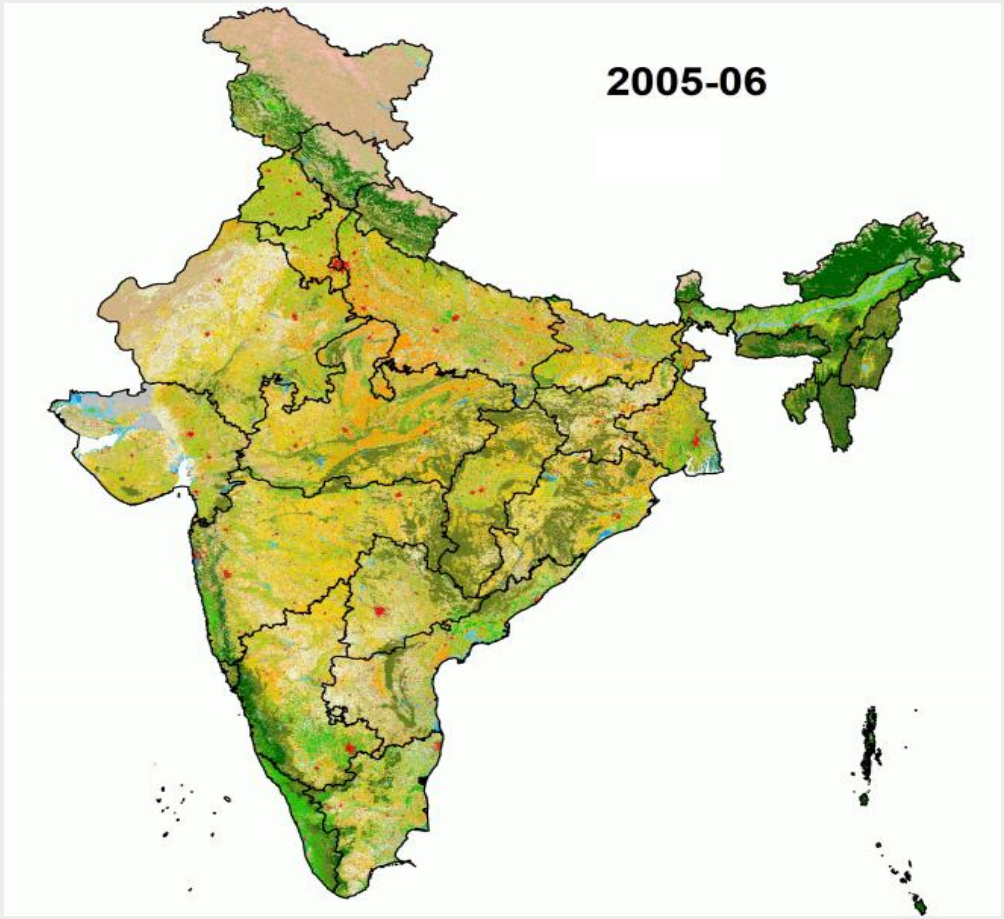





Remote Sensing based LCLUC Activities of ISRO



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Current Operational Remote Sensing Capabilities of ISRO

Natural Resources Inventory & Disaster Management

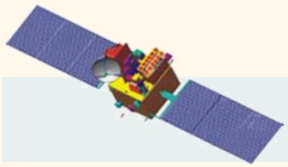
RESOURCESAT- 2 & 2A

- Three tier imaging : 56 m / 23 m / 5.8 m
- Revisit Capability : 03 / 11 / 03 days

Large Scale Mapping, Infrastru. Planning & Cartography

CARTOSAT-1, CARTOSAT-2 (3) & 2S (1), CARTOSAT-3

- 2.5 m Stereo imaging
- Sub-meter PAN and 1.5 m Multi-spectral
- 0.5m PAN with 1 m MX



Oceanography

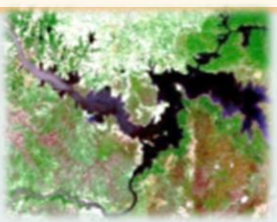
OCEANSAT-2 ; SARAL ; SCATSAT-1

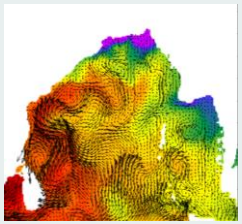
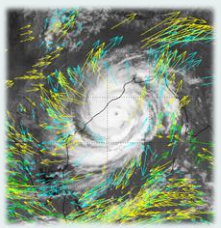
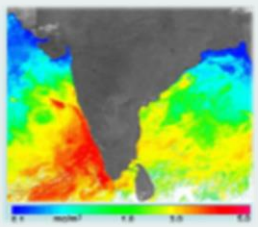
- Ocean color 360 m with 2 days revisit
- PFZ, Ocean State Forecast
- Ocean Altimetry, Surface Wind Vector

Weather & Climate

INSAT 3D & 3DR ; MEGHA-TROPIQUES

- 6 channel Imager – 48 images per day
- 19 Channel Sounder – Atm. Profiles
- Radio Occultation – humidity profiles

ISROs Vision and Strategy : Remote Sensing Applications

- Crop acreage & production
- Crop intensification
- Produce management
- Seasonal adversaries management
- Crop insurance

- Potential renewable & non-renewable resources
- Site suitability

- Water availability (Surface/Ground)
- Water harvesting & conservation
- Irrigation management
- Conjunctive use, Water quality
- Water informatics

- Early warning systems
- Near real time geospatial products and services
- Post disaster management
- Long-term management
- Communication & navigation

- Habitation suitability
- Construction monitoring
- Building typology

- e-health services
- Disease forewarning
- Risk zonation
- Control management

- Planning & site suitability
- Route alignment
- Monitoring of infrastructure development
- Environmental impact assessment

- Decision support tools
- Geo-Web applications
- Technology institutionalization
- Capacity building & handholding

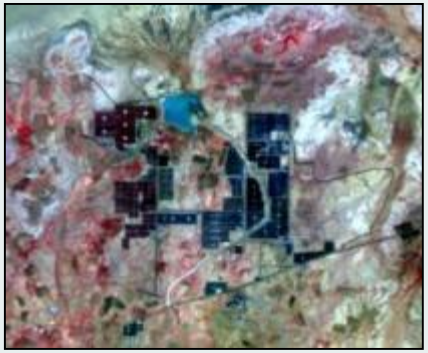
Remote Sensing Applications

Land Resources Assessment

Natural Resources Census	• Annual Land use/ Land cover at 1:250,000 (13 cycles since 2004-05) • 5yr interval Land use/ Land cover (1:50k) – 3 cycles since 2005-06 • Land Degradation (1:50,000)
	• Waste Land mapping and monitoring (1:50,000) – 2 Cycles
Soil Health	• GIS Technology support for Soil Health Card Repository and Fertilizer blend advisories • Digital Soil Maps
Land Development	• Carbon Neutrality, Predictive Soil Mapping, Soil Carbon, Water Logging, Solar potential sites, Sustainable Development
Largescale Mapping for Action Plans	• 10,000 scale mapping - Land degradation, Soil resources

Rural Development

Rural Assets	• GIS implementation of Mahatma Gandhi Rural Employment Guarantee Act (MGNREGA), PMKSY
Watershed Development	• GIS Technology support for online repository • Post-Implementation impact monitoring (IWMP, NABARD Watersheds) • GIS based planning of watershed schemes

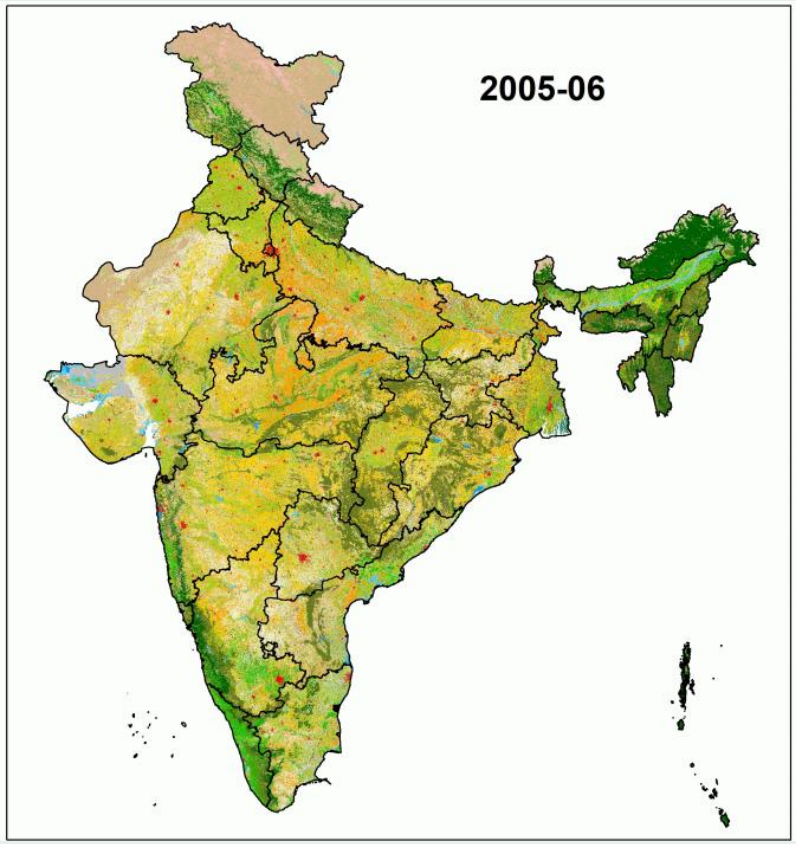


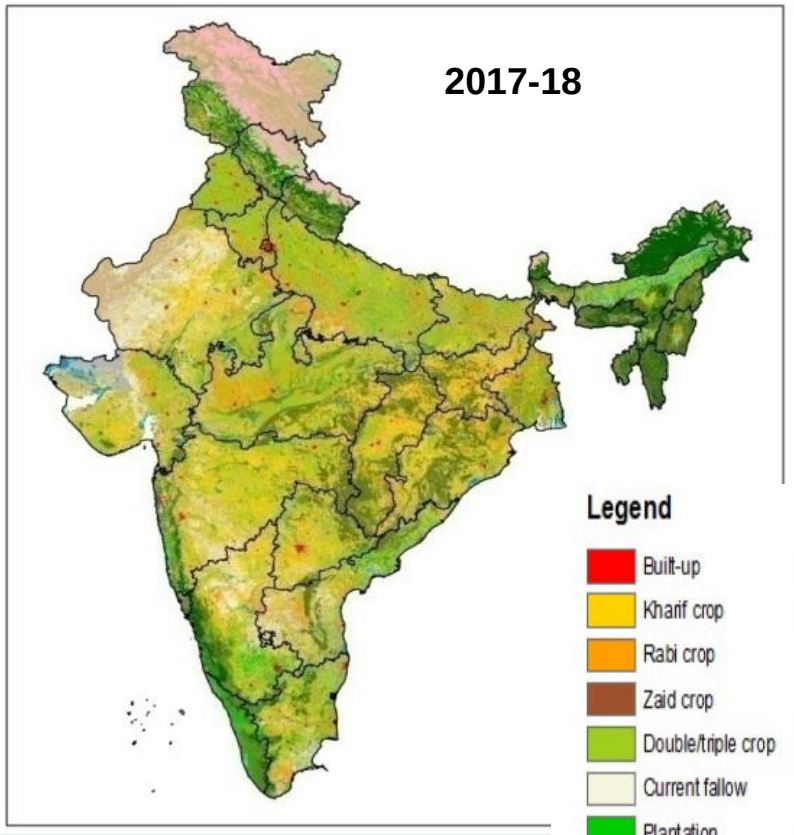
Wasteland to solar power generation

Land Use Land Cover Mapping

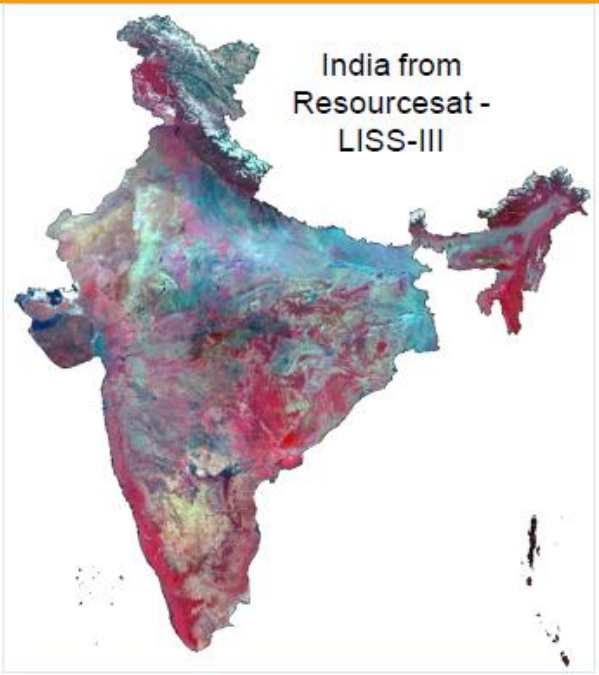
Annual Land Use / Land Cover (LULC) map of India with Kharif and Rabi sown areas since 2004-05 at 56m resolution (~1:250K) every year and 50K mapping at 5 year interval using IRS data.

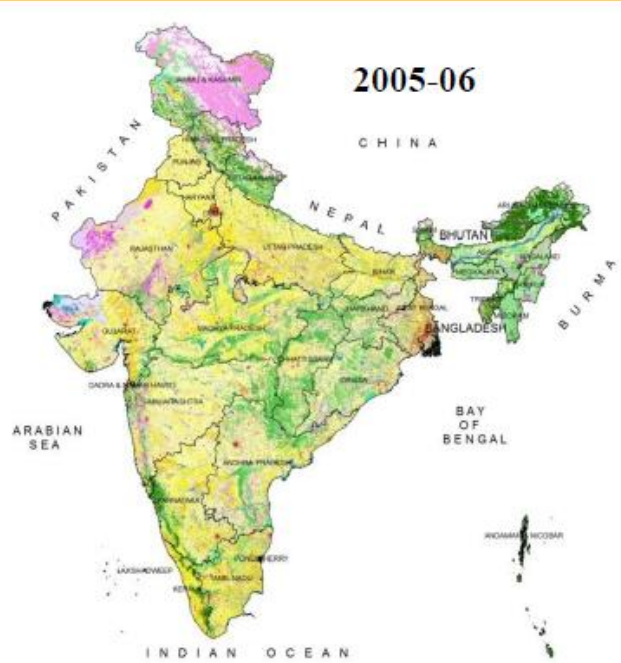
1:250k (Annual Time-series)

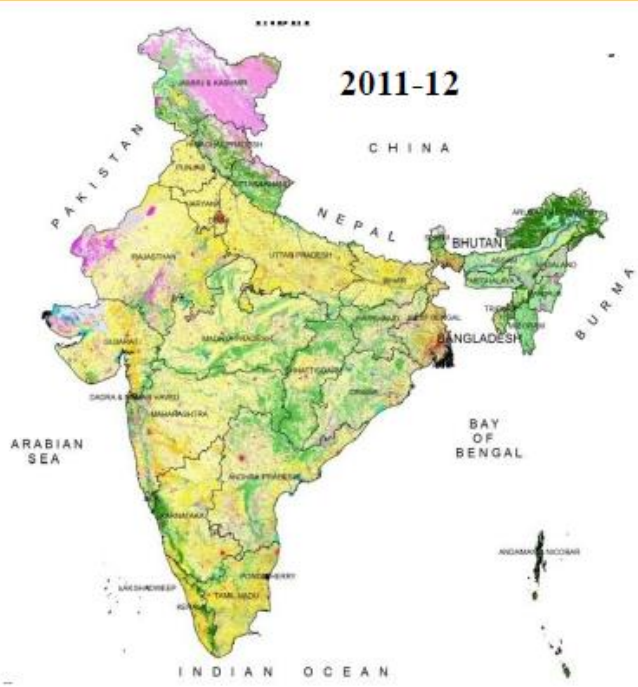




NRC: Land Use/land Cover Mapping on 1:50K using LISS III







Built Up
- Urban-Compact (Continuous)
- Urban-Sparse (Discontinuous)
- Vegetated/ Open Area
- Rural
- Industrial Area
- Ash/ Cooling Pond/ Effluent etc
- Mining - Active
- Mining - Abandoned
- Quarry

Agricultural Land
- Kharif
- Rabi
- Zaid
- Cropped in two seasons
- Cropped in more than two seasons
- Fallow Land
- Agricultural Plantation
- Aquaculture

Forest
- Evergreen/ Semi - Dense/ Closed
- Evergreen/ Semi - Open
- Deciduous - Dense/ Closed
- Deciduous - Open
- Forest Plantation
- Scrub Forest
- Swamp/ Mangroves - Dense/ Closed
- Swamp/ Mangroves - Open
- Tree Clad Area - Dense/ Closed
- Tree Clad Area - Open

Grass/Grazing
- Alphine/ Sub-Alpine
- Temperate/ Sub Tropical
- Tropical/ Desertic

Wastelands
- Salt Affected Land
- Gullied Land
- Ravinous Land
- Scrub Land - Dense/ Closed
- Scrub Land - Open
- Sandy Area - Desertic
- Sandy Area - Coastal
- Sandy Area - Riverine
- Barren Rocky

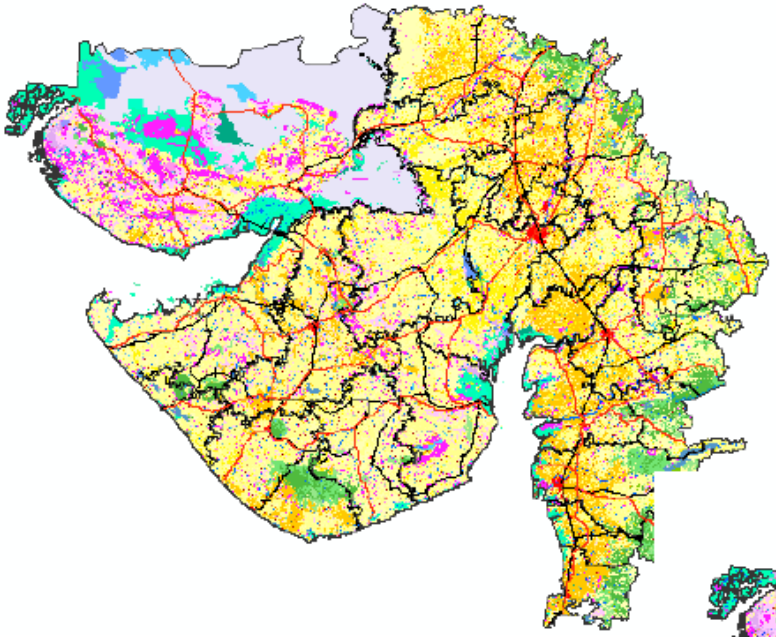
Wetlands
- Natural (Ox-bow lake/ Cut-off meander etc
- Manmade (Water logged/ Saltpans etc)
- Lagoons/ Creeks/ Mud flats etc
- Saltpans

Water bodies
- River - Perennial
- River - Non Perennial
- Canal/ Drain
- Lakes/ Ponds - Permanent
- Lakes/ Ponds - Seasonal
- Reservoir/ Tanks - Permanent
- Reservoir/ Tanks - Seasonal

Snow/Others
- Snow
- Shifting Cultivation - Current
- Shifting Cultivation - Abandoned
- Rann

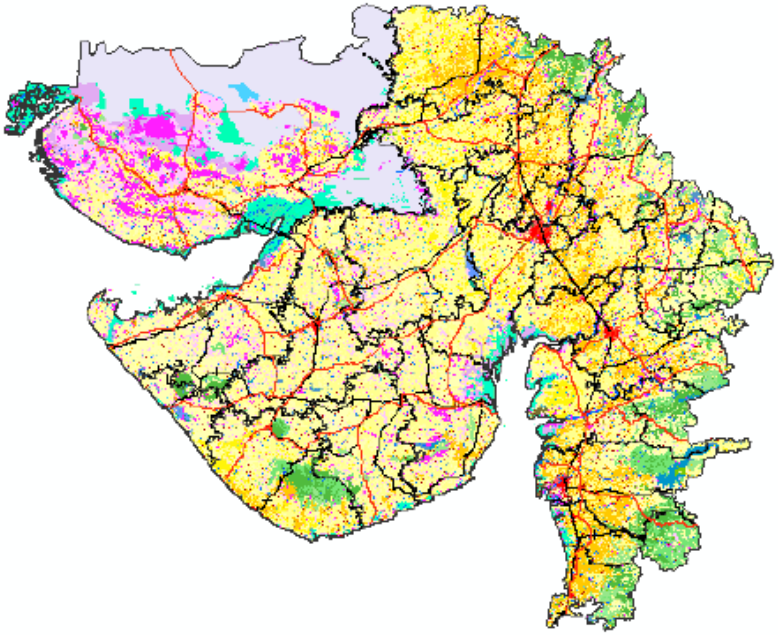
Land Use / Land Cover Maps: Gujarat

2011-12



2011-12 & 2015-16

2015-16



MAJOR CHANGES (11-12 to 15-16)

- Increase in Built-up (111.65 sq. km)
- Decrease in Agriculture land (64.17sq. km)
- Decrease in Wasteland (60.20sq. km)

Legend

Built Up
- Urban-Compact (Continuous)
- Urban-Sparse (Discontinuous)
- Vegetated/ Open Area
- Rural
- Industrial Area
- Mining - Active

Agricultural Land
- Kharif
- Rabi
- Zaid
- Cropped in two seasons
- Fallow Land
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- Deciduous - Open
- Forest Plantation
- Scrub Forest
- Tree Clad Area - Dense/ Closed
- Tree Clad Area - Open

Grass/Grazing
- Alpine/ Sub-Alpine
- Temperate/ Sub Tropical

Wastelands
- Scrub Land - Dense/ Closed
- Scrub Land - Open
- Sandy Area - Riverine
- Barren Rocky

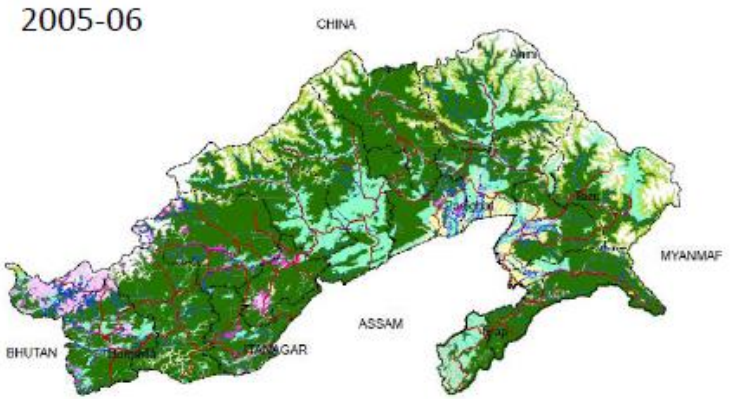
Wetlands
- Natural (Ox-bow lake/ Cut-off meander etc.)

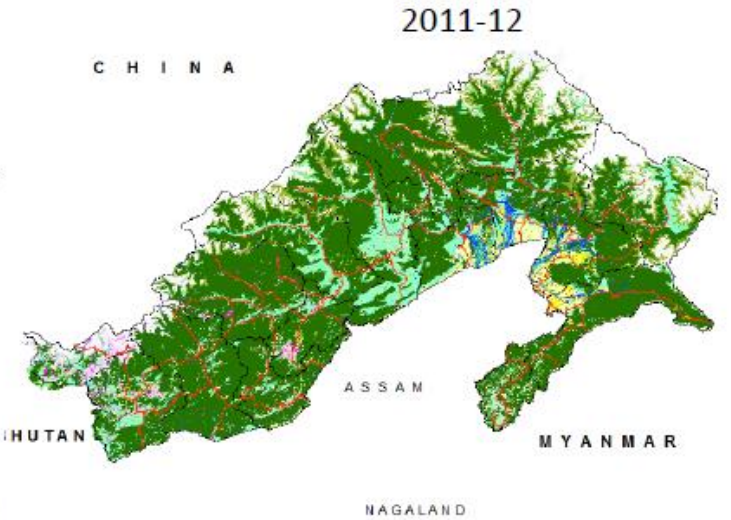
Water bodies
- River - Perennial
- River - Non Perennial
- Lakes/ Ponds - Permanent
- Lakes/ Ponds - Seasonal
- Reservoir/ Tanks - Permanent
- Reservoir/ Tanks - Seasonal

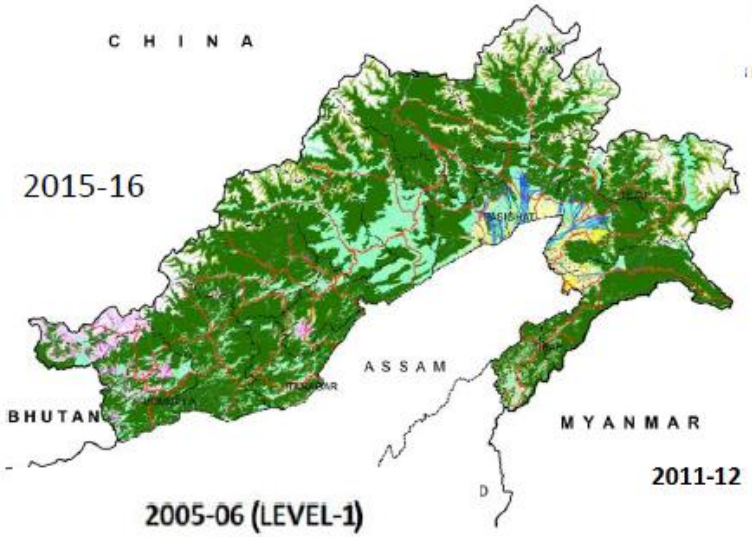
Snow/Others
- Snow
- Shifting Cultivation - Current
- Shifting Cultivation - Abandoned

Land Use / Land Cover Map: Arunachal Pradesh

2005-06, 2011-12 & 2015-16







MAJOR CHANGES (11-12 to 15-16)

- Increase in agriculture (31.69 sq. km)
- Decrease in wasteland (441.29 sq. km.)
- Shifting cultivation increased by 841.57 sq. km
- Decrease in forest 514.31 sq. km.

Legend

- **Built Up**
  - Urban-Compact (Continuous)
  - Urban-Sparse (Discontinuous)
  - Vegetated/ Open Area
  - Rural
  - Industrial Area
  - Mining - Active
- **Agricultural Land**
  - Kharif
  - Rabi
  - Zaid
  - Cropped in two seasons
  - Fallow Land
  - Agricultural Plantation
  - Aquaculture
- **Forest**
  - Evergreen/ Semi - Dense/ Closed
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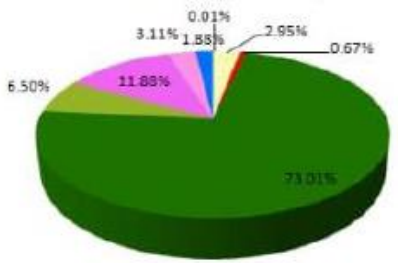
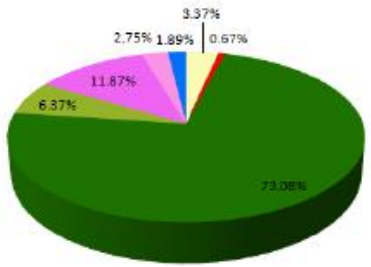
  - Sandy Area - Riverine
  - Barren Rocky
- **Wetlands**
  - Natural (Ox-bow lake/ Cut-off meander etc)
- **Water bodies**
  - River - Perennial
  - River - Non Perennial
  - Lakes/ Ponds - Permanent
  - Lakes/ Ponds - Seasonal
  - Reservoir/ Tanks - Permanent
  - Reservoir/ Tanks - Seasonal
- **Snow/Others**
  - Snow
  - Shifting Cultivation - Current
  - Shifting Cultivation - Abandoned

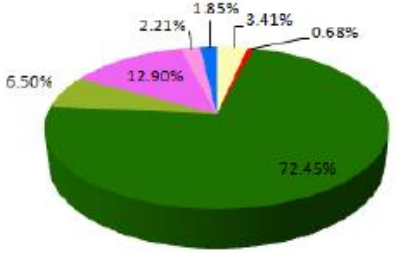
2005-06 (LEVEL-1)



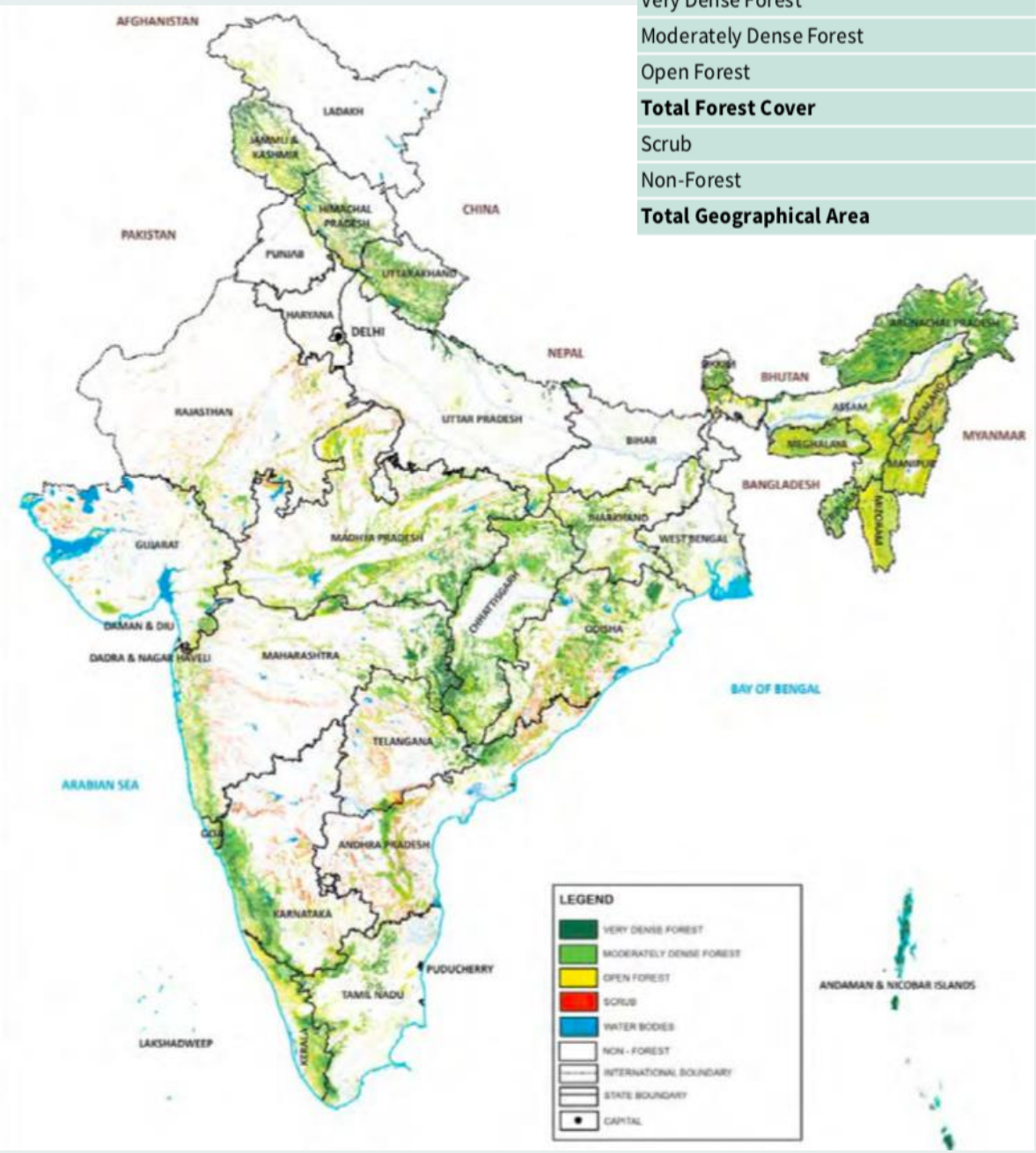
2011-12 (LEVEL-1)



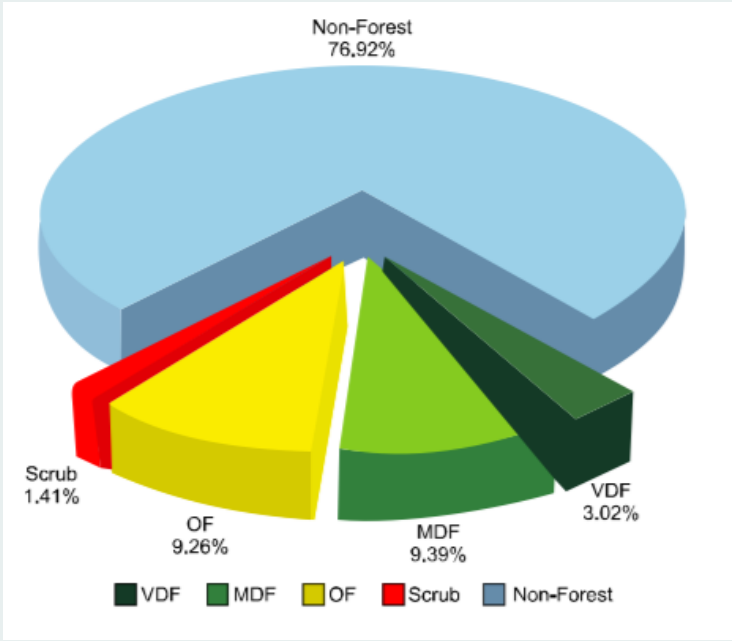
2015-16 (LEVEL-1)



Class	Area (sq km)	Percentage of Geographical Area
Very Dense Forest	99,278	3.02
Moderately Dense Forest	3,08,472	9.39
Open Forest	3,04,499	9.26
Total Forest Cover	**7,12,249**	**21.67**
Scrub	46,297	1.41
Non-Forest	25,28,923	76.92
Total Geographical Area	**32,87,469**	**100.00**

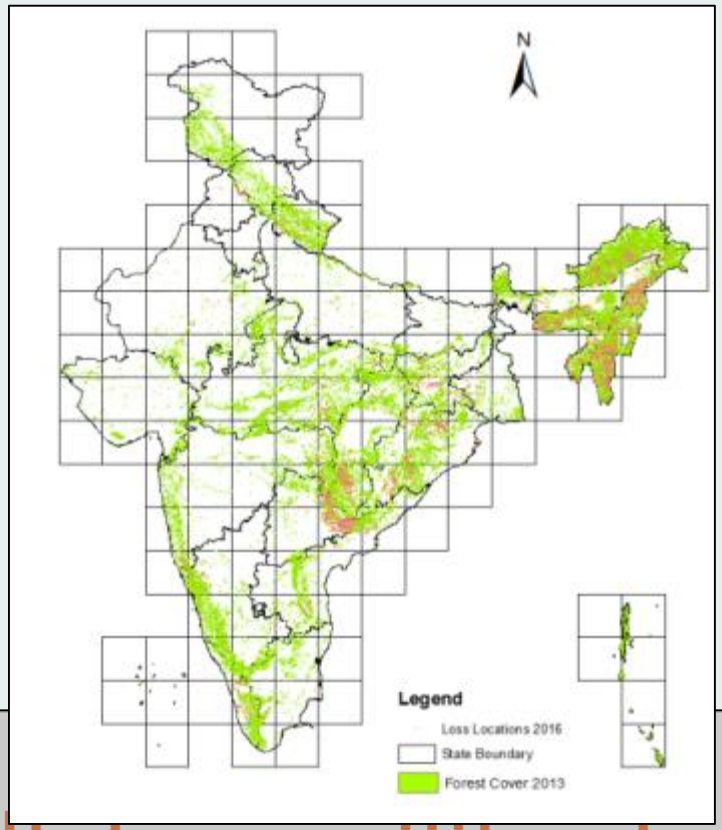


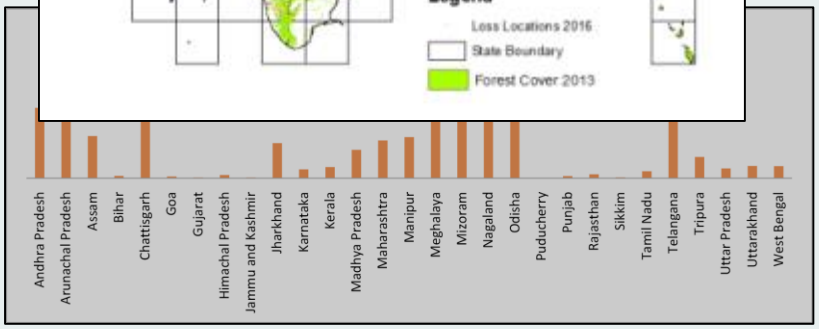
Forest Type Map of India 2019 by FSI



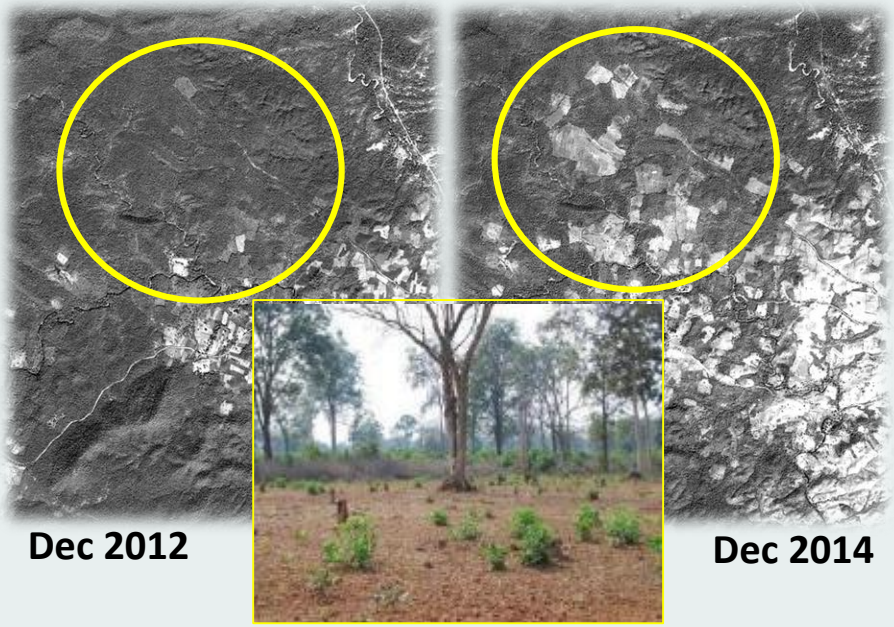
Forest Cover Loss

Actionable alerts from IRS AWiFS based Forest Cover Loss Locations at National Level for 2015-16 (Third) cycle





Telangana State



Dec 2012

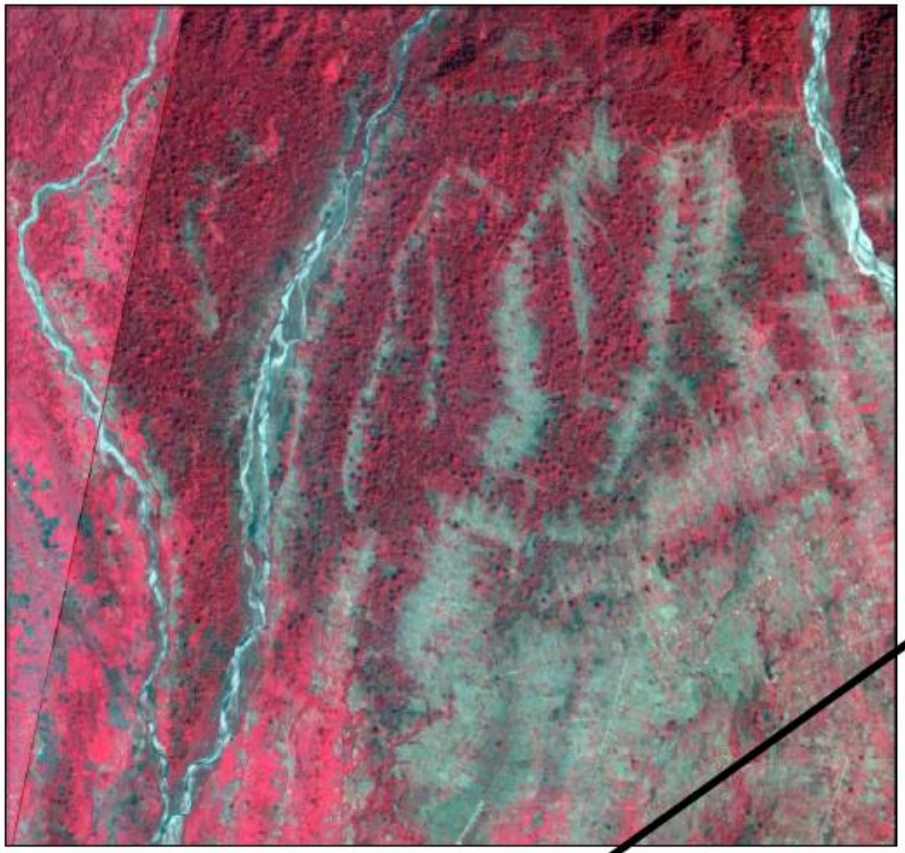
Dec 2014

- Total Locations of 4992 are observed (2015-16 Cycle).
- 20% of points are validated with high resolution images and ~90% accuracy was obtained.
- Forest loss locations are published on Bhuvan and available to state forest departments

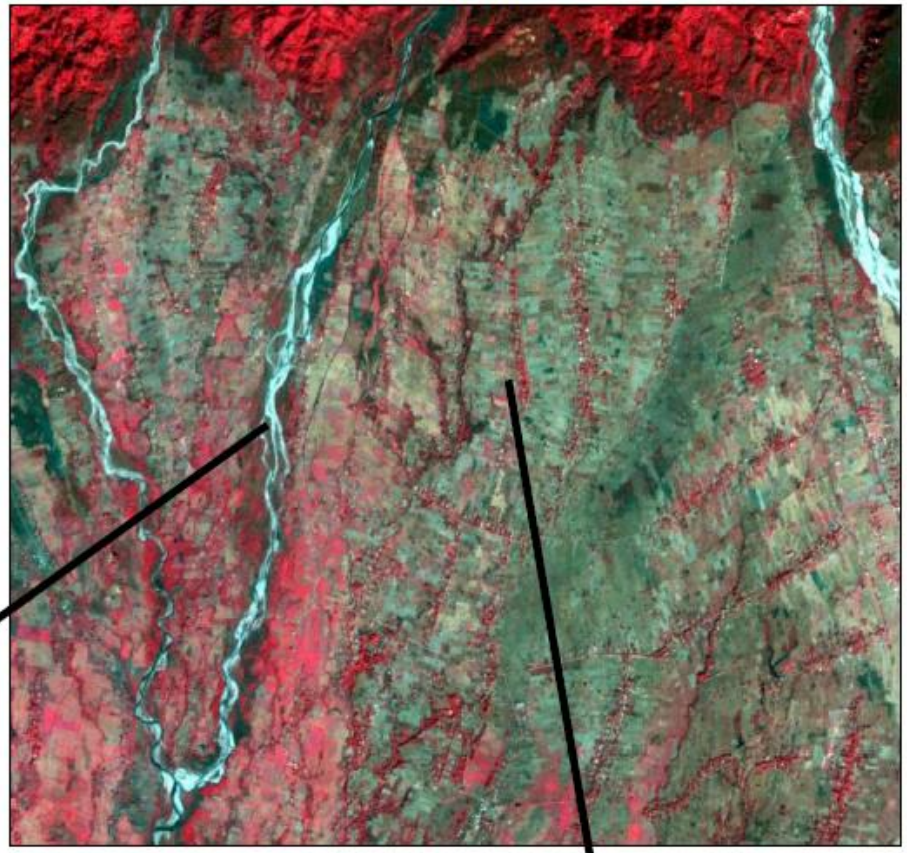
LULC Change in selected Hotspot Area

Sonai Rupai Wildlife Sanctuary - Assam

2005

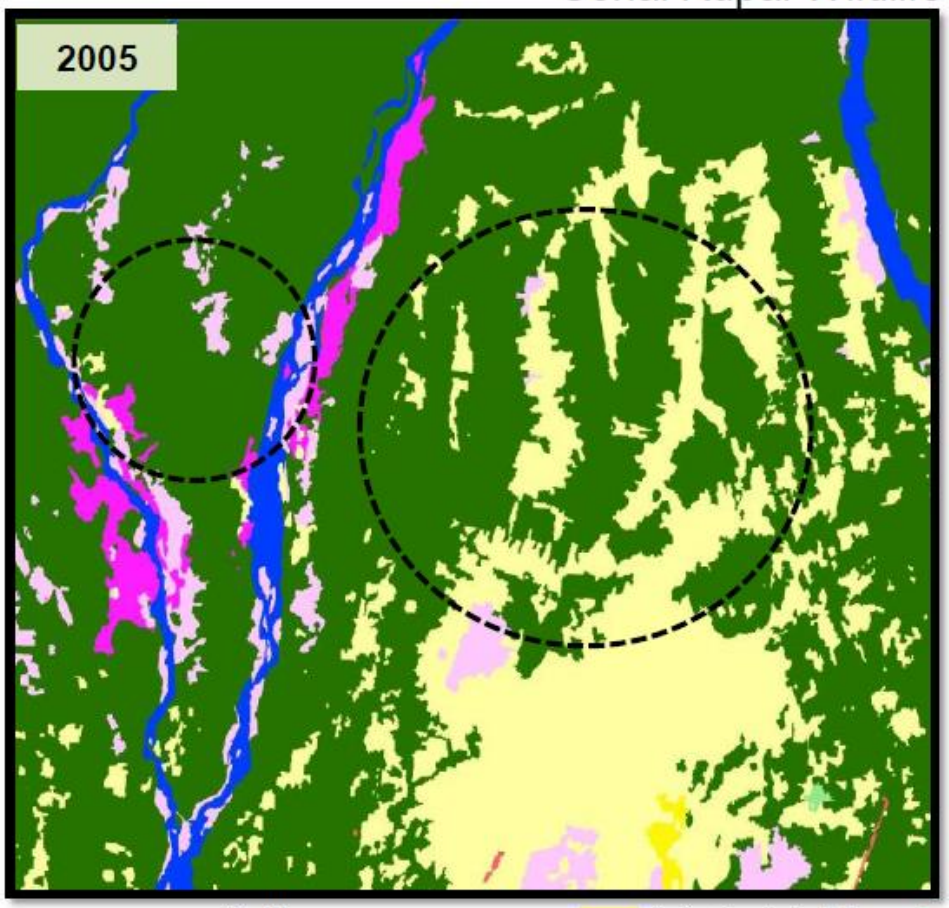


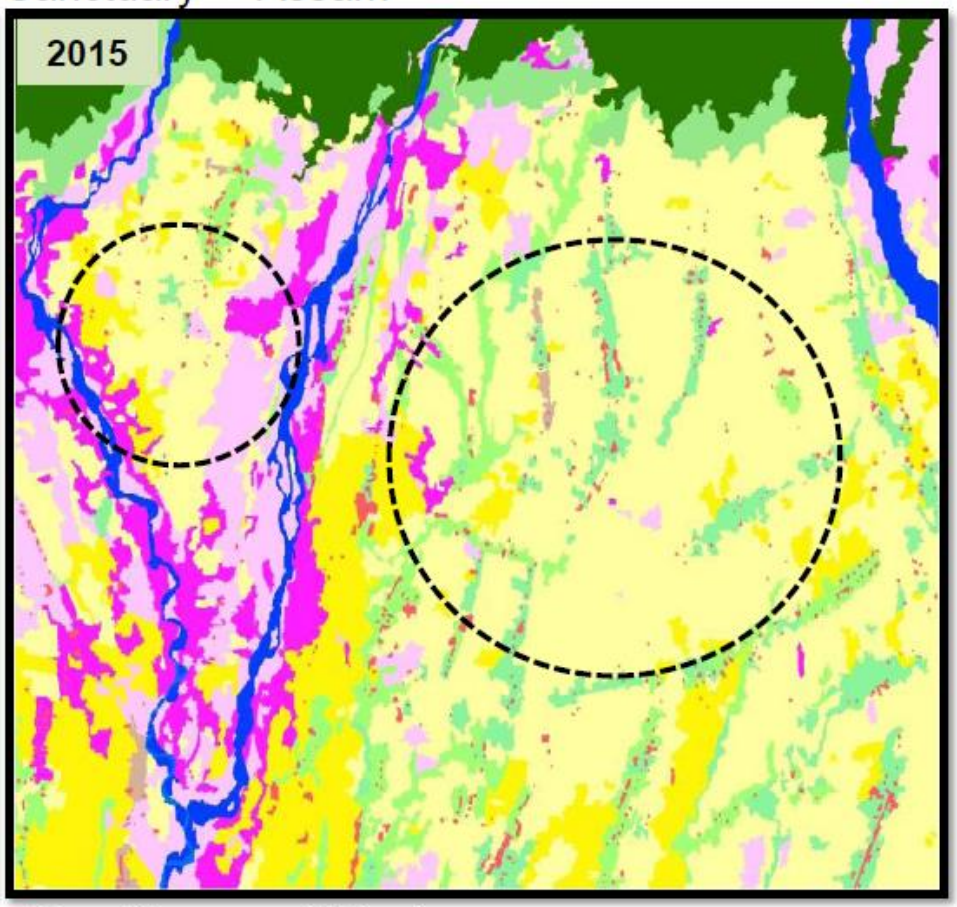
2015



LULC Change in selected Hotspot Area

Sonai Rupai Wildlife Sanctuary - Assam





Built-up
- Rural
- Industry / Mining

Agricultural Lands
- Crop lands
- Fallow land / Bare areas
- Agricultural plantations
- Aquacultures

Forests
- Forests
- Forest Plantations

- Swamp/ Mangroves

Wastelands
- Shrub / Scrub lands
- Sandy areas
- Barren areas / Rann

Wetlands
- Wetlands

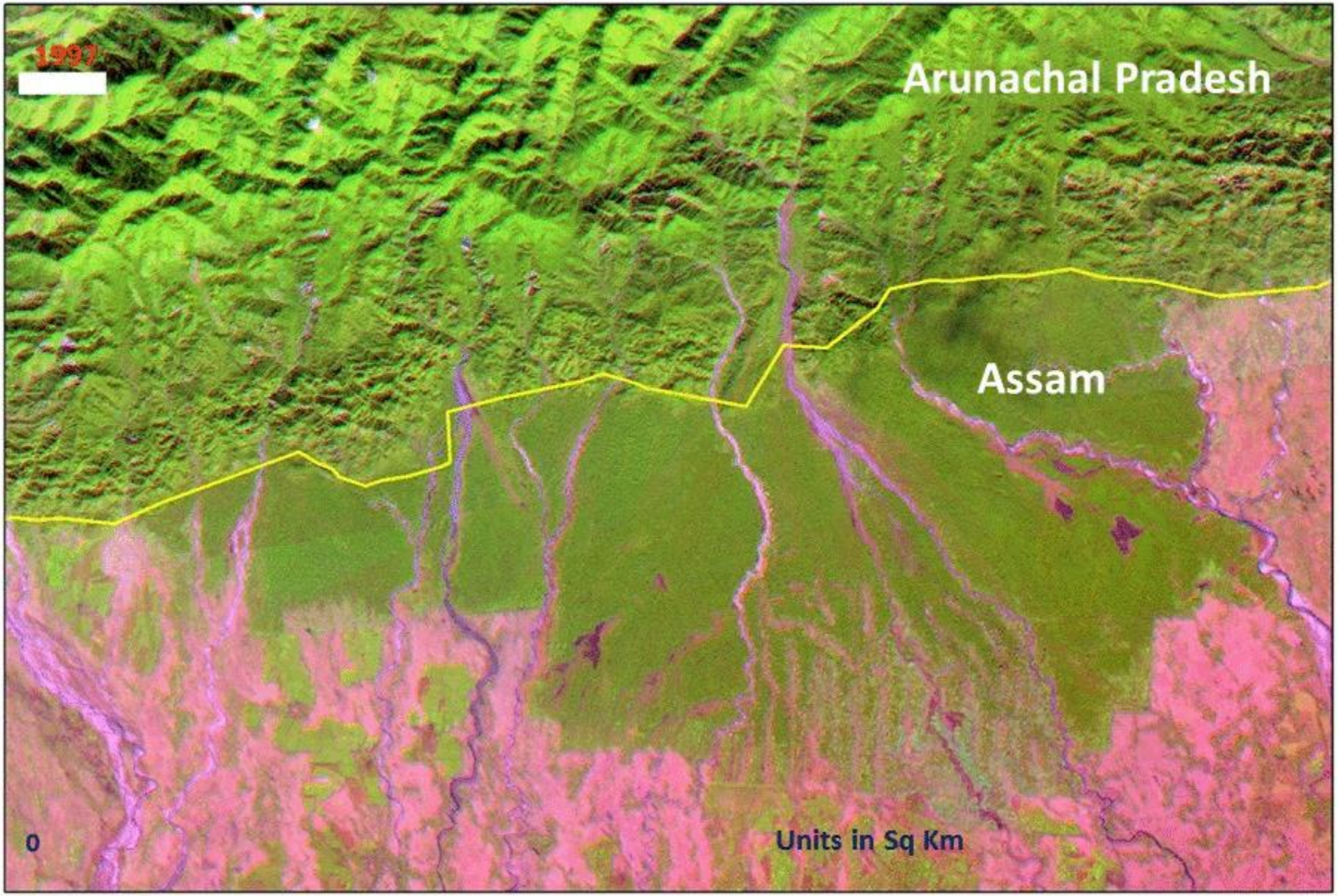
Water bodies
- Water bodies

Major Transformations

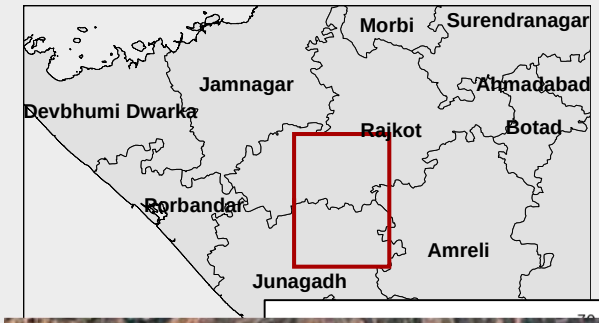
Increased in ⇧
- Croplands : 32.93 %
- Built up : 1.34 %
- Wasteland: 11.08 %

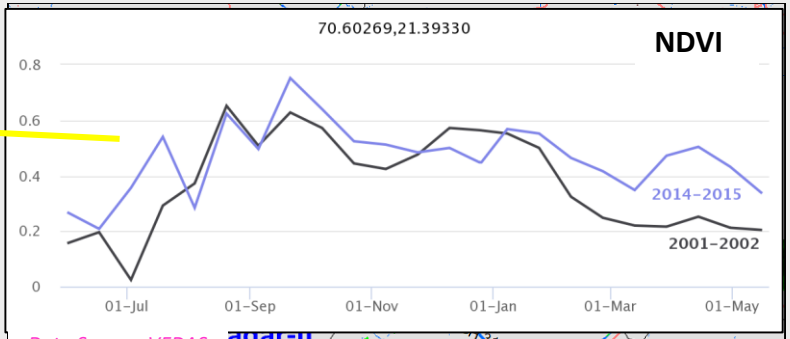
Decreased in ⇩
- Forest : 45.20 %
- Water body : 0.50 %

Large Scale Deforestation in Assam



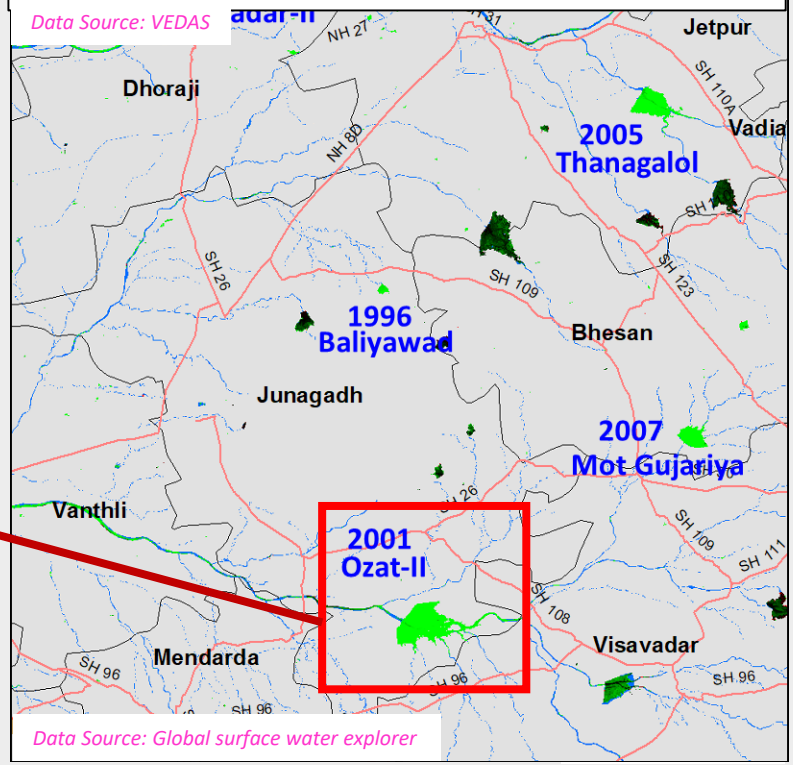
LCLUC due to Watershed Development Program in Gujarat State, India





Data Source: VEDAS

Data Source: Google Earth

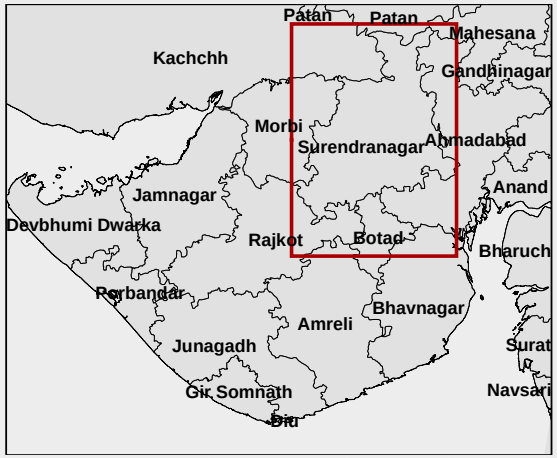


Data Source: Global surface water explorer

LCLUC due to Watershed Development Program in Gujarat State, India

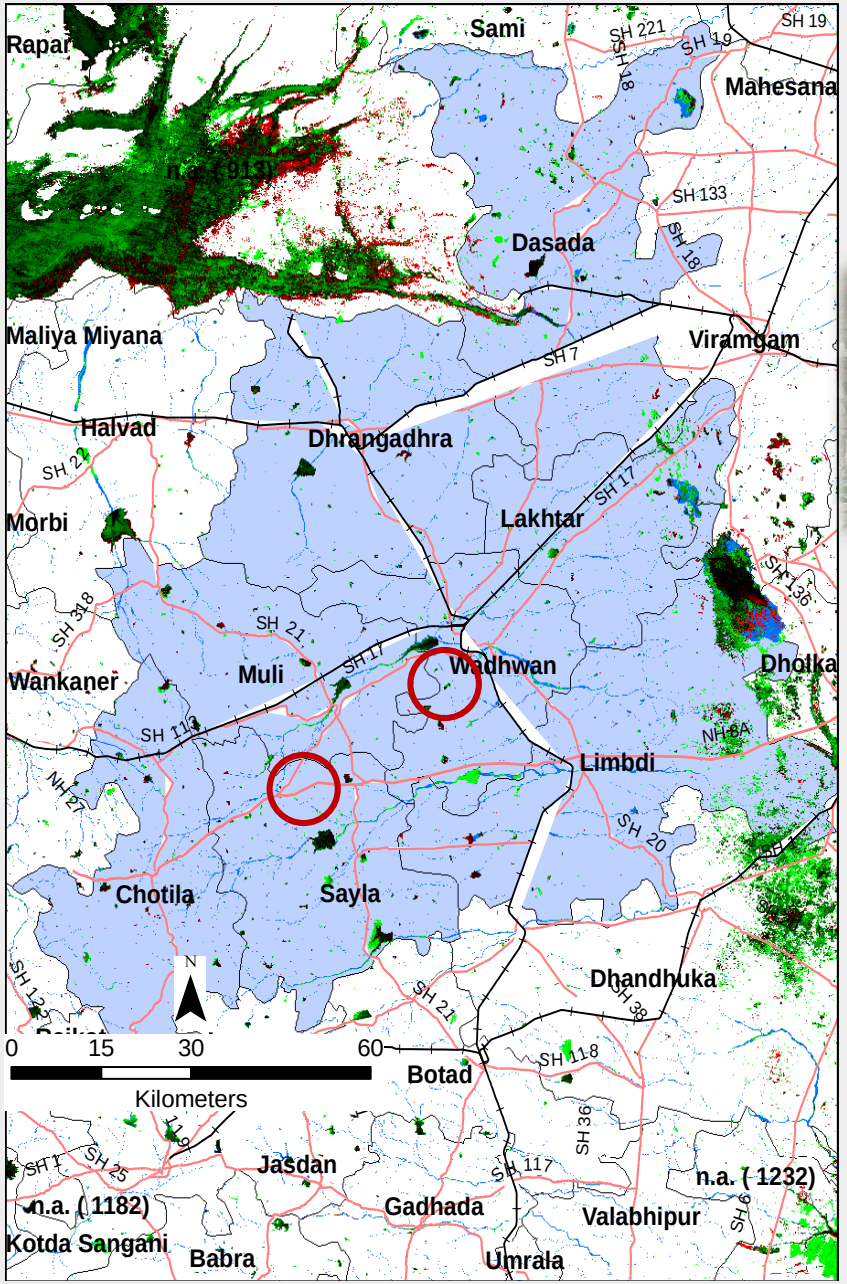
Surendranagar District

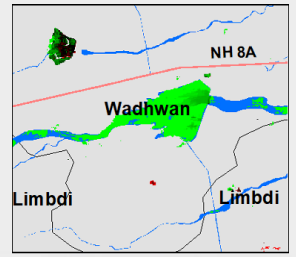
Water Harvesting Structures

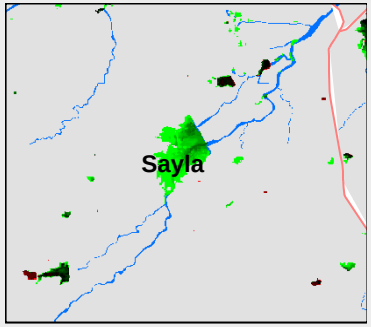


Structure Name Coordinates	Structure Observed	Water spread max (ha)	Year
Limdi (Bhogavo II) 22.552,71.65	1997-98	398	Nov 2017
- 22.415,71.448		173	Nov 2017

Data Source: Global surface water explorer



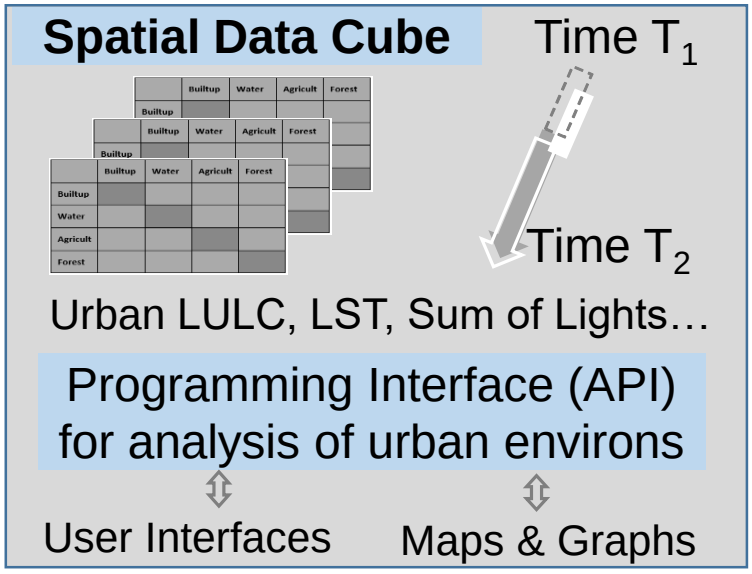


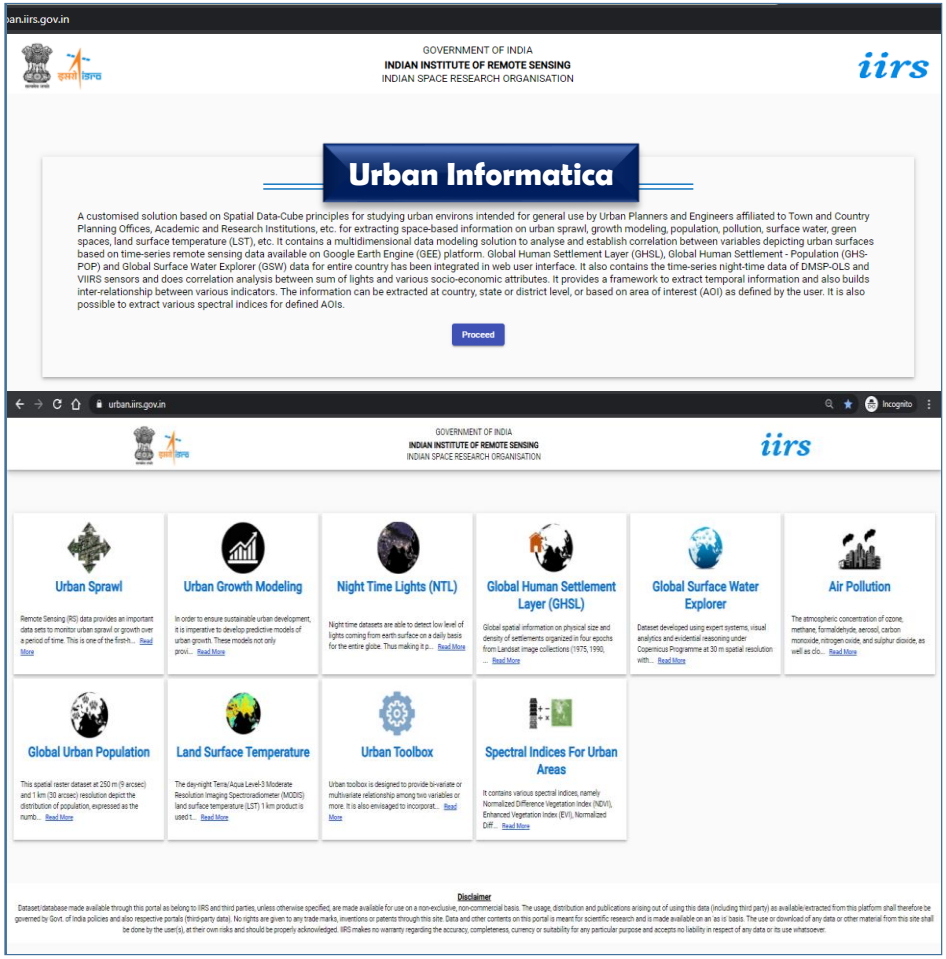


URBAN INFORMATICA

A Customized Spatial Data Cube of Urban Environs

- Uses Google Earth Engine (GEE) Apps/ platform to visualise/ analyse urban sprawl, growth modeling, LST pattern, night-time data analysis, air pollution, etc. and correlation with socio-economic attributes.
- Integration of Global Human Settlement Layer (GHSL), Global Surface Water, Night-time lights, Sentinel-5P, MODIS LST, Landsat time-series, etc.
- User-defined AOIs/ administrative boundaries, Image and graphical outputs



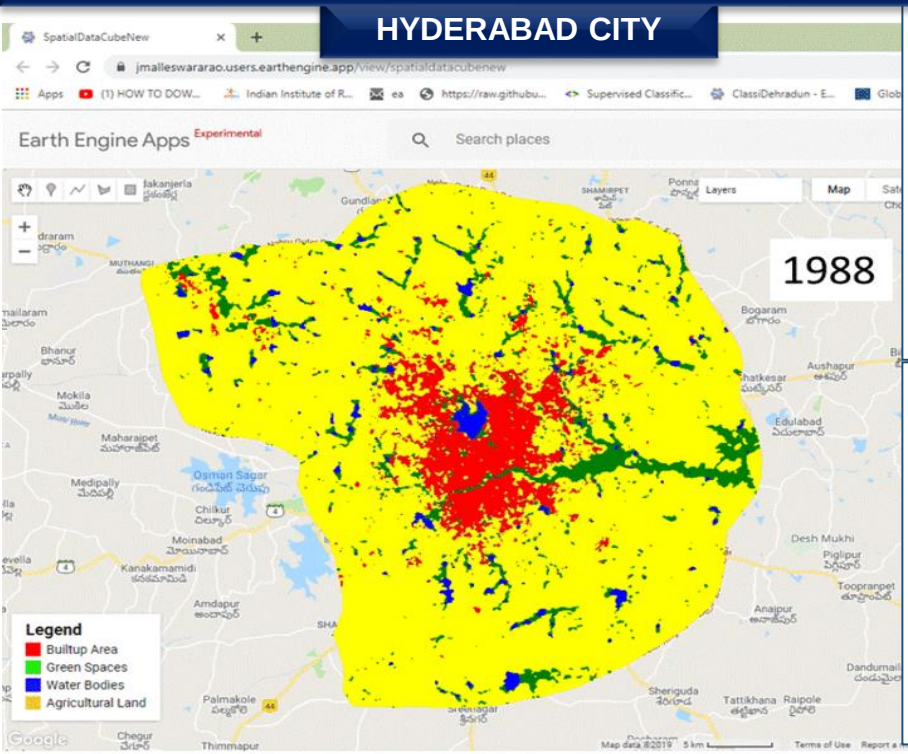


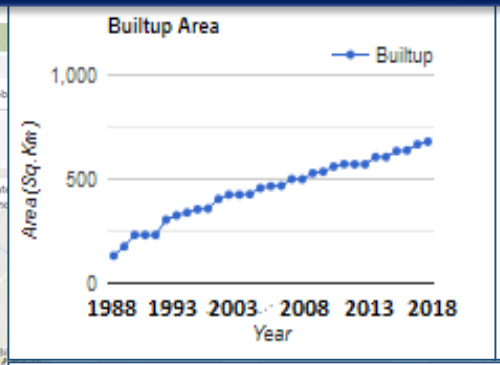
https://urban.iirs.gov.in/

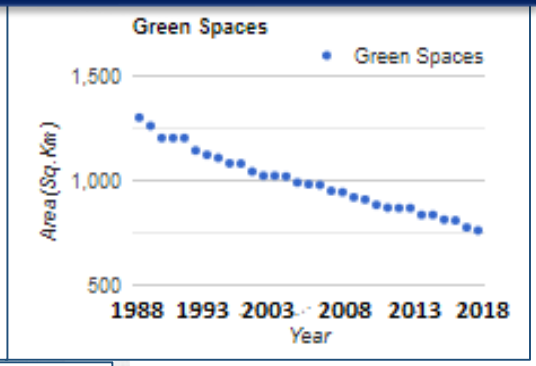
Alpha version

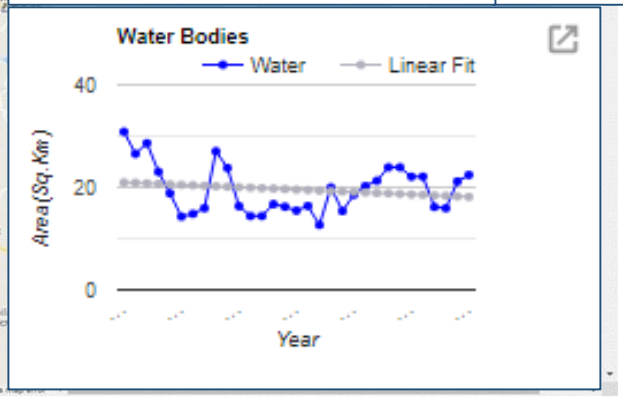
CUSTOMISED SPATIAL DATA CUBE OF URBAN ENVIRONS

HYDERABAD CITY









URBAN GROWTH MODELING

URBAN GROWTH MODELING

Urban suitability map is prepared based on the accessibility to the nearest roads and slope of the terrain. This Growth Model considered the criteria of Agricultural/Barren lands converted to Builtup

Urban Accessibility and Suitability Maps:

Urban Accessibility Map | Urban Suitablity Map | Clear Data

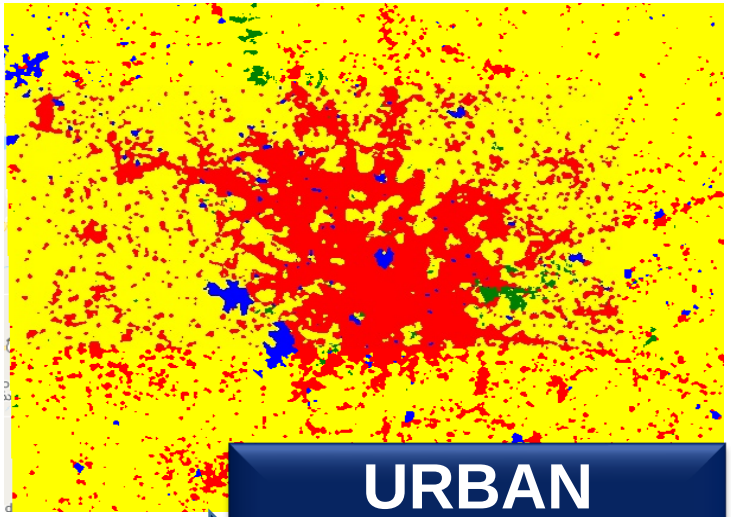
Model Validation and Accuracy:

LULC Map:2008 | LULC Map:2018 | Predict Map for 2018 | Validation Accuracy

Future Urban Growth Prediction:

Predict Map 2028 | Predict Map 2038 | Predict Map 2048

Predicted Urban Growth for 2048



User friendly GUI using Open Data Cube Architecture for time-series data analysis

URBAN INFORMATICA

Main users of Land Use / Land Cover

Major user of LULC can be grouped into following three major category:

1. Weather and climate prediction: Land cover interacts with the atmosphere, which leads to regulation of the hydrologic cycle and energy budget, and as such is needed both for weather and climate prediction. E.g. Land Surface Parameterizations (LSPs), produce databases of albedo, surface roughness, evapotranspiration and respiration.

2. Process involving carbon cycle: It acts as both sources and sinks of carbon. So, to measure rates of deforestation, afforestation, and regrowth play a significant role in the release and sequestering of carbon

3. Societal need: Availability of food, fuel, timber, fibre, and shelter resources for human populations, so it is a critical indicator of other ecosystem services such as biodiversity, many national/global applications like watershed management and agricultural productivity etc.

Thank You