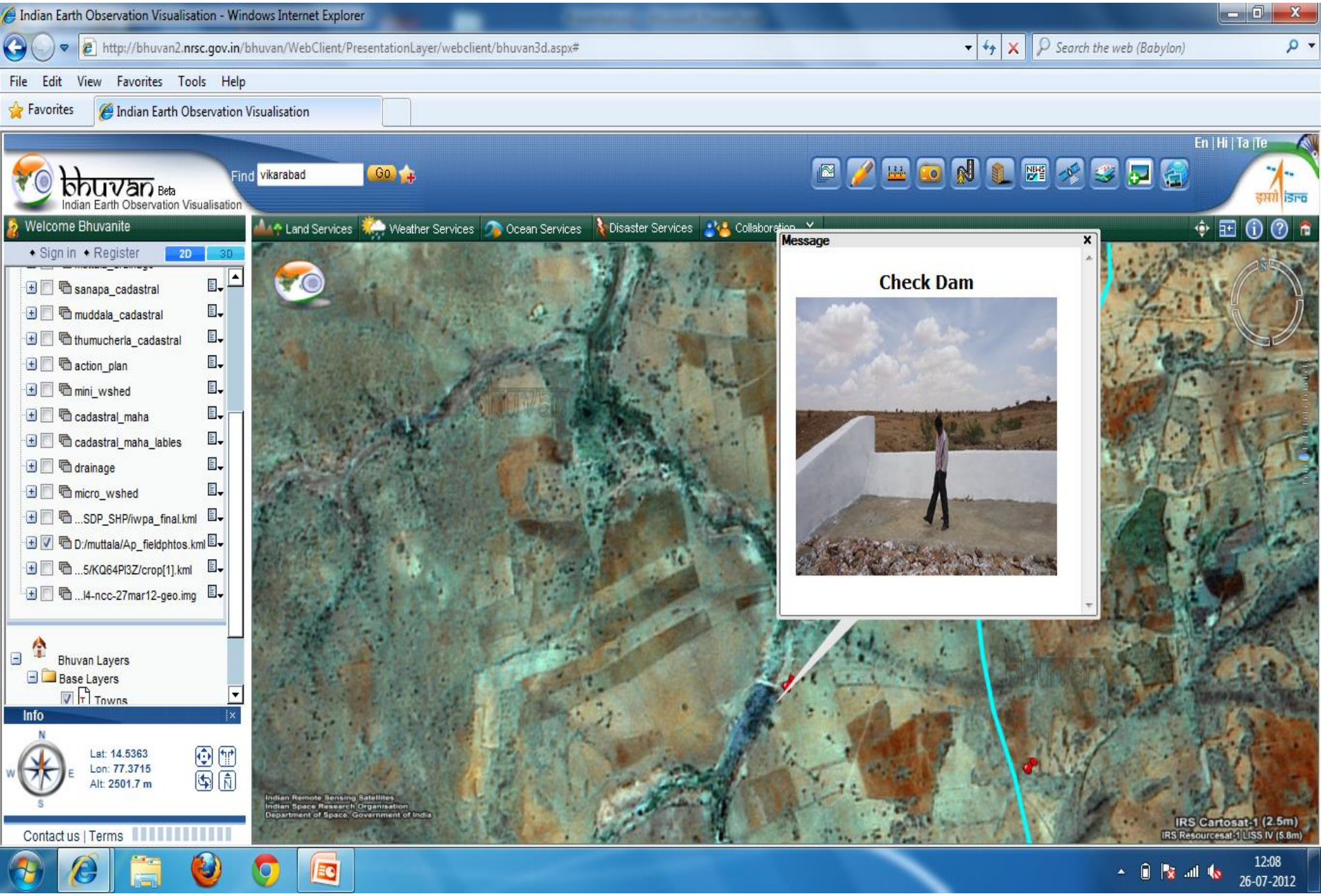
Water Resource Development Plan, Lohardaga District, Jharkhand



- Check Dam (Cultivable Land)
- Check Dam (Wastelands)
- Percolation Tanks
- Farm Ponds
- Farm Ponds with Seepage Contr
- Soil Consevation Measures



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


Indian Earth Observation Visualisation - Windows Internet Explorer
http://bhuvan2.nrsc.gov.in/bhuvan/WebClient/PresentationLayer/webclient/bhuvan3d.aspx#
Search the web (Babylon)
File Edit View Favorites Tools Help
Favorites
Indian Earth Observation Visualisation
En | Hi | Ta | Te
bhuvan Beta
Indian Earth Observation Visualisation
Find vikarabad
Go
Welcome Bhuvanite
Sign in
Register
2D
3D
Land Services
Weather Services
Ocean Services
Disaster Services
Collaboration
sanapa_cadastral
muddala_cadastral
thumucherla_cadastral
action_plan
mini_wshed
cadastral_maha
cadastral_maha_lables
drainage
micro_wshed
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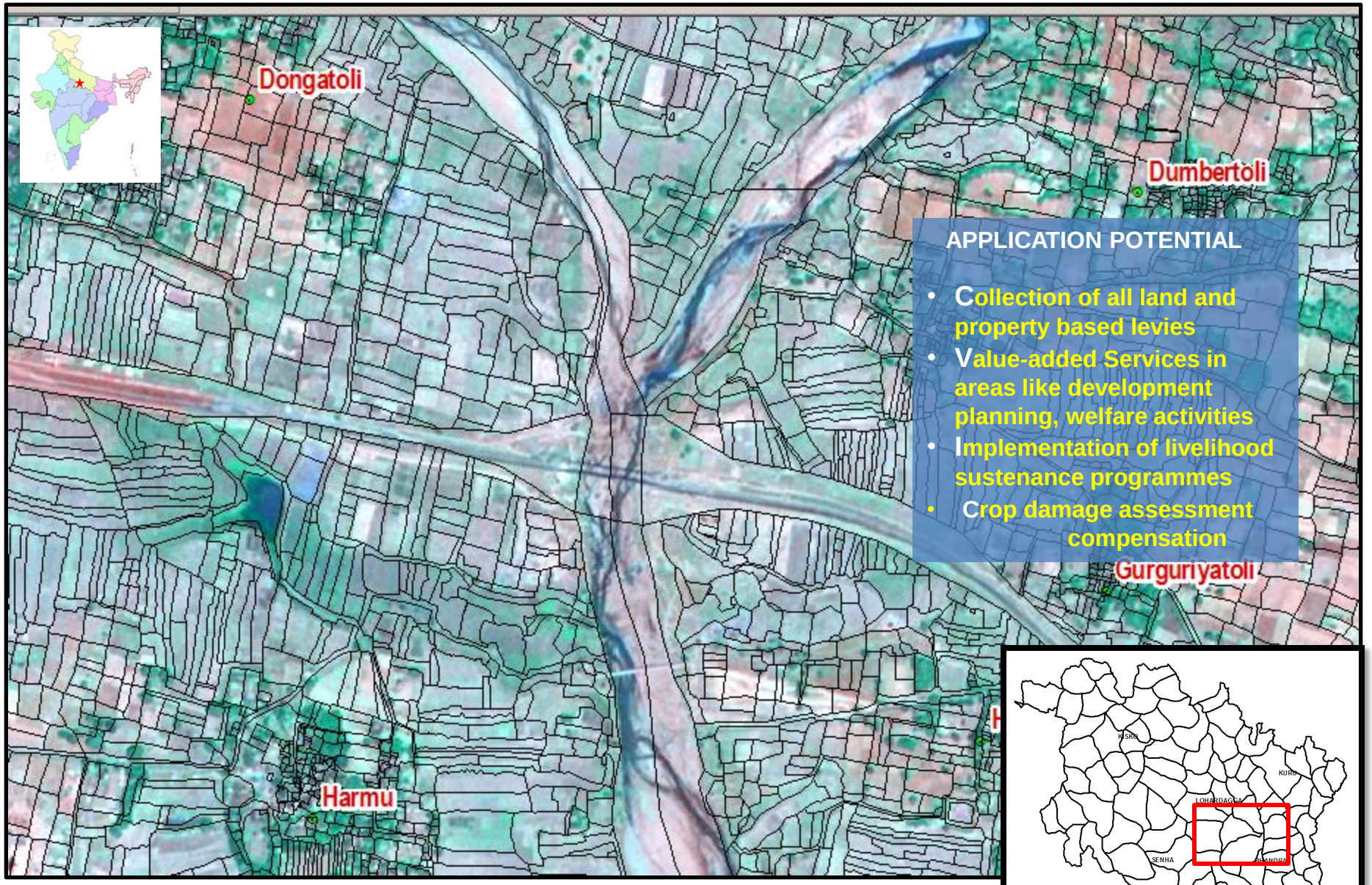
Bhuvan Layers
Base Layers
Towns
Info
Lat: 14.5363
Lon: 77.3715
Alt: 2501.7 m
Contact us | Terms
Message
Check Dam
Indian Remote Sensing Satellites
Indian Space Research Organisation
Department of Space, Government of India
IRS Cartosat-1 (2.5m)
IRS Resourcesat-1 LISS IV (5.8m)
12:08
26-07-2012

SATELLITE IMAGE with CADASTRAL (PARCEL) OVERLAY



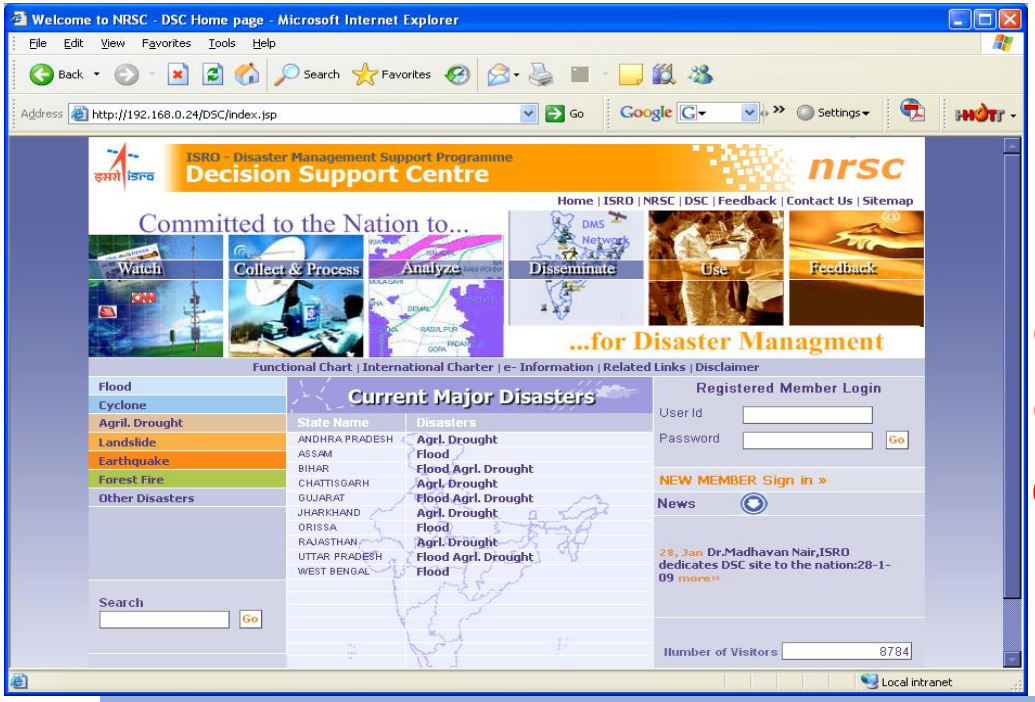
LOHARDAGA DISTRICT, JHARKHAND STATE

Disaster Management

Disaster Management Information Support

HUB

Out Reach



Online Geo-spatial Information on Near Real Time Basis

Services

Information Retrieval, Processing , Analysis , Dissemination – for Relief and Planning & Management

Decision Support Centre (DSC) Services

Seasonal Monitoring

Floods

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

Drought

- MonthlyAgril. Drought Report
- End-of-the-Season Agril. Drought Report

Forest Fire

- Active Fire Detection
- Damage Assessment

Event Based Monitoring

Earthquake

- Damage Assessment

Cyclone & Tsunami

- Inundation Maps
- Recession Maps
- Damage Assessment

Landslide

- Damage Assessment
- Hazard Zonation

Information Dissemination

Central: MHA, CWC, Min. of Agri, GSI, IMD, MOEF

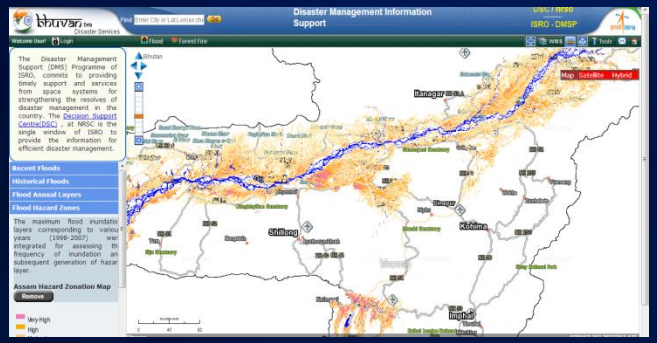
State: Relief Commr's., District Magistrates, Agriculture, Forest, Other Line Depts.etc

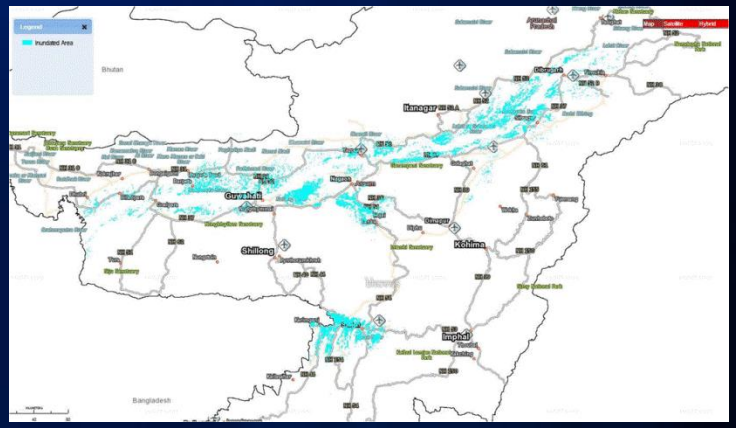
Bhuvan – Disaster Services

"Disaster Management Information Support"

Flood

- Recent Floods
- Historical Floods
- Flood Annual Layers
- Flood Hazard Zone





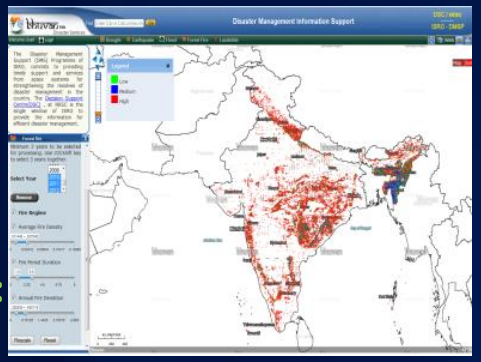
Forest Fire

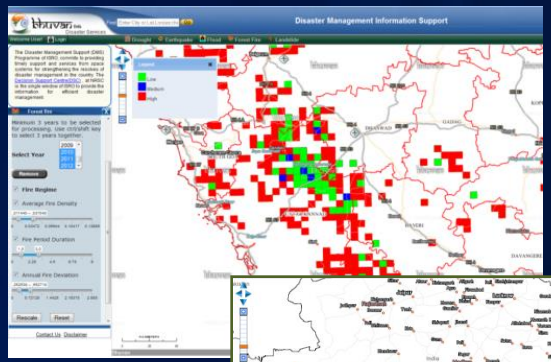
- **Archived Forest Fire Locations:**
  - Available for last 12 years
  - Terra & Aqua Satellite data
  - State wise Monthly Data is available for Visualization

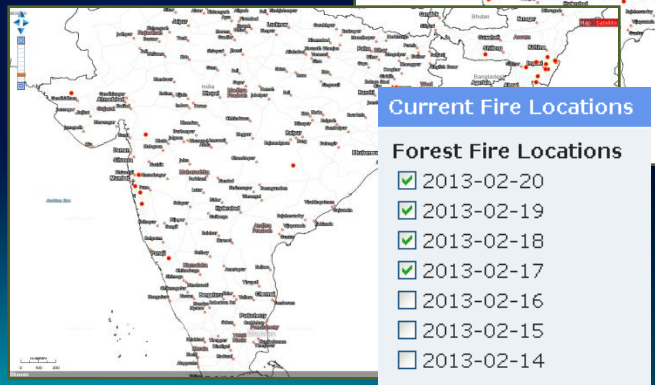
Forest Fire Regimes:

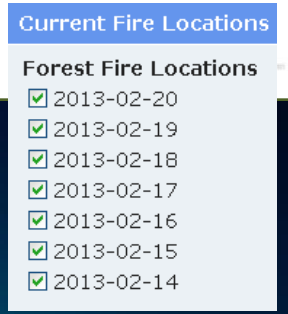
- Data Available from 2003-2012
- Dynamic Styling
- Regime parameters customization through Slider

5km Grids





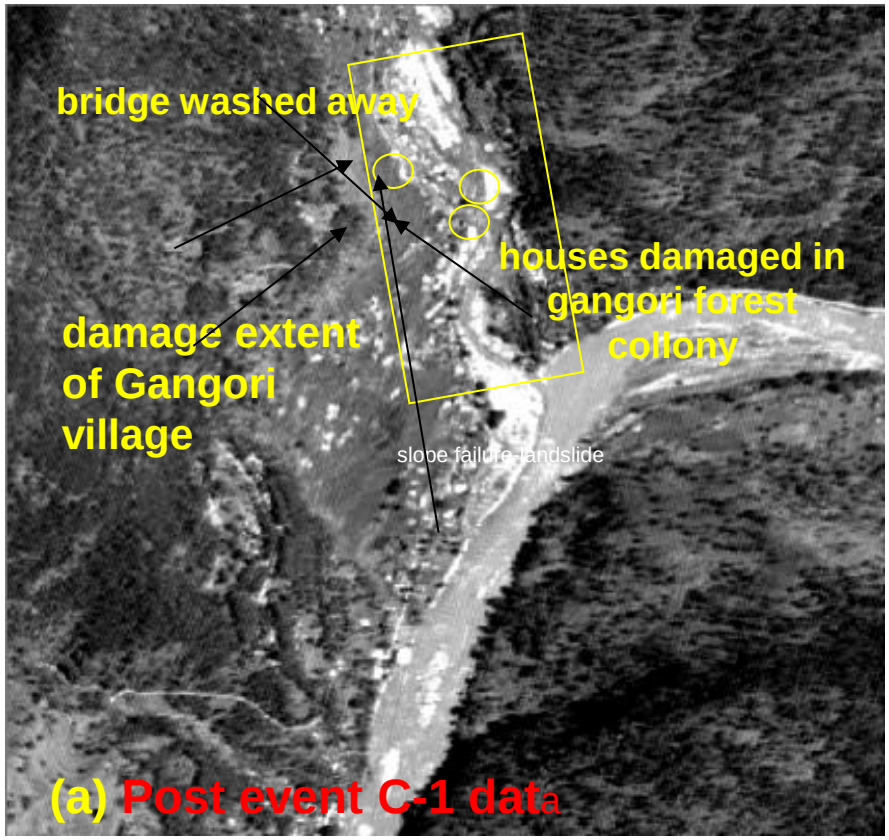




E-mail Alerts on update

http://bhuvan-noeda.nrsc.gov.in/disaster

Uttarkashi Flashfloods : August 2012

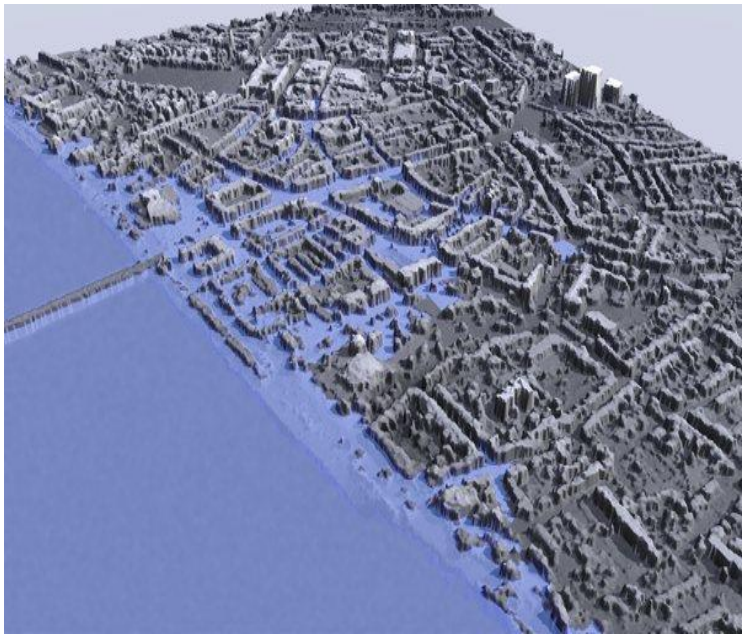


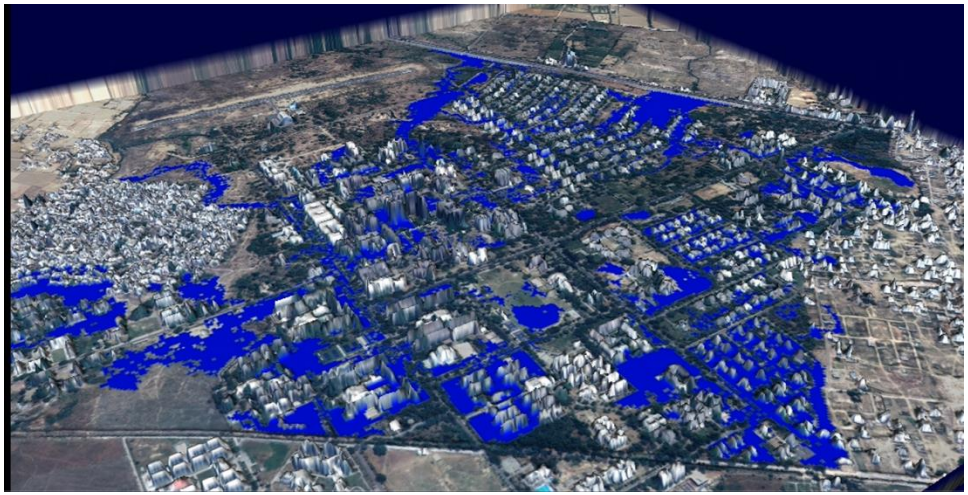
Urban Flood Modeling using LiDAR

- Improving flood forecast models and flood hazard zoning , risk & vulnerability operations.

- Determination of the friction coefficient on flood plains & low lying areas.

- Topographic data input to GIS based relief, rescue, and flood simulation modeling operations.





Web Portals

BHUVAN

OGC Geospatial Web-portal Platform to Create, Visualize, Share and Analyze Geospatial Data Products ,Services and Applications on Desktop and Mobile (since, 2009) in 2D and 3D)
in En/Hi/Te/Ta

Space with specific emphasis on Indian Region

(http://*bhuvan.nrsc.gov.in*)

Mail to : bhuvan@nrsc.gov.in

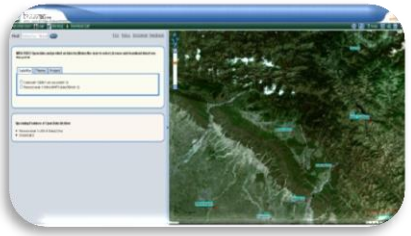
Post queries :http:// bhuvan-forum.nrsc.gov.in

Mobile Bhuvan

Bhuvan Home

Bhuvan 3D

Bhuvan 2D



Bhuvan - NOEDA

Space with specific emphasis on Indian Region

Web based Data Visualisation Delivery Mechanism

NNRMS Portal

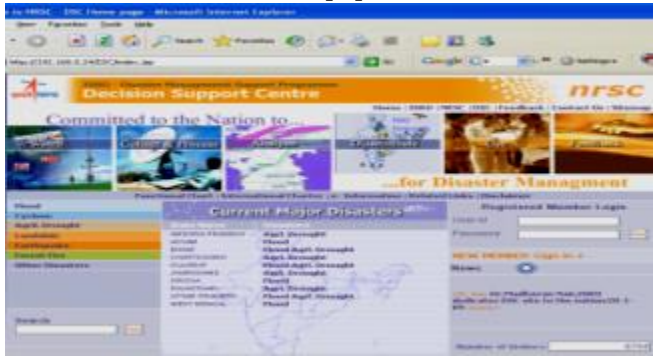
Bhuvan

MOSDAC

India-Water Resources Info. System

Forest Fire Info. System

Decision Support Centre



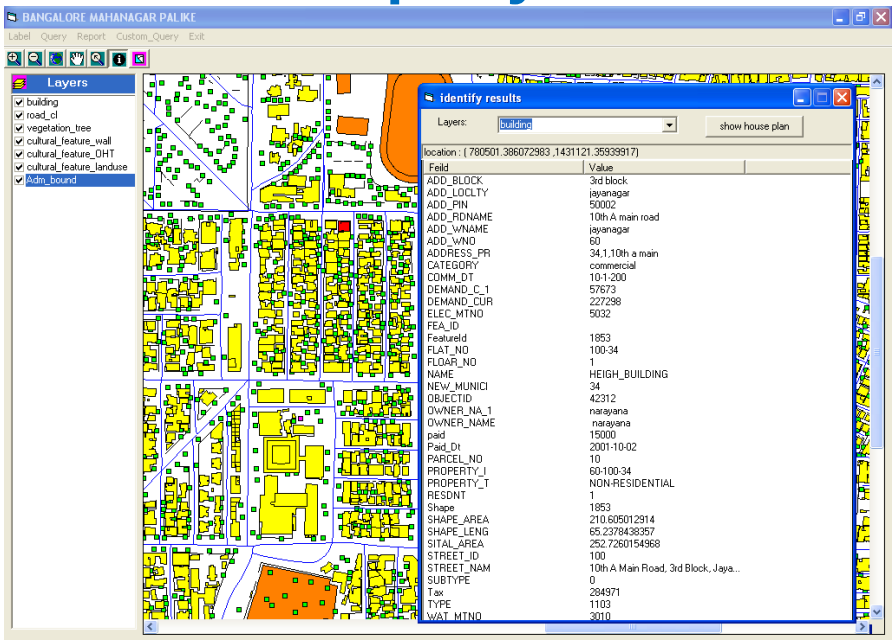
Biodiversity Info. System

ISRO Data Portal

GIS for - *egovernance*

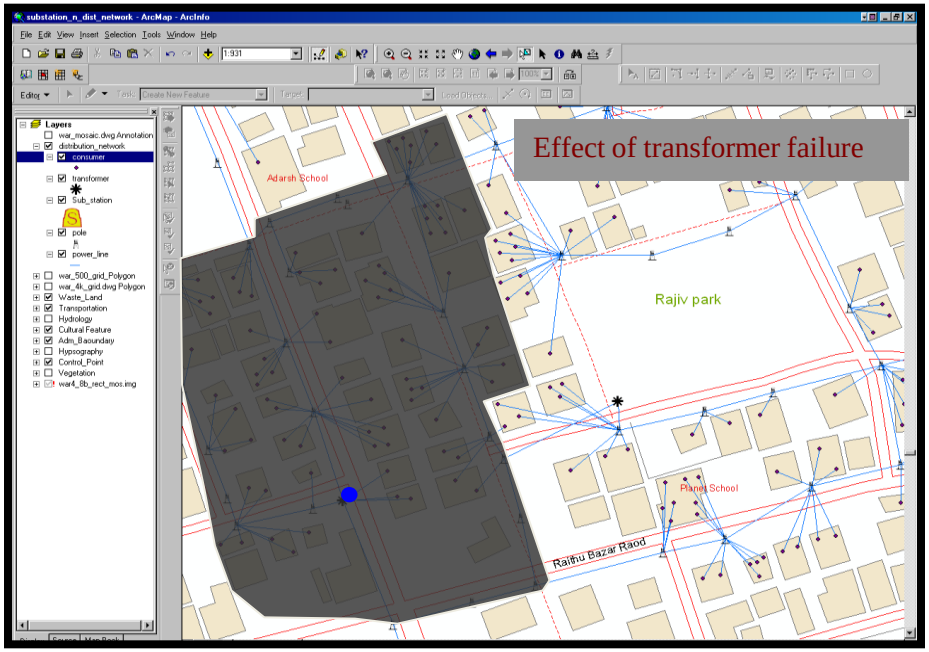
GIS based e-Governance is inherently based on geography or the "location." Understanding the location and Demographic patterns, critical infrastructure, transportation, utilities, natural and other resources, their interrelationship and the various constraints are fundamental to managing the entire system in an efficient & effective manner.

Property GIS



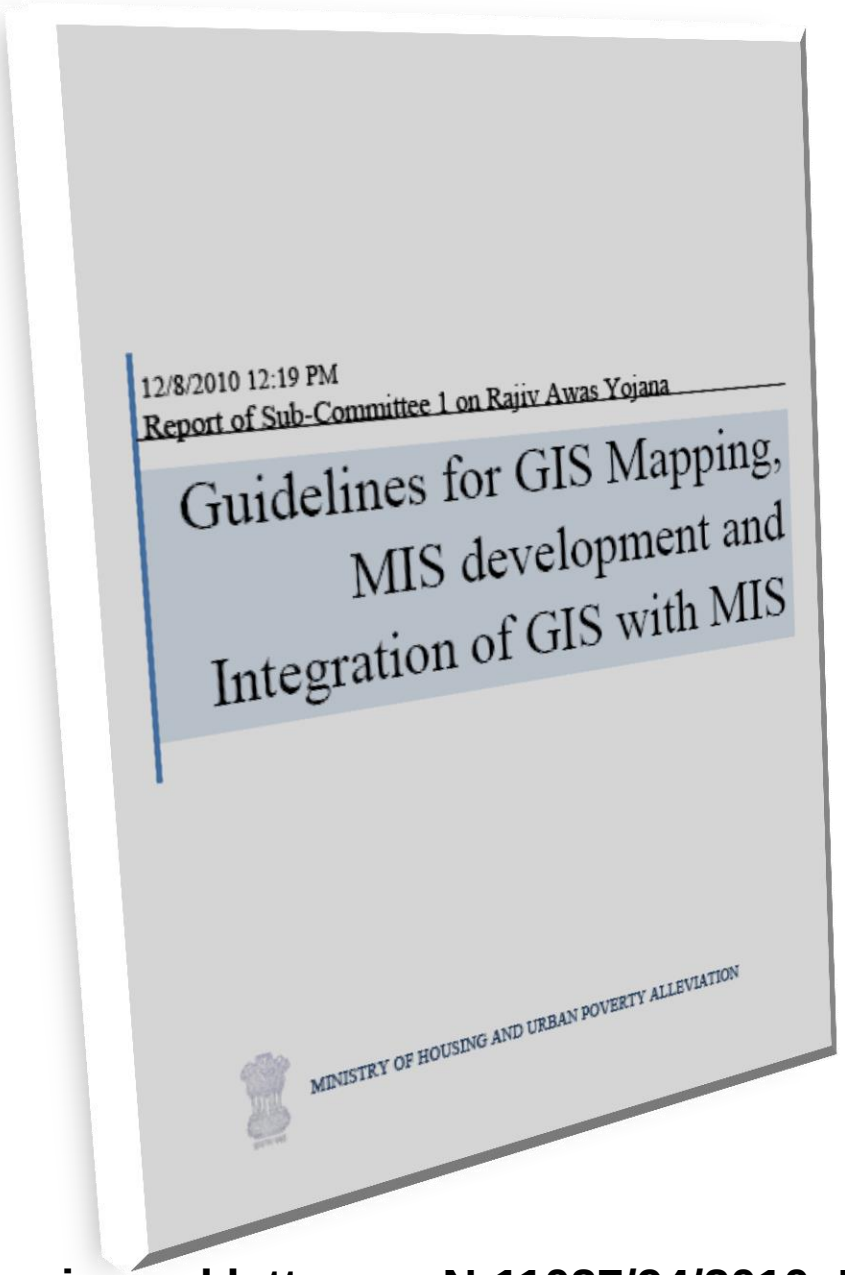
Jayanagar Locality, Bangalore

Power GIS



Adarsh Colony, Hyderabad

Specific Case Study
(SFCP)



GIS-MIS Guidelines issued letter no. N-11027/94/2010. RAY dated Jan. 24, 2011.
(available at : *http://mhupa.gov.in/W_new/GIS-MIS-Guidelines.pdf*)

Slum Free City Planning (SFCP) scheme **is based on *' Whole City –Whole Slum* 'Concept, wherein ' slums are treated part of process of city development and city landscape.**

The **Focus** is to provide / upgrade **a) Housing, b) Infrastructure / Facilities , c) Livelihood to Urban Poor.**

The main components are :

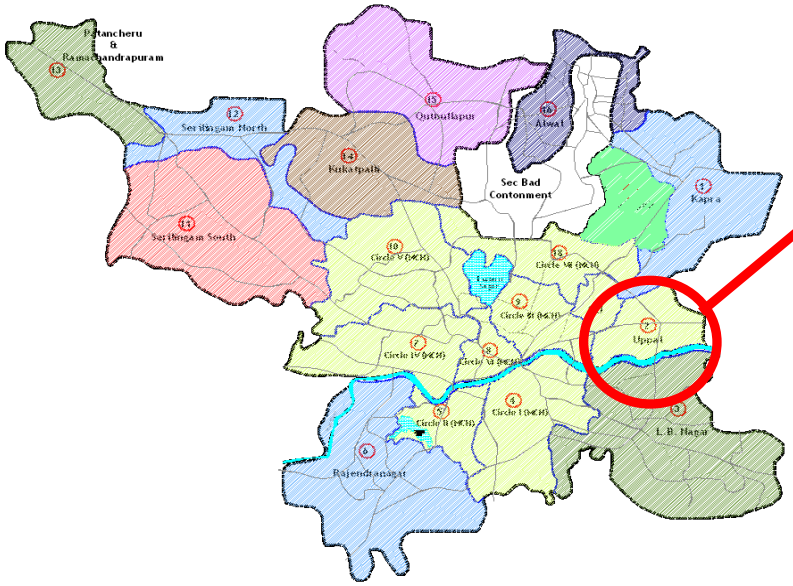
i) **Slum Survey ,**
ii) **Household & Livelihood Survey ,**
iii) **GIS Mapping ,**
iv) **MIS Development,**
v) **Slum Information Decision System**

Slum Definition :

" unit area with 100 population living in 20-25 households "
(MoHUPA , 2010)

" unit area with 300 population living in 50-60 households "
(Census ,2001)

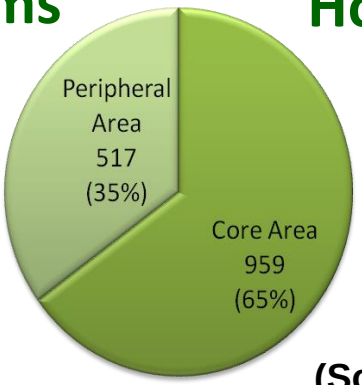
SLUMS IN GHMC, Hyderabad



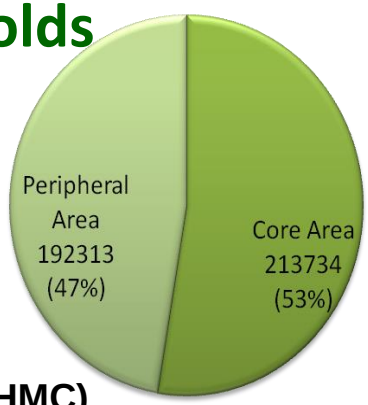
Uppal Circle

S.No.	Circle	No. of Slums
1	Circle 1 (Kapra)	-51 Slums
2	Circle 2 (Uppal)	-29 Slums
3	Circle 3 (L.B.Nagar)	-75 Slums
4	Circle 4 (Old Circle I)	-221 Slums
5	Circle 5 (Old Circle II)	-94 Slums
6	Circle 6 (Rajendranagar)	-45 Slums
7	Circle 7 (Old Circle IV)	-147 Slums
8	Circle 8 (Old Circle VI)	-38 Slums
9	Circle 9 (Old Circle III)	-193 Slums
10	Circle 10 (Old Circle V)	-160 Slums
11	Circle 11	-28 Slums
12	Circle 12	-33 Slums
13	Circle 13 (Patancheruvu)	-7 Slums
14	Circle 14 (Kukatpally)	-68 Slums
15	Circle 15 (Quthbullapur)	-64 Slums
16	Circle 16 (Alwal)	-49 Slums
17	Circle 17 (Malkajgiri)	-42 Slums
18	Circle 18 (Old Circle VII)	-132 Slums
	TOTAL	**-1476 Slums**

No. of Slums



Distribution of Households

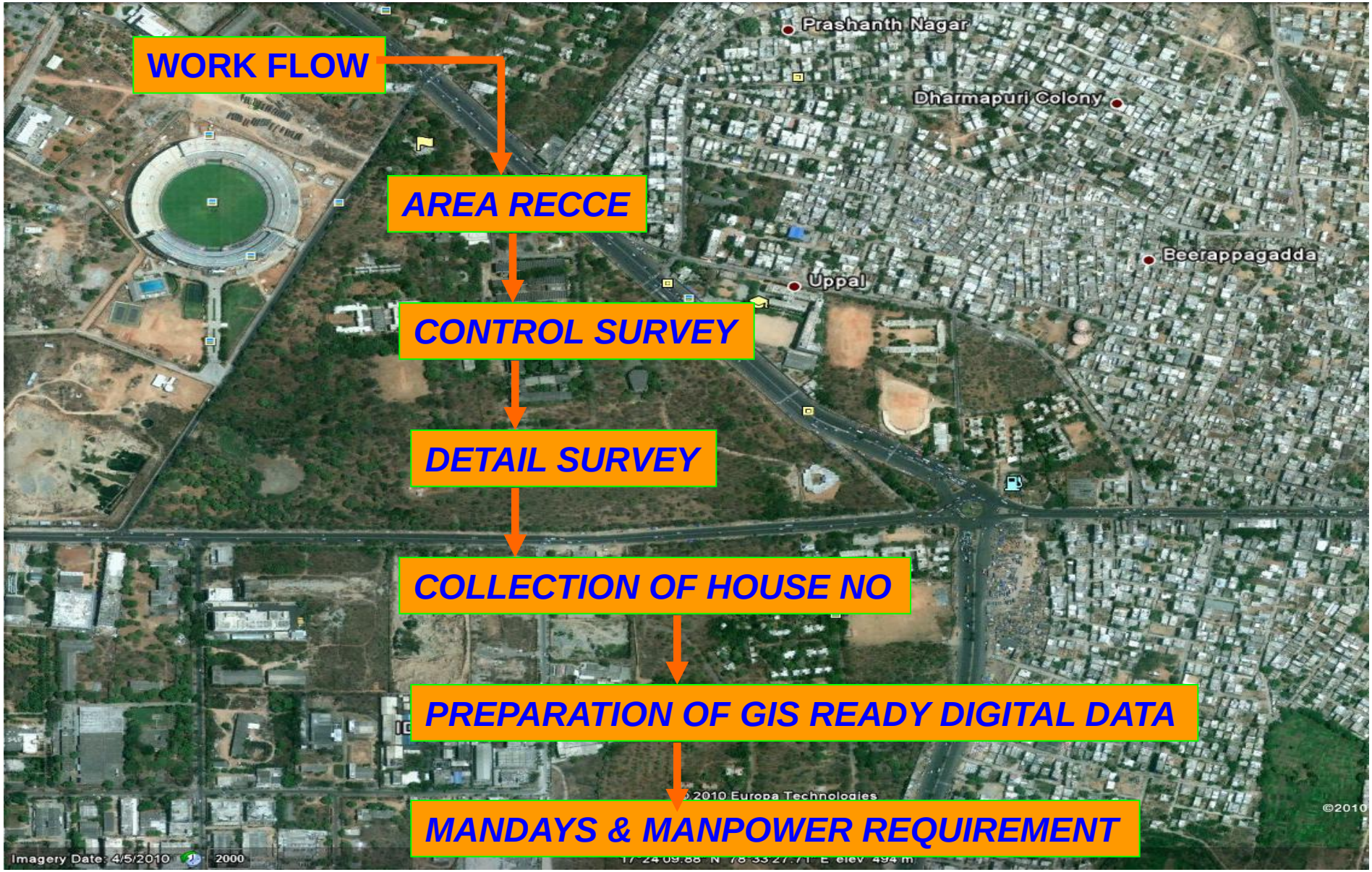


(Source : GHMC)

Total - 1476

Notified - 1179

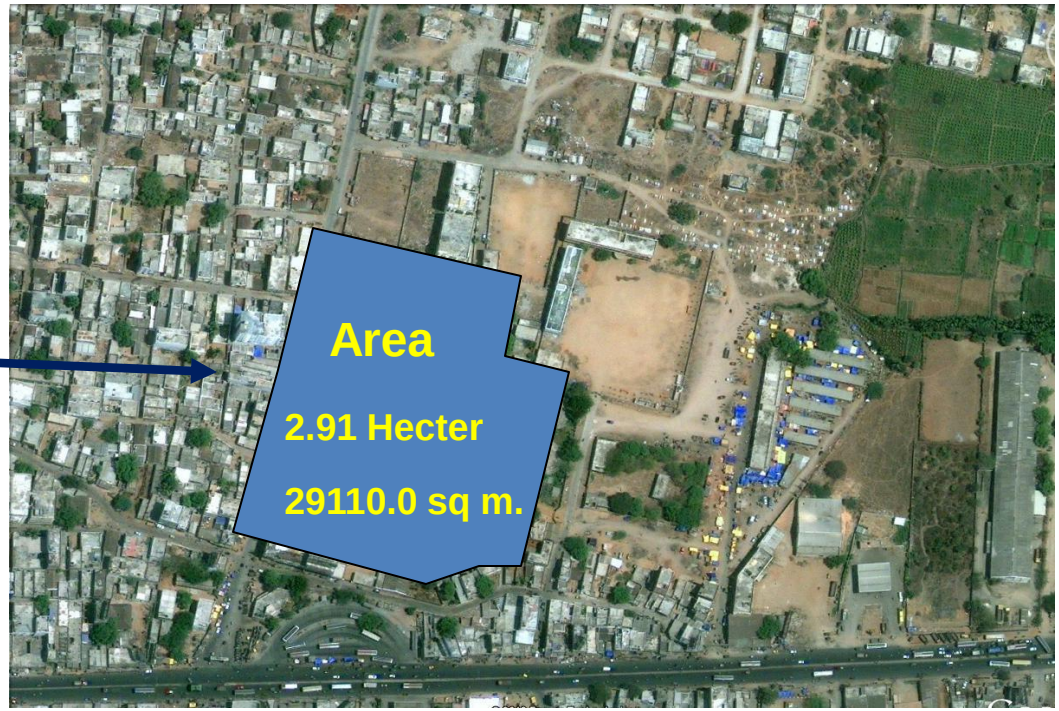
Un-notified - 297


WORK FLOW
AREA RECCE
CONTROL SURVEY
DETAIL SURVEY
COLLECTION OF HOUSE NO
PREPARATION OF GIS READY DIGITAL DATA
MANDAYS & MANPOWER REQUIREMENT
Prashanth Nagar
Dharmapuri Colony
Beerappagadda
Uppal
Imagery Date: 4/5/2010
2000
©2010

SLUM SURVEY

GANDHI NAGAR

(Notified Slum)



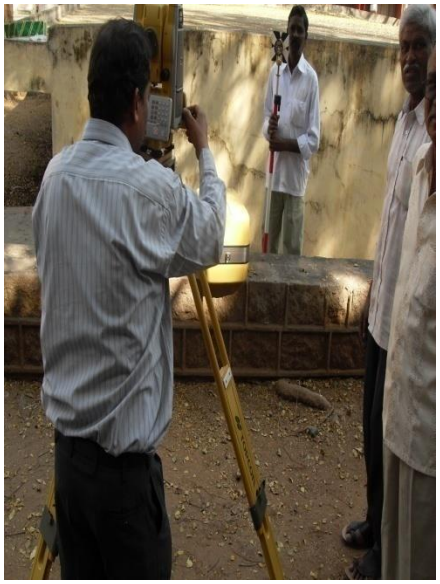
Interacted with GHMC and identified the ‘Slum Area’ for Pilot Study.

NRSC, SOI, & GHMC (Uppal) officers participated in Gandhi Nagar Slum Survey

Maps / Drawings ,Reports, Imagery, GPS, Total Station were collected, Field Recee was done,Teams were mobilised and Survey was completed and Results evaluated.

CONTROL SURVEY → **Total Station Traverse (TOPCON 7500)**

Gandhi Nagar Slum



Total Station Survey

Imagery with Traverse Lines

Using the GCPs' collected by GPS , Total Station survey was carried for Densification of Control Points in the Area.

Three Traverse lines using Total Station covering entire area was carried for detailing of objects in the Slum.

Collection of House No's → House to House Data Collection

ATTRITUBE TABLE FOR UPPAL LOCALITY

Sl no.	House Type	House No's.	Attributes
1	Pacca house	2-4-19	Brick wall / un-plastered
2	Katcha house	2-4-119/A	Asbestos Sheet Roof
3	Pacca house	2-4-119/1/A	Ground + First Floor

House / household No's. as appear o door / records of Individual House Attributecollected from the Slum and Tables /Reports were generated

House numbers,Type of House like Pacca, Katcha or Semi-Katcha and Type of Roof, Number of floor attributes etc collected during the survey.

“ Case Study : GIS & MIS Data Integration and Approach “

(NRSC,CGG,SOI)

GIS + MIS Integration

GIS- enabled Slum Information System:

- Integration of GIS Maps with Slum MIS to enable the preparation of a Dynamic GIS-enabled Slum Information System : Slum wise, Municipality wise and for Whole City

- The Common reference point between GIS and MIS:
  - The Slum Code in case of City Profile and
  - House Number (Name) incase of Household Profile for Slum

- Once the Integration of Two Databases is achieved, the Socio- Economic Household wise MIS data can be accessed from the GIS enabled Slum Information System

Socio Economic Survey (Unique codes/numbers)

Slum Code

- Each slum being surveyed should have a Unique Code which shall be used by both GIS and MIS teams

House Number

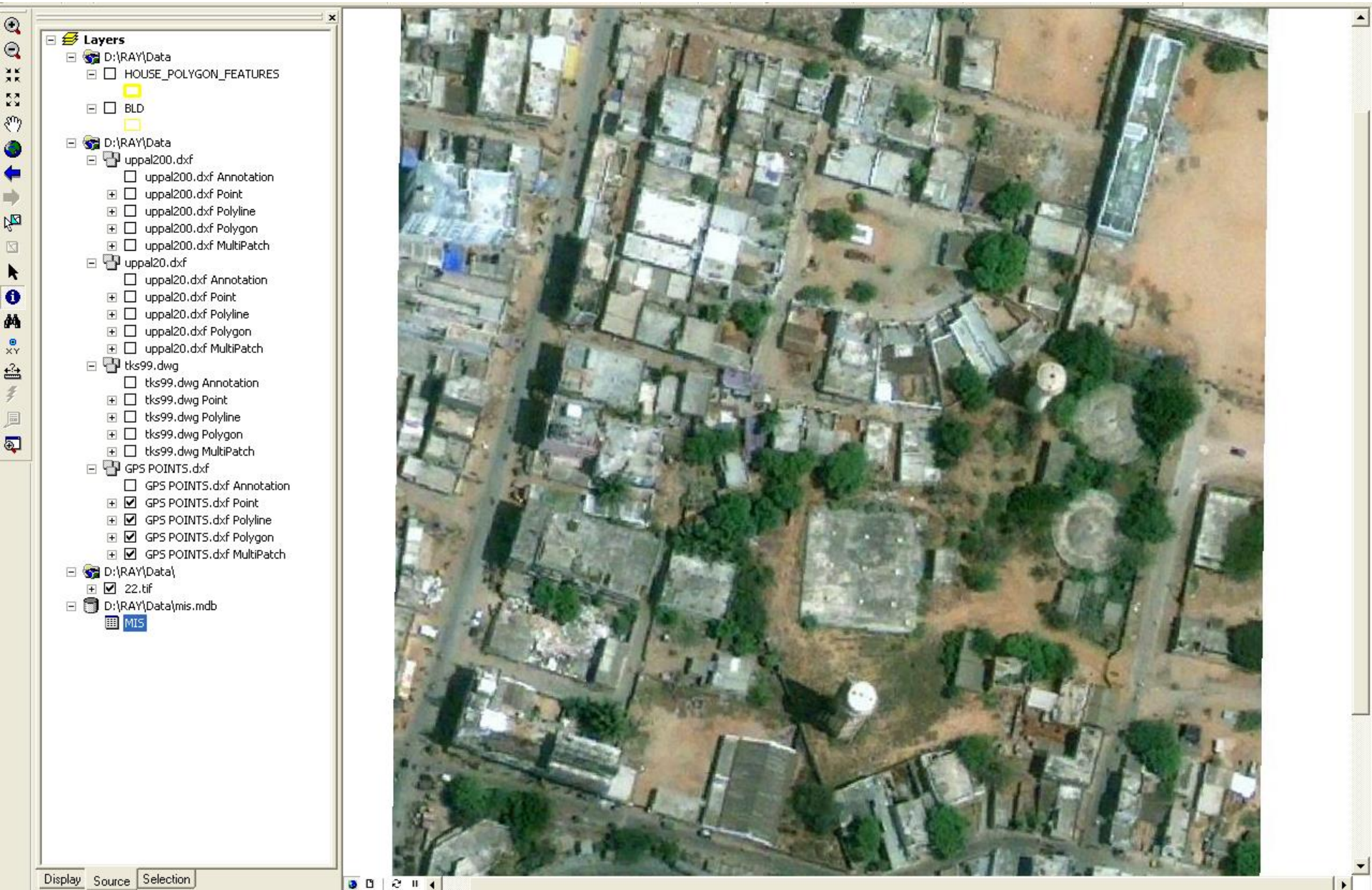
- Each house/dwelling unit in the slum should be assigned a number by Municipal authority. In case, houses/dwelling units do not have house number, ULB should issue unique numbers for each houses/dwelling units. In case of multi-storeyed housing unit each flat/ dwelling unit will be assigned unique no (as per Annexure II of NBO format - Sl. No 1.3 – House / Flat / Door No).

Household Number

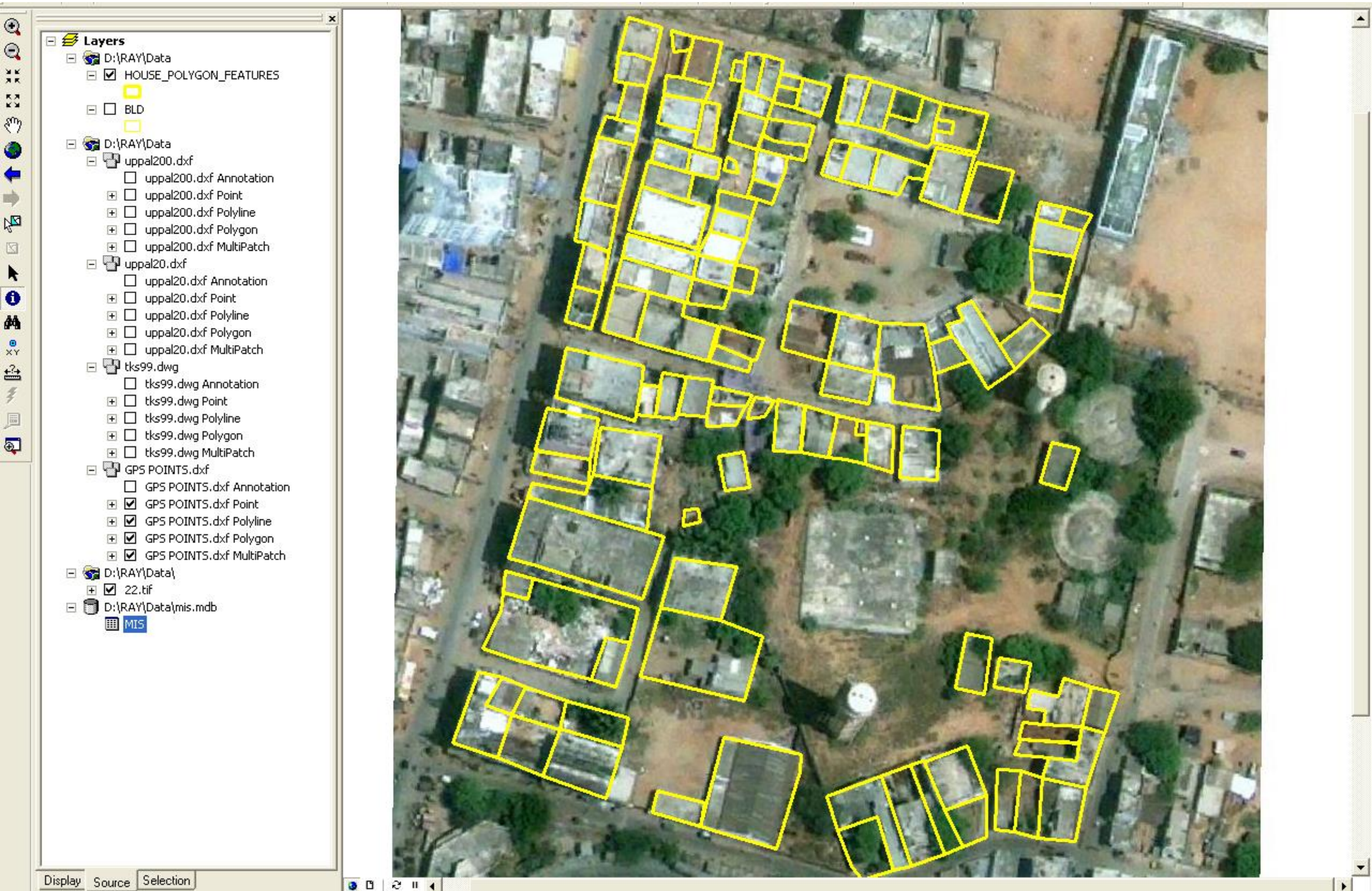
- Each house/dwelling may have multiple households. A Unique Household Number must be assigned to each household and should be communicated to the head of household. To Tag to : Aadhar / UniID in States.

All Data Collected must be ratified by the community

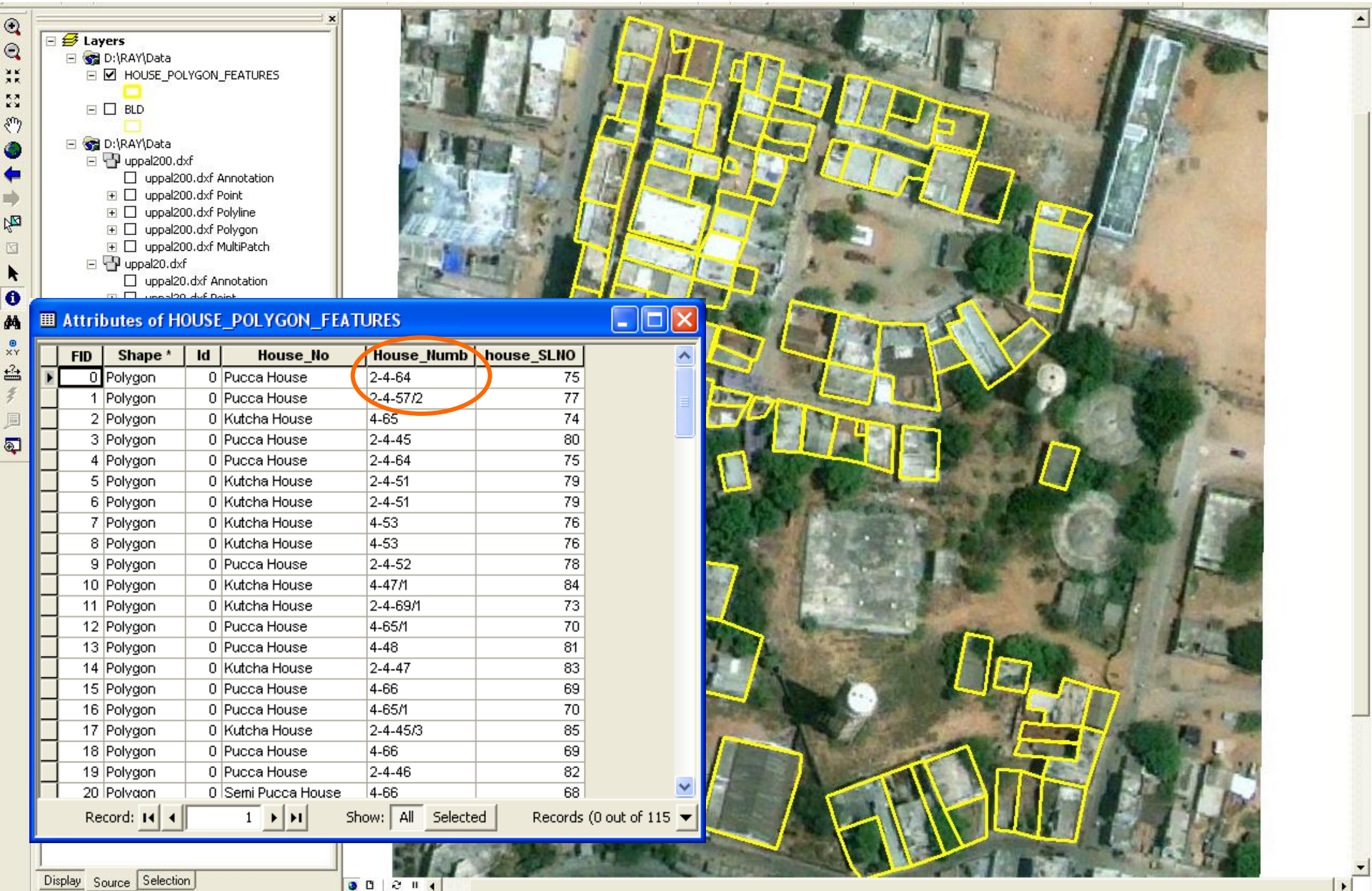
Slum Locations in VHR Satellite Image



Identification of Buildings: Total Station Survey

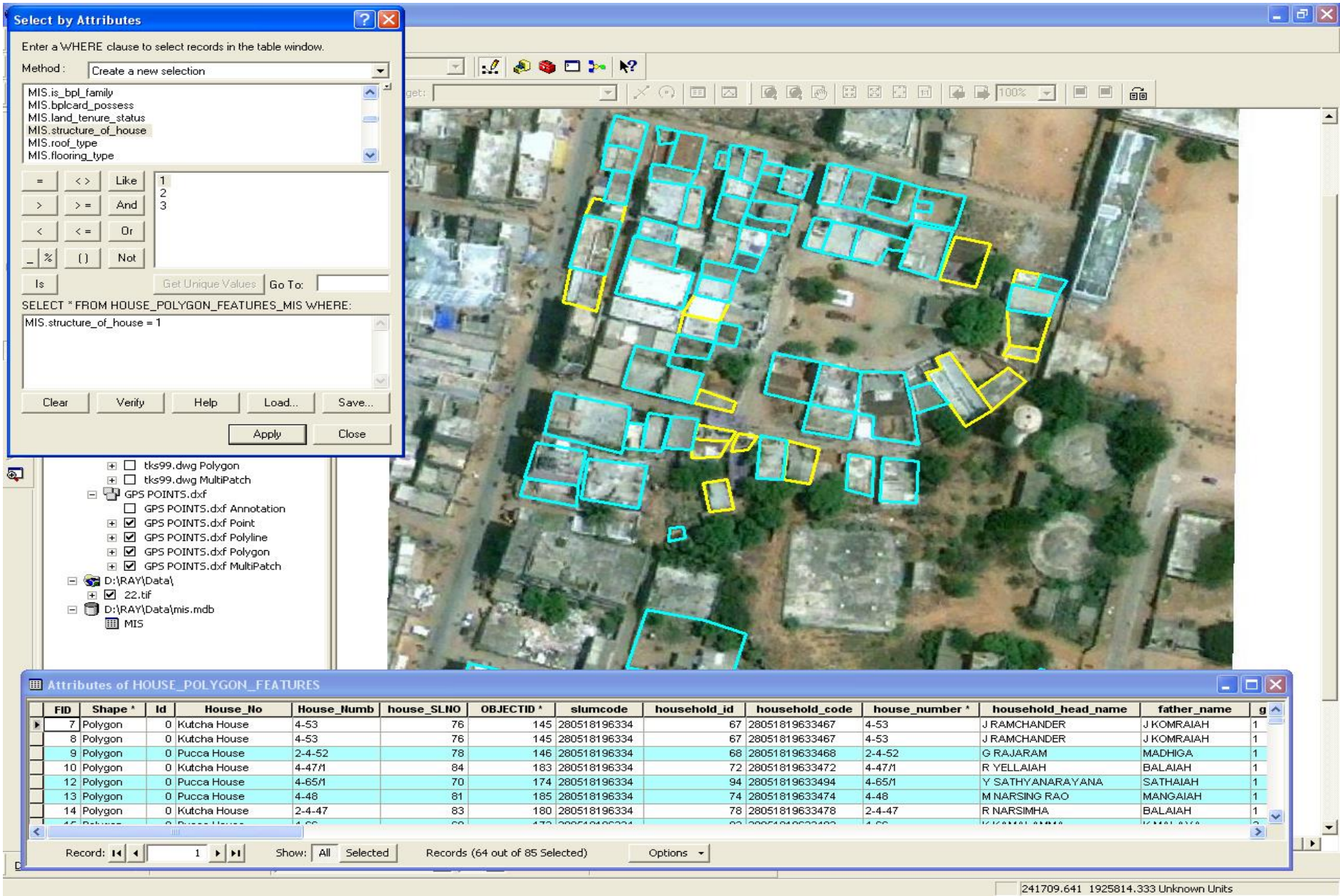


Attaching House Number (Primary Key) in Data Table



FID	Shape *	Id	House_No	House_Numb	house_SLNO
0	Polygon	0	Pucca House	2-4-64	75
1	Polygon	0	Pucca House	2-4-57/2	77
2	Polygon	0	Kutcha House	4-65	74
3	Polygon	0	Pucca House	2-4-45	80
4	Polygon	0	Pucca House	2-4-64	75
5	Polygon	0	Kutcha House	2-4-51	79
6	Polygon	0	Kutcha House	2-4-51	79
7	Polygon	0	Kutcha House	4-53	76
8	Polygon	0	Kutcha House	4-53	76
9	Polygon	0	Pucca House	2-4-52	78
10	Polygon	0	Kutcha House	4-47/1	84
11	Polygon	0	Kutcha House	2-4-69/1	73
12	Polygon	0	Pucca House	4-65/1	70
13	Polygon	0	Pucca House	4-48	81
14	Polygon	0	Kutcha House	2-4-47	83
15	Polygon	0	Pucca House	4-66	69
16	Polygon	0	Pucca House	4-65/1	70
17	Polygon	0	Kutcha House	2-4-45/3	85
18	Polygon	0	Pucca House	4-66	69
19	Polygon	0	Pucca House	2-4-46	82
20	Polygon	0	Semi Pucca House	4-66	68

Query on MIS Data and Display Outputs in GIS



FID	Shape *	Id	House_No	House_Numb	house_SLNO	OBJECTID *	slumcode	household_id	household_code	house_number *	household_head_name	father_name	g
7	Polygon	0	Kutcha House	4-53	76	145	280518196334	67	28051819633467	4-53	J RAMCHANDER	J KOMRAIAH	1
8	Polygon	0	Kutcha House	4-53	76	145	280518196334	67	28051819633467	4-53	J RAMCHANDER	J KOMRAIAH	1
9	Polygon	0	Pucca House	2-4-52	78	146	280518196334	68	28051819633468	2-4-52	G RAJARAM	MADHIGA	1
10	Polygon	0	Kutcha House	4-47/1	84	183	280518196334	72	28051819633472	4-47/1	R YELLAIAH	BALAIAH	1
12	Polygon	0	Pucca House	4-65/1	70	174	280518196334	94	28051819633494	4-65/1	Y SATHYANARAYANA	SATHAIAH	1
13	Polygon	0	Pucca House	4-48	81	185	280518196334	74	28051819633474	4-48	M NARSING RAO	MANGAIAH	1
14	Polygon	0	Kutcha House	2-4-47	83	180	280518196334	78	28051819633478	2-4-47	R NARSIMHA	BALAIAH	1

Example of GIS : Pune Municipal Council

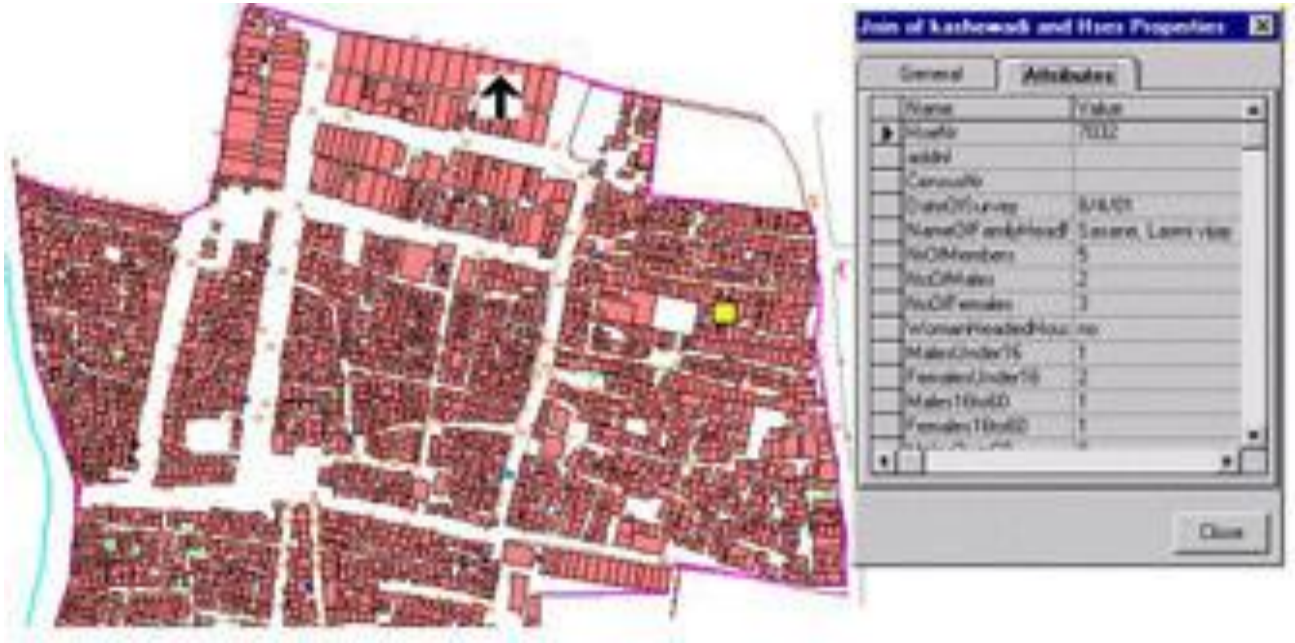
(GIS tool allows to apply, map, analyse, query and display spatial information, because Slum settlements are spatial entities)

‘ The Gandhinagar slum in Pune. Cyan circles are drawn at a distance of 100 feet around each common water standpost. Magenta rectangles are water standposts. This demonstrates that water to household reach is fairly good ’

‘ However, all houses in blue have their own individual water connections. Although nearly all houses had individual water connections, the Pune Corporation was still installing common water posts in the slum ’

Example of GIS : Pune Municipal Council

(…GIS tool allows to apply, map, analyse, query and display spatial information of Slum settlements in conjunction with Socio-economic information for effective Decision Making process…)



‘ Socio-economic data is superimposed on a plane-table map of a settlement, using GIS. The Dialogue Box popped up by clicking on one random house (the one in colour) gives detailed information about the selected household ’

Example of GIS : Rajkot City , Gujarat Municipality

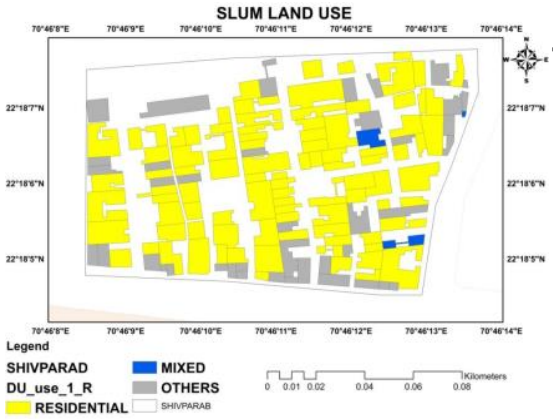
Methodology Steps

- Data collection and Sample Survey (Laxmi Nagar) ~ Ward No : 11
- Preparation of Socio-Economic Survey datasheet
- Field Survey of Slum
- Digitization of Data in GIS software and thematic map generation
- Slum Developement Strategy and Management

Multi- Criteria Evaluation (MCE) method

- Physical -
- Infrastructure
- Population
- Occupation

Slum Landuse



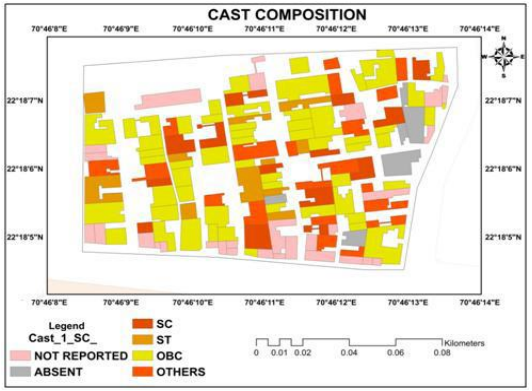
House Quality

Satellite data

Dwelling Footprints / Floors

Ward No: 11

Social Structure



Benefits of Using GIS

- **Automation (Cost Savings)**
- **Better Data Management (More Efficient Storage and Updating)**
- **Faster Information Access (Better Decisions)**
- **Operational Efficiencies**
- **Development of New Skilled Trainers**
- **etc**

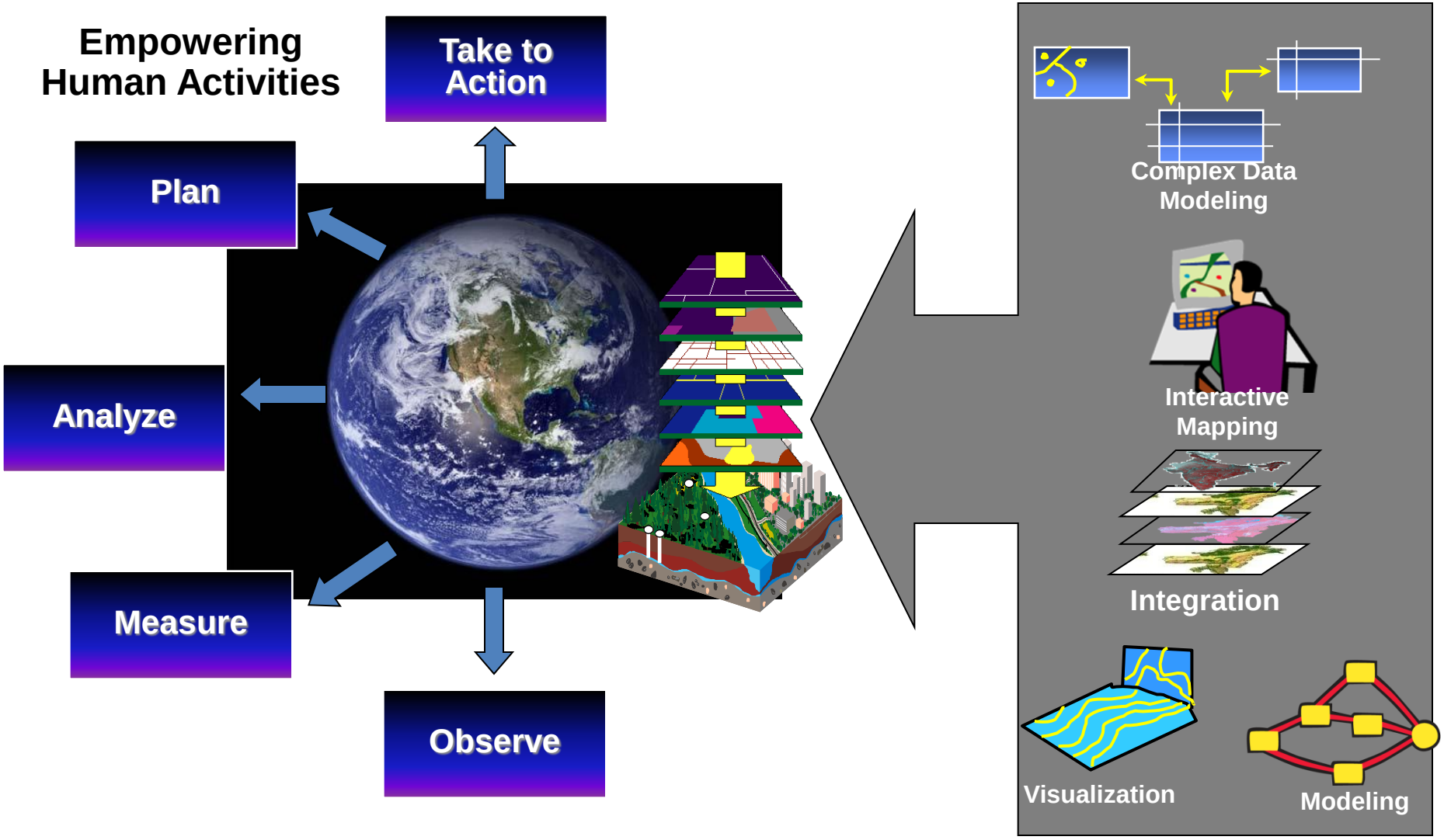
Geospatial Technologies Changes / Emphasis

Geoinformatics or Geomatics

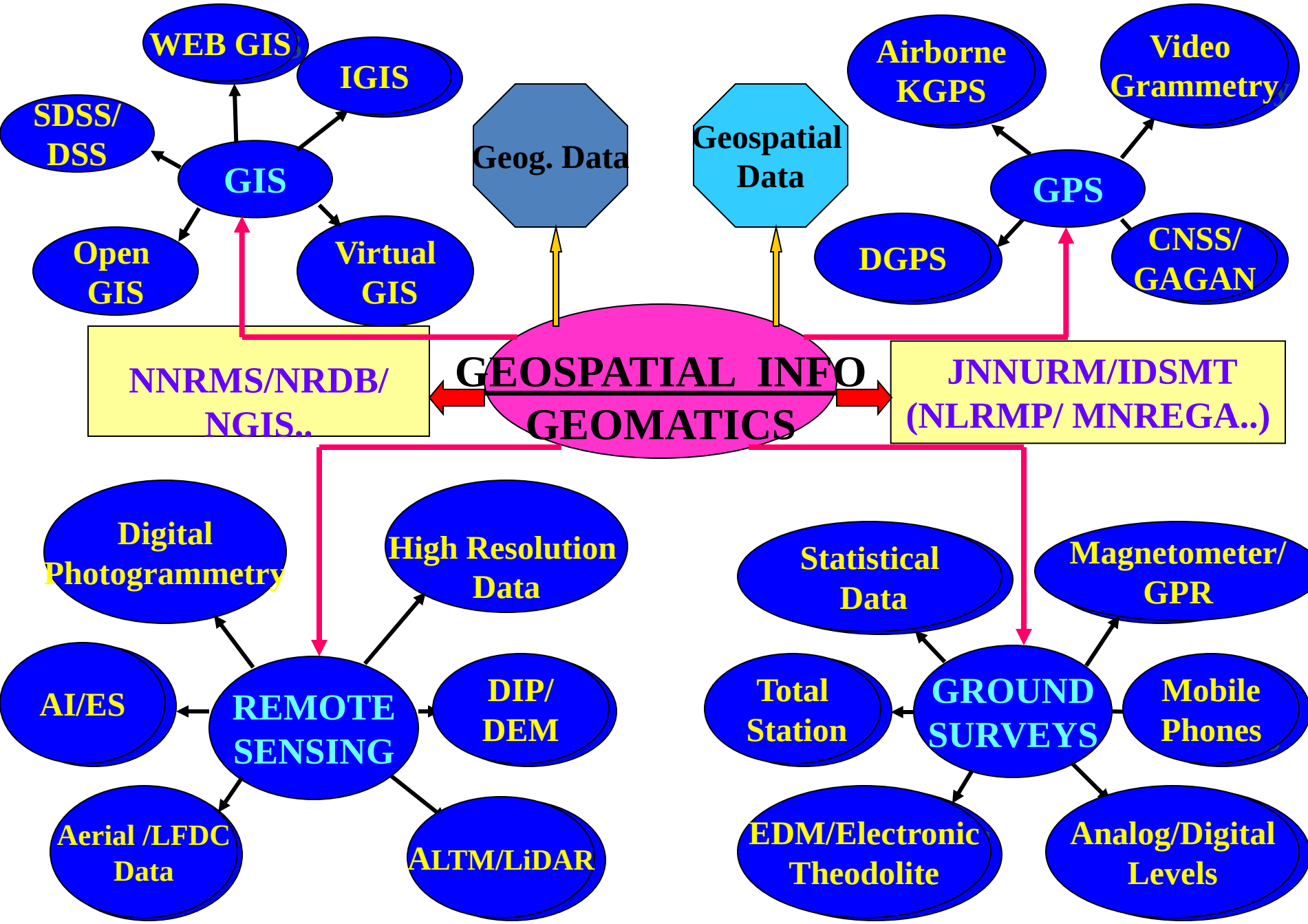
‘ Geo-Spatial technologies are one of the latest technologies that help in spatial data generation, storage, organization, retrieval and analysis in a user-friendly environment. Combining it with Information & Communication Technology (ICT) provides a new tool namely **“Geoinformatics”** for addressing the issues related to geospatial domain ‘.

‘ Geoinformatics is a science which uses information science infrastructure to address the problems of geographic sciences and related branches of earth sciences, computer engineering, remote sensing technology etc ‘.

Geoinformatics is advancing science to understand our earth as a System



. . . Application of this science is multi-disciplinary


WEB GIS
IGIS
SDSS/ DSS
GIS
Open GIS
Virtual GIS
Geog. Data
Geospatial Data
Airborne KGPS
Video Grammetry
GPS
DGPS
CNSS/ GAGAN
NNRMS/NRDB/ NGIS..
GEOSPATIAL INFO GEOMATICS
JNNURM/IDSMT (NLRMP/ MNREGA..)
Digital Photogrammetry
High Resolution Data
AI/ES
REMOTE SENSING
DIP/ DEM
Aerial /LFDC Data
ALTM/LiDAR
Statistical Data
Magnetometer/ GPR
Total Station
GROUND SURVEYS
Mobile Phones
EDM/Electronic Theodolite
Analog/Digital Levels

Geospatial Technologies
(Today / Status)

GeoSpatial Today - Space Tech Advances

Satellite Remote Sensing

- Mapping the Earth's Surface: 100+ times more accurate
- Measuring of assets/ infrastructures: 1/100+ of a metre accuracy in surface subsidence
- Disaster warning: 100+ hours advance risk warning
- On-board imaging: 100+ new satellite sensors for sustainable development
- Formation flying; On-board autonomy; Event triggering mission; Constellation

Satellite Meteorology

- Improved computational capabilities
- Predicting El Nino: 100+ days early warning
- Advanced warning of Tornadoes & flash floods

Event	20 years before	In 2000	In 2005
Tornadoes	3 min.	11 min.	15 min.
Flash floods	7.7 min.	15 min.	65 min.

- Weather Forecast
  - Today 3 day at 93%; 7 day at 62%
  - In 2010 5 day >90%; 7-10 day at 75%

Source: NWS; NOAA; ESTO

Satellite Communication

- Satcom capability >100+ new satellites advent of Ku, Ka bands
- Convergence > 100 times more
- Networks > 100 times and more
- Emergency Communication > 100 times
- Emerging Killer Applications: DTH; DARS; HDTV; DMB
- Global Mobile Personal Communication System (GMPCS)
- Satellite broadband internet

Last Mile to Last Foot Connectivity

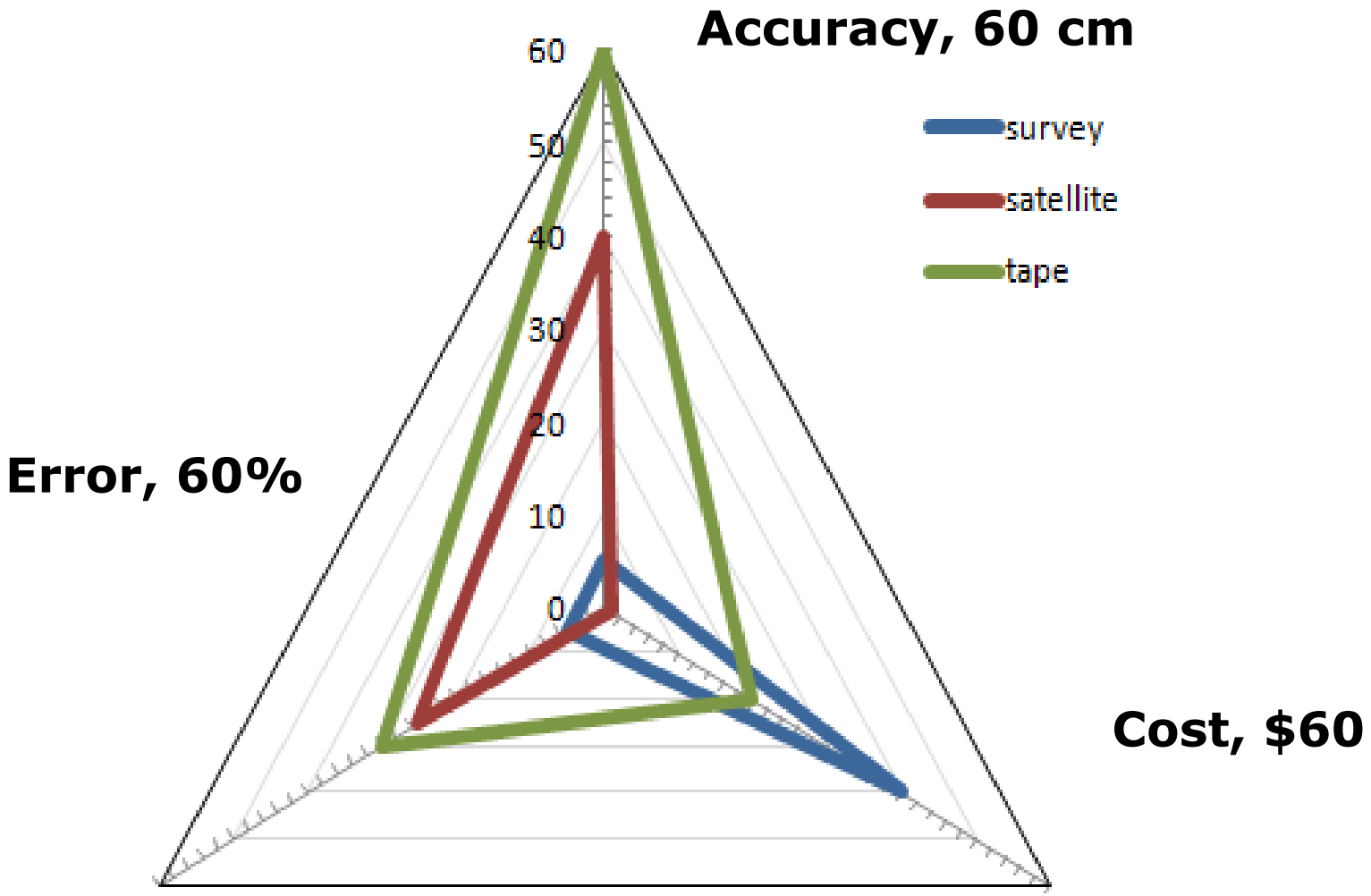
Satellite Navigation

- Moved from warplanes to car navigation to gaming in <10 years
- American Wide Area Augmentation System (WAAS): 350 ft in 2003; 200 ft in 2006
- Commercial operators with WAAS gain access to Cat1 equivalent approach services with no ILS
- European EGNOS: Japanese MSAS; Indian GAGAN
- GPS, GLONASS, ….., IRNSS

Geospatial Technologies - Status

Survey type	Equipment	Accuracy achievable	Advantage	Disadvantage
Ground surveys	Digital levels, Total station	Order of mm to cm	Highest accuracy	High cost Time consuming Total field visit
Aerial photography / LiDAR	Aerial cameras, Airborne Laser Scanner	Order of cm to dm	High accuracy	Medium cost Limited field visits for GCPs
Satellite stereo imaging	CARTOSAT-1 or any satellite with stereo capability	Order of m	Large area coverage Less cost	Less accurate compared to other technologies

Comparing Accuracy, Cost, & Error



Changing Emphasis

…From Description to Simulation & Modeling

Past

Picture worth a thousand words:

Maps & diagrams of how is, or how was

Web portals serve static data sets

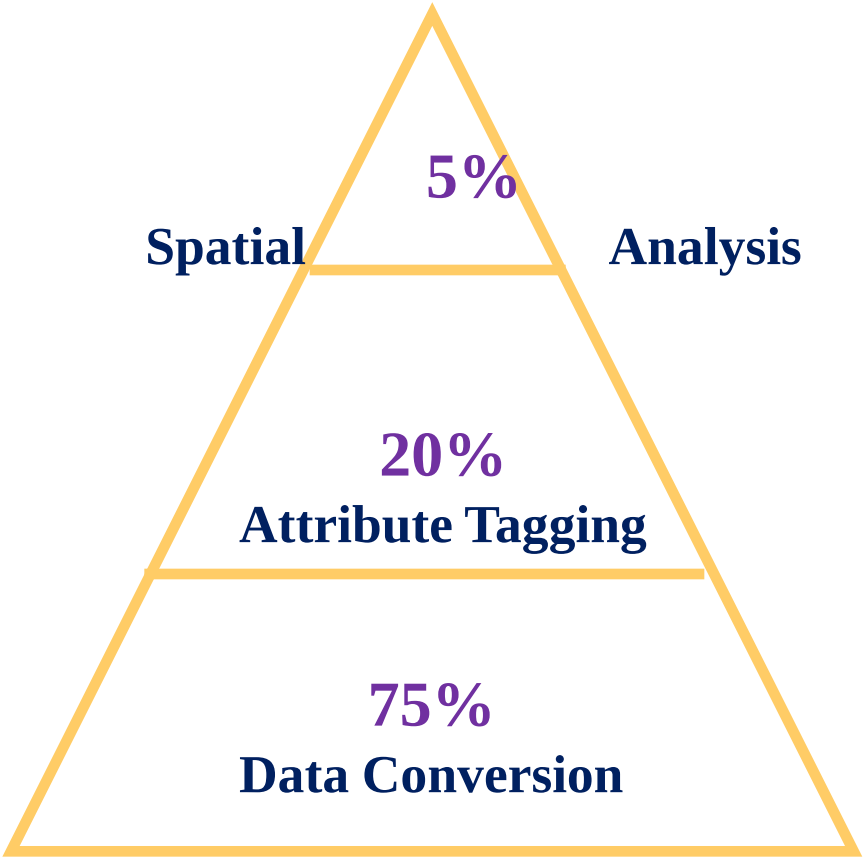
Future

Visual simulation & virtual reality.

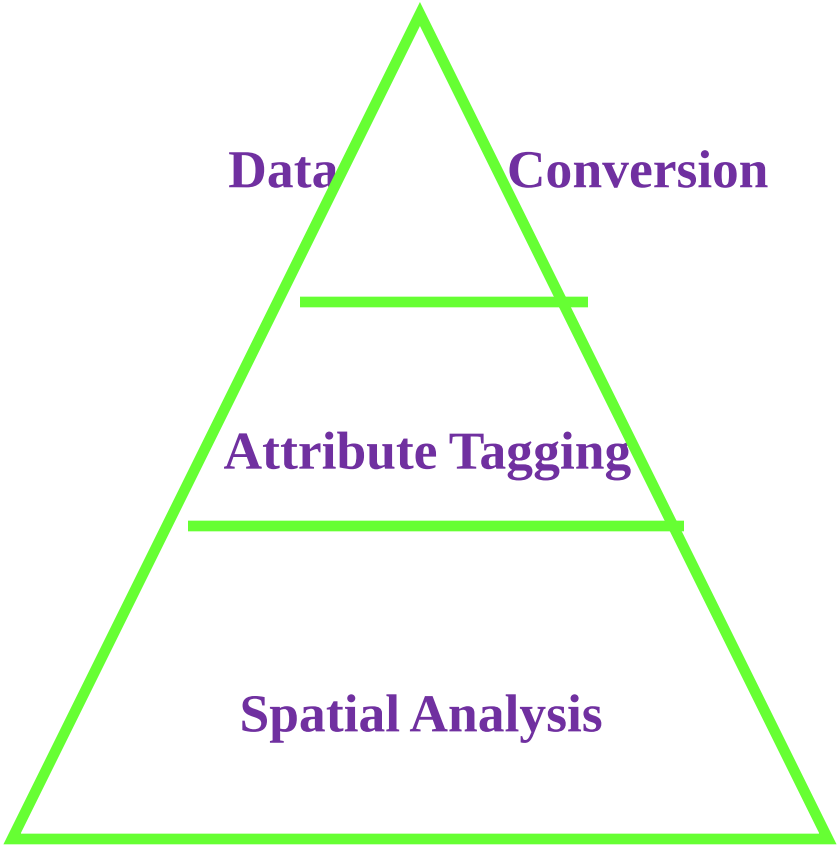
Real time display of how is, and how might be-Ex.
-forest fire
-freeway traffic flow

Web portals serve continuous sensor-derived data

Changing Emphasis: from Data to Analysis



Present



Future

Education, Training & Capacity Building

Regular Degree Programmes

- IIRS, IIST

Regular Training Courses

- NRSC,IIRS

Customized courses

- Disaster management ,Water Resources Management ,New sensor applications ,Other programmatic requirements

Student Projects (MSc, M. Tech) from Universities

Faculty : Research Projects (RESPOND)

Small Satellites – From Universities

Centers of Excellence established by ISRO

Execution of Projects with Collaboration

New Centers with Technology Support , Institutionalization

Remote Sensing Data Policy 2011

As per RSDP 2011 :

All data resolutions up to 1 m shall be distributed on a non-discriminatory basis and on "as requested basis".

All data better than 1m resolution will be supplied after excluding sensitive areas as below.

- **All Government Ministries/ Departments/ PSU / Autonomous bodies/ Govt. Educational Institutions can obtain the data without any further clearance with safe custody certificate.**
- **Private sector Users recommended by at least one Government agency can obtain the data without any further clearance.**
- **Other Private, Foreign and other users can obtain the data after further clearance from an inter-agency High Resolution Image Clearance Committee (HRC).**

Geospatial Web Services under ISRO/DOS

NRDB- Natural Resource - *http://www.nnrms.gov.in*

BHUVAN- Gateway to Indian Earth Observation - *http://bhuvan.nrsc.gov.in*

DSC-Disaster Decision Support - *http://dsc.nrsc.gov.in*

IBIN- Bio-resource Information - *http://www.ibin.co.in*

BIS- Biodiversity Information - *http://www.bisindia.org*

India WRIS- Water Resources - *http://india-wris.nrsc.gov.in*

Additional Web Enabled systems for

- Indian Forest Fire Response and Assessment System
- Wasteland Information System
- Wetland Information System
- Urban Information System

..Next Challenge – Data Discovery & Gateway : Unified Data Geoportal

THANK YOU

(raghavaswamy53@gmail.com

vraghavswamy@yahoo.com)